Regional Science Inquiry

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Contents

The articles published in RSI Journal are in accordance with the approving dates by the anonymous reviewers.

Regional Science Inquiry, Vol. XII, (2), 2020
Editorial Note

One decade after its first launch, on August 2009, the Regional Science Inquiry Journal (RSIJ), a journal that is published under the aegis of the Hellenic Association of Regional Scientists, has succeeded to systematically contribute to the academic dialogue about Regional Science and to freely promote to the academic community worldwide several ideas involving economy, space (geography), and society. The Editor in Chief, Prof. Christos Ap. Ladias, and currently (2020) over 110 Editorial Board Members, are continuously working on promoting, worldwide, the international academic dialogue and cooperation in matters of regional research, as long as the exchange of science perspectives. According to the *Scimago Journal & Country Rank* (SJR) scientific database, in which our journal was registered in 2012, for the year 2019, the RSIJ is ranked in the Q3 Quartile in the Subject Areas of "*Development*", "*Economics and Econometrics*", "*Geography, Planning, and Development*", and "*Sociology and Political Science*". On this journey towards the free promotion of the scientific ideas and culture, the RSIJ has traveled with more than 100 authors so far, who have contributed to the scope, academic dialogue, and the promising statistics of our journal by communicating their research through our journal. With the opportunity of this Editorial note, the community of RSIJ expresses its gratitude to these authors for their contribution to the journal and gets inspired from this contribution to become even a better journal.

Being in line with the heritage and the promising dynamics of the journal, the current issue includes several interesting papers that cover many major topics of the framework of Regional Science, such as energy and regional economies; spatial distribution of income, labor, employment, poverty, and consumption; land use, investments, and firm location issues; geography and tourism demand; productivity and income inequalities; education, economy, and human development; sustainable development of regional economies. However, these major and diachronic topics enjoy modern conceptual and methodological approaches and promote thus the multidisciplinary conceptualization in Regional Science that this journal is designated to serve.

In particular, the first paper entitled "*The importance of southeast Mediterranean natural gas reserves to EU's energy security; a geopolitical and economic approach*", by Antonios STRATAKIS and Theodore PELAGIDIS, investigates the economic impact of significant gas reserves in Southeast Mediterranean, the role that these discoveries play in EU's energy plans, the implementation of a forthcoming energy hub in Southeast Mediterranean region, and examines the conflicted interests of European Union, Russia, and USA in the energy equation of the region.

The second paper entitled "*Investigating the Impact of ATM and POS Terminals on Money Demand in Nine European Countries in the Context of a Random Effect Model as the Appropriate Panel data Model*", by Payam MOHAMMAD ALIHA, Tamat SARMIDI, and Fathin FAIZAH SAID, investigates the effects of financial innovations on the demand for money using panel data for 9 European countries from 2014 to 2018 by using quantitative methods.

The third paper entitled "*Monitoring land use / land cover changes using remote sensing and GIS: a case study on Kanchrapara municipality and its adjoining area, west Bengal, India*", by Somnath DAS and Abhay Sankar SAHU, paper demonstrates land-use changes in a municipality in India by using remote sensing and GIS techniques providing an interesting case study and insights about the comparative discussion of land-use detection techniques.

The fourth paper entitled "*Modeling logistic enterprise re-location decision by a nested LOGIT model*", by Y. Nguyen CAO, develops a model to analyze decisions about the relocation process for logistics enterprise by using discrete choice models, providing interesting insights about location modeling and the important role of spatial interactions in the logistics enterprise relocation decision process.

The fifth paper entitled "*Balanced scorecard as a tool for evaluating the investment attractiveness of regions comprising the arctic zone of the Russian federation*", by Vladimir MYAKSHIN and Vladimir PETROV, elaborates a balanced scorecard to reflect the performance of and the trends in the investment activity ongoing in regions comprising the Arctic Zone of the Russian Federation, providing insights about identifying major investment-related challenges and promising investment opportunities in regions.

The sixth paper entitled "*Gross job - creation and gross job - destruction determinants: empirical analyze at micro firms data level*", by Tadeu LEONARDO and Francisco DINIZ, applies econometric modeling to analyze the gross job-creation and gross job-destruction determinants at the firm level for a panel of Portuguese micro firms across four industry sectors, for time period going from 2010 to 2017, providing interesting empirical evidence about the importance of the independent variables in explaining micro firm's labor demand in Portugal.

The seventh paper entitled "*Detecting interregional patterns in tourism seasonality of Greece: a principal components analysis approach*", by Dimitrios TSIOTAS, Thomas KRABOKOUKIS, and

Serafeim POLYZOS, builds on principal component analysis to studying tourism seasonality, configuring distinguishable seasonal profiles of regions in terms of their socioeconomic attributes. The paper develops an integrated framework dealing with complexity of tourism seasonality.

The eighth paper entitled "*Effects on empirical economic performance in provincial cluster of the southern shore of the Gulf of Thailand*", by Kiatkajon CHAIRAT and Piya PECHSONG, studies the role of spatial concentration of economic activities and estimates the effect of provincial cluster in the Southern shore of the Gulf of Thailand on economic growth, providing an interesting case study about the role of externalities as the factor component in the operation of the economic activities in provincial cluster of the Southern shore of the Gulf of Thailand.

The ninth paper entitled "*Firm size and location choice of food industry: Izmir/Turkey case*", by Nilnaz AKBAŞOĞULLARI and Hasan Engin DURAN, analyzes the determinants of firm location in Izmir's food industry, providing an interesting case study about the concentration of large firms around urban areas and about competition between big and small firms.

The tenth paper entitled "*Expert analysis and impact assessment of the construction sector enterprises on the economy: the experience of Ukraine*", by Mykhailo LUCHKO, Stanisław SZMITKA, Yuriy PYNDA, and Lyudmyla KUTS, studies the impact of construction sector enterprises on the economy by using econometric modeling, which allow determining ranges of values of influence of the main indicators of functioning of the enterprises of the construction sector on the GDP.

The eleventh paper entitled "*Inflation and unemployment in Southeast Asian countries: a panel GMM application on Phillips curve*", by ALIASUDDIN, Sofyan SYAHNUR, and MALIA, analyzes the relationship between inflation and unemployment in Southeast Asian sample, extracted from 1996 to 2016, providing an interesting case study about the relationship between inflation and unemployment.

The twelfth paper entitled "*Human capital and higher education as drivers of economy in Albania*", by Etleva BAJRAMI and Brikena LEKA examines the impact of higher education in economic growth in Albania, focusing on higher education, and provides an interesting case study for the interdependence amongst space, economy, and education.

The thirteenth paper entitled "*Territorial differentiation of labor as a factor in the sustainability of regional economies*", by Lidia S. ARKHIPOVA, examines the degree of inter-regional inequality in the provision of the Russian Federation's regions with labor as one of the economic sustainability factors, providing interesting insights about the importance of the strategic tasks in economic development of a complex, subordinate and multicomponent regional system of the Russian Federation.

The fourteenth paper entitled "*Spatially induced effects and sustainability for special economic zones: implications for zones in Pakistan under China - Pakistan economic corridor*", by Ayesha KHAN and h.c. Hans-Dietrich HAASIS, is an interesting review of the existing literature about special economic zones in Pakistan, aiming to identify the role of sustainable development goals in the perspective of spatially induced zone-effects and their implications.

The fifteenth paper entitled "*Does ZAKAT matter for human development? Empirical evidence from Indonesia*", by I.K. Balyanda AKMAL, M. Shabri Abd. MAJID, and Eddy GUNAWAN, empirically studies the contribution of zakat to human development and towards the achievement of the Sustainability Development Goals program in Indonesia, providing an interesting case study about religion and regional development.

The sixteenth paper entitled "*Financial inclusion and poverty reduction in Aceh province: comparison between core region and periphery region*", by ALIASUDDIN, Taufiq C. DAWOOD, and Nanda RAHMI, examines the role of financial inclusion on poverty reduction in an Indonesian Province, providing an interesting case study about the determinants of poverty and inequalities.

The final (seventeenth) paper entitled "*Dynamic causalities between world oil price and Indonesia's cocoa market: evidence from the 2018 global financial crisis and the 2011 European debt crisis*", by Mukhlis MUKHLIS, Raja MASBAR, Sofyan SYAHNUR, M. Shabri Abd. MAJID, examines short-run and long-run dynamic causal relationship between prices of Indonesian and world cocoa beans during the 2008 global financial crisis and the 2011 European debt crisis, providing interesting insights about the influential relationship between Indonesian and world cocoa markets.

All these interesting works are available in the next pages of the RSIJ with the aim of promoting the academic dialogue in Regional Science.

On behalf of the Editor-in-Chief and the Editorial Board
Dimitrios Tsiotas, Ph.D. – RSI J.

Articles

THE IMPORTANCE OF SOUTHEAST MEDITERRANEAN NATURAL GAS RESERVES TO EU'S ENERGY SECURITY; A GEOPOLITICAL AND ECONOMIC APPROACH

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Abstract

It has been more than a decade since the Southeast Mediterranean region came to the forefront after the discovery of significant gas reserves in offshore fields located within the maritime territories of Egypt, Cyprus and Israel (Levantine Basin). Gradually, the region drew the attention of major oil companies (Total, Statoil, ENI, Exxon Mobil, BP, Rosneft Qatargas) which intensified their drilling operation activities; aiming to share the exploitation of the potential regional gas deposits with the involved countries in the future. The aim of this paper is to investigate (a) the economic impact of these discoveries on the countries concerned, (b) what role can these discoveries play in EU's energy plans, given the stated policy to reduce dependence on Russian supplies and (c) the implementation of a forthcoming energy hub in Southeast Mediterranean region, its viability and competitiveness towards other well-established or emerging gas producing areas. Finally, the paper examines the conflicted interests of European Union, Russia and USA in the energy equation of the region.

Keywords: Energy Corridors, Pipeline Networks, EastMed Project, LNG Terminals, Southeast Mediterranean

JEL classification: F10, F51, R41, R42, R48

1. Introduction

Energy has always been a key component of enhancing European sustainability and welfare. Since 2008, global economy has entered into a new era of economic instability which resulted in protectionist issues where transnational relations are tested. Moreover, the most recent COVID-19 pandemic exacerbates the uncertainty on economic and social level.

Since 2009, the region of the Southeast Mediterranean holds the lion's share of world's interest as the first potential gas reserves in the Levantine Basin came into light and consequently the energy geopolitics pillar emerged. On a pragmatism level, the so far proven reserves could supply the involved countries (Egypt, Israel and Cyprus) with sufficient quantities of gas and provide them the appropriate energy independence in order to meet their domestic needs. On the contrary, the best case scenario orders that more reserves will come into light in the next years and the worldwide impact will be significant.

Despite their sharp fall in the beginning of the pandemic, global energy prices seem to stabilize –WTI and Brent between 40-45 $/barrel. Furthermore, while drilling technologies are being constantly updated in a cost-saving direction, there have been no drilling operations during the COVID-19 period. All the above set the frame under of which, different energy policies and conflicted interests come to the forefront. European Union (EU) seeks to enhance its energy security in terms of supply by implementing a strategy of diversification of counterparts, routes and sources. As a result, EU tries to moderate its energy dependence from Russia, raise the exploitation of domestic sources (the so far proven and future Southeast Mediterranean gas reserves amongst others) and take advantage of the shale gas industry in the United States.

The market dynamics of global energy sector are very fragile nowadays as the status quo is changing; traditional players such as OPEC (mainly Saudi Arabia) seem to step aside via production cuts, while newcomers such as Unites States (via shale oil and gas production), Russia (via gas production in the Arctic), Qatar (via South Pars field) and other energy

superpowers come to the forefront. Additionally, in terms of consumption, the lion's share is being concentrated in Asia (China, India, Japan and S. Korea). At the same time EU promotes its energy transition target by implementing decarbonization policies towards a new "green era". Under this scope, the implementation of a Southeast Mediterranean energy hub might prove a game changer, a project of multilevel benefits but also of certain and important difficulties.

2. European Union's energy sector

As it is widely accepted, European Union is mainly an energy consumer and not a producer. In 2019, energy production levels stood at 268 million tons, a 2.2% of global market share. On the contrary, energy consumption levels reached 1643 million tons, a 12% of global market share. As a result, European energy needs outpace production levels by more than five times. As depicted in Table 1, European Union's energy consumption levels have been declined between 2009 and 2019 by 4.1% (BP 2020).

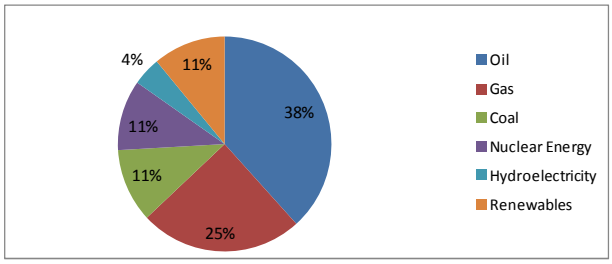
Table 1. EU's Energy Consumption Levels 2009 vs 2019 (in mil tons of oil equivalent)

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1715	1777	1719	1706	1649	1632	1653	1670	1692	1688	1643

Source: BP Statistical Review of World Energy – June 2020

European Union adopts a diversified energy consumption policy that includes the use of oil, natural gas, coal, nuclear energy, hydroelectricity and renewable energy in order to support its high domestic demand -mainly attributed to heavy industry, household heating and oil refineries. As depicted in Figure 1, oil and natural gas account for 63% of energy consumption in Europe, while there is a positive trend from the increasing use of renewable energy in power generation -wind and solar parks, as well as of natural gas. It is more than obvious that European Union has already shaped the aforementioned energy transition era towards "green energy projects" as depicted in Table 2. It is important to highlight that oil, coal and nuclear energy consumption levels have been declined in the decade while, renewables consumption levels have reached a decent market share.

Figure 1: Allocation of EU's energy consumption by fuel (2019)



Source: BP Statistical Review of World Energy – June 2020

Table 2. EU's energy consumption levels 2009 vs 2019 by fuel (in mil tons of oil equivalent)

Type of fuel	2009	2019	Decade change (%)	2009 market share	2019 market share
Oil	693	630	-9%	40%	38%
Coal	268	184	-31%	16%	11%
Natural Gas	417	404	-3%	24%	25%
Nuclear Energy	202	175	-14%	12%	11%
Hydroelectricity	76	70	-8%	4%	4%
Renewables	59	180	205%	3%	11%
Total	1715	1643	-4%		

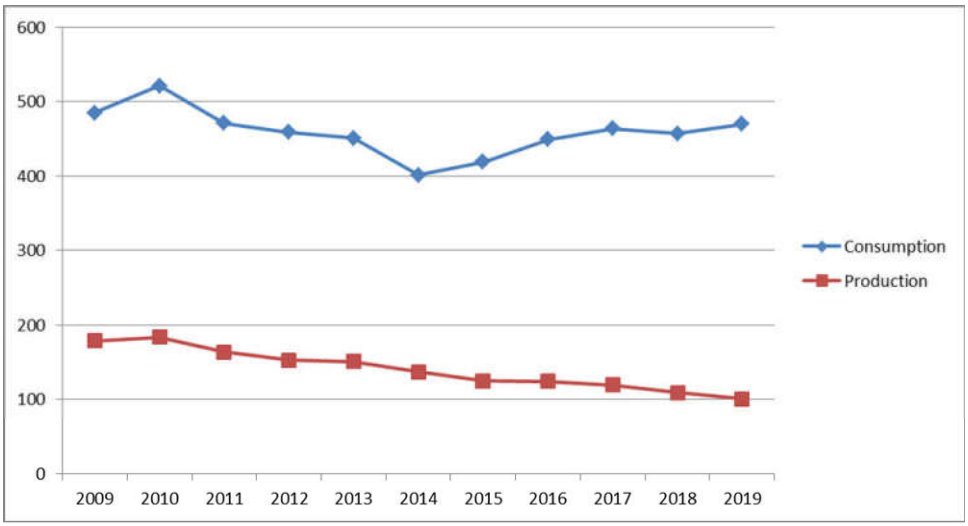
Source: BP Statistical Review of World Energy – June 2020

2.1. European Union's gas sector

Gas is an essential component of EU's energy mix, amounting to 25% of primary energy consumption and contributing mainly to electricity generation, heating and fuel for industry

and transportation (Hafner and Tagliapetra 2013). On a worldwide level, EU gas demand holds a share of 12% while, during the last decade it declined from 485 billion cbm in 2009 to 470 billion cbm in 2019. Since 2014 though, gas demand in Europe is on a recovery process. On the contrary, annual gas production during the last decade is on a constant declining mode, from 179 billion cbm in 2009 to 101 billion cbm in 2019 covering only 21.4% of EU's gas needs (Figure 2).

Figure 2: EU's gas consumption versus production levels 2009-2019 (in billion cbm)



Source: BP Statistical Review of World Energy – June 2020

It is more than obvious there is a huge supply deficit in EU's gas sector. Taking into account that EU holds only 0.3% of world total proved gas reserves, translated into 700 billion cbm or 23.9 trillion cbf, it comes as no surprise why Europe targets on specific regions in its eastern borders, such as Russia, Azerbaijan and others, in order to cover its energy deficit. The wider region of Eurasia for example holds 32% of world's proven gas reserves, 64.2 trillion cbm.

In 2019, European natural gas trade movements that took place by pipeline stood at 471 billion cbm -80% market share- while the LNG imports via vessels stood at 120 billion cbm (20% market share). Europe imports natural gas via pipelines mainly from Russia and Norway, accounted for 188 billion cbm and 109 billion cbm respectively, while in terms of LNG imports, Qatar supplied 32 billion cbm, Russia 21 billion cbm and United States 18 billion cbm respectively.

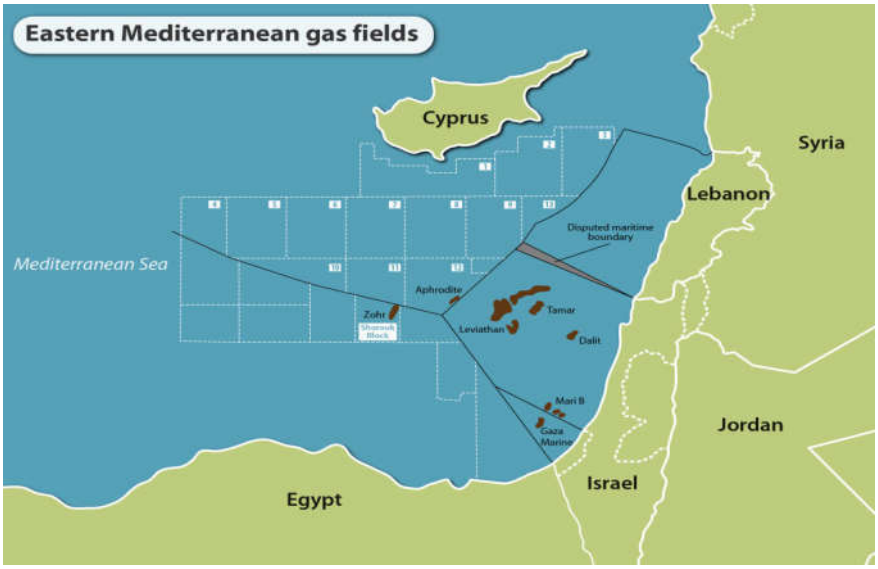
Consequently, EU's gas sector is a highly concentrated market, totally depended on a small number of external suppliers. Furthermore, consecutive and long lasting gas disruptions in many European countries amid Russian-Ukrainian disagreements on pricing and other geopolitical issues had generated a broader European debate over the years on the issue of gas supply security that led European Union in 2008 to take the decision of launching a strategic plan about the diversification of its gas supplies (European Commission 2008).

The anticipated future findings in Southeast Mediterranean could not only support European Union to achieve a steady and reliable domestic gas supply from indigenous sources but also to revive production levels generating cumulative benefits in the region.

3. Natural gas reserves in southeast Mediterranean; involved countries' energy needs

As mentioned before, the most important so far proven natural gas reserves in Southeast Mediterranean are mainly concentrated in Levantine basin between Israel, Cyprus and Egypt as depicted in Map 1. The so-called "first round of major gas discoveries" revealed the gas fields of Tamar-Israel, Leviathan-Israel, Aphrodite-Cyprus and Zohr-Egypt between 2009 and 2015. The quite low oil prices between 2015 and 2016 postponed any new drilling activity in the region but since 2017, drilling operations resumed and as a result Calypso-Cyprus Block 6 and Glafkos-Cyprus Block10 gas fields came into light. The exact recoverable quantities of natural gas in the aforementioned offshore fields are depicted in Table 3.

Map 1: Eastern Mediterranean Gas Reserves



Source: IEA

Table 3. Southeast Mediterranean gas reserves and involved countries (in billion cubic meters)

Gas Field	Year discovered	Country	Gas Reserves	Operational Status
Tamar	2009	Israel	280	Active-2013
Leviathan	2010	Israel	600	Active-2019
Aphrodite	2011	Cyprus	140	*2022-2025
Karish & Tanin	2013	Israel	60	*2H 2021
Zohr	2015	Egypt	800	Active-2017
Nooros	2015	Egypt	60	Active-2015
Calypso	2018	Cyprus	198	None
Glafkos	2019	Cyprus	180	None
Total			**2.318**	

The above natural gas reserves and operational fields are mainly covering the involved countries energy needs. For example, the output from Tamar field yields more than 60% of Israel's electricity while Cyprus aims to do the same since 2022 onwards (Platts 2019). At the moment Egypt emerges as a sole energy hub in Southeast Mediterranean; in 2019 the production capacity of Zohr field reached 28 billion cbm annualy, the largest production capacity in Southeast Mediterranean (ENI 2019), while Egypt also provides important export capacities from Idku LNG terminal.

The so far natural gas reserves in Southeast Mediterranean region are amounting 2.3 trillion cbm and as a result they hold a very limited market share of 1.2% taking into consideration that global proved gas reserves stood at 198.9 trillion cbm in 2019. All the Mediterranean players are dwarfed by Russia (38 trillion cbm), Iran (32 trillion cbm), and Qatar (25 trillion cbm). Moreover, the above gas discoveries do not reveal a sufficient amount of reserves capable of ensuring a steady gas supply to Europe on a permanent and exclusive basis.

Taking into account the current EU's gas consumption levels of 470 billion cbm, the Southeast Mediterranean gas reserves could exclusively cover European gas needs for only 4.9 years. All things considered, the recent findings in Southeast Mediterranean could **partially and for a limited time** contribute to the E.U.'s aim to obtain a steady and reliable domestic gas supply from indigenous sources.

In order to estimate the **future value** of the above natural gas reserves the methodology is as follows:

a) converting cubic meters (cbm) into barrels of oil equivalent (boe)

$$BOE = CBM \; X \; 0.00624096 \qquad (1)$$

b) calculating the decade average (2009-2019) Brent price (BP) based on monthly OPEC reports

$$[AVGBP09 + AVGBP10 + \ldots\ldots + AVGBP19] / 11 = 78.41 \; S/bl \qquad (2)$$

c) then multiplying equations (1) and (2) and we have future value in dollars $

$$\textbf{\textit{Future Value of natural gas reserves = Y x 78.41 \$/bl}} \qquad (3)$$

In order to estimate the **present value** of the above natural gas reserves we make use of the equation

$$PV = FV / (1 + i)^n \qquad (4)$$

PV = Present Value
FV = Future Value
i = annual interest rate
n = number of periods

The natural gas reserves are assumed to be commercially viable over a 20-year period (2025-2045) at a discount rate of 3% annually. The present and future value of the so far Southeast Mediterranean gas reserves as well as their economic impact on the involved countries' regional economies is clearly depicted in Table 4.

Table 4. Southeast Mediterranean gas reserves present and future values

Gas Field	Gas reserves (in bil boe)	Future value (in bil $)	Present value (in bil $)	2019 GDP (in bil $)	Present value as of GDP (%)
Tamar	1.75	137	76	395.1 (Israel)	19.2%
Leviathan	3.74	293	162	395.1 (Israel)	41%
Aphrodite	0.87	68	38	24.56 (Cyprus)	154.7%
Karish & Tanin	0.37	29	16	395.1 (Israel)	4%
Zohr	4.99	391	216	303.2 (Egypt)	71.2%
Nooros	0.37	29	16	303.2 (Egypt)	5.3%
Calypso	1.24	97	54	24.56 (Cyprus)	219,8%
Glafkos	1.12	88	49	24.56 (Cyprus	199.5%
Total	**14.45**	**1.133**	**627**	**722.86**	**86.7%**

The present and future value of Southeast Mediterranean gas reserves stand at $627 billion and $1.1 trillion respectively. If proceed in the allocation per country, significant findings emerge; the present value of Israeli total natural gas deposits stand at $254 billion, holding a 64.2% share of country's GDP, while the present value of Egyptian total natural gas deposits stand at $232 billion and a 76.5% share in the country's GDP. As it refers to Cyprus, the present value of its natural gas reserves is a game changer, standing at $141 billion overlapping the country's GDP by almost six times.

All things considered, the so far proven gas reserves in Southeast Mediterranean might not be of significant importance to European Union energy needs –at the moment, but on the contrary, they prove to have an unprecedented economic impact on the involved countries GDP's, so as the cumulative benefits analyzed in the next section.

3.1. Southeast Mediterranean countries' energy needs and impact on economies

In the geopolitically fragile Southeast Mediterranean region, Greece, Turkey, Italy, Israel, Egypt, Cyprus, and Libya are involved in shaping the new era in energy geopolitics.

In Cyprus, 94% of primary energy use is imported. Moreover, in 2018 energy consumption stood at 2.15 million tons of which over 2 million tons were oil, as renewable energy sources, biofuels and coal have a minor role in Cyprus' energy profile. Total energy consumption is still below its peak level of 2.75 million tons in 2008 and 18% below the EU

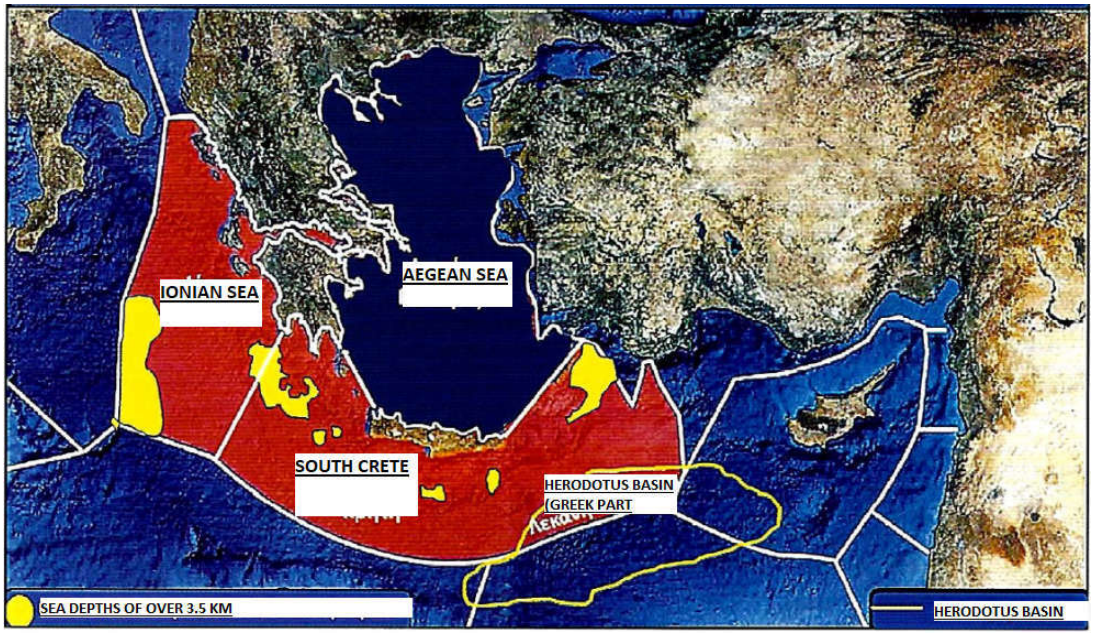
average. The recent gas discoveries give Cyprus the ability to change its orientation from a heavily dependent oil consumer to a sufficient gas producer and consumer (Henderson 2019). Furthermore, a natural gas market is under development and the first deliveries are expected by 2022 via LNG imports through FSRU terminal in Vasilikos. In 2030, the projected natural gas consumption in Cyprus is expected to reach 1 billion cbm, followed by $3 billion of potential savings in power generation, more than 9.000 jobs in natural gas activities. The annual estimated contribution of the above reserves in the Cypriot GDP is approximately 5% (Andriosopoulos 2020).

Egypt is an ambitious player in the region. Its energy consumption levels grew from 75 million tons in 2009 to 93 million tons in 2019, as its' energy sector is mainly dependent on the consumption of natural gas -51 million tons - and oil -36 million tons. As to natural gas consumption, Egypt has raised its from 41 billion cbm in 2009 to 59 billion cbm in 2019. According to BP, Egypt's proved gas reserves are 2.1 trillion cbm - 75.5 trillion cbf, providing energy sufficiency for 35 years, based on its current natural gas needs. Egypt has intensified its gas production levels, achieving a 7.6% growth in the decade -from 60 billion cbm in 2009 to 65 billion cbm in 2019. The surplus of 6 billion cbm in natural gas production is mainly exported to Asia Pacific region -2.7 billion cbm- and to Europe -1.7 billion cbm. In 2030, the projected natural gas consumption in Egypt is expected to reach 90 billion cbm, followed by $32 billion of potential savings in power generation, more than 100.000 jobs in natural gas activities. The annual estimated contribution of natural gas reserves in the Cypriot GDP is approximately 5%.

Greece is a relatively small player in the region. Its' energy consumption levels between 2009 and 2019 declined by 21%, from 34 million tons to 27 million tons. Like Cyprus, Greece's energy sector is mainly dependent on oil consumption -16 million tons- and less on natural gas -4.5 mil tons- and coal -3 million tons. As to natural gas though, consumption have risen by 50% in the last decade, from 3.4 billion cbm in 2009 to 5.1 billion cbm in 2019, mainly attributed to rising LNG imports from Qatar and the United States, as well as to the gradual conversion of the country into an important regional gas hub in Southeast Europe. Current -Revythousa LNG Terminal- and forthcoming infrastructures -TAP Pipeline, EastMed Pipeline and Alexandroupoli FSRU- are going to upgrade Greece's energy profile.

Greece remains one of the most "unexplored" countries of the world in terms of drilling activity, as the country's exploration rate is 4.27, while the global average is 121. The recent natural gas discoveries in Southeast Mediterranean raised again the discussion in Greece and proved to be a turning point offering a new perception of a sleeping energy giant, contrary to common belief. According to latest estimations (Konofagos 2018), there is an average possibility -50%- for the Greek territory to contain huge onshore and offshore hydrocarbon reserves of about 19.5 billion boe or 3.1 trillion cbm, of which more than 80% - 2.5 trillion cbm are located in the area between south Crete and Cyprus, including Herodotus Basin. It comes as no surprise that this area is disputed between Greece and Turkey (Maps 2). The present and future value of Greek hydrocarbon reserves per region are depicting in Table 5.

Map 2: Greece's EEZ (including Herodotus Basin)



Source: Konofagos Report

Table 5. Greek hydrocarbon reserves present and future values

Areas	Reserves (in bil boe)	Future value (in bil $)	Present value (in bil $)	2019 GDP (in bil $)	Present value as of GDP (%)
Epirus & Western Greece	0.5	39	22	209.85	10.5%
Aegean Sea	1	78	43		20.5%
Ionian Sea	2	157	87		41.5%
Offshore South-Southwest Crete	12	941	521		248%
Southeast Crete-Herodotus Basin	4	314	174		82.9%
Total	**19.5**	**1.529**	**847**		**403.6%**

Like Cyprus, the present value of Greek hydrocarbon reserves is a game changer, standing at $847 billion overlapping the country's GDP by almost four times. In 2030, the projected natural gas consumption in Greece is expected to reach 7 billion cbm, followed by $3 billion of potential savings in power generation, more than 16.000 jobs in natural gas activities. The annual estimated contribution of natural gas reserves in the Cypriot GDP is approximately 5%.

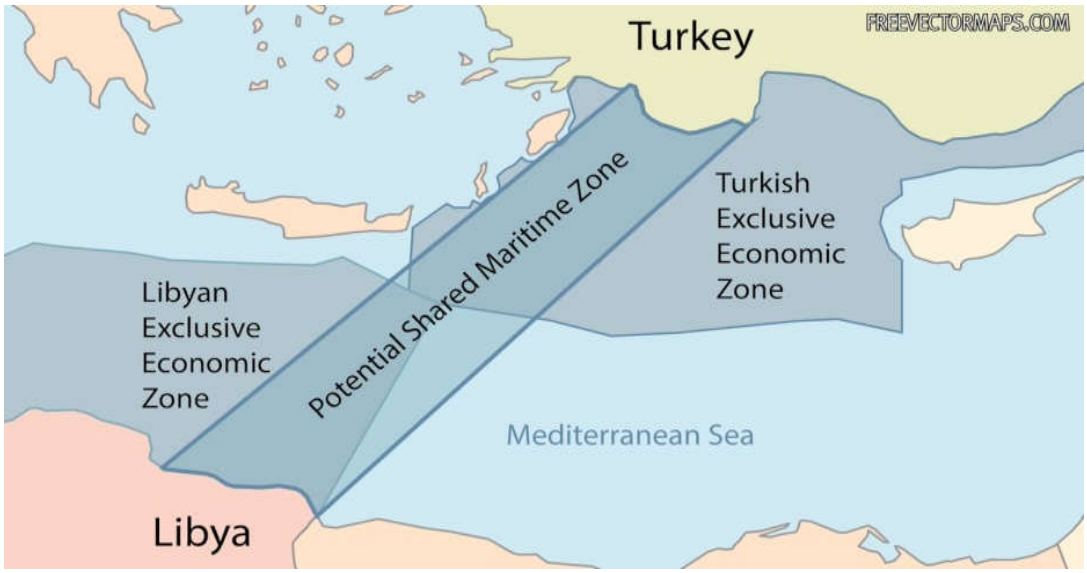
Israel is also a relatively small player in the region that managed to raise its' energy consumption levels from 22 million tons in 2009 to 27 million tons in 2019. Like Greece and Cyprus, Israel's energy sector is heavily dependent on the consumption of oil -12 million tons, natural gas -9 million tons- and coal -5 million tons. As to natural gas consumption levels, Israel shows a strong increase in the last decade from 4 billion cbm in 2009 to 10.8 billion cbm in 2019, achieving seven consecutive years of growth. Moreover, natural gas production in Israel reached 11 billion cbm in 2019. According to BP, Israel's proved gas reserves cover the country's energy needs in natural gas for the next 45 years. In 2030, the projected natural gas consumption in Israel is expected to reach 25 billion cbm, followed by $16 billion of potential savings in power generation, more than 15.000 jobs in natural gas activities.

Italy is the second largest player in Southeast Mediterranean after Turkey. Its' energy consumption levels have declined between 2009 and 2019, from 169 million tons to 152 million tons. The Italian energy sector is mainly dependent on the consumption of natural gas -61 million tons- and oil -59 million tons. According to BP, Italy's proved gas reserves are quite low and constantly declining, reaching 42 billion cbm in 2019 from 100 billion cbm in

2009. As a result, natural gas production in Italy has also declined in the last decade, from 7.6 billion cbm in 2009 to 4.6 billion cbm in 2019. Natural gas consumption levels stood at 71 billion cbm in 2019. The above huge gas deficit might justify the country's indirect –so far- engagement in the geopolitical issues of Southeast Mediterranean. In 2019 Italy imported 13.5 billion cbm of LNG mainly from Qatar -6.4 billion cbm and Algeria -2.9 billion cbm- as well as 54.1 billion cbm via pipelines mainly from Russia -20.7 billion cbm, other European countries -14.2 billion cbm, Algeria -9.7 billion cbm and Libya -5.4 billion cbm.

In Libya, the energy sector is underperforming. Gaddafi's fall and the outbreak of civil war had a huge impact on Libya's natural gas production that declined by 37%, from 15 billion cbm in 2009 to 9.4 billion cbm in 2019. Libya's energy potential though remains strong. According to BP, proved gas reserves are 1.4 trillion cbm something that might justify Turkey's active engagement in the country's political system and the recent memorandum that delineates the maritime jurisdiction between the two countries (Map 3).

Map 3: Turkey-Libya MoU and Potential Shared Maritime Zone

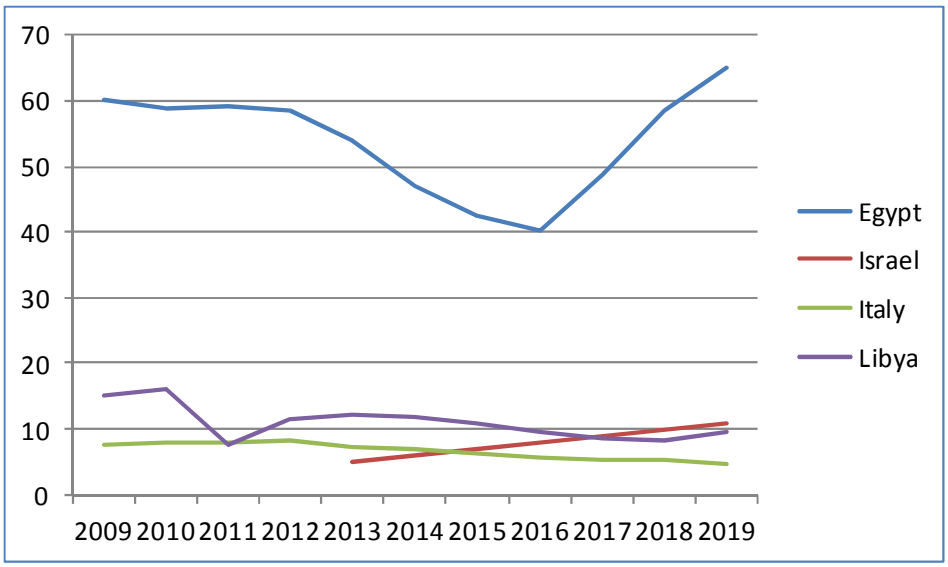


Source: Jerusalem Center for Public Affairs

Finally, Turkey is the largest consumer of the region. Between 2009 and 2019, its' consumption levels have risen from 102 million tons to 155 million tons respectively, a 52% growth in the decade. Turkey's energy sector is heavily dependent on the consumption of oil (48 million tons), natural gas (37 million tons) and coal (41 million tons), depicting an increase in natural gas consumption levels, from 33.7 billion cbm in 2009 to 43.2 billion cbm in 2019. The record high of 51.6 billion cbm gas consumption in 2017 was followed by a downward trend in the last two years, probably attributed to the instability of Turkish economy. In 2019, Turkey imported 12.9 billion cbm of LNG mainly from Algeria with 5.8 billion cbm, Nigeria and Qatar with 2.6 billion cbm each and the United States with 1.2 billion cbm as well as 31.3 billion cbm via pipelines mainly from Russia -14.6 billion cbm, Azerbaijan -9.2 billion cbm- and Iran -7.4 billion cbm.

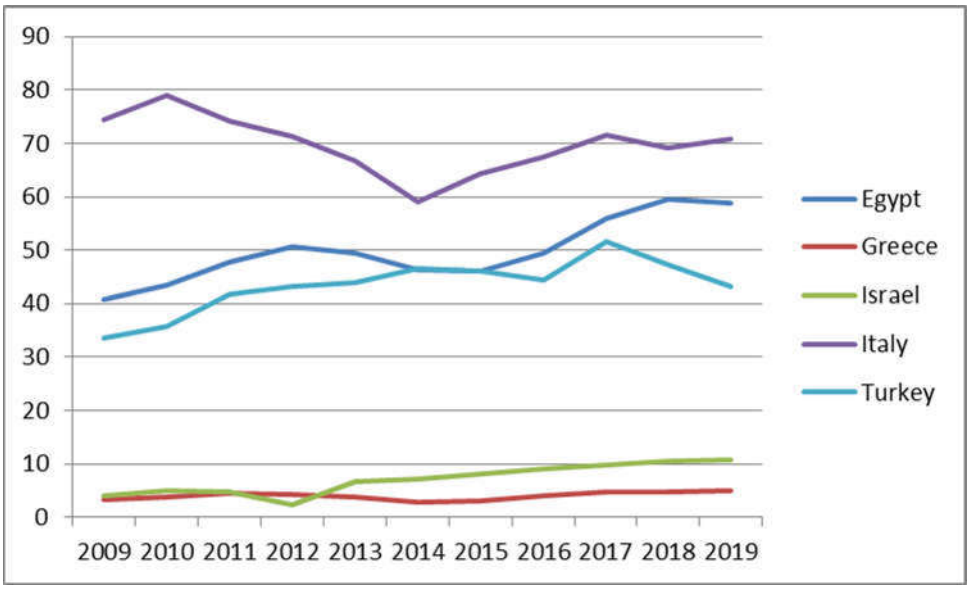
The energy status of all the aforementioned Southeast Mediterranean countries in terms of gas production and consumption is depicted in Figures 3 & 4.

Figure 3: Southeast Mediterranean countries gas production levels 2009-2019 (in billion cbm)



Source: BP Statistical Review of World Energy – June 2020

Figure 4: Southeast Mediterranean countries gas consumption levels 2009-2019 (in billion cbm)



Source: BP Statistical Review of World Energy – June 2020

4. The geopolitical and economic viability of the forthcoming Southeast Mediterranean energy hub

In early 2019, the East Mediterranean Gas Forum was established; a Cairo-based multilateral organization nicknamed "Club Med" that encompasses Cyprus, Egypt, Greece, Italy, Israel, Jordan, and the Palestinian Authority (Emam 2019). The Forum's main target is to promote the region into a major energy hub, to ensure supply and demand and to to offer competitive prices by promoting a "systematic dialogue" between producers and consumers on gas policies (Geropoulos 2019).

The promotion of the Southeast Mediterranean energy hub and the exploitation of the above reserves can be so far implemented by two alternative options (Stratakis & Pelagidis 2018): a) the EastMed Pipeline that could connect Israel, Cyrpus and Greece's future reserves or b) the promotion of an LNG terminals network in the region. The hub's viability is going to be highly depended on the great competition from existing pipeline networks (De Micco 2014) in the wider region as well as on other direct and indirect factors that are going to be analyzed.

The EastMed Pipeline is a planned offshore/onshore natural gas pipeline, directly connecting Southeast Mediterranean energy resources of the Levantine Basin to mainland Greece via Cyprus and Crete (Map 4). The project is designed to transport 10 bcm annually - with a potential to double capacity in the long term, through 1.300 km of offshore pipeline and 600 km of onshore pipeline. It will have exit points in Cyprus, Crete, mainland Greece as well as a connection point with Italy. Construction of the pipeline is expected to cost approximately €6 billion.

Map 4: The "EastMed Pipeline" and its interconnectors

Source: IGI Poseidon

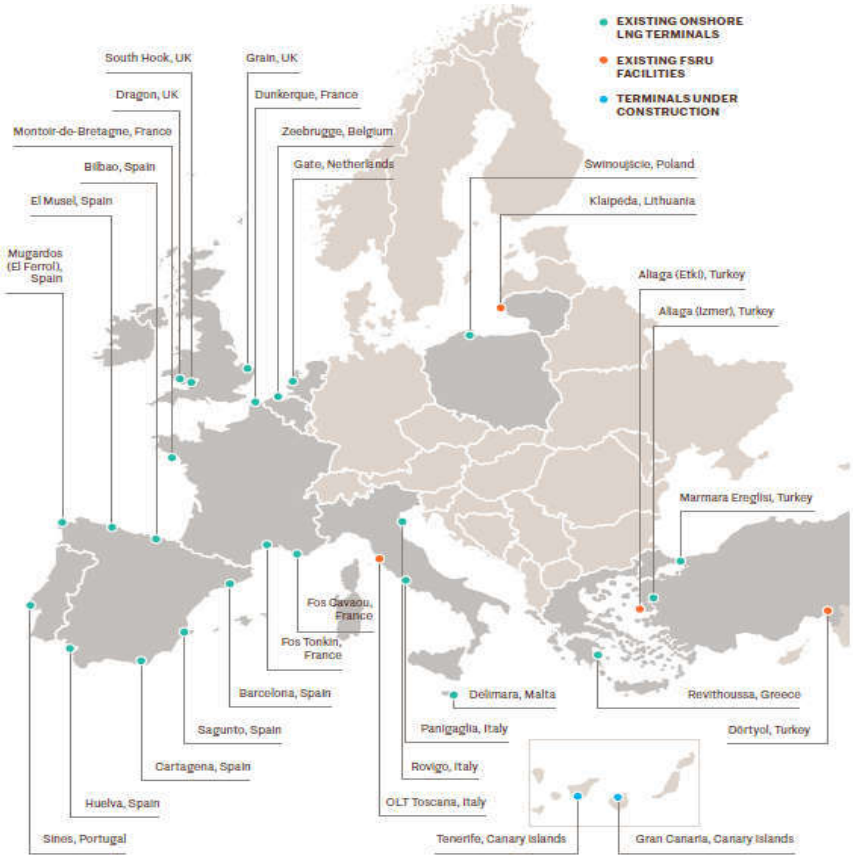
In July 2020 Israel, Cyprus and Greece have accorded to move forward with plans to complete the pipeline by 2025 (Reuters 2020). The countries aim to reach a final investment decision by 2022 (Naftemporiki 2020). The EastMed Pipeline will gain additional importance if the gas deposits in the Herodotus Basin are confirmed. The EastMed Pipeline has been classified as a project of common interest by European Commision, part of the IGI Poseidon Project that also involves Poseidon and IGB pipelines and it is financially supported by European Investment Bank and other institutions.

On the contrary, the trend of FSRU-LNG terminals infrastructure is emerging across Mediterranean Sea (Snyder 2020). If all projects come to fruition, there will be 32 large, mid and small-scale LNG terminals in operation of which, some are being developed to advance European policies of energy independence and security by lessening the dependence on Russian pipeline volumes. As floating terminals are capable of storing and regasifying liquefied natural gas, it would be of great interest if the Southeast Mediterranean ones could operate under a "network" based on the aforementioned state alliances, where terminals would cooperate in exploiting the export volumes, promoting unified pricing policies on the economic benefit of the countries involved.

So far, important investments and sufficient capacities start piling up in Italy -3 terminals of 10 billion cbm annual capacity, Croatia -1 terminal of 2.6 billion cbm annual capacity, Turkey –4 terminals- and Egypt -2 terminals of more than 15 billion cbm annual capacity (Map 5). As it refers to Cyprus, the new FSRU-based LNG import project at Vasilikos Bay will be able to start LNG import operations during H1 2021, designed to accommodate LNG vessels with capacity up to 217.000 cbm.

As far as Greece is concerned, DESFA's Revythousa LNG Terminal with a storage capacity of 225.000 cbm and annual capacity of 7 billion cbm is one of the 28 existing European LNG Terminals and Greece's unique one in accommodating LNG vessels of approximately 175.000 cbm (Geropoulos 2018). Moreover, an FSRU terminal is promoted in Alexandroupolis (Reuters 2015), where Gaslog's converted LNG vessel will be moored to 17 km out of the Alexandoupolis port and will be used as a floating of annual capacity 6.1 billion cbm. The facility is expected to cost between 350 and 380 million euros -$415 million, financed by EU funds. The project has the political support of the United States.

Map 5: LNG import terminals in Europe



Source: King & Spalding

Based on the above, the forthcoming Southeast Mediterranean energy hub seems to have the potential to claim a decent market share from its competitors in the decades to come. Its implementation seems to escalate in three phases through a 25-year period: Phase A, where the hub will service involved countries domestic needs, Phase B, where the hub will service EU's energy needs moderating the Russian factor and, Phase C where the hub will be oriented on covering global demand.

Constant discoveries of new gas reserves are a prerequisite in order for the hub to be viable over time. At this point, it needs to be highlighted that Greece could probably be a game changer in the viability of the hub, since as it is already mentioned; there might be 2.5 trillion cbm in offshore gas reserves in the wider region between south Crete and the Greek part of Herodotus Basin, a quantity equal or even higher than the so far discovered reserves in the Levantine basin (ELPE 2020).

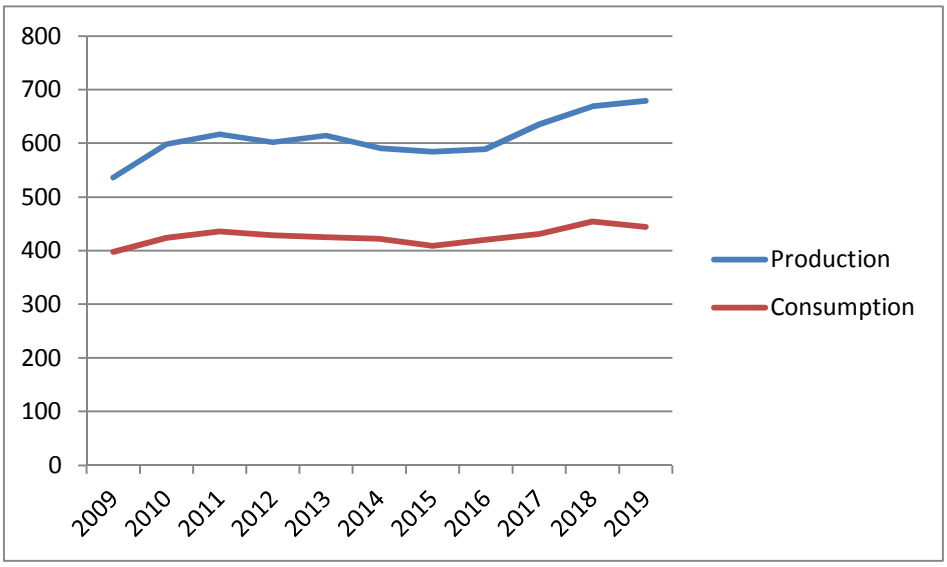
Of course there are other crucial factors needed to be taken into serious consideration before Southeast Mediterranean energy hub proceeds further.

4.1. The Russian factor

In the last decade there is an ongoing discussion on whether Southeast Mediterranean reserves could substitute a part of Russian gas flows and if so, up to what extent. Natural gas is an essential component of Russian foreign policy as the country's economic growth is driven by energy exports. Oil and natural gas revenues accounted for 39% of federal budget revenues in 2019 (Russian Ministry of Finance 2019). Russia is also the second largest gas producer worldwide, following United States with 921 billion cbm in 2019.

In 2019, Russia produced 679 billion cbm of natural gas, achieving an impressive 26.6% growth in the decade. On the other hand, and in terms of demand Russia consumed 444 billion cbm, achieving a 11.6% growth in the decade also. That means that Russia has a natural gas surplus of 235 billion cbm available for exports (Figure 5).

Figure 5: Russian natural gas production vs consumption levels 2009-2019 (in billion cbm)



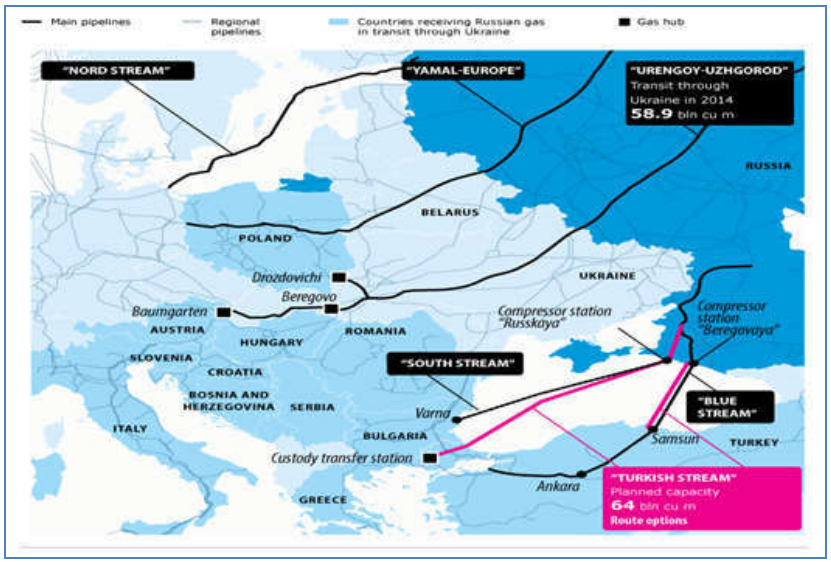
Source: BP Statistical Review of World Energy – June 2020

Russia's geopolitical concept is to encircle Europe with natural gas pipeline networks (Stratakis & Pelagidis 2019). The existing Russian gas pipeline network to Europe consists of (Map 6):

- Gazprom's "Nord Stream Pipeline" with a combined annual capacity of 55 billion cbm connecting Russia and Germany across the Baltic Sea,
- Gazprom's "Yamal-Europe Pipeline" with an annual capacity of 33 billion cbm connecting Russia and Germany through Belarus and Poland,
- Gazprom's "Blue Stream Pipeline" with an annual capacity of 16 billion cbm connecting Russia and Turkey, servicing Turkey's ambitions to be converted into the main energy hub in South-East Europe and an alternative import gate of Russian gas into Europe
- Gazprom's "TurkStream Pipeline" with an annual capacity of 31.5 billion cbm and a €11 billion construction cost, operative since January 2020. The project supplies equally Turkey and southeast/central Europe -17.5 billion cbm each- through Balkans and,
- d) the "Urengoy-Uzhgorod Pipeline" with an annual capacity of 32 billion cbm connecting Russian Siberia through Ukraine with Austria

Russia intends to gradually replace gas supplies to Europe through Ukraine and the "Urengoy-Uzhgorod Project" by "Nord Stream 2 Pipeline", a project in which five European energy companies are engaged with Gazprom, in order to construct an additional 1200 km pipeline that would transfer annually 55 bcm of Russian gas through the Baltic Sea to Germany. The total cost of the pipeline is estimated at $10.3 billion, scheduled to be completed by the end of 2020. The energy dependence of Germany on Russia has drawn heavy criticism from the United States, an emerging and ambitious supplier of LNG to Europe. While Russia seeks diversified energy routes that would seal its dominance over European gas markets, the USA is objected on both economic and political grounds (Geropoulos 2019).

Map 6: Russian Pipeline Networks in Eastern Europe



Source: Gazprom

In 2019, Russia totally exported 257 billion cbm of natural gas, a decade record high of which, 208.5 billion cbm were headed to Europe -188 billion cbm via pipelines and 20.5 billion cbm via LNG exports. On the contrary, European natural gas imports in 2019 stood at 591 billion cbm; in other words, Russian annual gas flows to Europe hold a 35% market share in European natural gas imports. At the moment, it seems quite difficult for the Southeast Mediterranean energy hub to substitute a huge part of Russian share.

4.2. The Turkish factor

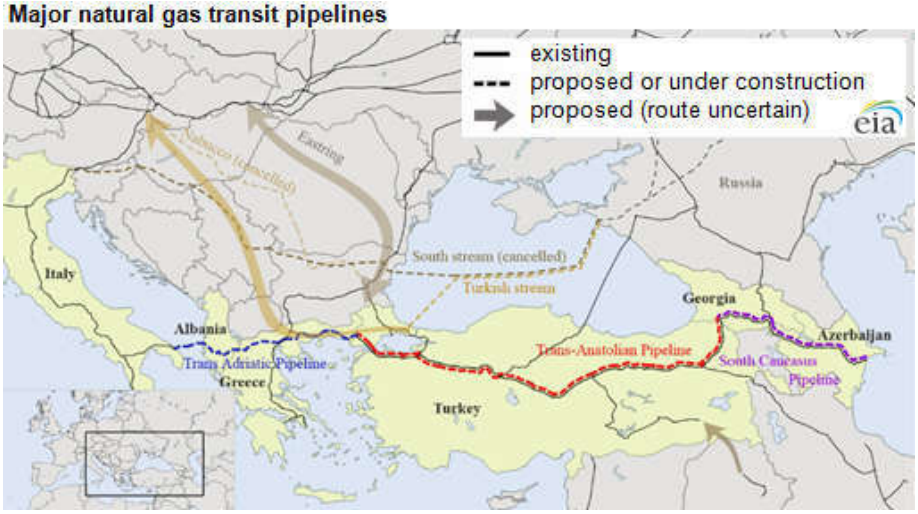
Turkey aims to become the major energy hub in the region by transiting natural gas flows from Caucasus and Central Asia, Middle East and Southeast Mediterranean to the rest of Europe. At the same time, it seeks to ensure domestic energy security by cementing its geostrategic importance. In this strategy, Turkey found a willing partner in Russia and the latter has found an important pillar to promote its energy interests in Southeast Europe.

Furthermore, Turkey remains the only energy gateway to Europe for emerging gas producers, such as Azerbaijan. The “Trans Anatolian Gas Pipeline-TANAP” carries gas from Azerbaijan’s Shah-Deniz gas field of 1.2 trillion cbm capacity, to Italy’s southeastern shore via Greece’s “Trans Adriatic Pipeline -TAP”, as depicted in Map 7. With a capacity of 16 billion cbm, 6 billion cbm cover Turkish domestic needs and the rest will be delivered to European countries once TAP Pipeline is completed (Barden 2015). TANAP had a construction cost of $8.5 billion and is in operation since June 2018. By 2030, an increase of pipelines annual capacity to 60 billion cbm is planned.

TANAP is a part of a $45 billion project called “Southern Gas Corridor”, an initiative of the European Commission for a natural gas supply route from the Caspian and Middle Eastern regions to Europe, aiming to reduce Europe's dependency on Russian gas and add diverse sources of energy supply by providing the necessary transportation capacity to deliver 60–120 billion cbm annually.

For the time being, there is a maritime area in dispute between Turkey and the Republic of Cyprus. The dispute extends to Greece as it refers to Kastelorizo, the area southeast of Crete and Herodotus basin (Map 8). Turkey claims an excess continental shelf of 148.000 km2 and as a result, its intensified naval presence in the region has postponed any new research and exploitation activity.

Map 7: TANAP and TAP Projects



Source: EIA

Map 8: Conflicting EEZ between Greece/Cyprus and Turkey

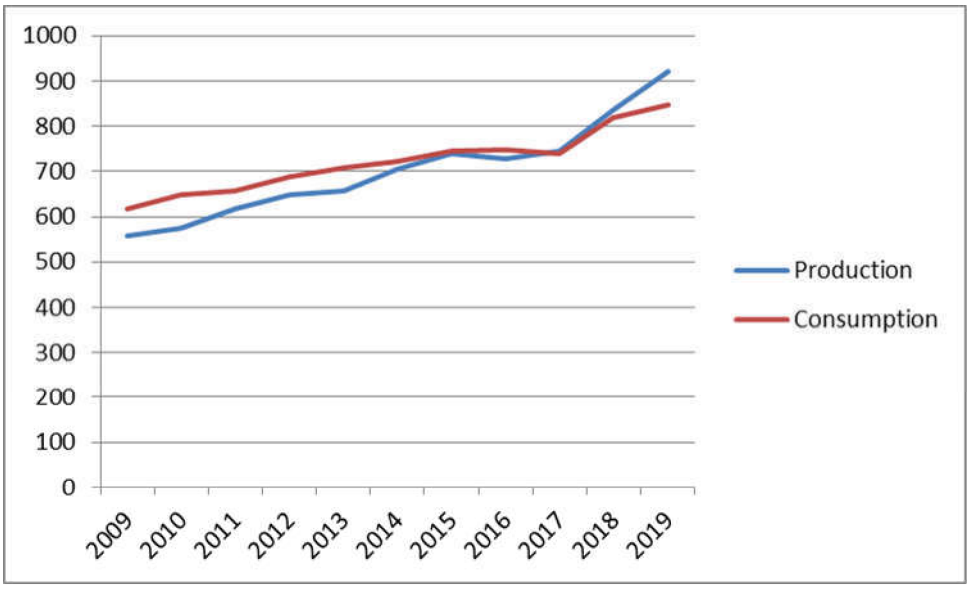
Source: Hurriyet

4.3. The United States factor

Since 2012 and the shale gas revolution in their domestic industry, United States have stepped forward and in less than a decade they have been declared as world's largest natural gas producer. At the same time, they hold a 6.5% of global share with 13 trillion cbm natural gas reserves. Between 2009 and 2014 United States had to manage their natural gas supply deficit while since 2017 they ramped up their production levels resulting in an important surplus that gives them the opportunity to be introduced as a natural gas producer and exporter (Figure 6).

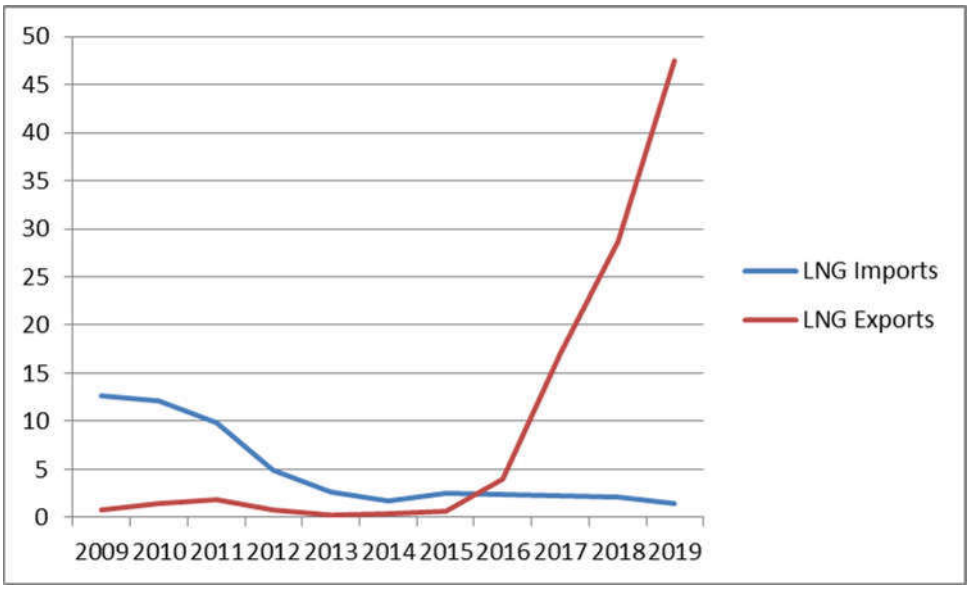
Indeed, between 2009 and 2019 LNG imports to the United States have been declined from 12.6 billion cbm to 1.5 billion cbm respectively, while LNG exports have been skyrocketed from 0.8 billion cbm to 47.5 billion cbm respectively (Figure 7). It is estimated that by 2025 American LNG exports are going to reach 120 billion cbm, overtaking countries such as Australia, Qatar and Russia. Indicatively, during 2019 Europe was the primary destination of American LNG with 38.5% market share and 18.3 billion cbm while Asia Pacific region followed with 17.8 billion cbm. As it refers to Europe, in 2019 the United States were the third largest LNG supplier following Qatar with 32.3 billion cbm and Russia with 20.5 billion cbm (European Commission 2019) while, in the first five months of 2020, the United States became the largest source of LNG supply to Europe, overtaking Qatar and Russia achieving a 25% market share.

Figure 6: United States natural gas production vs consumption levels 2009-2019 (in billion cbm)



Source: BP Statistical Review of World Energy – June 2020

Figure 7: United States LNG imports vs LNG export 2009-2019 (in billion cbm)



Source: BP Statistical Review of World Energy – June 2020

A competitively priced American LNG and the appropriate market conditions could play an increasing and strategic role in EU gas supply. Increased imports contribute to the EU's goal of diversification of energy supply as, the EU gas market is the second biggest single gas market in the world after the United States. European gas imports are projected to increase in the years to come as its domestic production is decreasing, while demand is projected to remain at a comparable level as natural gas has been identified as an important transition fuel in the EU's efforts to decarbonise its economy.

All things considered, it is important to highlight the new geopolitical aspects of the American presence and the promotion of its interests in the region of Southeast Mediterranean.

4.4. Opportunities and barriers in the implementation of a Southeast Mediterranean energy hub

The emerge of an energy hub in Southeast Mediterranean region indisputably enhances European security of gas supply (Tzogopoulos 2017). Greece and Cyprus are devoted to the principles of European Union, consisting important pillars that provide sustainability in a very fragile region -political unrest in Turkey and Libya, Syria Civil War etc. Moreover,

alternative plans about the construction of a new undersea pipeline in order to conduct exports of the region's reserves via Egyptian LNG terminals -Idku and Damietta- seem to be quite a risky business, as Egypt is indebted to energy companies (Baconi 2017). The successful operation of a Southeast Mediterranean energy hub would mean a lot for Greece and Cyprus, two countries that had been under strict European financial supervision in the last decade and are in a high need to attract massive investment programs.

As analyzed in section 3.1, the development of domestic gas markets in the involved countries would strengthen local economies, support private investments and create skilled workforce. On a second phase, the combined profits from direct sales of gas to regional markets could generate several billion of euros on a long term basis (Tsakiris 2016). For the time being, Turkey's maximalist ambitions and aggressive presence in the region intimidate international oil companies' plans resulting in postponing massive investment projects (Ellis 2017).

As it refers to the implementation of the Southeast Mediterranean energy hub and its final form several scenarios have come into light. According to the best case scenario the promotion of EastMed Pipeline seems to be a technically feasible and economically viable option as, important industry players –Edison and DEPA- have confirmed their participation in the project. In general, all energy companies engaged in the exploitation of Southeast Mediterranean gas fields are pioneers in global oil and gas industry, fully expertised in similar project around the globe and with all the appropriate equipment. As a result, in most cases they handle their operational expenses efficiently.

On the contrary and according to a modest scenario, constructing EastMed Pipeline requires a high capital investment of about $ 6 billion that could create obstacles in terms of return on investment. Moreover, certain technical challenges such as the unprecedented depth of 3 km in southern Crete that the pipeline must reach raise infrastructure costs and jeopardize the final gas prices offered while they have to rival the cheaper Russian or Qatari gas. In general, pipeline projects require large initial capital outlays and they must be able to secure long-term commitments from buyers, guaranteeing 10-20 years of cash flow.

It should be also highlighted that as global energy market remains fragile and global energy prices outlook uncertain due to COVID-19 pandemic, there will be an unavoidable slowdown in Southeast Mediterranean Energy Hub's emerge (Stratakis & Pelagidis 2020). According to latest estimations, during 2020 the industry will experience the largest recorded demand shock in the history of global natural gas markets, as gas consumption is expected to fall by 150 billion cbm, twice the size of the drop following the 2008 crisis (IEA 2020). The major consumption decline is expected in mature markets across Europe, North America and Asia while, natural gas demand will progressively recover between 2021-2025. Consequently, the Covid-19 crisis will have long-lasting impacts on natural gas markets resulting in 75 bcm of lost annual demand by 2025. As expected, energy companies' appetite in investments is clearly negatively affected (Exxon Mobil 2020).

It goes without saying that the existing and proposed pipeline networks analyzed in sections 4.1 and 4.2 will definitely cause a "pipeline bottleneck" in the region and harsh competition on a first place. Many analysts are quite pessimistic regarding the completion of the proposed pipelines in total. Inevitably some of them will remain plans given the so far proven reserves is Southeast Mediterranean unless, new immense reserves coming into light and give new gravity to the aforementioned pipeline networks. In any case, pipeline networks remain highly depended on geopolitical issues, face capacity restrictions and discontinuities in finance and long term implementation schedules that in most of cases extend to over a decade. All the above might jeopardize the perspective of a Mediterranean Energy Hub Project based on pipelines.

Intense geopolitical competition might requires the adoption of a more flexible, safe and cheaper option - millions instead of billions invested- of exploiting Southeast Mediterranean reserves such as, a floating LNG terminals network between the involved countries. Converted LNG vessels of capacity between 150.000 to 250.000 cbm are being used as floating storage and regasification units. That practice leads to production security, independence from geopolitical factors, immediate adjustment to demand spikes, transport flexibility and guaranteed return as commercial LNG vessels can be long-term chartered to deliver shipments all across the globe.

Furthermore, Greek and Cypriot maritime cluster could play a vital role by providing a modern and cutting edge technology LNG fleet -16.3% market share in terms of global fleet capacity (UGS 2020), as well as integrated and wide esteemed shipping management practices. Additional factors such as close proximity to key maritime routes –Suez Canal – and emerging markets –Asia Pacific and the existence of the entire appropriate infrastructure - port terminals, refineries, shipyards and human capital- ensure the viability of this option.

Finally, time is not an ally since according to the latest estimations the era of Renewable Energy Sources is approaching; between 2030 and 2035 renewable energy sources will cover a decent market share of more than 20% of global energy consumption (DNV GL 2020). As a result, it is of high importance for Southeast Mediterranean gas reserves to be exploited the soonest possible, as the fossil-fuel share of the energy mix will decline from 81% to 54% by 2050.

5. Conclusions

The main challenge in the exploitation of Southeast Mediterranean gas reserves is the high drilling cost as well as the political and logistical complexity of reaching markets in the second phase. The building of pipelines has developed into a fully-fledged geopolitical and economic fight and, thus, is of great importance in the understanding of the situation and in developing win-win solutions for all regional parties. As it refers to the involved countries so far, Israel fuels most of the country's domestic needs by its own gas. Along with Cyprus, they have an ever greater need to find export options given their very small domestic market. At the moment, a pipeline to an Egyptian LNG plant with spare capacity seems to be the most reasonable option. On the other hand, Egypt became self-sufficient in natural gas in late 2018 and is seeking to become a regional energy trading hub.

Judging by its recent movements and the escalated tension in Southeast Mediterranean, Turkey seems unwilling to be restricted as a transit energy hub only, intending to move a step forward by continuously contesting the boundaries of the exclusive economic zones of Greece and Cyprus, demanding the lion's share of the revenues generated from the exploitation of proven and future gas reserves in the region. Turkey's strategic goal is to maximize its geopolitical position, extending its claims from the Aegean Sea and the Southeast Mediterranean, to the areas of Syria and Iraq.

On the contrary, Greece promotes a diplomatic stance via the proclamation of its Exclusive Economic Zone with neighboring countries such as Italy, Albania, Egypt and Cyprus excluding Turkey. For the moment, Greece remains an x-factor in the region as if the anticipated Herodotus basin gas reserves are proven to be recoverable, then the whole area between 28th and 32nd meridian will come at the forefront and will definitely shape the final form of the anticipated Southeast Mediterranean energy hub which would lead to competitive advantages and the establishment of a new geopolitical status-quo in the region.

All things considered, the aim of this paper was to highlight the importance of Southeast Mediterranean gas reserves to Europe's energy needs, taking into account the geopolitical implications between involved countries combined with the interests of the United States and Russia in the region. Simply put, Southeast Mediterranean has a limited strategic role to play in terms of European energy independence as its importance lies primarily on the economic impact that an increase in energy self-sufficiency will have in the countries of the region.

Finally, the uncertainty about the duration and impacts of COVID-19 on global economy, as well as to energy prices and other industrial sectors, could definitely slow down any vast investment in the region.

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INVESTIGATING THE IMPACT OF ATM AND POS TERMINALS ON MONEY DEMAND IN NINE EUROPEAN COUNTRIES IN THE CONTEXT OF A RANDOM EFFECT MODEL AS THE APPROPRIATE PANEL DATA MODEL

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Abstract

This study investigates the effects of financial innovations on the demand for money using panel data for 9 European countries from 2014 to 2018. Such models assist in controlling for unobserved heterogeneity when this heterogeneity is constant over time and correlated (fixed effects) or uncorrelated (random effects) with independent variables. Hausman test and Breusch and Pagan Lagrangian multiplier test (LM) both indicate that the random effects model is appropriate. We use the conventional money demand that is enriched with the number of automated teller machines (ATM) and the number of point-of-sale (POS) terminals to proxy for the financial innovations. The estimation result of the chosen random effects regression indicate that the elasticity of the demand for real money to POS is about 10 percent meaning that money demand is not elastic with regard to POS. Also, the estimated coefficient of ATM is not significant.

Keywords: EU, money demand, random effects, fixed effects, financial innovation, panel data

JEL classification: C13, C40, C51, E40, E44

1. Introduction

Trade and commerce have been transformed since the introducing of new advanced information technology and technical innovations. Low-cost and high-speed data transfer because of these advancements has created an outstanding platform for e-commerce to grow rapidly which in turn helped to improve the efficiency and boost the competitiveness and economic growth.

Modern payment instruments is a pre-requisite for modern business environment to spread across economy and replace paper-based method which is a hinder for trade to pave the way for fast and efficient transfer of funds. Electronic transfer of funds as a new payment instruments are best characterized by secure, convenient, speedy, low cost and highly efficient means of payment to satisfy the need of modern business and commerce, allow smooth functioning of its financial and real sectors and facilitate speedy, secure and reliable exchange of goods and services through real time settlement of financial transactions. Large scale using of new payment instruments has significant business, economic, political and social impacts.

Electronic payment can be made by new payment technologies such as automatic teller machines (ATMs) that include electronic money (e-money), electronic cards (e-cards) and electronic check and by point-of-sale (POS) terminals.

The purpose of this study is to examine the impact of financial innovation on money demand using panel data which includes nine European countries during 2014-2018 for a conclusive result while gaining the most accurate estimates due to the use of the richest dataset. The results of this study may be of interest to some world organizations such as the

World Bank and the International Monetary Fund and the European monetary authorities such as European Central Bank or the central banks of the these countries. This study hopes to shed light on the relationship between ATM & POS and money demand using the most recent data. The rest of the paper includes a literature review followed by theoretical background and methodology and ends up with data analysis and conclusion.

2. Literature review

Here, we briefly review major studies with focus on the effect of ATM and POS on the demand for money in chronological order.

Zilberfarb (1989) presents empirical results for Israel supports those findings based on the results that he obtained from an empirical analysis using Israel data. The hypothesis is that ATM usage lowers the transaction cost and the reduced transaction cost increases demand deposits. To test this hypothesis a model was regressed. In that regression, the dependent variable is real demand deposits (monthly data) and independent variables include the real transactions (measured by the real GDP), the opportunity cost and the intensity of use of ATM with the inclusion of a variable time trend and monthly dummy variables. The hypothesis is supported by the empirical results meaning that the use of ATM in fact increased the demand deposits. However, he mentions that more research with data covering more countries is needed for a firm conclusion regarding the impact of technological innovations on money demand.

The payment habits in the Netherlands in 1990 based on micro data is analysed by Boeschoten (1992). The results of this empirical analysis indicate that using ATMs, cheques and POS terminals considerably reduces cash holdings. Boeschoten comes to the conclusion that those who use alternative payment media end up with 20 percent lower cash balances. In other words, using check, credit/debit cards and automatic teller machines led to the reduction of demand for cash in this country. According to Boeschoten, the use of ATMs significantly reduces cash holdings. However, he mentions that this finding is not very vigorous.

Humphrey et al. (1996) estimate a system of demand equations for five payment instruments including check, electronic or paper giro, credit card, and debit card. The study cover 14 countries between 1987 and 1993. They conclude that only debit cards do not substitute for cash and other instruments do indicating that using debit cards for POS transactions and ATM withdrawals may restrict the substitution of cash for cards.

Boeschoten (1998) investigates the effect of ATM on cash demand using Dutch data in the period 1990–1994 and finds that ATMs has reduced cash demand by the public but banking sector experienced increased inventories of currency in order to use for ATM. Therefore the total effect of ATMs on the total amount of currency depends on the strengths of public and banking effects. They mostly cancel each other out and the total effect is very modest.

Attanasio et al. (1998) estimates the demand for money in Italy for the period 1989 - 1995. In their estimation, they use data on households and firms. The results reveal this fact that the elasticity of consumption and interest rate are significant and different for households with or without having ATM cards. Most notably, the interest elasticity money demand for households who are in the possession of ATM cards is much higher than that of households who do not have these cards (-0.59 compared to -0.27) due to the fact that the two groups of households use different transaction technologies.

Blanchflower et al. (1998) investigate the effects of ATM on cash demand using Dutch data for the period 1990–1994. Their findings indicate that ATMs reduces cash demand for the public and increases cash demand for the banking sector thus making the total effect of ATMs on the total cash demand quite moderate.

Hancock and Humphrey (1998) argue the impact of ATMs on cash holdings is rather mixed.

Snellman et al. (2001) use panel data method based on data for 10 European countries for the period 1987-1996 to estimate demand for money. They conclude a negative relationship between the use of ATM and cash balances and that the diffusion of both ATM and POS terminals have a negative impact on money balance.

Money demand in Belgium is estimated by Rinaldi (2001) which shows that the expansion of card payments has a dampening effect on the demand for money. She estimate demand for currency in Belgium to determine the degree of cash substitution by other payment

instruments. The number of debit and credit cards, the number of EFTPOS merchants and the number of ATM machines are included in the equation as a proxy for financial innovations. Conducting stationary test reveals that real GDP, interest rates, currency in circulation and the card variables are not stationary yet cointegrated according to cointegration tests. Then, she estimate an error correction model and finds that there is a long run relationship between currency in circulation and the other variables. The number of ATMs and POS merchant acceptance have a negative effect while the number of credit and debit cards have a positive yet weak effect on currency in circulation in this long-run equilibrium relationship as attested by the cointegration test. In short, her results reveals a negative strong effect of ATMs and POS terminals and a weak positive effect of credit and debit cards on currency demand.

Goodhart and Krueger (2001) argue that the number of ATMs has a positive effect on the demand for small bank notes. On one hand, people visit ATMs more frequently and withdraw smaller amounts of cash on the other hand. The total effect, however, would be an increased demand for small bank notes.

Attanasio et al. (2002) conclude that the interest rate elasticity of money demand is lower for people who have ATM cards compared to those who do not. Furthermore, it is in line with the fact that cash holding is significantly higher in Central and in Southern Italy (where most people did not have ATM cards) than in Northern Italy (where most people had ATM cards) and that the interest rate elasticity of currency demand for households with ATM cards is more elastic than those without ATM cards. This is because, the economy of the Central and in Southern Italy was less developed compared to Northern Italy at that time.

Drehmann et al. (2002) analyse the impact of new payment technologies on the cash demand using annual data for the period 1980 - 1998 in 18 OECD countries with the results that POS terminals are negatively related to the demand for small banknotes while ATMs are positively related to the demand for small banknotes, although the impact on large notes are ambiguous. They conclude that cash will still play an important role despite the introduction of advanced payment technology.

Markose and Loke (2003) state that substitution of modern instruments for cash can be accelerated by increased accessibility to cash through high density of ATMs and other payment instruments which in turn leads to fostering cashless economy.

Stix (2004) analyze the cash withdrawals of the people in Austria from May 2003 to February 2004 with the goal of measuring the effect of ATM withdrawals and EFTPOS payments on cash demand. The results are an indication of the fact that the use of debit cards significantly impacts cash demand and that individual with frequent use of debit card will have their cash demand affected differently from cash demand of those who use debit card infrequently.

Lippi & Secchi (2009) also use ATM data for the case of Italy. By introducing POS terminals, debit cards can be used to make purchases as an alternative to ATM cards. Therefore, the use of debit cards will depend on consumers' preferences and on the availability of ATMs and POS. The effect of POS transactions on cash-electronic payment substitution is not fully known.

By investigating the transactional demand for cash for 13 OECD countries during 1988 – 2007, Amromin and Chakravorti (2009) conclude that more usage of debit card at the POS reduces cash withdrawal at ATMs.

Columba (2009) investigates the effect of ATM and POS diffusion on the demand for currency in circulation. GDP, the opportunity cost, the number of ATM and the number of POS as independent variables are used in the estimates with the result that the transaction technological innovation has a negative impact on currency in circulation.

By applying OLS method to the quarterly data for the period 2005-2010, Hataiseree and Banchuen (2010) investigates the impact of e-payment instruments on the use of cash. Debit card usage and ATM are included in currency demand equation to account for the effects of e-payment instruments. The results indicate that debit cards have a negative impact on currency in circulation, while GDP and interest rates have positive and negative impacts on currency demand that is in line with the theory. The estimated coefficient of card-cash substitution of 0.15 meaning that if debit cards transactions increase by, say, 10%, demand for cash transactions will be reduced by 1.5%.

Ramlall (2010) investigate the impact of credit cards and debit cards on currency in circulation (noted and coins are assessed separately) in Mauritius from 1999 to 2008. To test the extent to which other modes of payments has substituted the demand for currency in circulation, he employs three functions with notes and coins, notes and coins at their first differenced as dependent variables and the number of ATMs, number of debit/credit cards, CPI, interest rate, and GDP in log form as independent variables. Results indicate that the use of debit cards is complements and not substitutes to notes in circulation.

Safdar and Khan (2014) use the cointegration technique for Pakistan and conclude that there is an inverse relationship between money demand and the numbers of ATM and cards both.

3. Methodology

3.1. Empirical model

The standard specification, based on the quantity theory of money that is the conventional money demand function, used in many empirical works in several country specific models is as below. In estimating the effect of financial innovation (technology payments) proxied by the number of automated teller machines (ATMS) and the point-of-sale (POS) terminals per inhabitant on the demand for money, we estimate a semi log-linear specification of the form based on a general form of the theory of money demand (Sriram, 2000):

$$\text{Log } MOD_{it} = \beta_0 + \beta_1 \text{Log } GDP_{it} + \beta_2\ RIR_{it} + \beta_3 \text{Log } (ATM_{it}) + \beta_4 \text{Log } (POS_{it}) + e_{it} \quad (1)$$

Five independent variables are used in our model. The amount of currency in circulation in real term for the 9 European countries (denoted by MOD) was used as the dependent variable to estimate a demand for real balance of money. Independent variables include real gross domestic product denoted by GDP, real effective exchange rate denoted by REER, real interest rate denoted by RIR, the number of automated teller machines that is denoted by ATM, the number of point of sale terminals (denoted by POS) and e_t is the error term with t spanning from 2014 to 2018. The countries under investigation in this study include Bulgaria, Czech Republic, Denmark, United Kingdom, Croatia, Hungary, Poland, Romania and Sweden. money demand data for the rest of the European countries is not available so the study had to be limited to these nine countries.

An effective exchange rate is a weighted average of a basket of foreign currencies to measure the external competitiveness of a country. The Bank for International Settlements recommends effective exchange rates for gauging whether a currency has appreciated overall relative to trading partners. Effective exchange rates has been used by researchers (most notably Bahmani-Oskooee &, Malixi, 1991) mainly to obtain exchange rate sensitivity of money demand.

Data is collected from the official websites of the World Bank and the European Central Bank. According to the World Bank, the definitions of data are as follow:

"GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2010 U.S. dollars. Dollar figures for GDP are converted from domestic currencies using 2010 official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used.

Real interest rate (expressed as percent) is the lending interest rate adjusted for inflation as measured by the GDP deflator.

Broad money (in constant 2011 international dollars ,PPP) is the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper"

3.2. Panel estimation methods

3.2.1. Qualitative description

Random effect models assist in controlling for unobserved heterogeneity when the heterogeneity is constant over time and not correlated with independent variables. This constant can be removed from the data through differencing, for example by taking a first difference which will remove any time invariant components of the model.

Two common assumptions are made about the individual specific effect: the random effects assumption and the fixed effects assumption. The random effects assumption is that the individual specific effects are uncorrelated with the independent variables. The fixed effect assumption is that the individual specific effect is correlated with the independent variables. If the random effects assumption holds, the random effects model is more efficient than the fixed effects model. However, if this assumption does not hold, the random effects model is not consistent.[1]

3.2.2. Estimation background

The basic class of models that can be estimated using a pool object may be written as:

$$Y_{it} = \alpha + X_{it}'\beta_{it} + \delta_i + \gamma_i + \varepsilon_{it} \quad (2)$$

Where Y_{it} is the dependent variable, and X_{it} is a *k*-vector of regressors, and ε_{it} are the error terms for *i = 1, 2, ..., M* cross-sectional units observed for dated periods *t = 1, 2, ..., T*. The α parameter represents the overall constant in the model, while the δ_i and γ_i represent cross-section or period specific effects (random or fixed). Identification obviously requires that the β coefficients have restrictions placed upon them. They may be divided into sets of common (across cross-section and periods), cross-section specific, and period specific regressor parameters. We may view these data as a set of cross-section specific regressions so that we have *M* cross-sectional equations each with *T* observations stacked on top of one another:

$$Y_i = \alpha l_T + X_i'\beta_{it} + \delta_i l_T + I_T\gamma_i + \varepsilon_i \quad (3)$$

For *i = 1, 2, ..., M* , where l_T is a *T*-element unit vector, I_T is the *T*-element identity matrix, and γ is a vector containing all of the period effects, $\gamma' = (\gamma_1, \gamma_2, \ldots, \gamma_T)$. Analogously, we may write the specification as a set of *M* period specific equations, each with *T* observations stacked on top of one another.

$$Y_i = \alpha l_M + X_i'\beta_{it} + I_M\,\delta + \gamma_t l_M + \varepsilon_i \quad (4)$$

for *t = 1, 2, ..., T*, where l_M is a *M*-element unit vector, I_M is the *M*-element identity matrix, and δ is a vector containing all of the cross-section effects, $\delta' = (\delta_1, \delta_2, \ldots, \delta_M)$. For purposes of discussion we will employ the stacked representation of these equations. First, for the specification organized as a set of cross-section equations, we have:

$$Y = \alpha l_{MT} + X\beta + (I_M \otimes l_T)\delta + (l_M \otimes I_T)\,\gamma + \varepsilon \quad (5)$$

where the matrices β and *X* are set up to impose any restrictions on the data and parameters between cross-sectional units and periods, and where the general form of the unconditional error covariance matrix is given by:

[1] https://en.wikipedia.org/wiki/Random_effects_model

$$\Omega = E(\varepsilon\varepsilon') = E\begin{bmatrix} \varepsilon_1\varepsilon_1' & \varepsilon_2\varepsilon_1' & \cdots & \varepsilon_M\varepsilon_1' \\ \varepsilon_2\varepsilon_1' & \varepsilon_2\varepsilon_2' & \ddots & \vdots \\ \varepsilon_M\varepsilon_1' & \cdots & & \varepsilon_M\varepsilon_M' \end{bmatrix} \quad (6)$$

If instead we treat the specification as a set of period specific equations, the stacked (by period) representation is given by:

$$Y = \alpha l_{MT} + X\beta + (l_M \otimes I_T)\delta + (I_M \otimes l_T)\gamma + \varepsilon \quad (7)$$

with error covariance:

$$\Omega = E(\varepsilon\varepsilon') = E\begin{bmatrix} \varepsilon_1\varepsilon_1' & \varepsilon_2\varepsilon_1' & \cdots & \varepsilon_T\varepsilon_1' \\ \varepsilon_2\varepsilon_1' & \varepsilon_2\varepsilon_2' & \ddots & \vdots \\ \varepsilon_T\varepsilon_1' & \cdots & & \varepsilon_T\varepsilon_T' \end{bmatrix} \quad (8)$$

The presence of cross-section and period specific effects terms δ and γ may be handled using fixed or random effects methods. The fixed effects portions of specifications are handled using orthogonal projections. In the simple one-way fixed effect specifications and the balanced two-way fixed specification, these projections involve the familiar approach of removing cross-section or period specific means from the dependent variable and exogenous regressors, and then performing the specified regression using the demeaned data (see, for example Baltagi, 2005).

The random effects specifications assumes that the corresponding effects δ_i and γ_i are realizations of independent random variables with mean zero and finite variance. Most importantly, the random effects specification assumes that the effect is uncorrelated with the idiosyncratic residual ε_{it}. The random effects models are handled using feasible GLS techniques. The first step, estimation of the covariance matrix for the composite error formed by the effects and the residual, uses one of the quadratic unbiased estimators (QUE) from Swamy-Arora, Wallace-Hussain, or Wansbeek-Kapteyn. Briefly, the three QUE methods use the expected values from quadratic forms in one or more sets of first-stage estimated residuals to compute moment estimates of the component variances (σ_δ^2, σ_γ^2, σ_ε^2). The methods differ only in the specifications estimated in evaluating the residuals, and the resulting forms of the moment equations and estimators.

Fixed Effects: If instrumental variables estimation is specified with fixed effect, any constants implied by the fixed effect will be added automatically to the instrument list so that the orthogonal projection is also applied to the instrument list. Thus, if Q is the fixed effects transformation operator, we have:

$$\begin{aligned} \beta_{OLS} &= (\textstyle\sum_i X_i' Q X_i)^{-1}(\sum_i X_i' Q Y_i) \\ \beta_{IV} &= (\textstyle\sum_i X_i Q P_{Z_i} Q X_i)^{-1}(\sum_i X_i' Q P_{Z_i} Q Y_i) \end{aligned} \quad (9)$$

Where $Z_i = QZ_i$.

Random Effects and GLS: Similarly, for random effects and other GLS estimators, the weighting will be applied to the instruments as well as the dependent variable and regressors in the model. For example, with data estimated using cross-sectional GLS, we have:

$$\begin{aligned} \beta_{OLS} &= (\textstyle\sum_i X_i' \Omega_M^{-1} X_i)^{-1}(\sum_i X_i' \Omega_M^{-1} Y_i) \\ \beta_{GIV} &= (\textstyle\sum_i X_i \Omega_M^{-1/2} P_{Z_i} \Omega_M^{-1/2} X_i)^{-1}(\sum_i X_i' \Omega_M^{-1/2} P_{Z_i} \Omega_M^{-1/2} Y_i) \end{aligned} \quad (10)$$

Where $Z_i^* = \Omega_M^{-1/2} Z_i$.

In the context of random effects specifications, this approach to IV estimation is termed generalized two-stage least squares (G2SLS) method. In implementing the various random effects methods (Swamy-Arora, Wallace-Hussain, Wansbeek-Kapteyn), the existing results have been extended to derive the unbiased variance components estimators in the case of instrumental variables estimation. More generally, the approach may simply be viewed as a

special case of the Generalized Instrumental Variables (GIV) approach in which data and the instruments are both transformed using the estimated covariances. One should be aware that this has approach has the effect of altering the implied orthogonality conditions.[2]

4. Results

Table 1 shows the results of the estimation of the pooled regression model along with the statistics for the model.

Table 1: Pooled regression model estimates

Source	SS	df	MS	Number of obs	=	45
				F(5, 39)	=	404.95
Model	14.4319174	5	2.88638349	Prob > F	=	0.0000
Residual	.277979245	39	.007127673	R-squared	=	0.9811
				Adj R-squared	=	0.9787
Total	14.7098967	44	.334315834	Root MSE	=	.08443

lmod	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lgdp	1.068241	.0317673	33.63	0.000	1.003985	1.132496
rir	-.0040749	.0054913	-0.74	0.462	-.0151821	.0070322
leer	.4888103	.7000794	0.70	0.489	-.927234	1.904855
latm	.1943001	.1021895	1.90	0.065	-.0123977	.4009979
lpos	.4126154	.0843176	4.89	0.000	.242067	.5831638
_cons	-3.751424	1.274019	-2.94	0.005	-6.328371	-1.174477

We note that the coefficients of LGDP and LPOS are statistically significant at 5% level meaning that these variables have significant impact on LMD. The estimated coefficient of LATM is statistically significant at 10% level. The signs of LGDP and RIR are positive and negative, respectively, as we expected. However, the estimated coefficient of RIR is not statistically significant. The sign of LPOS is positive. To be precise, 1 percent increase in the level of POS leads to 0.41 percent increase in the level of money demand. The sign of LATM is also positive, however, it is not significant at 5 percent level. Regarding (Prob > F = 0.0000), as it is less than 0.05, we conclude that the model is OK overall. It shows that all the coefficients in the model are different from zero. Adjusted R-squared shows that 97.87 percent of variance of LMD is explained by the independent variables which is satisfactory. Next, we consider the fixed effects regression model.

The fixed effects or LSDV model allows for heterogeneity or individuality among the 9 countries by allowing them to have their own intercept values. The term fixed effects is due to the fact that although the intercept may differ across countries, but it does not vary over time, that is, it is time invariant. Table 2 shows the fixed effects regression model estimates accompanied by the resulting statistics of this estimate.

[2] https://eviews.com/help/content/panel-Estimation_Background.html

Table 2: Fixed effects regression model estimates

Fixed-effects (within) regression — Number of obs = 45
Group variable: **countrycode** — Number of groups = 9

R-sq: — Obs per group:
within = 0.9179 — min = 5
between = 0.9652 — avg = 5.0
overall = 0.9650 — max = 5

F(5,31) = 69.30
corr(u_i, Xb) = 0.1746 — Prob > F = 0.0000

lmod	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lgdp	1.0898	.2104626	5.18	0.000	.6605587	1.519041
rir	.0006647	.0012474	0.53	0.598	-.0018794	.0032089
leer	-.316012	.1321667	-2.39	0.023	-.5855677	-.0464563
latm	.0555842	.07119	0.78	0.441	-.0896088	.2007773
lpos	.102638	.0591808	1.73	0.093	-.018062	.223338
_cons	-.5973304	1.003727	-0.60	0.556	-2.644445	1.449784
sigma_u	.1147258					
sigma_e	.01100018					
rho	.99089033	(fraction of variance due to u_i)				

F test that all u_i=0: F(8, 31) = 283.28 — Prob > F = 0.0000

Here, from table 2 it is obvious that the coefficient of LPOS is significant at 10% level while bearing the positive sign. LATM does not have significant influence on LMD. The estimated coefficients of LGDP and LEER are significant while bearing positive and negative signs, respectively. The statistics (Prob > F) indicates that all the coefficients in the model are different from zero as it is less than 0.05. corr (u_i, xb) indicates that the errors u_i are correlated with the regressors in this fixed effects model. rho which is intraclass correlation shows that 99.08 percent of the variance is due to differences across panels. sigma_u is the standard error of residuals within countries and sigma_e is the standard error of residuals (overall error term). Finally, we consider the random effects regression model as appears in Table 3. Here, the 9 countries have a common mean value for the intercept.

Table 3: Random effects regression model estimates

Random-effects GLS regression — Number of obs = 45
Group variable: **countrycode** — Number of groups = 9

R-sq: — Obs per group:
within = 0.9176 — min = 5
between = 0.9662 — avg = 5.0
overall = 0.9660 — max = 5

Wald chi2(5) = 552.19
corr(u_i, X) = 0 (assumed) — Prob > chi2 = 0.0000

lmod	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lgdp	1.111455	.07826	14.20	0.000	.9580678	1.264841
rir	.0008179	.0011526	0.71	0.478	-.0014411	.003077
leer	-.3210563	.1297138	-2.48	0.013	-.5752908	-.0668219
latm	.0784308	.0664013	1.18	0.238	-.0517133	.208575
lpos	.100051	.0326464	3.06	0.002	.0360652	.1640368
_cons	-.7577957	.4535801	-1.67	0.095	-1.646796	.131205
sigma_u	.12230064					
sigma_e	.01100018					
rho	.99197505	(fraction of variance due to u_i)				

Here, coefficients of LGDP, LEER and LPOS are all significant and also, they have positive (LGDP and LPOS) and negative (LEER) influence on the dependent variable (LMD). To be precise, 1 percent increase in the level of POS leads to 0.10 percent increase in the level of money demand. RIR coefficient is positive and maybe that explains why it is not significant. The coefficient of LATM is positive yet insignificant. chi2 confirms that the

model is overall significant. corr (u_i, xb) indicates that differences across units are uncorrelated with the regressors. To decide between fixed or random effects model, we run a Hausman test (Table 4). It basically tests whether the unique errors are correlated with the regressors, the null hypothesis is they are not.

Table 4: Hausman test (hausman Random)

	Coefficients (b) Fixed	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lgdp	1.0898	1.111455	-.0216546	.1953711
rir	.0006647	.0008179	-.0001532	.0004771
leer	-.316012	-.3210563	.0050444	.0253448
latm	.0555842	.0784308	-.0228466	.0256688
lpos	.102638	.100051	.002587	.0493617

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 1.47
Prob>chi2 = 0.9168

Null hypothesis is that random effect model is appropriate while alternative hypothesis is that fixed effect model is appropriate. We cannot reject null (as the probability is higher than 0.05) so we conclude that random effects model is appropriate. In the last step, we need to choose between random effects regression and the simple pooled OLS regression. For this purpose, we apply Breusch and Pagan Lagrangian multiplier test (LM) for random effects (Table 5). The LM test helps to decide between a random effects regression and a simple OLS regression. The null hypothesis in the LM test is that variances across units is zero. In other words, there is no significant difference across units (i.e. no panel effect). In other words, null hypothesis is that pooled regression model is appropriate while alternative hypothesis is that random effect model is appropriate.

Table 5: Breusch and Pagan Lagrangian multiplier test for random effects

lmod[countrycode,t] = Xb + u[countrycode] + e[countrycode,t]

Estimated results:

	Var	sd = sqrt(Var)
lmod	.3343158	.5782005
e	.000121	.0110002
u	.0149574	.1223006

Test: Var(u) = 0
chibar2(01) = 62.14
Prob > chibar2 = 0.0000

We can reject null (as probability is less than 0.05) in favor of the alternative hypothesis so we conclude that the pooled OLS regression is not appropriate and that the random effects is appropriate. Hausman test and Breusch and Pagan Lagrangian multiplier test are both confirming that random effects is appropriate.

Finally, we check the model for the presence of serial correlation. According to this autocorrelation test (Wooldridge test for autocorrelation in panel data), null hypothesis is that there is no serial correlation (no first-order autocorrelation) while alternative hypothesis is that there is serial correlation.

Table 6: Wooldridge test for autocorrelation in panel data for the chosen random effect model

F(1, 8) = 2.421
Prob > F = 0.1583

The probability of 0.1583 (which is greater than 0.05) indicate that there is no first-order autocorrelation.

5. Conclusion

Finally, we summarize the paper as follow. The random effects assumption is that the individual specific effects are uncorrelated with the independent variables. The fixed effects assumption is that the individual specific effect is correlated with the independent variables. Hausman test was used to find out which model is appropriate, fixed effects model or random effects model. The test result indicates that the random effects model is appropriate. By applying Breusch and Pagan Lagrangian multiplier test for random effects, we decided that random effects model is superior to the pooled OLS model. The outcome of these two tests both confirm that the random effects model is appropriate. Based on random effect model, coefficients of LGDP, LEER and LPOS are significant while LGDP and LPOS having positive influence on the dependent variable. Effective exchange rate in logarithm form (LEER) has a negative relationship with money demand in logarithm form (LMOD). For example, 1 percent increase in the level of POS leads to 0.10 percent increase in the level of money demand meaning that the sensitivity of money demand to POS is not very high. In other words, money demand is not elastic with regard to POS. RIR coefficient is positive and insignificant. The coefficient of LATM is positive yet insignificant.

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MONITORING LAND USE / LAND COVER CHANGES USING REMOTE SENSING AND GIS: A CASE STUDY ON KANCHRAPARA MUNICIPALITY AND ITS ADJOINING AREA, WEST BENGAL, INDIA

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Abstract

Changes in land use are a very important issue. Through the discussion of land use change it is easy to know the relationship of a person living in that place with that place. This paper demonstrates the land use changes of Kanchrapara Municipality and its adjoining area through the use of some techniques of remote sensing and GIS (Geographical Information System). Two Landsat satellite images with a range of twenty years have been used to apply these techniques. These images were of the Landsat-7 ETM+ (Year 2000) and Landsat-8 OLI-TIRS (Year 2019). ArcGIS 10.5 software has been used for pre-processing of these images. Then the supervised classification method has been used for the classification of those images using QGIS 3.4 software using the maximum likelihood algorithm. Four types of land use categories have been identified by image classification based on satellite images and Google maps. These were water bodies, vegetation coverage area, bare soil and built up area. Of these, only the amount of bare soil has increased (+17.22%) and the rest of land use categories decreased comparatively. The reasons for the increase and decrease of this level were also discussed here. Accuracy assessment has been also done to determine the accuracy of image classification. Where the overall accuracy of two decades was 82.39 % and 83 % respectively, with the Kappa coefficient was 0.75 and 0.76 respectively. Finally, there is a comparative discussion of two decades of land use using change detection techniques.

Keywords: Land use/ land cover changes, Image processing, Accuracy assessment, Kappa Coefficient, Change detection technique

JEL classification: C00, C89, R14, R52

1. Introduction

In the context of global environment, land use/ land cover (LULC) changes are major changes. Land cover describes the variations in the region or type of physical materials on the Earth's surface, like as water, forest, grass etc., which can be directly observed by the remote sensing techniques (Fisher et al., 2005). Land cover is a primary parameter, which describe the Earth's surface. Different parts of human and physical environments are also linked with this parameter (Foody, 2002). On the other hand, land use means the use of land. According to Nanavati (1957), "Land utilization is the conversion of land from one major use to another general use. Land is the basic natural resource which provides space and many raw materials for various development and other activities." But in the present context, this component is used in a frequently manner due to the human activities. For this reason uses of land are changed continuously. One of the reasons for the change in land use is the growing socio-economic needs. As a result, unplanned and uncontrolled land uses changes (Seto et al., 2002). LULC change usually results from mismanagement of settlements, cultivation, deforestation and other uses for water bodies. It also results in various environmental problems.

On the basis of different techniques of Remote Sensing and GIS, this type of land use change is clearly observed. Remote Sensing and GIS techniques are very useful to mapping the land use/ land cover change and detailed method to enhance the selection of areas

designed to agricultural, urban and industrial areas of a particular region (Selcuk et al., 2003; as cited in Rawat et al., 2013).

The accuracy of spatial data has been defined by the United States Geological Survey (USGS) as: "The closeness of results of observations, computations, or estimates to the true values or the values accepted as being true" (USGS, 1990; as cited in Banko, 1998). For the process of analyzing remote sensing data accuracy assessment is an important step. It sets the data value of the result data to the user. Overall accuracy of the classified image is explained that out of all of the references sites what proportion were mapped correctly. Omission error indicates the reference sites which were omitted from the correct class in the classified map and its help to calculate the producer's accuracy. Another type of accuracy is user's accuracy, which is calculated form commission error. User's accuracy expresses that how often the class on the map will actually be present on the ground (Rwanga et al., 2017). Error matrix and Kappa coefficients are currently used to accurately assess the accuracy of accuracy assessment.

Change detection technique is one of the various strategies that have been developed to understand the past and present situation of land. Change Detection process is identifying variety of an object in a region through the time, which provides to study the pattern and processes of ecosystems at a range of geographical and temporal scales (Singh, 1989). "Remote sensing has been widely used in updating land use/cover maps and land use/cover mapping has become one of the most important applications of remote sensing" (Lo, 2004; as cited in Rawat et al., 2013).

2. Objective

The main objective of the study is to analyze the land use/ land cover (LULC) changes using remote sensing and GIS techniques within two decades of the study area.

3. Study Area

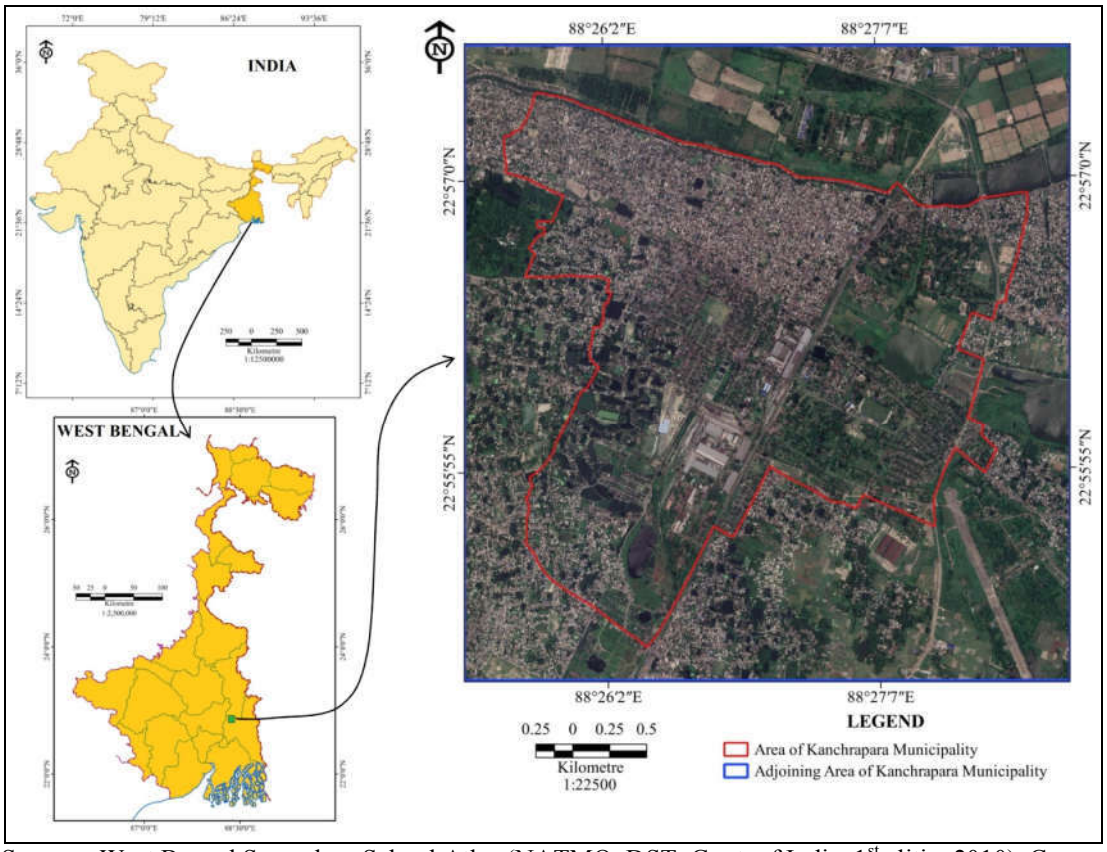
In this study, Kanchrapara Municipality and its adjoining areas have been taken as study area. Locationally, the study area belongs to the Barrackpore-I sub-division of North 24 Parganas district in the Indian state of West Bengal. The study area belongs to the Kolkata Metropolitan District Area (KMDA). The study area is 17.88 sq. km. (Based on Landsat-8 satellite image) and its latitudinal extension is 22°55′09″N to 22°57′30″ N and longitudinal extension is 88°25′28″E to 88°27′53″E (Figure 1). Its average elevation is 10 metre from mean sea level (Banerjee et al., 2014).

Geographically, the study area belongs to the lower Gangetic plain on the east bank of the Hooghly River. As a result, the surface area (Figure 2) of the land is almost equal. Usually the height of the land here is 8 metre to 22 metre (Google earth pro, 2020). In the study area, part of a lake called Mathura Lake (local name Mathura Jhill) is located to the east, which is the Oxbow lake of Hugli river (Rudra, 2012).

Geologically, the study area was formed in the Holocene and late Holocene (Meghalayan) age. This is also a newer alluvium sub-region of the lower Gangetic Plain; basically here four types of formation are found namely Panskura (western side), Chinsura (southern side), Bhagirathi-Ganga (northern side) and present day formation. Study area belongs to the present day formation which is formed by the sand, silt, clay and yellowish brown fine sand (Figure 3).

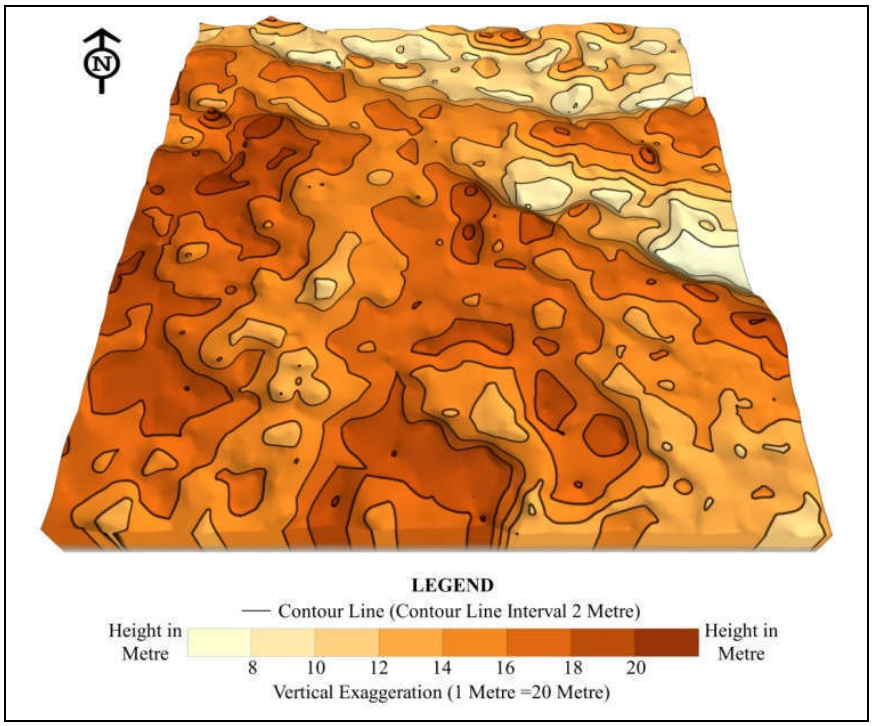
Study area is belonging to the monsoonal climate. Its maximum temperature and minimum temperature are 39°C and 8°C respectively (District Census Hand Book, North Twenty Four Parganas, 2011). The distribution of rainfall is uneven across the year. Total annual rainfall is 1693mm (State Statistical Handbook 2015). Most of the rainfall is found to occur during the months of May, June, July, August, September and October (District Census Handbook, North 24 Parganas, 2011).

Figure 1: Location Map of the Study Area



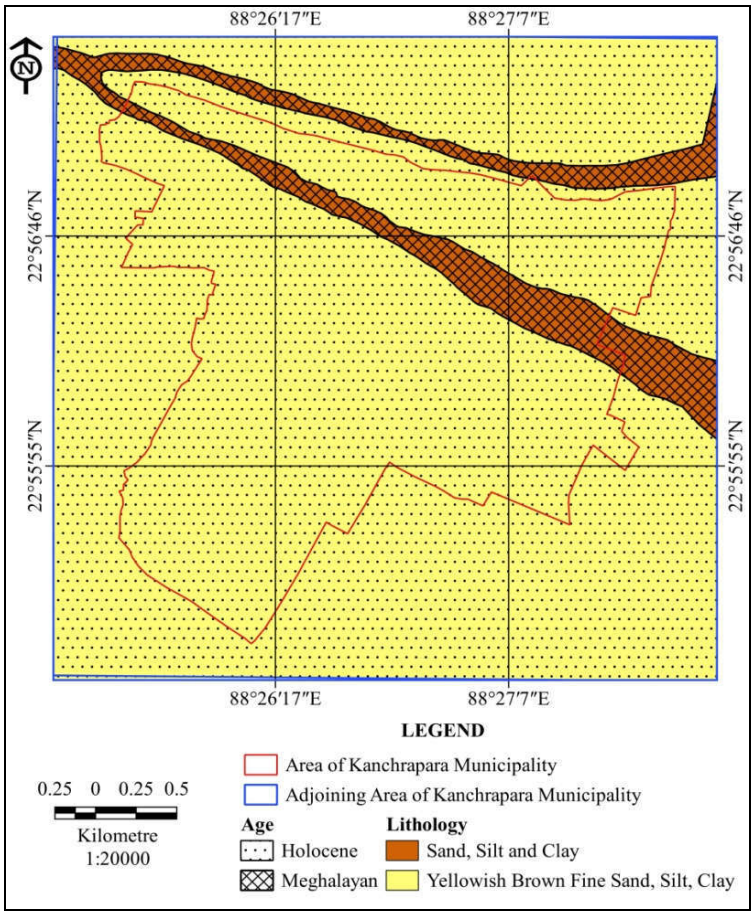
Sources: West Bengal Secondary School Atlas (NATMO, DST, Govt. of India, 1st edition2010), Census of India (2011), Kanchrapara Municipality and Google Earth Pro, 2020

Figure 2: Land Surface of the Study Area



Source: Google Earth Pro, 2020

Figure 3: Geology of the Study Area



Source: Totosheet no. 79B05, Geological Survey of India

4. Methodology

4.1. Data

Landsat ETM+ and Landsat 8 OLI/TIS images (path 138 and row 044) were used in this study. The Landsat ETM+ (acquisition date 17th November 2000) and Landsat 8 OLI/TIS satellite images (acquisition date 6th may 2019) were downloaded from United States Geological Survey (USGS) Earth Explorer (https://earthexplorer.usgs.gov/). The dates of the selected Landsat satellite images (Table 1) were chosen to be closely as possible in the same season. Spatial resolution is 30 metre of the both Landsat satellite images. All visible bands were included in the analysis. In this study, using Arcgis 10.5 and QGIS 3.4 software for the purpose of image processing.

Table 1. Details of Satellite Images

Satellite	Path/row	Projection	Layers	Date of acquisition	Spatial resolution
Landsat 7 ETM+	138/044	UTM-WGS84	8	17th November 2000	30 m
Landsat 8 OLI/TIS	138/044	UTM-WGS84	11	6th May 2019	30 m

Source: United States Geological Survey (USGS) Earth Explorer

4.2. Preprocessing of the Satellite Images

Both Landsat satellite images were georeferenced to the Universal Transverse Mercator (UTM) coordinate system and WGS_84 datum. Pre-processing such as georeferencing, layer stacking, geometric correction and radiometric correction were done in the ArcGIS 10.5 software.

4.3. Image Classification

In this study, only supervised classification method was used for compared the two dated Landsat satellite images. According to supervised classification report only four LULC classes were founded as water bodies, vegetation coverage area, bare soil and built up area. Land cover classes descriptions are presented in table 2. Both images are independently classified in supervised classification method with the help of maximum likelihood algorithm using QGIS 3.4 software. The supervised classification was applied after identified the area of training classes. The training classes were selected based on Landsat image, Google Earth and Google map.

Table 2. Land Cover Classification Scheme

Land cover classes	Description
Water body	Lakes, ponds
Vegetation coverage area	Mixed forest with higher density of trees (mango, jack fruit, sal tree etc.) Shrub, agricultural land
Bare soil	Areas with no vegetation cover, uncultivated agricultural land, land with exposed soil, bare ground
Built up area	Residential area, industrial area, commercial services, transportation and other manmade structures

4.4. Sample Selection

After the supervised classification, the next stage was to calculate sample size (Kothari et al., 2019) based on pixel value of the training classes. For which this formula has been applied here

$$n = \frac{z^2_{\alpha/2}.p.q.N}{e^2(N-1) + z^2_{\alpha/2}.p.q} \quad (1)$$

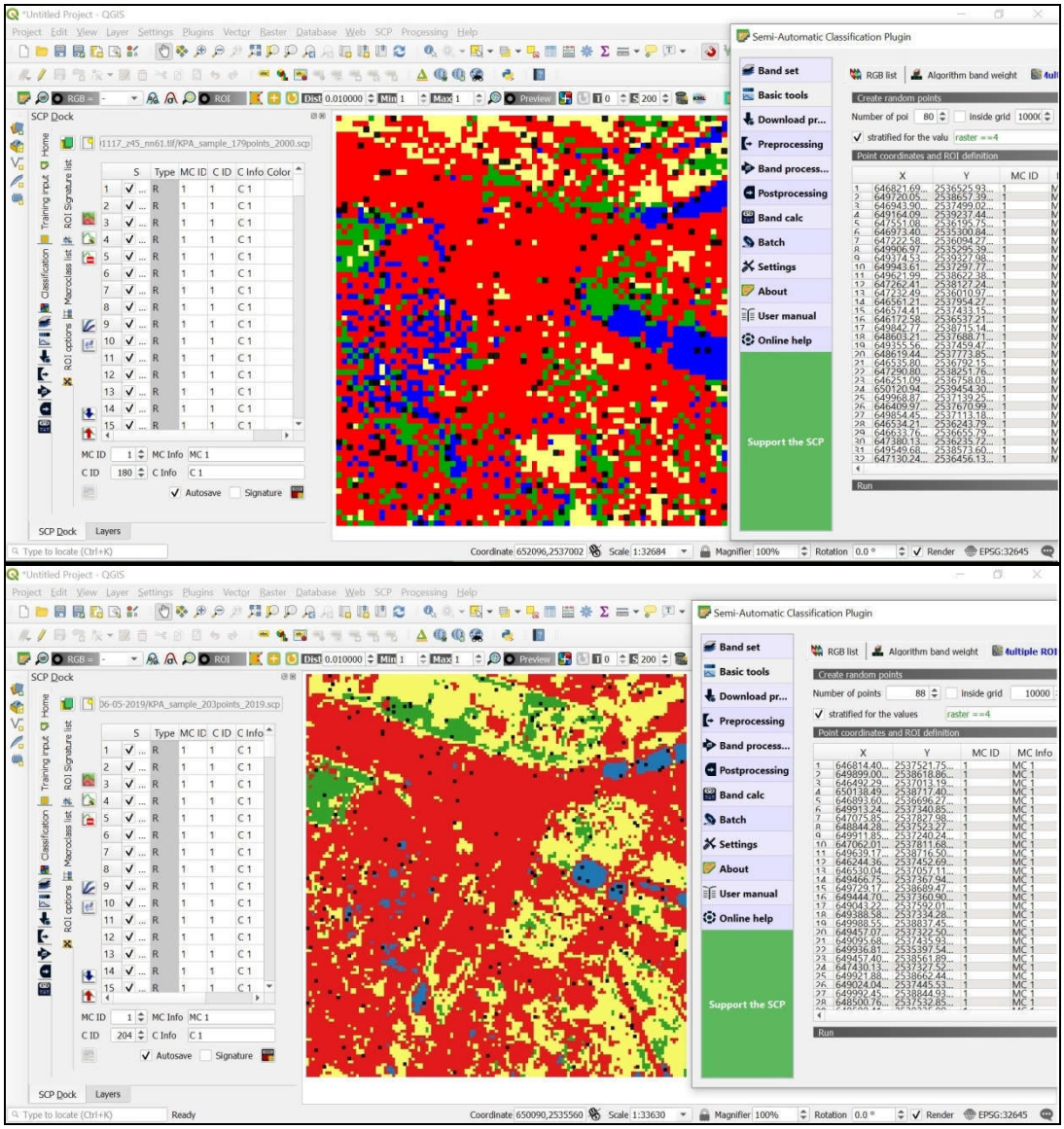
where, n = sample size, N = total sample, $z_{\alpha/2}$ = 1.96 (as per table of area under normal curve for the given confidence level of 95%), p= proportion of the total number of sample (0.51), q= $(1-p)$, e = estimation error (0.03)

After determining sample size, the stratified sample method has been used for random point selection of the training classes.

4.5. Accuracy Assessment

Accuracy assessments determine the correctness of the classified image. Accuracy is a measure of the agreement between a standard that is assumed to be correct and a classified image of unknown quality. If the image classification corresponds closely with the standard, it is said to be accurate (Bhatta, 2013). There are several ways to complete the accuracy assessment, one of which is to compare the reference image with the classified image. In this study, to generated some random set of point and compared the classification results with the ground truth data through the Google earth, Google map and satellite images (Figure 4).

Figure 4: Landsat Classified Image (year 2000 and 2019 respectively) of the Study Area Covered with Points from Random Sampling



Error matrix is in the most common way to present the accuracy of the classification results (Fenglei et al., 2007 as cited in Selçuk, 2008). In this matrix, classification result is shown as row wise and ground truth result is shown as column wise for each sample point. The diagonal elements in the error matrix indicate the correct data, which is already compared between the reference data and ground truth data. Overall accuracy, producer's accuracy and Kappa statistics were derived from the error matrix (Gebhard, 1998 and Sophia, 2017). The Kappa coefficient (K) has been computed by this equation:

$$K = \frac{N\sum_{i=1}^{r} X_{ii} - \sum_{i=1}^{r}(X_i + X_{+i})}{N^2 - \sum_{i=1}^{r}(X_i + X_{+i})} \qquad (2)$$

where, N = total number of observations (pixels), r = number of rows and columns in error matrix, X_{ii} = number of observation in row i and column i, X_i += marginal total of row i, and X_{+i}= marginal total of column i

If the value of Kappa coefficient is equal to one that the agreement is perfect, and if it is close to zero that it is not better as expected. As per (Rwanga, 2017) categorization of Kappa statistic is widely referenced which is re-produced in (Table 3).

Table 3. Rating Criteria of Kappa Statistics

Sl. No.	Value of K	Strength of agreement
1	<0.00	Poor
2	0.00 – 0.20	Slight
3	0.21 – 0.40	Fair
4	0.41 – 0.60	Moderate
5	0.61 – 0.80	Good
6	0.81 – 1.00	Very good

Source: Rwanga, 2017

The overall accuracy represents the sum of all correctly classified samples (pixels) divided by the total number of reference samples (test pixels). For expressing the overall accuracy this equation (Bhatta, 2013) has been applied:

$$\omega = \frac{\sum_{i=1}^{nc} e_{ii}}{NT} \times 100 \quad where, NT = \sum_{i=1}^{nc}\sum_{j=1}^{nc} e_{ij} \tag{3}$$

Where, ω= overall accuracy in percentage, nc= total number of class, e_{ii}= element in i^{th} row and i^{th} column, NT= total number of samples, e_{ij}= element in i^{th} row and j^{th} column

The mapping accuracy for each land use land cover class is known through comparative discussions between producer accuracy and user accuracy. The more errors of omission and commission exist, the lower producer's accuracy and also lower user's accuracy. To calculate the producer's accuracy and user's accuracy (Abdelkareem et.al., 2018) using the following equations:

$$\text{Producer's accuracy} = \frac{aii}{\sum_{i=1}^{n} a_{i+}} \tag{4}$$

$$\text{User's accuracy} = \frac{aii}{\sum_{i=1}^{n} a_{+i}} \tag{5}$$

Where, aii= number of samples correctly classified, a_{i+}= column total for class i, a_{+i}= row total for class i

5. Result and Discussion

5.1. Land Use/ Land Cover (LULC) Classification in 2000 and 2019

Land use land cover classification was done in the study area under the supervised classification method using maximum likelihood algorithm. On the basis of the number of pixels count the area of each class was calculated. Thus the allocations of each classified area are tabulated in Table 4 and shown in the Figure 5.

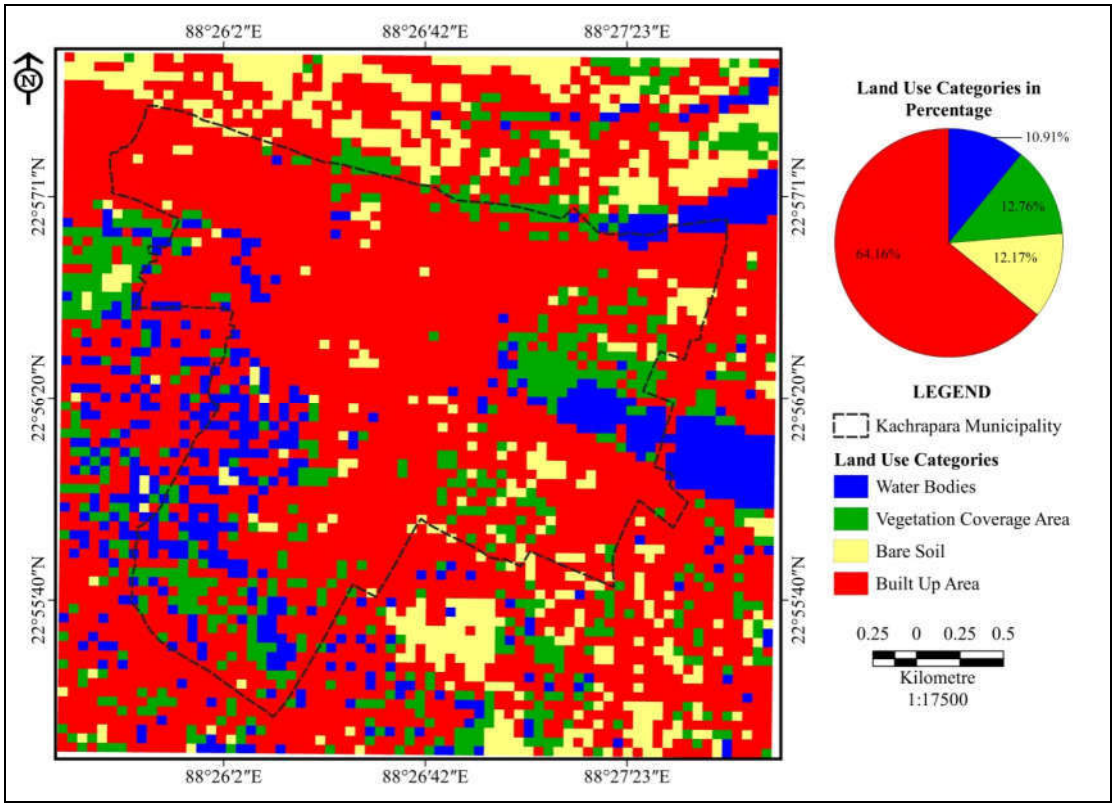
Table 4. Land Use/ Land Cover (LULC) Categories of the Study Area in 2000

Land use / land cover categories	Area in Sq.Km.	Percentage (%)
Water bodies	1.94	10.91
Vegetation cover	2.27	12.76
Bare soil	2.16	12.17
Built up area	11.41	64.16

Source: Data Computed by Authors from Landsat 7 ETM+ Satellite Image (2000)

Based on the land use land cover map of 2000 (Figure 5), the area and percentage of areas as classified are water bodies 10.91 % (1.94 Sq.Km.), vegetation coverage area 17.76 % (2.27 Sq.Km.), bare soil 12.17 % (2.16 Sq.Km.) and built up area 64.16 % (11.41 Sq.Km.). The dominated land use class was built up area, which is occupied around 64% of the total study area.

Figure 5: Land Use/ Land Cover (LULC) Map of the Study Area, 2000



Source: Landsat 7 ETM+ Satellite Image, 2000

But in the year of 2019, some changes are going to be noticed in the study area. During the field survey and also through Landsat satellite images and also satellite view through the Google Earth it is observed that maximum area under the residential and commercial used.

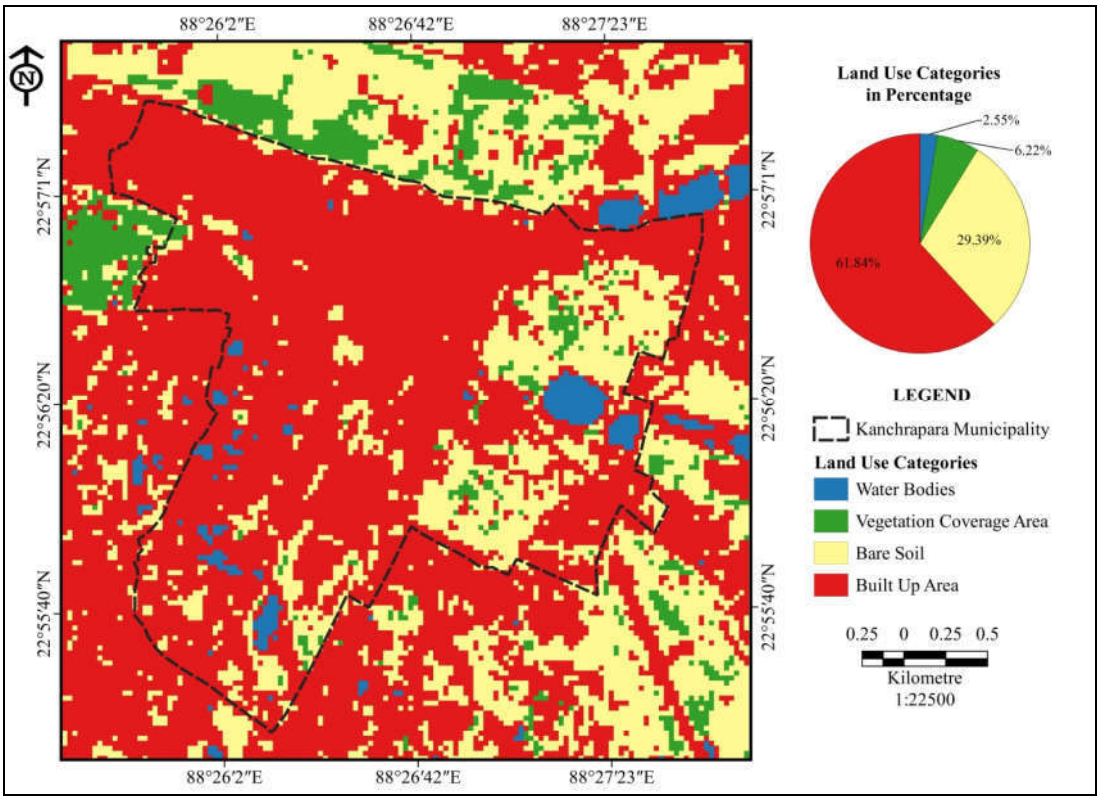
In the land use land cover map of 2019 (Table 5 and Figure 6), area and percentage of classified land use classes are water bodies 2.55 % (0.46 Sq.Km.), vegetation coverage 6.22 % (1.11 Sq.Km.), bare soil 29.39 % (5.25 Sq.Km.) and built up area 61.84 % (11.06 Sq.Km.). Even at this time the amount of built up area is more than other land use classes, with the amount of bare soil were also increased.

Table 5. Land Use/ Land Cover (LULC) Categories of the Study Area in 2019

Land use / land cover categories	Area in Sq.Km.	Percentage (%)
Water bodies	0.46	2.55
Vegetation cover	1.11	6.22
Bare soil	5.25	29.39
Built up area	11.06	61.84

Source: Data Computed by Authors from Landsat 8 OLI/TIS Satellite Image (2019)

Figure 6: Land Use/ Land Cover (LULC) Map of the Study Area, 2019



Source: Landsat 8 OLI/TIS Satellite Image, 2019

5.1. Classification Accuracy Assessment

The most important step of the classification process is accuracy assessment. For this purpose, 176 points for Landsat 7 ETM+ (year 2000) and 200 points for Landsat 8 OLI-TIRS (year 2019) were randomly selected to evaluate classification accuracy. Error matrix shows in the table 6 and table 7. The column of the error matrix shows the ground truth data and row show the reference data. The diagonal elements of the error matrix indicate the number of corrected classified pixels. Table 6 and table 7 are also shows the overall accuracy and the Kappa coefficient. The overall accuracy of both classified Landsat satellite images (Figure 5 and 6) were 82.39% and 83% respectively.

Table 6. Accuracy Assessment of the Landsat 7 ETM+ 2000

LULC	W	V	BS	BA	Total	CS	CE (%)	UA (%)
W	**31**	0	0	1	32	31	3.13	96.88
V	0	**31**	2	0	33	31	6.06	93.94
BS	0	3	**18**	11	32	18	43.75	56.25
BA	0	2	12	**65**	79	65	17.72	82.28
Total	31	36	32	77	**176**	**145**		
OE (%)	0.00	13.89	43.75	15.58		**Overall accuracy = 82.39 %**		
PA (%)	100.00	86.11	56.25	84.42		**Kappa Coefficient = 0.75**		

Note: LULC= Land Use/ Land Cover, **W**= Water bodies, **V**= vegetation coverage area, **BS**= Bare Soil, **BA**= Built up Area, **CS**= Corrected Sample, **OE**= Omission Error, **PA**= Producer's Accuracy, **CE**= Commission Error, **UA**= User's Accuracy

Table 7. Accuracy Assessment of the Landsat 8 OLI/TIS 2019

LULC	W	V	BS	BA	Total	CS	CE (%)	UA (%)
W	**24**	0	1	1	26	24	3.85	92.31
V	0	**31**	1	0	32	31	3.13	96.88
BS	1	5	**40**	8	54	40	25.93	74.07
BA	2	5	10	**71**	88	71	19.32	80.68
Total	27	41	52	80	**200**	**166**		
OE (%)	11.11	24.39	23.08	11.25		**Overall Accuracy = 83 %**		
PA (%)	88.89	75.61	76.92	88.75		**Kappa Coefficient = 0.76**		

Note: LULC= Land Use/ Land Cover, **W**= Water bodies, **V**= vegetation coverage area, **BS**= Bare Soil, **BA**= Built up Area, **CS**= Corrected Sample, **OE**= Omission Error, **PA**= Producer's Accuracy, **CE**= Commission Error, **UA**= User's Accuracy

In the classified LULC map of 2000, producer's accuracy ranged from 56.25% to 100% while user's accuracy ranged from 56.25% to 96.88%. The more error of omission exist in bare soil which was indicated the lower producer's accuracy. But a water bodies were found to be more reliable with 96.88% of user's accuracy.

In another classified LULC map of 2019, producer's accuracy ranged from 75.61% to 88.89% while user's accuracy ranged from 74.07% to 96.88%. The more user's accuracy reflects the more reliability of the classification to the user. In that sense user's accuracy and the producer's accuracy were also extremely high so the classification was highly reliable.

The Kappa coefficient of both classified Landsat satellite images were 0.75 and 0.76 respectively which is rated as good.

5.2. Parrallel Discussion between Two Classified Land Use/ Land Cover (LULC) Maps on the Basis of Change Detection Method

If we side-by-side compare between two land use / land cover maps we clearly understood that land use categories has been changed, and we can easily say that it is the result of human activities. It is because of most of the study area is covered by the human residential and commercial area. Here to view the amount of land use/ land cover change, change detection matrixes (Rawat et al., 2013) have been used. Area was calculated through the GIS software.

The following are the four parameters which have been considered to understand the changes in the study area (Table 7).

5.2.1. Water Bodies Area

At present many lakes and ponds were shut for the residential or commercial purposes. In the year of 2000 and 2019 water bodies area was 10.91 % and 2.55 % respectively. So, it is clear that water bodies area are decreased and its decreasing rate is 8.36 %.

5.2.2. Vegetation Coverage Area

Once upon a time the area was dominated by the vegetation namely *"Kanchra"*, which was the one type of edible plant. But in the year of 1863, Kanchrapara Railway Workshop was established. After this time residential area was developed. This trend of residential area expansion is continuing in present days.

Result of this trend, vegetation area is encroached by the other human activities. Amount of vegetation coverage area in 2000 was 12.76 %. But, in the year of 2019 its amount is 6.22 %. So its decreasing rate is 6.53 %.

5.2.3. Bare Soil

In 2000, the amount of bare soil area was 12.17 % and in 2019 its amount was 29.39 %. Rate of change is 17.22%. In that case the rate of change is positive. But during the field survey it is observed that some types of cultivated land and water bodies were converted into

bare soil. Because people are buying land and enclosing it with walls, even filling the pond and encircling the area for the future.

5.2.4. Built Up Area

In the year of 2019, the total area of the municipality was fully encroached by the residential and commercial purposes. Because people are coming from different states for the purpose of job. Kanchrapara Railway Workshop is also situated in the study area, so large numbers of employee are lived in the study area. In this paper, roads, settlements, railway workshop area, defense areas are also considered as built up area.

In the year of 2000 and 2019 amount of built up area was 64.16 % and 61.84 % respectively. It decreases 2.32%. In this study area, maximum area is under the Kancharapara Railway Workshop authority. One of the reasons for the decrease in the built up area, during the field survey it is observed that the condition of the staff quarters under Kanchrapara Railway workshop is very bad at present because most of the people are leaving these quarters and moving elsewhere, as a result of which the quarters are no longer habitable and are crumbling due to lack of maintenance.

Table 8. Area and Amount of Change in Different Land Use/ Land Cover Categories in the Study Area During 2000-2019

Land Use / Land Cover Categories	2000		2019		Change 2000-2019	
	Sq.Km.	%	Sq.Km.	%	Sq.Km.	%
Water bodies	1.94	10.91	0.46	2.55	-1.48	-8.36
Vegetation	2.27	12.76	1.11	6.22	-1.16	-6.53
Bare soil	2.16	12.17	5.25	29.39	+3.09	+17.22
Built up area	11.41	64.16	11.06	61.84	-0.35	-2.32

Source: Classified Satellite Images [Landsat 7 ETM+ (2000) and Landsat 8 OLI/TIS (2019)]

In summary, from the analyses and comparative study between two land use maps, it could be found that:

i. The most effective reason for the change in land use in the area is human activity.
ii. Unplanned filling of ponds and use of the area for residential or commercial purposes is one of the reasons for the change in land use pattern.
iii. During the field observations have shown that some lands used to be agricultural field but are now lying bare.
iv. In addition of these, trees have been cut down in many places and all those lands are being used for other purposes.

6. Conclusion

The main aim of this paper is to discuss the changes in land use in Kanchrapara municipality and its adjoining areas between 2000 and 2019 through the use of Remote Sensing and GIS. One of the most important image classification method is supervised classification which is used in this paper. For the post image classification the accuracy assessment in terms of Kappa statistics and error matrixes have been used for classification results to be sure. This paper concluded with excellent producer's and user's accuracy, and the Kappa coefficient also rated as good strength of agreement. However, some classes reached the satisfactory level of user accuracy. The change detection method is also used

here, which makes it easy to understand the extent of land use change. Thus, to achieve the high level of classification accuracy it is recommend that to use the high resolution of remotely sensed satellite data with low temporal difference.

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MODELING LOGISTIC ENTERPRISE RE-LOCATION DECISION BY A NESTED LOGIT MODEL

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Abstract

This paper develops a model to analyze decisions regarding the relocation process for logistics enterprise by using discrete choice models. In this framework, two decision points in the relocation process are assumed and maintained in the micro-simulation modeling. The first decision, move or non move, is modeled by using a binary logit form with outcome the probability of moving. The second decision, choosing the destination location, is modeled by a mixed logit model incorporating spatial effects with the outcome of the conditional probability of choosing a zone. This study also applied the relocation decision structure of each logistics enterprise by nested logit model to find out the best model.

In case study, the logistics enterprise relocation decision model has acceptable performance by the nested logit model. However, the nested logit model has to follow the IID Gumbel distribution holds within each nest. Therefore, nested logit model cannot take into account the various tastes among alternatives in the random part of utility function to improve the implementation of the model.

The proposed model also confirm again the important role of spatial interactions among individual logistics enterprise and among zones in the logistics enterprise relocation decision process. The results indicate that big logistics enterprises have a lower probability of relocating and the migrating enterprises are more attractive in the zone which has a high accessibility. Finally, the population density, number of employees and the average land prices of zone strongly affect on the relocation decision making process of individual logistics enterprises.

Keywords: Mixed Logit Model, Logistics Firm, Re-location Decision Model, Nested Logit Model

JEL classification:

1. Introduction

Most logistics enterprises must constantly adjust themselves to new and changing circumstances to survive in a competitive business environment. Relocation of an individual logistics enterprise can be considered as a form of the adaptation (Brouwer et al. 2004). Pellenbarg *et al.* (2002) defined enterprise relocation as a change of address of an individual enterprise from this location to the other location. The factors influencing a logistics enterprise's propensity for moving are internal factors such as number of employee, floor area, transportation costs, and so on; external factors including the number of companies in market, population density..; and location factors such as average land price of location, distance between location and the IC highway. (see more, e.g. Van Dijk and Pellenbarg, 2000; Brouwer et al. 2002). This research, therefore, analyzes the influence of these factors on relocation decision behavior of logistics enterprise in order to better understand the key factors.

There have been a number of studies concerning the issue of relocation decision making behaviors of an individual firm, which is also discussed in these papers (see, e.g. Charles, 1979; Van Dijk et al. 2000; Leitham et al. 2000; Wissen, 2000; Brouwer et al. 2004; Holguín-Veras et al. 2005; Clifton et al. 2006; Ozmen-Ertekin et al. 2007). However, very little research has been done concerning a model for individual logistics enterprise' relocation decision by means of a discrete choice model with spatial effects. Therefore, the objective of this paper is to present a nested logit model and discrete choice model to analyze logistics enterprise's relocation decision making behaviors considering spatial effects in order to better

understand the key factors that influence the decisions made by logistics enterprises as to where they relocate in metropolitan areas.

2. LITERATURE REVIEW

2.1. Nested Logit Models

Waddell (1996) considered the interaction of workplace, residential mobility, tenure and location choices. In his research, the model is on the basis of the description of a household's location choice as a bundle of choices which consist of the decision to move, and the subsequent selection of a housing tenure and location. One motivation for the treatment of mobility and location choice as separate but linked choices is that he intends to model marginal changes in residential location as a function of changes over time in household characteristics and location characteristics, including such policy-relevant factors as accessibility and housing prices. His model is conceived as a dynamic adjustment to changing conditions, rather than as a cross-sectional static or equilibrium solution.

Zondag et al. (2005) analyzed the importance of accessibility in explaining residential relocation choice. They proposed the detailed structure of the housing market module which illustrated the various steps at the demand side of the housing market. First, a household makes a decision to move or to stay. Once, a household has a decision to move this household to enter the residential location choice module. The residential location choice module consists of a nested structure which includes the first level is a household chooses a region and the second level is a specific zone within a region. Their research results suggested that the significant role of accessibility but rather small compared to the effect of demographic factors, neighborhood amenities and dwelling attributes, in explaining residential location choices.

Holguín-Veras et al. (2005) placed their concentration on studying the problem of the business relocation and applied both the aggregate and disaggregate approaches taking account of the fundamental geographic models of business relocations, and an econometric investigation of the role of the transportation accessibility in the process of the business relocation. The disaggregate approach applied in their study is involved in the development of the multinomial logit (MNL) models representing the decision to choose an alternative among a set of the aggregated alternatives.

In the research process, however, less attention has been given to the use of a mixed logit model in particular, and discrete choice models in general, in the analysis of spatial effects for the location choices of logistic companies.

2.2. Discrete Choice Models with Structuralized Spatial Effects

Boots and Kanaroglou (1988) incorporated the effect of spatial structure in discrete choice models of migration. Dubin (1995) developed a spatial binary logit model to predict the diffusion of a technological innovation. In Dubin's model, the probability of the adoption of a new technology varies depending upon a firm's own characteristics and its interactions with those who have previously adopted its technology. Paez and Suzuki (2001) tested the application of a spatial binary logit model to a land use problem related to the effects of transportation on changes in land use. Mohammadian and Kanaroglou (2003) expanded the binary choice model into a more general form to derive a spatial multinomial logit model, and tested it on a problem related to the choice of housing type.

Bhat (2004) proposed a mixed spatially correlated logit (MSCL) model for location-related choices. The MSCL model is a powerful approach that can capture both random variations in taste and spatial correlation in location choice analysis. The empirical results underscore the need to account for these variations and this spatial correlation, both to obtain an improved data fit and to realistically assess the effect of socio-demographic, transportation system, and land use changes on residential location choices. In addition, Miyamoto (2004) presented a discrete choice model with a systematic specification of the spatial influences upon the choice process. The utility function of this model is specified with autoregressive expressions for the deterministic and error component, and the model is evaluated with reference to three alternative models: the standard logit model, a logit model with an

autoregressive deterministic term, and a mixed logit model with autoregressive error terms. Furthermore, Mohammadian and Kanaroglou (2005) attempted to incorporate spatial dependencies in random parameter discrete choice models. They formulated a mixed spatial multinomial logit model that incorporates spatial dependencies to predict the choice of type for new housing projects. Their results suggest that the choices in a housing project are influenced by factors related to other projects in adjacent zones, resulting in correlated choice behavior over space.

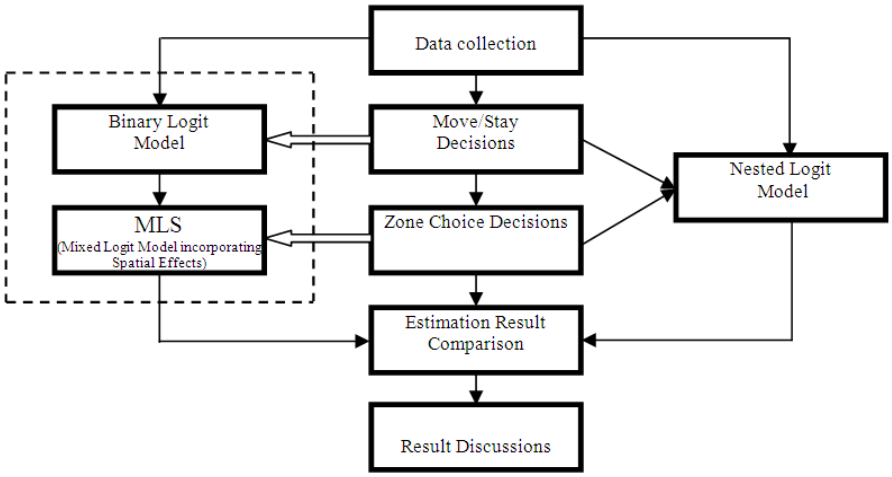
As described above, in previous research efforts, the debate focused on a model for residential location choice in urban areas. Very little research, however, has been conducted regarding a model for relocation choice for logistic firms using a discrete choice model with spatial effects. Therefore, the objective of this paper is to present a mixed logit model for the analysis of relocation choice behavior in order to better understand the key factors that influence the decisions made by logistic firms as to where they relocate in metropolitan areas.

3. STUDY METHODOLOGY

3.1. Conceptual Framework of Re-location Choice Models

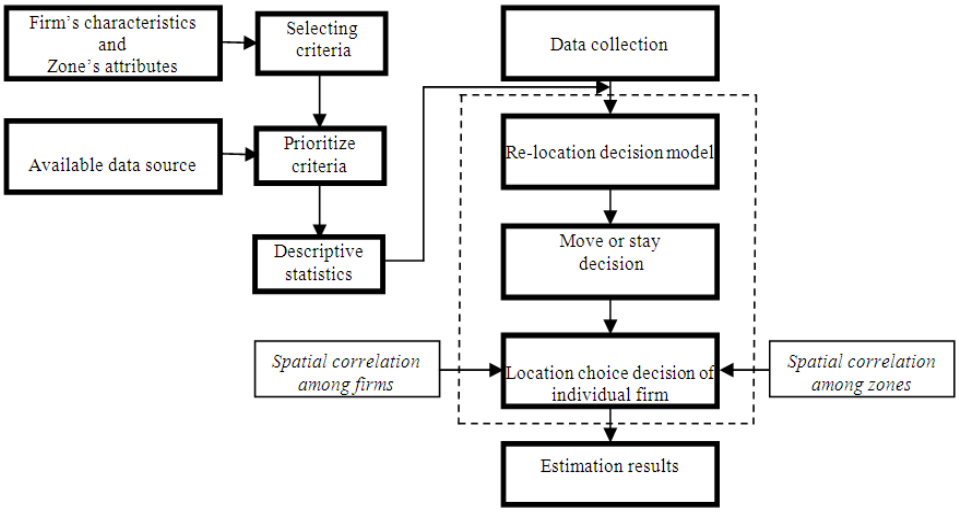
The methodology framework focuses on the logistics enterprise relocation model of individual logistics enterprise incorporating spatial interactions to analyze how the current conditions of location or logistics enterprises' characteristics have influence on the logistics enterprise relocation decision process.

Figure 1.1 Conceptual Framework of Re-Location Models



In reality, the logistic enterprise or household relocation behavior decision process is very complex. This process has been separated into many steps from one more step up to seven steps in the many previous researches. Nevertheless, the most common relocation choice process has been chosen for this research. Therefore, the logistic enterprise relocation model of the proposed model is assumed to include two steps such as move/stay decision and location choice decision in this research.

Figure 1.2 Proposed Re-location Model Structure Incorporating Spatial Effects



Firstly, the moving decision of each individual logistic enterprise often is influenced by internal factors. Besides, the moving decision of each individual logistic enterprise also is affected by the characteristics of each firm and the level of attractiveness of the destination. Hence, the moving decision of each logistics firm of this research has been considered within the influence of all aspects which include the condition of current location, the characteristics of each individual logistic enterprise and the attribute of the destination based on the moving plan of each individual firm. The individual firm relocation model has been analyzed by the binary logit model in this research.

Secondly, the zone choice decision of each individual logistic enterprise is considered by the firms which have been decided by means of moving from the current location to another. The zone choice preference is mainly influenced by the attribute of each destination zone and special industrial characteristics of individual logistic enterprises. Mixed logit model incorporating spatial effects has been proved that it is the best model to explain the actual decision of an individual logistic enterprise for an alternative location from a choice set. This part of the study, therefore, applies a mixed logit model to identifying the zone choice behavior from the zonal attractiveness variables.

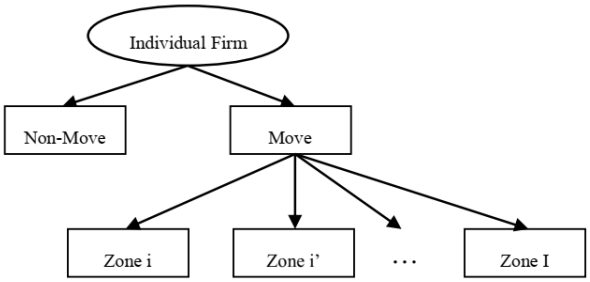
The relocation decision process also is considered by the nested logit model. Firstly, the individual logistic enterprise makes a decision to move or to stay. One, an individual logistic enterprise has a decision to move this individual logistic enterprise to enter the zone choice decision. In addition, the similar input of variables for proposed model has been applied in the nested logit model.

3.2. Proposed Re-location Models Structure

This paper proposes the firm relocation process that consists of two levels, namely, (1) moving probability, and (2) location choice probability.

The proposed model structure can be drawn as the following chart which shows clearly in Figure 1.3. For each individual firm *n*, the relocation process is assumed to consist of two levels, namely (1) move/stay, and (2) zone choice decision.

Figure 1.3 Re-location Models Structure



The joint decision of firm *n* to move and to relocate to zone *i* is assumed to the product of the probability firm *n* that will move and the conditional probability that firm *n* chooses location *i*. The probability of relocation decision of individual firm can be expressed as follows:

$$P_n(i) = P_n(m) \times P_n(i/m)$$

Where,

$P_n(i)$ = probability firm *n* will relocate and choose zone i;

$P_n(m)$ = probability firm *n* will move;

$P_n(i/m)$ = probability that firm *n* chooses zone *i* after deciding to move;

n =1,…, N with N= the total number of firms.

3.2.1. Move/stay Decision Process

The probability of firm *n* $P_n(m)$ is determined by the firm characteristics and the attributes of the current location.

$$P_n(m) = \frac{1}{1 + \exp(-\beta x_{mn})}$$

Where,

$P_n(m)$ = the moving probability of firm *n;*

x_{mn} = characteristics of an individual firm and attributes of the current location;

β = utility coefficient.

3.2.2. Zone Choice Decision Process

This section discusses the estimation of the zone's attractiveness for the moving logistic enterprise. The attractiveness measure is intended to capture the utility provided to the business relocating to the zone associated with the attributes of the zone. Mixed logit model incorporating spatial effects has been proved the best model to explaining the location choice decision making behavior (Train, 2003). Therefore, the methodology of an individual logistic enterprise location choice model using mixed logit model is utilized to explain in the process of relocation model of an individual firm. The average value of these probabilities yields the following simulated probability:

$$\hat{P}_{ni}(\theta) = \frac{1}{R}\sum_{r=1}^{R} L_{ni}(\beta^r)$$

Where,

R = a total number of draws;

$\hat{P}_{ni}$ = an unbiased estimator of P_{ni} by construction.

The simulated probabilities of an individual firm location choice model that incorporates spatial correlation among firms in the deterministic term, and incorporates the spatial correlation among zones in the error term, can be expressed as follows:

$$\hat{P}_{ni} = \frac{1}{R}\sum_{r=1}^{R} \frac{\exp(\sum_{k=1}^{K}\beta_k X_{nik} + \sum_{s=1}^{S}(\lambda \exp(-d^{\delta}{}_{nsi}))y_{si}) + (I-\rho W)^{-1}{}_i T\zeta_{ni})}{\sum_{j\in Z}\exp(\sum_{k=1}^{K}\beta_k X_{njk} + \sum_{s=1}^{S}(\lambda \exp(-d^{\delta}{}_{nsj}))y_{sj}) + (I-\rho W)^{-1}{}_j T\zeta_{nj}}$$

Where,

R = a total number of draws;

$\hat{P}_{ni}$ = an unbiased estimator of P_{ni} by construction;

X_{nik} = a ($Z \times K$) matrix of explanatory variables;

β_k = a ($K \times 1$) vector of unknown parameters; λ, δ = unknown parameters;

ρ = the parameter indicating the spatial autocorrelation;

W = the spatial weight matrix;

I = the identity matrix;

T = a lower triangular matrix of unknown parameters σ ;

ζ_{ni} = a vector of i.i.d random variables with zero mean and unit variance.

3.3. Re-location Models by Nested Logit Model

In this study, the moving decision of each individual logistic enterprise and location choice are assumed to be two related steps of the individual firm relocation choice process that can be modeled jointly by using a nested logit (NL) structure. The two-tier nested structure of (Lee et al. 2010) for residential mobility and location choice has been utilized to explain the relocation decision of an individual logistic enterprise. Some notes are utilized in the structure of logistic enterprise relocation model by nested logit model.

The mathematical formulation of this model follows the utility maximizing NL model developed by McFadden (1974), as described by Koppelman and Wen (1998), but with an additional sampling correction procedure added to ensure consistent estimation of the model parameters using a subset of alternatives. The probability of an individual firm choosing zone *i* is defined as follows:

$$P^n{}_z = P^n{}_{z/m} P^n{}_m$$

Where,

$P^n{}_z$ = the probability of firm *n* will relocate and choose zone *z*;

$P^n{}_m$ = the marginal probability of an individual firm *n* choosing move;

$P^n{}_{z/m}$ = the conditional probability that firm *n* chooses zone *z* after decided to move;

n = 1,…, N with N= the total number of firms.

First level: the bottom level conditional choice probability is equivalent to the standard multinomial logit (MNL) equation (Lee et al. 2010) and has the form as follows:

$$P^n{}_{(z/m)} = \frac{\exp(\mu_z V^n{}_{z,m})}{\sum_{k=1}^{I}\exp(\mu_z V^n{}_{k,m})}$$

Where,

$V^n{}_{z,m}$ = the observable components of the utility function for each elemental alternative *z*;

μ_z = the associated scale parameter.

There is no correction that is needed here as it has been shown that the standard MNL form produces consistent estimates of the model parameters due to the IIA property when the

simple random sampling strategy is used to draw a subset of zones (McFadden, 1978). In addition, the other researches also mentioned other sampling strategies which include independent importance sampling or stratified importance, different additional adjustment terms as described in Ben-Akiva and Lerman (1985) are needed to correct for sampling bias. The marginal choice probability of an individual firm for choosing move decision can be expressed as follows:

$$P^{n}{}_{m} = \frac{\exp(\mu_{m} V'_{m})}{\sum_{m'}^{M} \exp(\mu_{m'} V'_{m'})}$$

4. DATA COLLECTION FOR CASE STUDY

The input, output, and data source in each of the models are summarized in Table 1.1 in the case study of the proposed model. With regard to the data source of the move/stay decision, the distance from the current location of individual firm to the nearest IC highway and the average land price of current location were collected from the survey A and D of TMGMS. The number of employees of the firm and the floor area also was collected from the survey D of TMGMS. For the data source of the zone choice decision, the number of employees of the firm was collected from the survey D of TMGMS. The number of the population of a zone was collected from the population census of Japan. The number of firms of zone and the number of employees of the zone was collected from the establishment and the enterprise census (EEC). In addition, the accessibility of each zone was calculated based on the accessibility formula of Allen *et al*. based on the average travel distance of each zone which can get from the RTC. The average land price of a zone can be computed from the land price survey of Japan. The average distance between zones obtained from the empirical data is used as the zonal impedance variables in this research.

Table 1.1 Input, Output, and Data Source in Logistics Firm's Relocation Model

Model		Input	Data source	Output
Re-location Model	**Move/stay Probability**	- The number of employees of each firm. - The floor area of each firm - The land price of the current location of each firm. - The distance from the current location of each firm to the nearest IC Highway	Survey A and D of TMGMS	Probability of moving decision.
		- Dummy variables of destination characteristics	Survey D of TMGMS	
		- The weight of commodity per day and the travel distance from firm to customers - Transportation cost	Survey B of TMGMS	
	Zone Choice Probability	- Average land price of zone	Land price survey	Probability of a zone being selected.
		- Number of firms of zone	EEC	
		- Population number of a zone	PCJ	
		- Total area of zone	GIS	
		- Employees number of firm - Floor area of each firm	TMGMS	
		- Accessibility of each zone - Distance	RTC	

5. RESULTS AND DISCUSSIONS

5.1. The Comparison of Estimation Results for Move/stay Decision

The estimation of this study is based upon chemical manufacturers, machinery manufacturers and retailers because of the limitation of available data sources. The total number of samples of each industry type which includes chemical manufacturers, machinery manufacturers and retailers is 571, 659 and 519 (firms), respectively. Moreover, Table 1.2 describes the comparison of estimation results of the binary logit model for move/ stay decision of individual firm among three types of industry.

The results show the value of floor area, number of employees of each firm for three types of industry. The parameter for retailers has the lowest value which means that retailers often have a higher moving probability than that of chemical manufacturers or machinery manufacturers. The reason can be interpreted as the number of employee and floor area of retailers are smaller than that of chemical manufacturers and machinery manufacturers. In other words, the influence of floor area and number of employees of retailers on their moving decisions is lower than that of manufacturers with a large floor area and employees. The negative sign of the number of employees of chemical manufacturers, machinery manufacturers and retailers implies that large firms are less willing to move. The statistical significance of the estimated parameter shows that this factor maintains an important role in the moving decision for chemical and machinery manufacturers. An explanation is that the number of employees is high for the manufacturers companies. Therefore, the manufacturer companies usually require many employees. The results of Table 1.2 also show that the floor area of each individual firm has the influence and statistically significant with the number of employees of each individual firm on the move/ stay decision for each type of industry.

Table 1.21 Comparison of Estimation Results for Move or stay Decision

Variables	Chemical manufacturers	Machinery manufacturers	Retailers
	Coeff (*t-value*)	Coeff (*t-value*)	Coeff (*t-value*)
Constant	-5.9815 (-7.73)	-4.4000 (-6.41)	-4.5047 (-3.75)
Number of employee of each firm (persons)	-0.0243 (-3.35)	-0.0315 (-3.54)	-0.0904 (-4.01)
Floor area of each firm (1,000 m^2)	-0.0048 (-1.09)	-0.0075 (-3.66)	-0.0252 (-1.82)
Land price of current location of each firm (1,000 yen/m^2)	0.1885 (2.15)	0.9237 (2.30)	1.0661 (1.02)
Distance from current location of each firm to IC Highway (1,000 *m*)	0.0374 (1.95)	0.1121 (3.55)	Omitted*
Transportation Cost (10,000 yen)	0.0008 (1.67)	0.0006 (2.22)	0.0002 (2.17)
Firms need for large land (Yes =1, No =0)	1.2477 (3.29)	1.0955 (2.79)	1.0715 (1.98)
Firms need to be near to IC Highway (Yes =1, No =0)	0.6431 (1.97)	0.1181 (1.41)	Omitted*
Firms need to be near to major customers (Yes =1, No =0)	0.8723 (2.56)	0.5733 (1.82)	0.7242 (1.80)
Firms need to be near to customers (Yes =1, No =0)	1.1576 (3.51)	Omitted*	Omitted*
Firms need to be convenient for employees to commute (Yes=1, No = 0)	1.2215 (3.32)	1.6574 (3.86)	Omitted*
Firms need to be available for land to expand area (Yes =1, No =0)	0.3338 (0.94)	2.6348 (3.97)	0.9064 (2.28)
Firms have problems about loading and/or unloading at road in front of your firm (Yes =1, No =0)	1.0663 (2.89)	0.6909 (0.90)	1.7468 (2.17)
Firms have problems of parking space (Yes =1, No =0)	0.5120 (1.40)	0.8711 (1.33)	1.7373 (3.20)
Number of observation	571	659	519
Log-likelihood at convergence	-162.3	-173.8	-135.7
Log-likelihood at zero	-271.0	-345.9	-229.7
Log likelihood ratio	0.400	0.497	0.409
Hit ratio (%)	62.5	63.1	50.0

The results compare the value of land price of the current location of each firm, and distance from the current location to the nearest IC highway among three types of industry. The results show that the land price coefficients of the current location of each individual firm has statistically significant and positive signs for chemical manufacturers, machinery manufacturers and retailers. This result indicates that the land price of the current location has a significant positive effect on a firm's moving decision for all manufacturers companies and

retailers. The reason for this is that individual firms which have a high land price of current location will have a high probability of moving. The land price of the current location factor, therefore, is an important factor that influences the relocation decision behavior of chemical manufacturer firms, machinery manufacturers and retailers. In addition, the result indicates that the parameter of land price for retailers has the highest value which means that retailers have a higher mobility than that of chemical manufacturers and machinery manufacturers. Because retailers prefer to locate in the central zone with high land price of the current location to closely to customers, therefore, the influence of land price of current location on the retailer's moving decision is higher than that of manufacturers.

This result also illustrates that the distance from each logistics firm to the nearest IC highway has a statistically significant and positive effect on the moving decision of chemical manufacturers and machinery manufacturers. This also means that manufacturers companies are more likely to locate in the locations that are near the IC highway. The reason for this is that the companies can reduce their cost of travel which is an important cost for the manufacturer firms. This factor, however, is less important for the retailers based on the value of statistic insignificance. Therefore, the value of this factor has been statistical omitted from the proposed model. Furthermore, the transportation cost of each individual firm is statistically significant with reasonable signs for retailers, machinery manufacturers, and chemical manufacturers. The parameter of transportation cost for retailers is the lowest value. This can be explained that commodity of retailers often distributed in the short distance with smaller weight than that of manufactures. However, the positive sign of transportation cost means that retailers and manufacturers prefer to move to the locations which have a lower transportation cost.

The results indicate that the need for large land of each individual firm is statistically significant with a reasonable sign for manufacturers and retailers. This means that the need for large land of each firm has a positive effect on the moving decision of that firm. With the high demand for large land, the probability of moving decision will increase for each individual firm. In regard to the need to be near to the IC highway of individual firms, these factors keep an important role for chemical manufacturers and machinery manufacturers but less important role with retailers. This can be interpreted that commodity of manufacturers often distributed in the long distance and the near distance to IC highway will reduce the average travel distance in order to reduce transportation cost for manufacturers. Similarly, with regard to the need to be convenient for employees to commute, this dummy is statistically significant for chemical manufacturers and machinery manufacturers. The reason for this is that number of employees of manufacturers often is large and manufacturer firms prefer to move to the location which has a high convenience for employee to commute.

The result also compares the value of dummy parameters for three industry types. The parameter of dummy for machinery manufacturers has the highest value which means that manufacturers often require a large floor area which is available. However, retailers often require the small floor area for available land.

Regarding the other dummy, the parameter of these dummy for retailers has the highest value. This can be interpreted that retailers often locate in the central zone which has limited parking space or limited space for loading or unloading of road in front of the retailer's firm. Whereas, chemical manufacturers and machinery manufacturers are often located in the zones which are outer of the central zones and the space for parking, loading or unloading may be large in these zones.

Finally, the results summarized the estimated results of the models for three industry types in the case study. The measures of fit of the models, represented by log-likelihood ratio and hit ratio, which are shown at the end of Table 1.2 are rather high for all industry types in this study. The results of log-likelihood ratio of chemical manufacturers, machinery manufacturers and retailers are 0.400, 0.497 and 0.409, respectively. Considering the results of log-likelihood ratio, it is straightforward to say that the proposed model for move/stay decision making behavior of an individual firm has a good model performance. In addition, the results of hit ratio of chemical manufactures, machinery manufacturers and retailers are 62.5%, 63.1% and 50.0%, respectively. The values of hit ratio indicate that the proposed model for move/stay decision of each individual firm is sufficient to predict the move/stay decision making behavior.

5.2. The Comparison of Estimation Results for Zone Choice Decision

Table 1.3 describes the comparison of estimation results of the mixed logit model incorporating spatial effects for the zone choice decision.

Firstly, the obtained results in this table indicate that the coefficients of population density and number of employees of each zone have a statistically significant and positive effect on the preference of the chemical manufacturers and machinery manufacturers. This means that all manufacturing firms are more likely to choose the zones that have a high population density and therefore a large employee pool. The manufacturers often require a lot of employees in the manufacturing process and the cost of employee recruitment is one important part in the total cost. Therefore, the cost of recruitment can reduce if an individual firm can organize the committee for recruitment in the same area or the same zone which employees live. It will contribute to maximizing the profit of each individual firm. Additionally, this factor is also the important factor for the retailers based on the statistically significant and reasonable signs of the estimated coefficients. This issue of retailers can be explained that retailers can increase the number of regular customers to maximize their profit purpose if they located in the zone with high population number. The retailers also can get other benefit from to get close to the customers in the zone.

Secondly, the estimated result also shows that the average land price of each zone has negative and significant effects on the zone choice decision for chemical manufacturers, machinery manufacturers and retailers. In the real situation, the manufacturers not only require a lot of employees but also require a large floor area. Therefore, the average land price of a large floor area is one of the most important costs of each manufacturer. From this reason, it is straightforward to see that any firm always prefers the zone which has a low land price and this market can help firm to maximum profit. The average land price of each zone is not only important for each manufactures but also very important for each retailer. In fact, the retailer requires a smaller floor area than that of each manufacture. However, the location of each retailer is normally located in the center of cities or located near the rail station to get close to the customers. In addition, the land price of these kinds of location is very high in the cities. Therefore, the average land price of each city keeps a key role for retailer in the competitive business environment.

Thirdly, the estimated coefficient value of the distance parameter (impedance variables) has the expected sign as a negative sign for the all industry types in this study. The values of coefficient of distance parameter for chemical manufacturers, machinery manufacturers and retailers are -0.0055, -0.0039 and -0.0115, respectively. In which, the parameter of retailers has the lowest value which means that retailers prefer to choose the zone in the shortest distance to lower the cost of transportation. The other reason for this is that the commodity originated from retailers will be distributed in the shortest distance to customers who are the final users of commodity.

Furthermore, the negative sign implies that the zone which located near the current zone will be more attractive for individual firms. In other words, the individual firm prefers to relocate at zone in short moving distance. The other reason for this is that the transportation cost is one of the main costs of each manufacturer. The manufacturers always want to reduce the transportation cost to maximize their profit.

Table 1.3 Comparison of Estimation Results for Zone Choice Decision

Variables	Chemical Manufacturers	Machinery Manufacturers	Retailers
	Coefficients (*t-value*)	Coefficients (*t-value*)	Coefficients (*t-value*)
Zonal Attributes Variables			
Average land price of zones (1,000 yen/ m^2)	-0.0034 (-2.87)	-0.0031 (-1.94)	-0.0003 (-1.29)
Population density of zones (in 1,000 persons/ km^2)	0.2031 (3.69)	0.0614 (1.03)	0.1510 (2.73)
Number of employee of zones (in 1,000 persons)	0.0031 (2.53)	0.0012 (1.05)	0.0010 (0.81)
Impedance Variables			
Distance (1,000 m)	-0.0035 (-5.60)	-0.0058 (-3.63)	-0.0020 (-1.33)

Variables	Chemical Manufacturers	Machinery Manufacturers	Retailers
	Coefficients (*t-value*)	Coefficients (*t-value*)	Coefficients (*t-value*)
Firm Characteristics Variables			
Number of employee of firms (in persons)	-0.0003 (-1.06)	-0.0036 (-1.37)	Omitted*
Floor area of firms (m^2)	-0.0087 (-1.82)	-0.0035 (-1.32)	Omitted*
Distance from firm to IC Highway (1,000 m)	0.2595 (2.00)	0.0111 (1.31)	0.0675 (2.32)
Correlation Variables			
Spatial correlation among firms			
δ	0.3953 (6.52)	0.4402 (6.15)	0.6577 (3.62)
λ	0.1835 (3.53)	0.2938 (3.37)	0.5802 (1.60)
Spatial correlation among zones			
ρ	0.5454 (9.30)	0.6923 (1.97)	0.0876 (1.98)
***Standard deviation of lower triangular matrix* T**			
σ	0.6427 (1.86)	1.3072 (2.83)	0.5917 (1.86)
Number of observation	60	92	53
Log-likelihood at convergence	-172.2	-221.4	-156.3
Log-likelihood at zero	-237.0	-363.5	-209.4
Log likelihood ratio	0.273	0.390	0.253
AIC test	6.14	5.09	6.27
Hit Ratio (%)	55.38	64.21	40.69

5.3. The Results of Firm Re-location Decision by Nested Logit Model

Table 1.4 shows the results of individual firm relocation decision by nested logit model. The nested logit model of individual firm mobility and location choice has a relatively parsimonious specification but it, nevertheless, includes the important exploratory variables that are expected to be an integral part of the individual firm relocation decision process. The model has an acceptable good fit based on the value of log-likelihood ratio and AIC test, which are shown at the end of Table 1.4 are 0.267, 0.176 and 0.149 for chemical manufacturers, machinery manufacturers and retailers, respectively. In addition, the model gives the same sign of the estimated parameters, each of which is as expected. For example, the average land price of each zone has a negative effect on the individual firm location choice decision as it's intuitive that an individual firm tends to locate in the zone with lower land price. Next, as we expected that the number of employees of each individual firm has negative sign. This means that the large firms or big firms have a lower mobility of re-locating.

Regarding with the logsum of nested logit model, the logsum value can be considered as the links between the two levels of the nested logit model by bringing information from the bottom level into the upper level. Therefore, the logsum coefficient reflects the degree of independence among the unobserved portions of utility for alternatives the moving nest. Note that the probability of choosing moving nest in the first level depends on the expected utility that the individual firm receives from choosing that nest. This expected utility is made up to the utility that an individual firm receives no matter which zone an individual firm chooses in the moving nest. The expected extra utility that an individual firm receives from being able to choose the best zone in the moving nest, which is the multiple between logsum value and logsum coefficient (see more, Wen, Chieh-Hua & Frank S. Koppelman.2001, Vovsha, Peter.1997, and Heiss, F. 2002, Matt Golder).

In this research, the log-sum coefficient showing a degree of independence in the unobserved parts of utility for alternatives in a nest, and the estimated logsum parameters of the move nest are 0.0455, 0.2592 and 0.3664 for chemical manufacturers, machinery manufacturers and retailers, respectively. Therefore, the low values of the log-sum coefficients mean that an increase would affect slightly on the probability of the move nest of being selected, as the expected maximum utility would affect slightly on the choice between move decision and non move decision.

Table 1.4 The Estimation Results of Firm Re-location Decision by Nested Logit Model

Variables	Chemical Manu	Machinery Manu	Retailers
	Coefficients (*t-value*)	Coefficients (*t-value*)	Coefficients (*t-value*)
Zone choice			
Average land price of zones (1,000 yen/ m^2)	-0.0042(-3.37)	-0.0085(-3.23)	-0.0029(-4.94)
Population density of zones (in 1,000 persons/ km^2)	0.0079 (2.30)	0.0023 (1.52)	0.0016 (1.28)
Number of employee of zones (in 1,000 persons)	0.0731 (2.01)	0.0402 (3.12)	0.0230 (0.76)
Distance (1,000 m)	-0.0006 (-1.72)	-0.0002 (-1.11)	-0.0017 (-1.15)
Number of employee of firms (in 1,000 persons)	-0.0734 (-0.85)	-0.0212 (-0.47)	Omitted*
Distance from firm to IC Highway (1,000 m)	0.0111 (2.40)	0.0047 (1.43)	0.0012 (0.69)
Move/stay choice			
ASC_move	-0.0793 (-3.62)	-0.2704 (-1.71)	-0.3119 (-1.42)
Land price of current location of firm (1,000 yen/m^2)	0.0016 (0.96)	0.0022 (1.45)	0.0036 (0.98)
Transportation Cost (10,000 yen)	0.0015 (1.37)	0.0013 (1.35)	0.0004 (0.82)
Firms need for large land (Yes =1, No =0)	0.0378 (0.83)	0.0118 (0.69)	0.0148 (0.41)
Firms need to be near to major customers (Yes =1, No =0)	0.0455 (1.07)	0.0816 (1.21)	0.0211 (0.97)
Firms need to be convenient for employees to commute (Yes=1, No = 0)	-0.0109 (-2.35)	-0.0106 (-1.24)	Omitted*
Firms need to be available for land to expand area (Yes =1, No =0)	0.5854 (0.89)	0.7054 (1.86)	0.0499 (1.31)
Firms have problems about loading and/or unloading (Yes =1, No =0)	0.1714 (1.59)	0.0943 (0.78)	0.0116 (0.47)
Firms have problems of parking space (Yes =1, No =0)	-0.6417 (-0.65)	-0.8595 (-1.23)	-0.0710 (-1.45)
Move nest logsum μ_m	0.0455 (3.62)	0.2592 (3.91)	0.3664 (2.06)
Number of observation	571	659	519
Log-likelihood at convergence	-1652.5	-2144.2	-1743.7
Log-likelihood at zero	-2256.1	-2603.8	-2050.6
Log likelihood ratio	0.267	0.176	0.149
AIC test	5.85	6.55	6.77

The estimation results of the nested logit model arrange in a line with those found in previous empirical studies (Lee et.al 2010). Number of employee, floor area, distance between the current location to the nearest IC highway, transportation cost and land price of current location of each individual firm, the demand to get a large land, need to be near to customers or major customers, need to be near IC highway, and need to be convenient for employees to commute, the pressures of many problems such as loading and unloading at road in front of firms, parking space were determined to be important individual firms' characteristics which helped to explain the individual firm's mobility and zone choice decision making process with the important attractiveness of zones. In general, large firms or big companies are less likely to move and change location than the small firms with high land price of current location and transportation cost.

Even though, the individual firm relocation decision model has acceptable performance by the nested logit model. However, the nested logit model has to follow the IID Gumbel distribution holds within each nest (Ben-Akiva et al. 1985). Therefore, nested logit model cannot take into account or considering the various tastes among alternatives (zones) in the random part of utility function to improve the implementation of the model. It means that the nested logit model has some disadvantages to deal with the incorporating spatial interactions among zones in the error part of utility function in the individual firm zone choice decision model.

6. CONCLUSIONS AND RECOMMENDATIONS

The main contribution of this paper is to get insight in the process of the logistics firm relocation incorporating spatial interactions and the explanatory variables determining this decision. The proposed individual firm relocation model structure consists of two levels, namely (1) moving probability, and (2) location choice probability. In which, the model has analyzed the influences of the factors on the firm relocation decision process by using the discrete choice models which include binary logit model and mixed logit model incorporating spatial effects.

The zone choice decision level of the proposed model shows that the population density of the zone has a statistically significant and positive effect on the preference of the chemical manufacturers and machinery manufacturers. Besides, the average land price of each zone has

a negative and significant effect on the zone choice decision for all manufacturers and retailers.

Finally, this research has analyzed the relocation decision structure by using nested logit model. In general, the results are not significant different between nested logit model and the proposed model. However, the proposed model of relocation decision process can get some advantages such as taking into account the correlation among zones and the correlation among firms to improve the implementation of the model. Meanwhile, the nested logit model has to follow the IID Gumbel holds within each nest (Ben-Akiva et al. 1985). Therefore, nested logit model cannot take into account the correlation among alternatives (zones) in the random part of utility function. In addition, the t statistic values of most variables are higher in the proposed model than that of the nested logit model.

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BALANCED SCORECARD AS A TOOL FOR EVALUATING THE INVESTMENT ATTRACTIVENESS OF REGIONS COMPRISING THE ARCTIC ZONE OF THE RUSSIAN FEDERATION

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Abstract

Prerequisite to sound investment decision-making is the availability of reliable, objective information on earlier investments and which economic sectors they have benefitted, as well as methods allowing for multi-faceted analysis of investment performance. This study aims to elaborate a balanced scorecard to reflect the performance of and the trends in the investment activity ongoing in the regions that comprise the Arctic Zone of the Russian Federation. Methodologically, the study relies on a systemic, balanced approach; balanced scorecard concept; and foreign and domestic practices of estimating regional investment attractiveness. The study is novel in that it has achieved a customized balanced scorecard that allows for analyzing the RF Arctic regions' investment attractiveness from various perspectives, while also allowing to identify these regions' major investment-related challenges and promising investment opportunities. Further, the study contributes to the scientific soundness of strategies that seek better investment image. Among key outcomes of this study is the economic model that uses the said balanced scorecard to measure the RF Arctic regions' investment attractiveness with regard to investment stakeholders (public authorities, investors, population). The outcomes of this study are expected to be used as guidance by the public authorities in the RF Arctic regions when shaping local investment policies. The prospects of this study lie in further improvement of the contents and the structure of the balanced scorecard as the Russian economy progresses in its development and, hence, improved models will be required for measuring its regions' investment appeal.

Keywords: The Arctic Zone of the Russian Federation, investment activity, investment risks, investment climate, investment policy, investment attractiveness, important investment aspects, estimation of investment attractiveness, balanced scorecard, regional economic system.

JEL classification: D29, L50, L52, L90

1. Introduction

In the Arctic Zone of the Russian Federation (the RF AZ), efforts to enhance investment attractiveness are crucial to social, economic and infrastructural growth. Previous studies into the investment portfolios of the RF AZ regions have enabled a conclusion that the majority of investment resources are being channeled into the production of export-oriented raw materials, which explains why the sectoral make-up of the local economy is dominated by extractive industries.

The main reasons for the occurrence of the said sectoral imbalance lie in the fact that the regions in question lack a sustained investment policy, as well as practice-oriented methods for identifying their investment priorities. The solution lies in creating an economic mechanism which would make it possible to harmonize the interests of private investors, public authorities and population. One such mechanism is, in our view, a balanced scorecard and its potential to reflect the economic relations between the state and private businesses. The relevance of using the balanced scorecard as a tool for measuring the RF AZ regions' investment attractiveness comes from the fact that it also provides a picture of the information resources being sought by the parties to an investment process – an aspect contributive to the overall image of an area's invest attractiveness.

In order to ensure that the evaluation methodologies remain reflective of the changes that are likely to cause a tactical shift in national and regional policies, it is necessary that these evaluation methodologies are duly revised and corrected for the actual socioeconomic make-up of Russia and its regions.

The efforts to shape domestic methodology for exploring the investment appeal of the Russian regions, largely draw on the concepts and approaches developed by H. Henzler, Ph. Kotler, P. Walters, B. Toyne, and Harvard Business School. In their descriptions of the investment attractiveness of different countries and parts of the world, they operate with such notions as 'investment attractiveness', 'investment climate' and 'investment risks'. Commonly used in international studies is the notion 'business environment'. R. Anderson argues that 'investment climate' and 'business environment' cannot be used indiscriminately as the former fails to take into account the contribution to the economic growth from private businesses. Many international and domestic research teams point to the tangible connection between the performance of public authorities and the level of local investment attractiveness (business climate). Particularly, the studies have provided ample evidence of the positive economic growth dynamics being dependent on the authorities' efforts towards better entrepreneurship climate. We cannot but agree with the authors' statement that a policy to deregulate economies at national and regional levels has a beneficial effect.

In this paper, we suggest a balanced scorecard that allows to evaluate not only the investment attractiveness levels but also the performance by regional authorities towards making the RF AZ regions more appealing investment-wise.

Over the recent decade, there has been some significant progress in exploring the investment attractiveness of the Russian regions. Most prominent domestic studies in this area are led by I. Grishina, I. Roizman, G. Marchenko, A. Shakhnazarov, A. Folomyev, among others. Their integrated research into the Russian regions' investment attractiveness enables a conclusion that the majority of studies are, despite their positive aspects, not without methodological flaws, meaning that their outcomes may not be considered one hundred per cent reliable. For instance, the fact that many of the methodologies, that are used in the analysis of the investment appeal, use points-based systems and expert judgements that are based on rather statistics, speaks of these methodologies ignoring the actual variation in the indicator values, which aren't meant to be influenced by subjective judgements. The subjectivity of judgement as to indicator values is aggravated by the expert vision being combined with weighing of specific indicators (that are similarly established based on expert judgement). Furthermore, the majority of methodologies involve labour-consuming expert procedures and seem to be devoid of any objective validation criteria (relationship with region's investment attractiveness adjusted to time lag), a considerable methodological shortcoming.

Methodological shortcomings are the reason why domestic investment ratings can sometimes be contradictory and even illogical, and why regions' rankings lack sufficient substantiation. Despite their usefulness as a yardstick for measuring the success of the authorities' efforts to improve business environment, these ratings can't be considered meeting the information demand of all user categories. Moreover, the use of these ratings in managerial decision-making is limited by structural variations across regional economies.

Since the said methodological shortcomings can be expected to persist in further studies into the investment attractiveness of the RF regions, there is a need for new approaches to evaluating regional investment-related processes. One such approach is presented herein and represents an authorial methodology which uses balance scorecard (BSC) as a basis for evaluating the investment appeal of the RF AZ regions. It is essential that new approaches to evaluating regions' investment appeal take into account the interests of all stakeholders – state, private businesses and population – when elaborating regional investment strategies.

Meanwhile, little research has been conducted into the investment attractiveness of the RF Arctic Zone and how its investment strategy can achieve a better balance of stakeholder interests. Relevant in this regard is a balanced scorecard that would serve as guidance for the governmental agencies in their work to evaluate the investment attractiveness of the RF AZ regions.

This paper proposes a new, BSC-based methodological approach to measuring a region's investment attractiveness and analyzes its applicability as a tool for a more comprehensive

measuring of regional authorities' performance towards higher investment image of the RF Arctic Zone.

2. Research methodology and techniques

This authorial methodology uses as its conceptual basis the balanced scorecard approach.

According to researchers, the concept of balanced scorecard has seen three phases in its development.

Balanced Scorecard, often abbreviated as BSC, has evolved from a simple matrix-based performance evaluation approach to a component of corporate strategic management. Initially proposed by D. Norton and R. Kaplan as a 'four perspective' approach to corporate performance measurement, BSC later expanded to include, additionally to financial performance indicators, three more perspectives of a business – learning and growth, internal business processes and customer, the latter representing key stakeholders in a business.

The first generation of BSC designs had two issues to overcome, one dealing with the process of filtering (selection process) and the other with clustering of indicators (grouping of the indicators selected within each of the perspectives). While clustering is still being widely debated in the economic literature, the process of filtering is argued only rarely and referred to as a step constituting BSC design method.

The second generation of BSC designs had evolved from an approach to indicator selection process to a "strategic linkage model" allowing managers to draw links between strategic objectives within each of the perspectives. This style of balanced scorecard is thought of by some of the authors as representing the "2nd generation" of BSC design approach.

Kaplan and Norton's studies during 1992-1996 focused more on ways to represent cause-effect chains among key indicators and objectives, the cause-effect chains being seen as what provides greater justification for the indicators chosen. With this modified approach, the strategic objectives are distributed so as to form a visual presentation of strategy and performance indicators. This attempt to present the cause-effect chains graphically had led to the emergence of a strategic linkage model or strategy map.

Kaplan and Norton (1996) stated that those modifications had changed the very function of the BSC design: it ceased to be an advanced evaluation system and became a basic element of corporate performance management system. Thus, the second-generation balance scorecard had transformed from what earlier functioned to merely draw lines between perspectives, to a full-fledged strategy management framework.

The third generation design method for balanced scorecards refined those that went before to give more relevance and functionality to strategic objectives and processes of modeling, analyzing and coordinating interrelationships across time.

Kaplan and Norton argued that the subsequent variants of BSC could serve as tools allowing businesses to manage their strategic performance more effectively.

Later versions of BSC offer a more flexible and user-friendly approach to planning and growth, suiting a wider range of sophisticated organizational types.

Despite BSC being widely used at a corporate level for performance managing purposes, there is no research on the applicability of BSC as a tool for analyzing the investment appeal of economies, including regional ones. Therefore, any further research concerning the use of BSC for evaluating the investment attractiveness of the RF Arctic Zone, can, in our opinion, be thought of as novel and likely to produce results that might prove helpful in modern economic governance. The concept of our BSC-based approach to measuring the investment attractiveness of the RF Arctic Zone builds on the assumption that evaluation findings must meet the information needs of all stakeholders in an investment process. This paper focuses exclusively on BSC-based model for the regions that comprise the RF Arctic Zone. To add to objectivity, repeatability and transparency of the proposed method, and to avoid methodological incoherence in calculations and evidence base, we made use of the statistics made by federal government officials.

To achieve better comparability of indicators and to eliminate the influence of size and economic scale across the regions, all sub-indicators are relative values, the core ones being population size, area, fixed assets value, etc.

When determining the overall scores, all sub-indicators on the BSC are to be converted into dimensionless relative values using the multivariate mean formula, with prior standardizing to be performed by way of normalizing the numerical values of each sub-indicator to a particular target value, which, in turn, is a way to avoid the influence from the average investment attractiveness score across Russia. For target levels, one is free to use the 'best values' of the sub-indicators on the BSC over a time period in question (i.e. the highest for direct indicators and the lowest for reverse indicators).

In this study, we did not use any weighing factors when calculating the overall scores as all our selected indicators are interrelated with the key parameters of investment attractiveness. This helped us ensure equal significance of indicators and achieve higher assessment objectivity (independence from expert assessments).

Given the limitations of the modern statistical databases, as well as the assumptions made for our BSC design, it may be difficult to determine precisely and concurrently the values of all sub-indicators of investment attractiveness. At the same time, the proposed set of indicators enables a precise identification of trends in the dynamics of the investment attractiveness of each of the regions in question, while also eliminating the dependence on the dynamics the in investment attractiveness scores of other RF regions.

The sub-indicators on the proposed BSC, grouped into four perspectives, are presented in Table 1.

Table 1. BSC sub-indicators for measuring investment attractiveness of the regions comprising RF Arctic Zone (2016)

Perspectives, indicators and sub-indicators	Republic of Karelia	Murmansk Region	Arkhangelsk Region, exclusive of Nenets Autonomous Area	Krasnoyarsk Territory	Komi Republic	Republic of Sakha (Yakutia)	Yamal-Nenets Autonomous Area	Chukotka Autonomous Area	Nenets Autonomous Area
1. MANUFACTURING AND FINANCE PERSPECTIVE									
1. Financial performance indicators									
1. High-performing businesses, share	0,638	0,628	0,791	0,772	0,673	0,742	0,682	0,609	0,526
2. Region's budget balance (revenues vs. expenditures), share	0,938	1,036	0,933	0,936	0,920	0,963	0,998	1,093	0,811
3. Overdue accounts payable, share	0,053	0,068	0,556	0,106	0,079	0,141	0,588	0,172	0,099
Score	***0,543***	***0,577***	***0,760***	***0,605***	***0,557***	***0,615***	***0,756***	***0,625***	***0,479***
2. Environmental safety indicators									
4. Harmful emissions from all fixed sources, trapped and decontaminated, share	0,553	1,110	0,918	0,909	0,480	0,814	0,000	0,689	0,000
Score	***0,553***	***1,110***	***0,918***	***0,909***	***0,480***	***0,814***	***0,000***	***0,689***	***0,000***
3. Financial and operational performance indicators									
5. Wear of fixed assets, share	0,302	0,349	0,299	0,359	0,333	0,364	0,255	0,294	0,346
6. ROI of employees, %	0,434	0,974	0,293	2,111	0,523	1,459	3,003	2,144	1,451

Perspectives, indicators and sub-indicators	Republic of Karelia	Murmansk Region	Arkhangelsk Region, exclusive of Nenets Autonomous Area	Krasnoyarsk Territory	Komi Republic	Republic of Sakha (Yakutia)	Yamal-Nenets Autonomous Area	Chukotka Autonomous Area	Nenets Autonomous Area
7. Return on assets within Mineral Production sector, %	0,226	0,504	0,066	0,163	0,041	0,285	0,106	0,476	0,033
8. Return on assets within Manufacturing sector, %	0,860	0,890	0,290	1,970	2,140	0,430	2,700	-0,240	-0,020
9. Return on assets within Energy, Gas and Water Management sector, %	0,981	0,915	1,430	0,960	1,072	1,264	1,280	0,605	0,676
10. Profitability of sales (products, works, services) within Mineral Production sector, %	0,313	0,865	0,595	0,476	0,149	1,006	0,229	1,158	0,121
11. Manufacturing sector, %	1,890	1,270	0,850	5,720	2,090	-0,010	6,940	-3,670	-0,390
12. Energy, Gas and Water Management sector, %	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Score	***0,626***	***0,721***	***0,478***	***1,470***	***0,794***	***0,600***	***1,814***	***0,096***	***0,277***
PERSPECTIVE SCORE	**0,653**	**0,783**	**0,638**	**1,317**	**0,773**	**0,678**	**1,526**	**0,303**	**0,332**
2. GROWTH PERSPECTIVE									
1. Intellectual potential indicators									
13. University-trained employees, share	0,838	0,838	0,838	0,838	0,838	0,838	0,838	0,838	0,838
14. Skill formation, share	0,073	0,054	0,109	0,081	0,094	0,110	0,044	н/д	0,087
Score	**0,455**	**0,446**	**0,473**	**0,459**	**0,466**	**0,474**	**0,441**	**н/д**	**0,462**
2. Innovational potential indicators									
15. R&D expenditure, share	0,041	0,056	0,036	0,096	0,044	0,030	0,001	0,006	0,002
16. Use of IT, share	0,638	0,680	0,689	0,620	0,705	0,641	0,139	0,237	1,220
17. Technological innovation expenditure, share	0,061	0,060	0,017	0,435	0,047	0,079	0,018	0,050	0,056
19. Sales investment requirement, share	0,757	1,187	1,061	1,185	1,832	1,585	2,793	0,737	1,666
18. Renewal of fixed assets, share	0,308	0,270	0,399	0,624	0,574	0,798	0,617	0,454	0,800
Score	**0,361**	**0,451**	**0,440**	**0,592**	**0,641**	**0,626**	**0,714**	**0,297**	**0,749**
3. Infrastructural capacity indicators									
20. Density of communication	0,244	0,119	0,084	0,029	0,081	0,008	0,013	0,001	0,002

Perspectives, indicators and sub-indicators	Republic of Karelia	Murmansk Region	Arkhangelsk Region, exclusive of Nenets Autonomous Area	Krasnoyarsk Territory	Komi Republic	Republic of Sakha (Yakutia)	Yamal-Nenets Autonomous Area	Chukotka Autonomous Area	Nenets Autonomous Area
routes, km/1 K sq.km									
Score	**0,244**	**0,119**	**0,084**	**0,029**	**0,081**	**0,008**	**0,013**	**0,001**	**0,002**
PERSPECTIVE SCORE	**0,370**	**0,408**	**0,404**	**0,488**	**0,527**	**0,511**	**0,558**	**0,332**	**0,584**
3. NATURAL RESOURCES PERSPECTIVE									
1. Resource endowment indicators									
1.1. Skills availability									
21. Economically active population, share	0,695	0,784	0,677	0,687	0,731	0,678	0,799	0,853	0,697
1.2. Region's energy and communication security indicators									
22. Per capita energy production, kWh per capita	0,587	1,698	0,449	1,767	0,884	0,726	1,108	1,052	2,562
23. Mobile broadband subscriptions, per 100 residents	0,524	0,622	0,659	0,807	0,840	0,943	0,798	1,007	н/д
24. Stationary broadband subscriptions, per 100 residents	1,490	1,295	0,895	0,700	1,440	0,690	1,015	0,795	0,130
1.3. Financial security indicators									
25. Internal corporate funds, share	1,032	1,066	0,770	0,990	0,868	0,884	0,462	0,494	1,276
Score	**0,866**	**1,093**	**0,690**	**0,990**	**0,953**	**0,784**	**0,836**	**0,840**	**н/д**
2. Region's geographical location indicator									
26. Favorableness of geographical location	1,000	1,000	1,000	0,714	0,714	0,571	0,857	0,571	0,714
Score	**1,000**	**1,000**	**1,000**	**0,714**	**0,714**	**0,571**	**0,857**	**0,571**	**0,714**
3. Natural climate favorableness indicators									
27. Region's climatic conditions	0,714	0,571	0,714	0,571	0,714	0,429	0,714	0,429	0,429
Score	**0,714**	**0,571**	**0,714**	**0,571**	**0,714**	**0,429**	**0,714**	**0,429**	**0,429**
PERSPECTIVE SCORE	**0,863**	**1,005**	**0,738**	**0,891**	**0,885**	**0,703**	**0,822**	**0,743**	**0,968**
4. POLITICAL, ECONOMIC AND SOCIAL PERSPECTIVE									

Perspectives, indicators and sub-indicators	Republic of Karelia	Murmansk Region	Arkhangelsk Region, exclusive of Nenets Autonomous Area	Krasnoyarsk Territory	Komi Republic	Republic of Sakha (Yakutia)	Yamal-Nenets Autonomous Area	Chukotka Autonomous Area	Nenets Autonomous Area
1. Prospects of region's economic growth									
28. Dynamics of GRP, share	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,987
29. GRP per capita, RUB per resident	0,106	0,160	0,109	0,176	0,183	0,258	1,049	0,378	1,663
30. Openness of economy, thousand $ per resident	0,134	0,407	0,233	0,210	0,123	0,579	0,391	0,239	0,000
31. Property relations	0,520	0,513	0,358	0,553	0,593	0,380	0,749	0,230	0,568
32. Inflation in manufacturing sector, %	0,850	0,990	0,952	0,920	0,916	0,920	1,107	0,936	0,996
33. Inflation in consumer sector, %	0,964	0,952	0,959	0,960	0,959	0,948	0,956	0,949	0,960
34. Entrepreneurship development level	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Score	**0,368**	**0,432**	**0,373**	**0,403**	**0,396**	**0,441**	**0,607**	**0,390**	**0,739**
2. Social security indicators									
35. Common diseases incidence (per thousand residents)	0,090	0,120	0,098	0,127	0,093	0,097	0,091	0,093	0,070
36. Injuries, intoxications and some other externally induced effects (per thousand residents)	0,418	0,627	0,421	0,495	0,462	0,444	0,505	0,442	0,373
37. Recorded crime (per thousand residents)	0,327	0,353	0,394	0,351	0,314	0,544	0,468	0,438	0,403
Score	**0,278**	**0,366**	**0,304**	**0,324**	**0,290**	**0,362**	**0,355**	**0,324**	**0,282**
3. Employee satisfaction indicators									
38. Welfare spending, K roubles per resident	1,063	1,603	1,201	1,402	1,534	2,968	3,820	5,164	5,395
39. Population with income above subsistence line, share	0,835	0,879	0,866	0,824	0,841	0,810	0,935	0,918	0,904
40. Unemployment rate, share	0,217	0,260	0,282	0,328	0,230	0,278	0,769	0,571	0,235
41. GRP/average wage growth ratio	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,979
Score	**0,529**	**0,685**	**0,587**	**0,639**	**0,651**	**1,014**	**1,381**	**1,663**	**1,878**
PERSPECTIVE SCORE	**0,395**	**0,490**	**0,419**	**0,453**	**0,446**	**0,588**	**0,774**	**0,740**	**0,967**
TOTAL SCORE	**0,543**	**0,644**	**0,532**	**0,774**	**0,629**	**0,617**	**0,923**	**0,544**	**0,692**

Source: developed by authors

The above BSC consists of four perspectives which have been analyzed, based on a total of 41 sub-indicators and 12 overall scores, to measure the investment appeal of the RF AZ regions.

3. The BSC-based evaluation of the RF AZ regions' investment appeal: findings

As stated in the RF Presidential Edict N296 dd. 2 May 2014 "Concerning the Land Territories of the Arctic Zone of the Russian Federation", the Arctic Zone of the Russian Federation comprises the following regions:

1. Territory of Murmansk Region.
2. Territory of Nenets Autonomous Area.
3. Territory of Chukotka Autonomous Area.
4. Territory of Yamal-Nenets Autonomous Area.
5. Territory of municipal urban district Vorkuta (Komi Republic).
6. Territories of Allaikhovsky Ulus (district), Anabar (Dolgano-Evenkiisky) National Ulus (district), Bulunsky Ulus (district), Nizhnekolymsky District, Ust'-Yansky (district) (Republic of Sakha (Yakutia)).
7. Territories of the urban district of Norilsk, Taimyr Dolgano-Nenetsky Municipal District, Turukhanovsky District (Krasnoyarsk Territory).
8. Territories of the municipal entities City of Arkhangelsk, Mezen Municipal District, Novaya Zemlya, Town of Novodvinsk, Onega Municipal District, Primorsky Municipal District, Severodvinsk (Arkhangelsk Region).
9. Lands and islands in the Arctic Ocean as specified in the Decree of the Presidium of USSR Central Executive Committee, dd. 15 April 1926 "Concerning Declaring the Lands and Islands in the Arctic Ocean a Territory of the USSR" and related legal instruments of the USSR.

The balanced scorecard presented above has been used to evaluate the RF AZ regions' investment attractiveness over the period from 2010 through 2016.

As can be seen from Table 2, investment attractiveness has been found to increase in the following RF AZ regions: Yamal-Nenets Autonomous Area (1.9-fold), Republic of Sakha (Yakutia) (1.4-fold), Arkhangelsk Region exclusive of Nenets Autonomous Area (1.7-fold) and Republic of Karelia (1.2-fold).

Table 2. Dynamics of the RF AZ regions' investment attractiveness scores (2010-2016)

Year	Yamal-Nenets Autonomous Area	Krasnoyarsk Territory	Nenets Autonomous Area	Murmansk Region	Komi republic	Republic of Sakha (Yakutia)	Chukotka Autonomous Area	Republic of Karelia	Arkhangelsk Region exclusive of Nenets Autonomous Area
2010	0,491	0,907	0,812	0,631	0,656	0,451	0,540	0,467	0,306
2011	0,628	0,823	0,807	0,667	0,669	0,580	0,534	0,551	0,311
2012	0,667	0,762	0,818	0,643	0,669	0,633	0,520	0,534	0,392
2013	0,768	0,763	0,626	0,623	0,630	0,585	0,619	0,530	0,487
2014	0,863	0,779	0,606	0,699	0,606	0,595	0,615	0,537	0,534
2015	0,871	0,825	0,695	0,753	0,652	0,592	0,645	0,590	0,570
2016	0,923	0,774	0,692	0,644	0,629	0,617	0,544	0,543	0,532

Source: developed by authors

In Yamal-Nenets Autonomous Area (YNAA) and the Republic of Sakha (Yakutia), the investment attractiveness has increased mainly due to better performance in Manufacturing, Finance and Resources, while the score of Political, Economic and Social Environment has risen only slightly. Thus, in YNAA, the Manufacturing and Finance score had increased 6.5-fold, Resources 1.7-fold and Growth only 1.1-fold; in the Republic of Sakha (Yakutia) these scores have risen 17.6-, 1.5- and 1.3-fold, respectively.

In Arkhangelsk Region (exclusive of Nenets Autonomous Area), the increase in investment attractiveness had been caused by, in the first place, better performance in Growth (a 14.4-fold increase), with all other perspectives enjoying higher scores as well (2.2-fold increase within Manufacturing and Finance; 1.8-fold one within Resources; 1.2-fold one

within Political, Economic and Social Environment). The Republic of Karelia has enjoyed better performance in Manufacturing and Finance (a 1.5-fold increase) and Resources (1.6-fold) and lower performance within Growth (a 2 percentage point decrease) and Political, Economic and Social Environment (a 21 percentage point decrease), an indication of an imbalance in the economic growth.

Krasnoyarsk Territory and Nenets Autonomous Area (NAA), despite the fact that they continue to enjoy the highest ratings (the second and the third, respectively), have been found to be suffering a 15 percentage point decrease in their investment attractiveness, caused by lower performance within Manufacturing and Finance (a 30 percentage point decrease in Krasnoyarsk Territory and a 53 percentage point one in NAA) and Political, Economic and Social Environment (a15 percentage point decrease in Krasnoyarsk Territory and a 24 percentage point one in NAA), which is partly offset by the increased scores in Resources (a 29 percentage point increase in Krasnoyarsk Territory and a 31 percentage point one in NAA) and Growth (a 21 percentage point increase in Krasnoyarsk Territory and a 53 percentage point one in NAA), which is indicative of an imbalance in the economies of these two regions of the RF AZ.

Murmansk Region has been found to have an investment attractiveness score varying between 0.6 and 0.7, and Chukotka Autonomous Area and Komi Republic between 0.5 and 0.6, which is due to fluctuations across all their BSC perspectives, giving them stably middle positions in the rankings.

The sub-indicators and the overall scores for each of the RF AZ regions have been calculated by way of benchmarking their current performance levels against the target ones. Ratings have been compiled, based on the findings, concerning the investment attractiveness of each of the regions in the Arctic Zone of the Russian Federation.

The top positions (top three places) are occupied by Yamal-Nenets Autonomous Area (0.923), Krasnoyarsk Territory (0.774) and Nenets Autonomous Area (0.692). Least attractive (bottom three places) are Chukotka Autonomous Area (0.544), Karelian Republic (0.543) and Arkhangelsk Region (exclusive of NAA) (0.532). Murmansk Region (0.644), Komi Republic (0.629) and the Republic of Sakha (Yakutia) (0.617) rank in the middle.

Given the analytical capacity of BSC-based evaluation, it is possible to identify main challenges and develop recommendations as to how the RF AZ regions can enhance them investment attractiveness.

Let us analyze, based on the results of the investment attractiveness BSC, the core challenges that are faced by the regions of the RF AZ with regard to their investment strategies.

For seven regions of the RF AZ, the highest-scoring perspective is Natural Resources and the lowest-scoring one is Growth (with exception of Krasnoyarsk Territory and Yamal-Nenets AA).

For Yamal-Nenets AA and Krasnoyarsk Territory (ranked first and second, respectively), the highest-scoring perspective is Manufacturing and Finance and the lowest-scoring one (for Krasnoyarsk Territory) is Political, Economic and Social Environment. Nenets Autonomous Area scores lowest in Manufacturing and Finance.

Our analysis of the influence the Natural Resources have on the investment attractiveness of the RF AZ regions enables a conclusion that this perspective appears to be crucial to the total score of each of these regions.

Further, the analysis of the main indicators comprising the Natural Resources perspective (Appendix 1-9) has found that Karelian Republic and Arkhangelsk Region (exclusive of Nenets AA) have their per capita energy production sub-indicator deviating greatly from the target level (in the rest of the RF AZ regions, per capita energy production rates are near the target level).

An indicator with highly positive impact on the investment attractiveness levels is, in the first place, resource endowment. The ‘internal corporate funds’ indicator is found to be near its target level in almost all the RF AZ regions (with exception of Yamal-Nenets AA), as is the ‘economically active population’ (which varies between 0.7 and 0.9). At the same time, the ‘economically active population’ shows negative growth, indicating insufficiency of efforts to meet regions’ staffing needs for better economic growth.

Our analysis of the charts for the sub-indicators that comprise the Manufacturing and Finance perspective (Appendix 1-9) has found the regions' performance to be deviating greatly from the target levels for return on assets within Mineral Production sector; wear of fixed assets; share of high-performing businesses; overdue accounts payable (all regions of the RF AZ); and profitability of sales (products, works, services) within Mineral Production sector (with exception of Murmansk Region, the Republic of Sakha (Yakutia) and Chukotka AA, where this indicator is near or above the target level). Not far from the ideal target are 'region's budget balance (revenues vs. expenditures)', 'environmental safety', 'return on assets, sales and products (works, services) within Manufacturing sector' (with exception of the Republic of Sakha (Yakutia), Chukotka AA, Nenets AA), 'ROI of employees' (with exception of Karelian Republic, Arkhangelsk Region (exclusive of Nenets AA) and Komi Republic).

The fluctuations within the Manufacturing and Finance perspective are caused mainly by the RF AZ regions' unstable performances in manufacturing and finance sectors.

The fluctuating Manufacturing and Finance score is, in turn, an indication of fragility of the financial situation in the RF AZ regions (with exception of Krasnoyarsk Territory and Yamal-Nenets AA), a major factor inhibiting the increase in their investment attractiveness.

Wear of fixed assets remains consistently high, putting a constraint on the regions' manufacturing capacity.

One more indicator with positive effect on the investment attractiveness is 'environmental safety', provided that its level is near the target one.

Our analysis of indicators that comprise Political, Economic and Social Environment perspective (Appendix 1-9) – dynamics of GRP, workforce productivity/average wage growth ratio, population with income above subsistence line, welfare spending – enables a conclusion that they almost equal their target levels.

At the same time, such indicators as entrepreneurship development level, openness of economy, GRP per capita (with exception of Yamal-Nenets AA and Nenets AA) and property relations (with exception of Yamal-Nenets AA), have been found to deviate greatly from their target levels, an indication that the process of creating market economy institutions is slow and more efforts should be channeled into their formation.

Contributive to the increase in the investment attractiveness is growth in gross regional product (GRP). Even though its level accounts for 0.9 of the target one, the GRP per capita remains consistently low.

The negative effect of social security level on the investment attractiveness is due to the following factors: diseases incidence rate, which is 10-fold higher than its target level, and registered crimes per 1,000 residents, which exceeds its target level 3-fold. The 'social security' indicator shows a consistently low score.

Within Growth, a perspective crucial to the economic progress in the RF Arctic Zone (Appendix 1-9), the following key indicators have been found to deviate significantly from their target levels: R&D expenditure, technological innovation expenditure (with exception of Krasnoyarsk Territory), infrastructural capacity index, use of IT, skill formation, renewal of fixed assets (with exception of the Republic of Sakha (Yakutia) and Nenets AA).

Near its target level is 'share of university-trained employees'. 'Sales investment requirement' indicator exceeds its target level (with exception of Karelian Republic and Chukotka Autonomous Area), a factor with positive effect on the investment attractiveness of the RF AZ regions.

'R&D expenditure' and 'technological innovation expenditure' show negative dynamics, an indication of underperformance within research and development sector.

The challenges relating to renewal of fixed assets remain unsolved. In the future, the lack of adequate production capacities may complicate the manufacture of globally competitive products.

Benefitting the investment attractiveness of the RF AZ regions is the increase in investment requirement, which is found to exceed its target level. Consistently negligible is the growth in infrastructural potential, confirming the need to expand the transport infrastructure in the regions of the RF AZ. The share of university-trained employees has experienced a major growth and almost reaches its target level. At the same time, the low

value of 'skill formation' indicator (10 times lower than the target level) points to the need in the advanced training which would meet sector-specific needs.

With some of the directions in regions' investment attractiveness strategies receiving disproportionate amounts of efforts, as can be seen from the analysis of the perspectives of the above scorecard, almost all of the RF AZ regions (with exception of the Republic of Sakha) are experiencing challenges unfolding their investment potential – particularly, with regard to Growth, an aspect essential to overall economic progress.

As to the Republic of Sakha (Yakutia), its performance within all BSC perspectives deviates from target levels only slightly (the variation range being 0.5-0.7), which enables a conclusion that this region operates a balanced investment strategy.

4. Final remarks

The elaboration and implementation of a balanced scorecard-based performance evaluation system represents an effective way for raising the investment attractiveness of the projects being deployed in the Arctic Zone of the Russian Federation, which is fully in line with the targets of the RF economic development strategy. Further, the BSC-based assessment of a region's investment attractiveness can be seen as a way of harmonizing the interests of all stakeholders in an investment process, thereby achieving the desired changes in the investment attractiveness of the regions of the RF Arctic Zone.

Being a tool for evaluating regions' performance factors that are crucial to their investment attractiveness over a certain period of time, BSC serves also as a tool to identify and present, using a system of quantifiable indicators, the best regional practices towards better investment attractiveness. Conducting a balanced assessment of the effectiveness of a region's investment strategy appears to be especially important when it comes to improving the environment for business and investment activity.

Using federal data statistics, the proposed toolkit ensures an objective, balanced assessment which relies on cause-effect relationships between key factors of investment attractiveness and BSC indicators, while meeting the information demand of all stakeholders in an investment process. In addition to its repeatability (applicability for different regions), the proposed tool is open to change and can be altered subsequently as the RF Arctic regions progress in their economic and social development.

The main outcome of the study consists of the scientific rationale for and the description of a BSC-based model for measuring a region's investment attractiveness based on the analysis of the efficiency of its performance towards higher investment image of the Arctic Zone.

The obtained results will enable the authorities to identify pivotal issues in regional investment activity, shape strategies towards better investment image of the Arctic Zone and evaluate the effectiveness of regional investment strategies.

The study is novel in that it has achieved a balanced scorecard that allows the regions in the RF Arctic Zone to analyze their investment attractiveness with regard to the stakeholder interests and goals. The study provides a rationale for the expediency of the proposed method for use by regional authorities when analyzing their investment policies and measuring the current investment attractiveness of the RF Arctic regions.

The proposed method is hands-on in nature and can help the local governments in the RF Arctic Zone to shape better investment strategies and business corporations to decide on the expediency of investing in the Arctic projects.

The transparency of the proposed BSC-based assessment method makes it suitable for application to various social and economic environments as a research tool, while also raising its value in regional investment governance.

The contents of the proposed BSC are subject to change. Changes should be introduced to reflect dynamics of the social and economic growth in subsequent periods as the Russian economy and system of official statistics evolve.

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GROSS JOB - CREATION AND GROSS JOB - DESTRUCTION DETERMINANTS: EMPIRICAL ANALYSE AT MICRO FIRMS DATA LEVEL

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Abstract
This study analyses gross job-creation and gross job-destruction determinants at the firm level for a panel of Portuguese micro firms across four industry sectors, using the Ordinary Leat Square and Fixed Effect econometrics model to analyse a database consisting on 15.686 micro firms, for time period going from 2010 to 2017. It was found that laggard gross job-creation, assets tangibility, financial leverage, profits and the fact firms belong to the construction sector determines gross job-creation. Regarding gross job-destruction, its was found that this variable is determined by its laggard variable, firm's size, worker's tenure and the fact the firm belongs to the hotels and restaurants sector. Finally, findings suggest that a resource-based approach explains gross job-creation and gross job-creation for micro firms by using microdata. This study contributes to the state of the art on the determinants of employment and firing at micro firms' level as it investigates the importance of the independent variables in explaining micro firm's labour demand in Portugal.

Keywords: Gross job-creation, gross job-destruction, micro firms, Portugal
JEL classification: M10, O14, O18, O44

1. Introduction

This work intends to analyses gross job-creation's determinants at a micro firm level in Portuguese economy from 2010 to 2017.Most literature points towards the idea that micro firms are the main responsible for gross job-creation, because of tax incentives, regulatory policies and other government programs that favor them to enter market and implement their business. That's why firms and plants classified in this size exhibit higher gross job-creation rates, meaning they represent a larger number of workers (Davis et al.,1998). In order to achieve this goal, this article seeks to analyses if firm's size, tenure measured as the workers experience, liquidity availability, financial leverage, asset tangibility and profits impact positively or negatively on employment as it was find by (Lawless et al.,2013) when studying Ireland firms, recurring to microdata from this country's Central Bank and (Davis et al.,1998) when measured size and worker age, in terms of experience impact in the gross job-creation and destruction. We also intend to see if industry affiliation are positively related with gross job-creation and gross job-destruction as it is pointed out by Yazdanfar and Salman(2012), when studying Swedish micro firms. To achieve this goal, Ordinary Least Square Dummy Variable, Fixed Effect and Random Effect econometric methods are applied to regress the models with the main object of investigating whether Portuguese micro firms behave similarly or if they display different patterns. The results show that gross job-creation does not increase with increases in firm's size and worker's tenure. However, it increases with increases in its lagged value, assets tangibility, financial leverage, profits and industry affiliation. In what gives respect to gross job-destruction the same conclusion can be obtained regarding its lagged variable impact. Nonetheless, all the remnant variables display the opposite effect, except for the case of profits and financial leverage, that were not statistically significant. The rest of the paper is organized as follows. In the section two is presented the literature reviews, in the section three the methodology and section four the empirical analyses and conclusions.

2. Theoretical Framework

Most empirical research has shown that there are many factors that have impact on the labour market, both in the supply and in the demand side. According to Davis et al. (1996), job - creation and job - destruction are two faces of the same coin that determine the job reallocation rate. The authors defined job - creation as the total variation in employment level caused by all firms that expand or start their businesses in a given period of time. Similarly, Lawless et al.(2013), define gross job - creation in the present time as the difference between the total level of employment gains caused by all business entities that expand or set-up between time t minus time t-1.

On the other hand, job - destruction is the opposite of job creation. Thus, it exists

whenever we observe changes in employment that are assumed by the total number of firms that contract their businesses or exit the market in a given period of time (Centeno et al.,2007; Davis et al.,1996 and Yazdanfar and Salman ,2012). From this perspective, we were able to infer that all businesses that do not expand or contract during a given moment of time will not influence on any employment's increase or decrease. As these changes in the employment level will not be reflected, the impact of the firm regarding its contribution in the labour market for job - creation or job - destruction will be equal to zero. Therefore, and to simplify, Davis et al.(1996), argued that all changes that can occur ought to be thought as having in its essence the reshuffling of job opportunities across locations. These job- creation and job - destruction concepts presented above are defined in conventional terms and in line with the concepts presented by Mark at all (2011), when study the job flow in the UK.

Mark et al. (2011), evaluated job-creation and job-destruction in the UK from 1998

to 2010. Similarly, Hussing and Abdullah (2019) measured the firm's expenditure on research and development and its impact on job-creation and job-destruction for the Malaysian labour market. Also, John Haltiwanger (2019) seek to know the influence of innovation on job-creation in U.S and Colombian firms. These three studies added many related or derivative concepts from the previous job-creation and job-destruction ones.

Net employment (or net employment change, according to some authors) is defined as changes in the level of employment between two consecutive years. Putting it in another way, net employment is the difference that arises from the comparison between the number of jobs created and the number of the jobs lost at a given period. Likewise, net employment rate results from the difference between the job-creation rate and job- destruction rates.

In contrast, the definition of job-reallocation rate appears not to be quite right because the variable in question is defined as the job-creation rate plus job-destruction rate, for a given period. But Mark et al.(2011) and Hussing and Abdullah(2019) agreed with job-reallocation rate's measure, referring that, this measure is very important as it gives us total employment flows that can occur in the labour market. In addition, Davis et al.(1996), considered job-reallocation summarizes the overall volume of changes that can occur in the employment level, representing the reshuffling of job opportunities across location as referred and gives us the net employment.

Finally, we consider the excess job reallocation rate, that measures the difference between the job reallocation rate and the net employment rate and indicates the extent of 'churn' in a given labour market, as it measures the extent to which job destruction exceeds the cutoff point that is needed to produce the observed net employment change. The literature in this field sustains that, if one subtracts the amount of job - destruction in a given period of the time from the correspondent job creation, the result will be net employment.

Lawless et al.(2013),Yazdanfar and Salman (2012) and Davis et al.(1996) defined net employment as a change in job creation minus job destruction. While, the employment rate is the difference between the job creation rate and the job destruction rate. These rates are normally influenced by many factors. Therefore, regarding this, many empirical evidences, as the previously mentioned, point out that firm specific characteristic impact differently in job creation or job destruction.

For instance, Centeno et al.(2007), when analyzing the Portuguese firms, have concluded that although larger firms' contribution on either job - creation or job - destruction overcomes the contribution from micro, small or medium firms. Both small and micro firms still have a significant role so that this process may be possible. Following the same line of thought,

Lawless et al.(2013), concluded that job turnover and firm productivity's growth are driven systematically according to firm's size group and firm's age.

2.1. Job - Creation and Job - Destruction Determinants

Bringing a new perspective, in comparison to many other studies, this one is focused on the deterministic resource-based approach with the purpose of surveying the firm level job-creation determinants. As we can find in the widespread related literature, the word resource is here meant to refer to all type of assets. For instance, among these large number of assets, we can mention some, such as cash, debt, capital, management skills, the firm's organizational level in terms of processes' organization, the information treatment level, firm's ability and firm's knowledge stock.

From the resource's based approach methods perspective point of view, firms are able to achieve their optimum performance level through several different types of paths. As a matter of fact, Yazdanfar and Salman (2012), mentioned various performance measures that firms can use in order to achieve their optimum performance level. Similarly to this measurement method, one can reccur to the analysis of profitability, variations in sales (or changes in sales) and job-creation as well as one can reccur to other available resources. Putting it in another way, if firms increase the level of inputs such as capital, labour and intermediate materials, as a result of an previous increases in investment expenditure, rise employment rate. According to Lawless et al.(2013), job-creation is positively impacted by the level of investment expenditure made by each firm. This increase in the investment expenditure impact innovation and benefit both, company and U.S employment.

This is indeed in line with the conclusions of Sobri Nayan et al. (2019), when studying Malaysian firms. They concluded that, in order to remain economically competitive

,firms needs to invest constantly so that they can generate and establish new sources for economic growth. There are many path that can be followed in order to achieve such goal. For instance, for the Malaysian case, the study recommends increasing Research and Development expenditure, as it is suggested to increase both science and technology level as well as job-creation.

However, the need for constant and permanent investment requires firms to have sources of financing. Firms can take debt from several financial institutions such as banks or other firms operating in the financial sector, that can lend money. From the new-Keynesian perspective, these financial institutions display information which is not equally available for all firms. This is the so-called asymmetric information's that prevail in the financial market allows those firms to have easier access to debt in comparison with the remnant ones. Therefore, those authors considered the asymmetric information as the main source of market imperfection. As a matter of fact, the information asymmetries, agency costs, moral hazards and adjustment can explain, at least, partially why some firms have access to financial resources while others have not (Greenwald e Stigitiz, 1993).

Yazdanfar and Salman(2012) found evidences of a positive association between liquidity availability and fixed capital investment. Other authors found that employment variation is associated with firm's financial pressure (Yazdanfar and Salman, 2012). However, Modiglian e Miller (1958), argued that firm's financial structure is not an important determinant of its market value. Firms can be financed by internal resources, debt, or a combination of both, however this will not affect its real operations. Therefore, market imperfections associated with asymmetric information problems, moral hazards (results from the asymmetric information, occurring when the part with more information about one action or intention tends to have or have the incentive to behave inappropriately from the perspective of the party with less information), agency conflicts between shareholders and the management team, labour market regulation and distortion in taxation leads to the separation of investment and financing decisions.

Regarding this, many empirical evidences, as the previously mentioned, point out

that firm specific characteristic impact differently in job creation or job destruction. For instance, Centeno et al.(2007), when analyzing the Portuguese firm's case have concluded that, although larger firms' contribution on either job - creation or job destruction overcomes the contribution from micro, small or medium firms, both small and micro firms still have a

significant role so that this process may be possible. Following the same line of thought, Lawless et al.(2013) concluded that job turnover and firm productivity's growth are driven systematically according to firm's size group and firm's age. Similarly, findings point out that micro and small sized enterprises are the backbone for Australia's creation of employment and new businesses.

Empirical studies have shown that micro, small and startups suffer more than large and incumbent ones from such market imperfections problems. Large firms explore economies of scale and they offer diversified goods and services. For these reasons, they face less liquidity constraints, asymmetric information's, moral hazards, financial distress, cash flow volatility and bankruptcy risk problems. These conditions allow them to have an easier access to debt and better opportunities to invest and employ labour. On the other hand, incumbent firms have the same opportunities as a result of the fact that they have more knowledge and network acquired over time than young or entrant ones do, what allows them to have an easier access to external financial resources than young's or entrant ones without an history and reputation in the market do. In the same line, studies provide details of age structure and employment growth for Australian SMEs firms which comprise around 98 percent of all firms and account for 41 percent of total employment over 2001 - 2011.

From the idea discussed above, we can infer that firm's age impacts positively on debt, capital, and job-creation. Thereby, Yazdanfar (2011), referred to financial constraints in terms of difficulties in obtaining debt as one of the most important barriers to firm's liquidity and employment. Also Acemoglu (2011) and Oliveira e Fortuna(2011), highlighted the association between liquidity and employment and between employment and the firm's economic activity sector because of the difference in the inputs (technology, capital, labour and material they need so that they can perform their activity.

2.2. Previous Empirical Evidences

Most studies made regarding labour demand and supply determinants have found that many factors analyzed at firm-level underline that the level of employment declines in the presence of market distortions, arising from information asymmetries. Young, micro, and small firms found this lack of information as a great barrier in access to the bank loan. They need so that they can invest. As a matter of fact, these firms face many financial constraints, less availability liquidity which contributes to a lower labour demand. On the other side, most literature and empirical research points for a significative contribution of micro and small firms to job-creation. The table below summarizes some results found in the literature.

Table 1: Summary of some Empirical Evidences

Author	Findings	Variables	Country
Coutor (1990)	-	high leverage and employment	USA
Coutor (1990)	+	Capital investment and employment	USA
Nickeel and Wadhwani (1991)	-	firm leverage ratio and employment	British companies
Sharp (1994)	-	Interest rate and firm leverage and employ- ment	USA
Greenwald and Stiglitz (1993)	-	Firm financial constraint caused by asymmetric informa- tion and demand for labour	USA

Arnold (2002)	-	Financial constraints derived from asym- metric information and employment	USA
Yazdanfar et al.((2012)	-	Size,age, debt, liquid- ity availability, indus- try and job-creation	Sweden
Henrekson, Mag- nus(2020)	+	Innovation,investment and employment and company	U.S
Hendrickson et al.(2015)	+	Age structure andem- ployment growth	Australian
Eslava, Marcela and Haltiwanger, John C and Pinz(2019)	+	Micro and Small and employment by using the number ofemploy- ees as proxy for size	U.S and Colom- Bia
Eslava, Marcela and Haltiwanger, John C and Pinz(2019)	-	Age and and employ- ment	U.S and Colom- Bia

Source: Produced by the author

3. Methodology

3.1. Dependent and Independent Variables

Based on the existent literature related to the factors that determine job-creation, for the Portuguese case we intend to identify what factors influence job-creation the most, considering the country's specificities. Therefore, four independents variables namely firm's liquidity, size, age, leverage, and industrial affiliation are incorporated in our model as independent variables. As my dependent variable, in which we expect to measure the impact of each of the explanatory variables above presented, I have chosen job creation. Also tangibility and profitability have been identified and used as instrumental variables, flowing the methodology of Yazdanfar and Salman(2012).

The variables are computed as it follows:

$$Job - Creation_{i,t} = \log(Employment - Employment_{t-1}) \quad (1)$$

$$Job - Destruction_{i,t} = \log(Employment - Employment_{t-1}) \quad (2)$$

In this perspective, we expect job-creation's behavior to be affected by changes that occur in explanatory variable, as liquidity can be generated by leverage.

Conversely, several independent variables were identified in the previous study as to be associated with job-creation. Most analyses were carried out by considering the data at the firm-level and found that job-creation is associated with firm's size, age, financial leverage, and liquidity.

Size can be proxied taking as a basis the number of workers, as it was considering for the case of the U.S and Colombian. In contrast, for this work this variable is defined as the mean of the number of workers following (Yazdanfar and Salman,2012).

$$Xe_{i,t} = \frac{(Employment_t + Employment_{t-1})}{2} \quad (3)$$

Since one knows that firm market knowledge is accumulated over time, one can infer that old firms have suffered less from asymmetric information increasing their probability of accessing to debt and this will reduce the liquidity constraints (Acemoglu, 2011). In the computation of this variable we follow (Yazdanfar and Salman,2012) and using as a proxy the natural logarithm of worker's tenure.

$$Tenure_{i,t} = Holdest\ worker\ number\ of\ year\ in the\ firm \quad (4)$$

Based on the previous existent literature, leverage is measured using the ratio between the book value of total liabilities and total assets (Yazdanfar and Salman,2012).

$$Financial\ Leverage_{i,t} = \frac{(Book\ Values\ of\ Total\ Liabilities)}{(Total\ Assets)} \quad (5)$$

For firm's liquidity, total current assets divided by total asset is mostly used as proxy.

$$Liquidity_{i,t} = \frac{(Total\ Current\ Assets)}{(Total\ Assets)} \quad (6)$$

Finally as the job-creation and job-destruction is expected to affect with firm in dustry affiliation and changes across industries, a dummy variable will be included in the model in other to control the sector impact in the job-creation.

3.2. Hypothesis

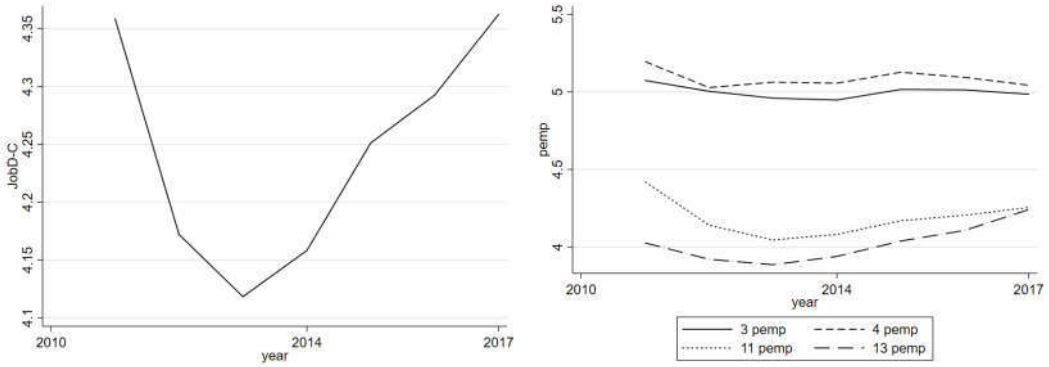
Based in the resource-based approach which implies that independent firm level variables positively or negatively impact on gross job-creation or gross job - destruction Yazdanfar and Salman (2012); Davis et al.(1994,1996); Kane(2010). And using data from SCIE and Quadros de Pessoal for Portuguese case, we test if gross job-creation and gross job-destruction are positively related with firm size, leverage, tenure, liquidity, profits, assets tangibility and industry affiliation.

3.3. The data and preliminary evidence

The data set used in this study is an unbalanced panel of Portuguese micro firms, recorded in the both SCIE and Quadros do Pessoal, over the time period going from 2010 to 2017. This data set contains firm's balance sheets and workers informations, respectively. Nonetheless, data does not provide any information for assets depreciation which positively biased the profit variable results.

After imposing some restrictions to the number of workers for firms with over 10 workers, with the object of selecting only micro firms and restrict it to four industries, namely, food, beverage and tobacco (3); textiles, dressing and leather (5); construction (11) and restaurants and hotels (13), our sample was reduced to 15.686 firms.

Figure 1: JobC and JobD for all sector and its growth

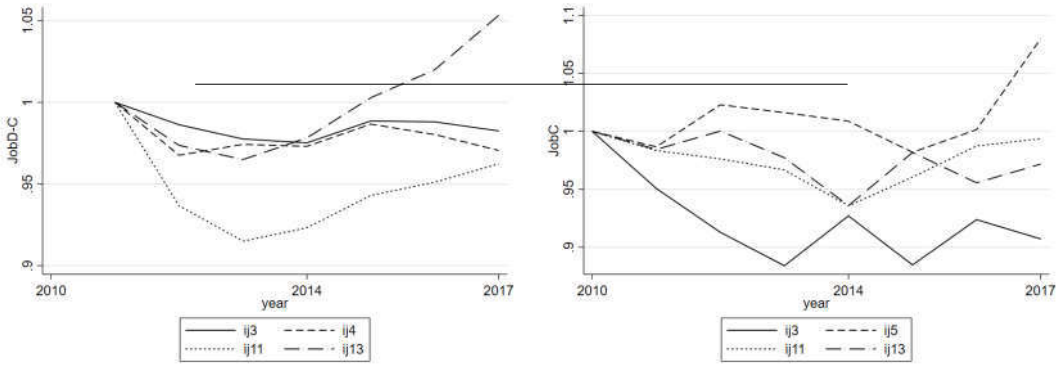


Source: SCIE, 2010-2017 *Source:* SCIE,2010-2017

In the graphs presented above one can see that there was the evidence of job- destruction from 2010 to 2012. From this moment on, firms started to recover their employment level, generating a job-creation effect. Also, one can see that textiles, dressing and leather were in the top of the employment over this time period, in comparison with the remnant sectors, followed by food, beverage and tobacco, construction and restaurants and hotels, respectively.

The two graphs above show the evolution and the growth observed in employment by sector. On the left side hand, one can see the evolution observed for Job-creation, sustaining hotels and restaurants' sector seems to have increased the level of employment

Figure 2: Job creation and its growth by sector



Source: SCIE, 2010-2017 *Source:* SCIE,2010-2017

Table 2: Descriptive Statistics

VARIABLES	(1) mean	(2) sd	(3) min	(4) max
year	2,014	2.160	2,011	2,017
Job C	0.513	0.0894	0.387	0.623
Xet	4.042	0.0789	3.955	4.178
tenure	10.03	0.319	9.480	10.27
FinLev	2.186	0.792	1.378	3.783
Liq	12.83	10.64	7.727	36.82
tangibility	74,197	1,910	71,996	77,138
profit	66,594	13,973	54,397	95,777
pemp	4.298	0.0948	4.184	4.414

compared with construction's, food's, and textiles' sectors firms. The same trend is observed when we analyses its growth. Firm's classification by industry in the selected data is distributed as it follow: 7.11% of the firms analysed belong to the food, beverage and tobacco sector; 7.49% to the textiles and dressing one; 43.61% to the construction sector and 41.76% to

the hotel and restaurants sector. The table with descriptive statistic presented below allows to explain our data better. The average number of paid workers is 4.298 and the minimum observed is 4.184. In terms of sector, the sectors with an average higher number of workers are food, beverage and tobacco and textiles and dressing sector, respectively. Regarding tenure, data shows that the oldest worker in our data sample has 62 year of experience. Worker's display an average tenure of 10.27 years and a minimum of 0.319 years. Regarding size, its mean value is settled at 4.24 workers and no firm reveals to have more than 10 employees over our data sample, as the maximum number of employees was settled at 10 workers.

3.4. Econometric model and estimation strategy

The following dynamic model was estimated:

$$LnGross - JobC_{i,t} = \beta_0 + \beta_1 LnXet_{i,t} + \beta_2 LnTenure_{i,t} + \beta_3 Liquid_{i,t} + \beta_5 Sect_{i,t} + \mu_{i,t} \quad (7)$$

$$LnGross - JobD_{i,t} = \beta_0 + \beta_1 LnXet_{i,t} + \beta_2 LnTenure_{i,t} + \beta_3 Liquid_{i,t} + \beta_4 FinLev_{i,t} + \beta_5 Sect_{i,t} + \mu_{i,t} \quad (8)$$

Where $Gross\ JobC_{i,t}$ and $Gross\ JobD_{i,t}$ represents the current year sum of the number of job-creation and job-destruction; $LnXet_{i,t}$ is the natural log of firms' size, $LnTenure_{i,t}$ the natural logarithm of the highest firm's tenure; $FinLev_{i,t}$, financial leverage; $Liq_{i,t}$, firm's liquidity; $Sect_{i,t}$, is the categorical variable for sector, taking values equal to 1(one) if the sector is verified and zero otherwise; $mu_{i,t}$, is the error term ; and finally, two instrumental variables, $Profitabily_{i,t}$ represents the difference between total sales and total cost and $Tangibility_{i,t}$ which is the portion of tangible assets.

3.5. Empirical Analysis and Conclusions

The results on fixed effect model will not be analysed as this model eliminate the industry effect which is important for this analysis. However, results of the main model, LSDV show that not all job-creation determinants show the expected coefficient's sign. The table above shows us that job-creation is positively impacted by its previous values (lagged). This implies that a one percentage change in this previous value, leads on average, ceteris paribus, to approximately, 20 percent increase in job - creation. Financial leverage ratio and tangibility also display a positive relationship. That mean that an increase of one percent in the referred variable, on average, ceteris paribus, leads to a change of 0.9 and 0.5 percent in firm's labour demand.

Regarding to profits also displays the same relationship with job creation, meaning that a one percent change in firm's profit leads, on average, ceteris paribus, to a 0.6 percent change on job-creation. This relation can be explained based on the base of marginal productivity of the labour: as firms are profit maximizers, a positive change in output resulting from hiring leads to an additional hiring of workers, holding constant all other inputs. Industrial affiliation, as construction and food, beverage, and tobacco, have a positive impact on job-creation, thus explaining the variation in job creation across firms. On the other hand, firm's size and tenure display negative influences on job-creation. An increase of one percent on those variable leads, on average, ceteris paribus, to a negative change of 39 and 9.6 percent respectively, in job creation. As size is computed taking as a basis the number of workers the firm has, it is normal to infer that hiring will decrease as the number of workers increase in line with the law of diminishing returns.

New workers may increase output substantially due to specialization, however, eventually, as we continue to increase the number of workers, labour marginal productivity decreases and job-creation decreases as well. Regarding tenure, the negative relation can be explained by the cost minimization firm's strategy. Firms, when they decide to hire, can choose to continue with the more experience workers in order to avoid spending money in providing training for

new workers and this strategy affects negatively job creation. On other hand, the negative relation can occur due to the fact the majority of micro firms are family owned and most of the workers belong to the owner's family, thus they will choose to keep the same workers for a long period of time, what will impact negatively on job creation.

Table 3: Gross job-creation and destruction estimates

	JC-LSDV	JC-FE	JC-RE	JD-LSDV	JD-FE	JD-RE
L.lnGet C	0.2143***	-0.2593***	0.1827***			
	(0.011)	(0.023)	(0.010)			
"lnXet"	-0.3895***	-0.5311***	-0.4008***	-0.8884***	-1.0771***	-0.9107***
	(0.017)	(0.057)	(0.017)	(0.014)	(0.044)	(0.015)
lntenure	-0.0960***	-0.2060***	-0.1017***	-0.0462***	-0.0353	-0.0445***
	(0.007)	(0.046)	(0.007)	(0.007)	(0.045)	(0.007)
lntangibility	0.0092***	0.0341**	0.0047	0.0085***	0.0244	-0.0004
	(0.003)	(0.017)	(0.003)	(0.003)	(0.015)	(0.003)
lnprofit	0.0340***	-0.0370**	0.0417***	0.0039	0.0152	0.0119***
	(0.005)	(0.019)	(0.005)	(0.005)	(0.014)	(0.004)
FinLev	0.0058***	0.0597***	0.0047*	0.0027	-0.0197	-0.0051*
	(0.002)	(0.021)	(0.002)	(0.002)	(0.015)	(0.003)
4.inda1	-0.0215			0.0504		
	(0.025)			(0.031)		
11.inda1	0.0454**			0.1111***		
	(0.022)			(0.020)		
13.inda1	-0.0193			-0.0172		
	(0.022)			(0.020)		
L.lnGet D				-0.0600***	-0.4887***	-0.0933***
				(0.013)	(0.027)	(0.012)
_cons	-0.7609***	-0.3400	-0.7884***	-0.0315	-0.5713**	0.0216
	(0.056)	(0.244)	(0.056)	(0.056)	(0.231)	(0.051)
N	8436	8436	8436	7250	7250	7250

"Notes: robust standard errors in parenthesis. Significance levels: *, 10%; **, 5%; ***, 1%."

Following an opposite trend, we find firm size. This variable displays a negative relationship with job creation, meaning that the number of workers firms hire decreases when firm's size is large or when firm's employment is close to 10 employees. This means that firms achieve their optimal employment level by increasing their size.

The negative relation with tenure means that firms with old workers reflect a higher level of impatience in hiring new workers and that most family firms tend to employ predominantly owner's family members.

Likewise, job destruction coefficients evidenciate that lagged job - destruction patterns impact negatively on current job destruction patterns. This evidence indicates that a one percent change in the previous job destruction increases, ceteris paribus, on average, the actual job destruction by almost 6 percent.

In what respect firm's size and tenure display, as well, a negative relation with job destruction by showing that a one percent change in the referred variables leads, ceteris paribus, on average, to an increase on job destruction of 8.8 and 4.6 percent respectively. However, an increase of one percent on the level of tangible assets reduces job destruction on

average, ceteris paribus, by 0.85 percent. Profits and Financial leverage display positive impacts but this relationship was not statistically significant.

Regarding industry affiliation, it is clearly evidenced that the construction sector displays a fundamental role in reducing job destruction over the time period analysed. The coefficient's sign are the same whem analyse random effect model changing according to its direction for fixed effect models.

4. Concluding Remarks

This paper focuses on analysing gross job-creation and gross job-destruction for Portuguese firms. The study is performed using micro firms data from SCIE and Quadros do Pessoal, for the time period going from 2010 to 2017. Our findings sustain that previous gross job-creation, asset tangibility, financial leverage and firm affiliation are important gross job-creation determinants for micro firms belonging to the food, beverage and tobacco; textiles, dressing and leather sector firms; construction and hotel and restaurants sectors. Contrarily to what we expected, firm's size and worker's tenure influence negatively gross job-creation, meaning that these two variables contribute to labour demand for Portuguese' micro firms.

Regarding gross job-destruction, the results show that previous gross job-destruction, firm's size and worker's tenure were in the base of the observed increases in gross job- destruction for Portuguese micro firm for the time period going from 2010 to 2017. This leads we to conclude that from 2010 to 2012 there was an accumulation in the gross job-destruction and that firms prefer to fire more recently hired workers rather than those who were linked to the company for a longer period oftime.

Conversely, tangible assets influences negatively gross job-creation by decreasing its rising trend. Regarding industry affiliation, evidences shows that the construction sector contributes for gross job-destruction reduction. Thus, the result of this study can have political implications and help defining fiscal policies for the micro firms in Portugal.

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DETECTING INTERREGIONAL PATTERNS IN TOURISM SEASONALITY OF GREECE: A PRINCIPAL COMPONENTS ANALYSIS APPROACH

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Abstract

Tourism seasonality is a complex phenomenon incorporating a temporal, a spatial, and a socioeconomic (ontological) dimension. This paper builds on principal component analysis (PCA) to provide an integrated methodological framework for studying all three dimensions of tourism seasonality. The proposed method classifies the seasonal patterns of tourism demand of the Greek prefectures into regional groups, which are examined in terms of their geographical and socioeconomic characteristics. The study aims to configure distinguishable seasonal profiles in terms of their socioeconomic attributes. The proposed method is applied to monthly data of tourism overnight stays for the period 1998-2018 and detects seven principal components described by diverse socioeconomic attributes. The overall analysis proposes a useful tool for tourism management and regional policy, it advances PCA to be used as a tool of regional classification, and it incorporates a multivariate consideration based on the socioeconomic evaluation of the principal components. The proposed methodology develops an integrated framework dealing with complexity describing socioeconomic research and particularly tourism seasonality.

Keywords: regional development; seasonal classification; spatiotemporal patterns; pattern recognition.

JEL classification: C18, C38, O52, R10, R58, Z30

1. Introduction

A major aspect in the research of regional science is related to the spatial asymmetry observed in the development of regions, countries, and generally of geographical areas (Polyzos, 2019). The uneven dynamics emerging in space induce inequalities affecting the economic growth, the opportunities for economic development, the quality of the environment, and even the culture and the mentality of societies evolving in time and space (Charles Edwards and Bell, 2013; Romao and Saito, 2017; Batista et al., 2019). Within this framework, the spatial dimension of economic phenomena has become a default variable in contemporary economic analysis (Mastronardi and Cavallo, 2020), in an extent to consider economics and regional science an integrated discipline. This is because, in economic research, which is multivariable covering diverse aspects of socioeconomic life, such as stock-markets (Patatoukas, 2020), energy (Zaman et al., 2016), productivity (Romao and Nijkamp, 2019), entrepreneurship (Hundt and Sternberg, 2016), trade (Brakman and Van Marrewijk, 2017), the web economy (Li et al., 2018), transportation (Cascetta et al., 2015), and other (Kalantzi et al., 2016; Romao et al., 2017; Kummu, M. et al., 2018), the spatial dimension is a common variable controlling either directly or indirectly these socioeconomic aspects. Taking into account that space suggests a default economic-variable, many traditional aspects of economic analysis that were mainly defined within a temporal context, such as productivity (Romao and Nijkamp, 2019), labor (Giannakis and Bruggeman, 2017), energy

(Zaman et al., 2016), tourism (Tsiotas, 2017; Batista et al., 2019), even the web economy (Li et al., 2018), are revisited.

A characteristic case of such reconsideration regards tourism, which suggests a major component for many economies worldwide (Charles Edwards and Bell, 2013; Kalantzi et al., 2016; Batista et al., 2019; Polyzos, 2019). In tourism economics, a main concern of research is dealing with the seasonality of this phenomenon (Butler, 1994; 2001, Gil-Alana, 2010; Polyzos et al., 2013; Kalantzi et al., 2016; Tsiotas, 2017; Ferrante et al., 2018), which is defined as the unequal distribution of demand along the year (Butler, 2001; Batista et al., 2019). Literature research has shown that tourism seasonality is multivariable and is affected by the type of the tourism product (Cuccia και Rizzo, 2011), the climate (Butler, 2001; Fang and Yin, 2015), the social configuration (Almeida and Kastenholz, 2019), the political regime (Fernandez-Morales et al., 2016), and other factors (Lee et al., 2008). The majority of relevant research mainly focuses on the study of the temporal dimension of tourism seasonality by examining the causes, impacts, and policy implications (Koenig-Lewis and Bischoff, 2005; Duro, 2016), as well as the temporal trends and patterns of demand (Connell et al., 2015; Ferrante et al., 2018; Batista et al., 2019; Duro and Turrion-Prats, 2019). However, all these temporal considerations have an immanent spatial dimension, which is related to the diversity caused by the effect of space and the geographical location of different tourism destinations (Romao and Saito, 2017; Batista et al., 2019). This brings up in the academic dialogue about tourism more avenues of research, such as the study of the competitiveness (Liu et al., 2018; Choe et al., 2019; Gomez-Vega and Picazo-Tadeo, 2019; Niavis and Tsiotas, 2019) and synergy (Niavis and Tsiotas, 2018, 2019; Tsiotas et al., 2019) between tourism destinations, along with the effect of geographical scale, either at the level of neighborhood (Duro, 2016), or at the regional (Romao et al., 2017), international (Batista et al., 2019), and worldwide level (Duro and Turrion-Prats, 2019). For instance, in Europe, tourism is unevenly distributed due to different geographic and socio-economic factors, such as the coastal, insular, and mainland morphology of countries, their cultural background, level of transport integration, and more (Batista et al., 2019). Further, Mediterranean countries are described by a growth-tendency in visitor arrivals that is simultaneously related to a significant increase of seasonality, unlike other competitive destinations, such as the Asia Pacific region that is described by growing demand with a simultaneous decrease of seasonality (Duro and Turrion-Prats, 2019).

A fundamental issue in quantitate studies is the measurement of tourism seasonality (Lundtorp et al., 2001), which is implemented by using a specific variable within a certain time period (e.g. monthly), regardless of their patterns (Porhallsdottir and Olafsson, 2017; Ferrante et al., 2018). The most common variables for measuring tourism seasonality are the number of visitors, arrivals, and overnight stays, while, in terms of economic impacts, income-defined variables are also used (Lundtorp et al., 2001; Porhallsdottir and Olafsson, 2017). Seasonality is also subjected to sensitivity due to subjectivity in the variables' selection (Martin et al., 2019). For instance, the rate and the intensity of seasonality, the seasonal peak factor (S), the maximal utilization constrained by seasonality (MUS), and the seasonality underutilization factor (SUF) were applied to measure seasonality in Cyprus, Sicily (Italy), Madeira (Portugal), and Hiiumaa (Estonia), in the context of increasing seasonality by developing winter tourism (Ruggieri, 2015). Other common indicators used for seasonality measurement in tourism seasonality studies are the seasonality range and ratio, the coefficient of seasonal variation, the seasonality span, the seasonality underutilization factor, and the share of seasonality (Koenig-Lewis and Bischoff, 2005; Duro, 2016). However, due to the complexity describing the phenomenon of tourism seasonality, more composite indicators appeared in literature, such as the Gini coefficient, the Theil index, and the coefficient of variation (CV) (Koenig-Lewis and Bischoff, 2005). These measures can be decomposed to sub-indices and thus include measurements at different scales (Fernandez-Morales et al., 2003; Cisneros-Martinez and Fernandez-Morales, 2015; Duro, 2016; Porhallsdottir and Olafsson, 2017; Rossello and Sanso, 2017). Despite their effectiveness, Gini coefficient and Theil index cannot sufficiently capture periodical (cyclical) structures (Lo Magno et al., 2017; Ferrante et al., 2018), they are restricted to annual computations (Karamustafa and Ulama, 2010), and they provide restricted information about regional seasonality (Cisneros- Martinez and Fernandez-Morales, 2014). Also, they are sensitive to scale around the average (Duro and

Turrion-Prats, 2019) and to subjectivity in variable's selection (Martin et al., 2019). Duro (2016) attempted a joint consideration of the Gini coefficient, the Theil index and the Coefficient of Variation (CV) to overcome the restrictions of their single use (Koenig-Lewis and Bischoff, 2005). However, in case studies conducted in Spain (Fernandez-Morales, 2003) and Iceland (Porhallsdottir and Olafsson, 2017), the authors showed that these indicators are highly correlated.

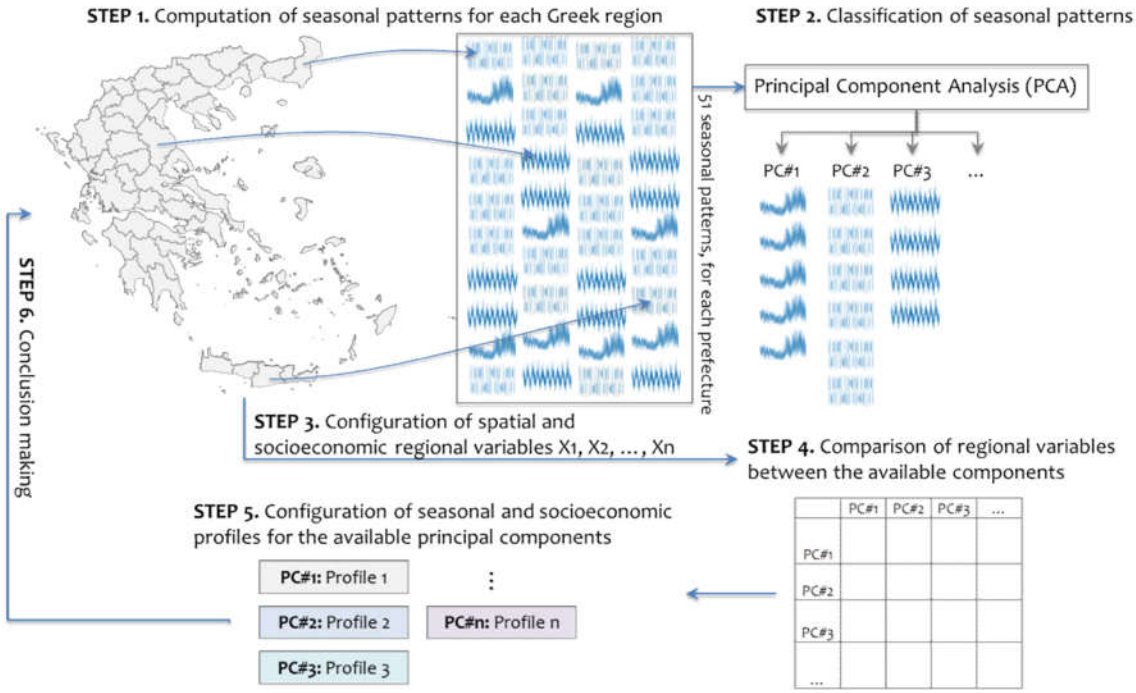
Although seasonality affects almost every tourism destination (Corluka et al., 2016), the complex relationship between seasonality and space has not yet been studied in a comprehensive quantitative context (Connell et al., 2015; Corluka et al., 2016; Cisneros-Martinez et al., 2017; Batista et al., 2019; Martin et al., 2019). This is because, on the one hand, many studies are focusing on the multivariable determinants of seasonality (Andriotis, 2005; Gil-Alana et al., 2010; Ferrante et al., 2018; Duro and Turrion-Prats, 2019), but this is mainly done for a single destination, while, on the other hand, many other studies are interested in tourism geography but without deeply examining the temporal tourism patterns emerging in space (Terkenli, 2005; Ahas et al., 2007). Exceptions to this double consideration (Polyzos et al., 2013; Charles Edwards and Bell, 2013; Connell et al., 2015; Romao et al., 2017; Batista et al., 2019) are not enough to configure a comprehensive context for this debate and therefore these works currently highlight the demand of integration between the temporal and spatial dimensions of tourism seasonality. Aiming to serve this demand, this paper introduces a novel approach for studying temporal patterns of tourism seasonality and next classifying them into regional groups. The proposed method builds on Principal Component Analysis (PCA) to classify the 51 (NUTS III) regions in Greece into groups (principal components), which are configured according to their seasonal patterns in terms of visitor-arrivals recorded for the period 1998-2018. The study focuses on the case Greece, which is a coastal country with a mixed mountainous, land, coastal, and insular morphology, consisting of more than 55km2 mountainous areas, more than 16,000 km of coastline and more than 1,350 islands, islets, and rocky islands, of which over 230 are inhabited (Tsiotas, 2017). Continental Greek regions occupy 13% of the national population, whereas insular ones occupy 12% (Tsiotas, 2017). The rich geomorphology of Greece has led to a composite tourism product (Kalantzi et al., 2016), which is diversely distributed along with the various tourism destinations of the country (Tsiotas, 2017; Polyzos, 2019). Within this context, the proposed method offers a quantitative tool for measuring and classifying the dynamics of the Greek regions in accordance with their seasonal patterns. This consideration can provide insights about how the geographical distribution of tourism seasonality in Greece can be organized along with the regional space and therefore it may contribute to the configuration of more effective and sustainable tourism development strategies leading the Greek tourism destinations to the desired regional balance.

The remainder of this paper is organized as follows: Section 2 is a brief literature review on tourism seasonality, highlighting its temporal and spatial aspects. Section 3 describes the methodological framework of the study, the available data, and the available variables participating in the analysis. Section 4 presents the results of the analysis and discusses them within the context of regional science and tourism development. Finally, at Section 4 conclusions are given.

2. Methodological Framework

The study aims to provide a methodological framework for studying temporal patterns of tourism seasonality and next classifying them into regional groups. The further purpose of the study is to detect commonalities of tourism seasonality between the Greek regions and to classify them into seasonal profiles. To do so, the proposed methodology builds on the principal component analysis (PCA) (Wold et al., 1987; Norusis, 2008), which is an established technique of dimension reduction useful in various applications. The methodological framework consists of six steps, as it is shown in Fig.1.

Figure 1. The conceptual diagram illustrating the methodological framework of the study



At the first step, the seasonal patterns of the Greek regions are computed on data referring to the monthly number of overnight stays (including both foreign and domestic visitors) per prefecture, for the period 1998-2018. The available data were granted upon request by the Hellenic Statistical Authority (ELSTAT, 2019a) to be used under an exclusive license, for the purpose of this study. At this step, 51 seasonal variables were created, each corresponding to a Greek prefecture (codes and names of the variables are shown see in the Appendix). All seasonal variables are of length 252, namely, they consist of 252 monthly scores composing the period 1998-2018. At the second step, a PCA (Wold et al., 1987; Norusis, 2008) is applied to the available 51 seasonal variables, which are classified into principal components that are coherent groups in terms of variability. In general, PCA is used to reduce the dimension of a set of possibly correlated (source) variables, by converting them into a set of linearly uncorrelated ones, which are called principal components (Norusis, 2008). For n in number available variables, the procedure applies an orthogonal transformation to them, which can be considered as fitting a p-dimensional ellipsoid ($p \leq n$) to the data. Each axis of the ellipsoid corresponds to a principal component. When some ellipsoid axes are relatively small, then the variance along them is also small and therefore the dimension of the available set of variables can be reduced by removing these axes from the dataset. The computational algorithm of the PCA (Wold et al., 1987; Norusis, 2008) is described as follows: first, to find the axes of the ellipsoid, the data are centered on the origin by subtracting the average of each variable from the dataset. Next, the algorithm computes the covariance matrix of the data, the eigenvalues, and the eigenvectors of the covariance matrix. Next, each of the orthogonal eigenvectors is normalized to a unit vector, which configures an axis of the ellipsoid fitted to the data. The total number (p) of the resulting principal components represents an uncorrelated orthogonal basis of the p-dimensional ellipsoid, on which each (of the n in number) source-variable can be projected to. The proportion of the variance each eigenvector captures is calculated by dividing its eigenvalue by the sum of the total eigenvalues. In the PCA algorithm, the resulting principal components are arranges in ascending order, according to which the first has the largest possible variance, the second one the second largest variance, and so on. Provided that not all principal components contribute the same to the total variance, their number can be reduced under a desired loss of information. In the PCA, the choice of the optimum number of principal components is facilitated by plotting them to a scree-plot, which displays an ascending sequence of the components according to the size of their eigenvalues (Norusis, 2008). The final number of principal components is then determined at the point where including more components adds insignificant variance to the total variance is currently

explained. The PCA is broadly used for data reduction in a variety of applications (Kim et al., 2002; Mudrova and Prochazka, 2005; Vyas and Kumaranayake, 2006; Acharya et al., 2012), but is particularly popular in primary research conducted with the use of questionnaires (Norusis, 2008). The principal components resulting by the PCA configure uncorrelated variables of a certain semiology, where items (source variables) within each component are relevant, first, to the extent they best describe the variability of their component and, secondly, to the extent they compose the semiology of their component (Norusis, 2008). In this study, each principal component includes seasonal variables corresponding to Greek prefectures. Within this context, variables included in each principal component express the prefectures that have relevant seasonal patterns during the period 1998-2018.

At the third step of the methodological framework, socioeconomic and geographical (spatial) variables are computed at the regional scale. These variables are of length 51 and include scores of the Greek prefectures for a set of various socioeconomic attributes extracted from the literature, as it is shown in the Appendix. Among these variables, two are included as measures of tourism seasonality, namely the Gini and Relative Seasonality index. The Gini coefficient (Fernandez-Morales et al., 2003; Kulendran and Wong, 2005; Cisneros-Martinez and Fernandez-Morales, 2015; Duro, 2016; Porhallsdottir and Olafsson, 2017) is a very common inequalities measure, which is computed according to the formula:

$$G = 1 - 2\int_0^1 L(x)dx \tag{1}$$

where $L(x)$ is the mathematical expression of the Lorentz curve (Polyzos, 2019). The Gini coefficient is a stable inequalities measure that is not affected by extreme values (Lundtorp, 2001; Duro, 2016; Duro και Turrion-Prats, 2019). However, its seasonality performance was submitted to criticism about its effectiveness in capturing cyclical structures (Lo Magno et al., 2017; Ferrante et al., 2018). On the other hand, the Relative Seasonality Index (RSI) was proposed by Lo Magno et al. (2017) as a measure of seasonality. This index was defined within the context of the transportation problem, formulated as the problem of minimizing the cost of eliminating seasonality by transferring units from high to low season periods (Lo Magno et al., 2017; Ferrante et al., 2018). The mathematical expression of the RSI is described as follows:

$$S_R(\mu, C) = \frac{\sum_{i\in A}\sum_{j\in B} c_{ij}x_{ij}}{\mu \cdot max_{i\in M}\left\{\sum_{j\in M} c_{ij}\right\}} \tag{2}$$

where x_i is the i-th observation of variable x, μ is the average value of the available observations, c is the total cost for eliminating seasonality, A is the set of high-season time periods, B is the set of low-season time periods, and M is the set of all possible observed time-patterns.

At the fourth step of the methodological framework, the principal components resulted from the PCA are compared in terms of their socioeconomic and geographical attributes that are shown in the Appendix. This approach builds on the formulation of error-bars of 95% confidence interval for the mean-values (Walpole et al., 2012), which are constructed for each principal component and then are being compared. Cases, where error-bars do not overlay, imply that average values (corresponding to the principal components' groups) are statistically different, under a 95% certainty (Walpole et al., 2012; Tsiotas, 2019). Therefore, comparisons between principal components for every socioeconomic and geographical variable (shown in the Appendix) are expected to reveal the groups (i.e. principal components) with maximum and minimum performance per available attribute. Within this context, at the fifth step of the methodological framework, the results of the comparisons are tabulated to configure seasonal and socioeconomic profiles of the available principal components. This approach develops a classification of attributes determining each principal component and thus it defines the conceptual framework of each principal component in a broader than the seasonal context. The overall approach is expected to provide a tool of quantitative analysis useful for the regional policy and tourism management. The results of

the analysis and the overall approach are discussed at the sixth step of the methodological framework.

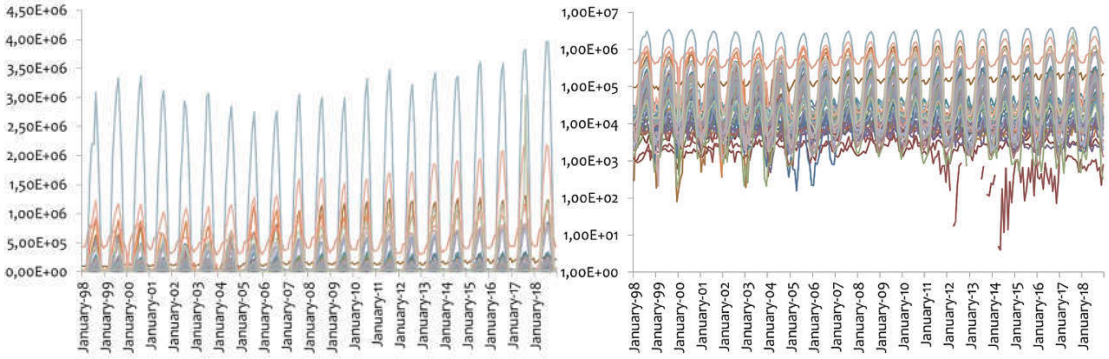
3. Results and Discussion

3.1. Principal component analysis

The available 51 seasonal variables participating in the PCA are plotted in the line-plots shown in Fig.2. Each seasonal variable corresponds to a Greek prefecture and has 252 monthly scores of tourism overnight stays, for the period from Jan 1998 to Dec 2018. As it can be observed, all variables are described by discrete seasonal patterns. In these patterns, we can observe differences in scale (height of oscillation) and trend (e.g. some patterns show increasing trend). Within this context, the PCA is applied to reduce the dimension of this dataset and to organize these diverse patterns into classes (principal components). The further purpose of the analysis is to detect socioeconomic and geographical attributes describing the principal components and to shape a profile describing each group.

The results of the PCA are shown in Fig.3 consisting of four sub-plots. The first (Fig.3a) is the PCA's scree plot showing an ascending sequence of the components according to the size of their eigenvalues (Norusis, 2008). This plot indicates the point after which including more components adds insignificant variance to the total variance is currently explained. According to this plot, 7 principal components can be extracted from the total of 51 available seasonal variables. These principal components explain an amount of ~85% (84.86%) of the total variance. The second sub-plot (Fig.3b) illustrates the coefficients included in the PCA's component matrix (Norusis, 2008), shown on a color scale instead of in absolute numbers. These PCA coefficients illustrate the level at which a source variable is correlated to the resulting principal components, in a context similar to the coefficient of correlation (Walpole et al., 2012). To reduce the complexity of this figure (which includes 51×7=357 coefficients of correlation), the next pair of sub-plots apply maximum (Fig.3c) and minimum (Fig.3d) filters to the information of Fig.3b. In particular, Fig.3c shows with which principal component the Greek prefectures (source variables) are most positively correlated, while Fig.3d shows with which principal component they are most negatively correlated. As it can be observed, the Greek prefectures are all included in the first five components in the maximum coefficients' plot of Fig.3c, whereas are scattered throughout all seven principal components in the minimum coefficients' plot of Fig.3d.

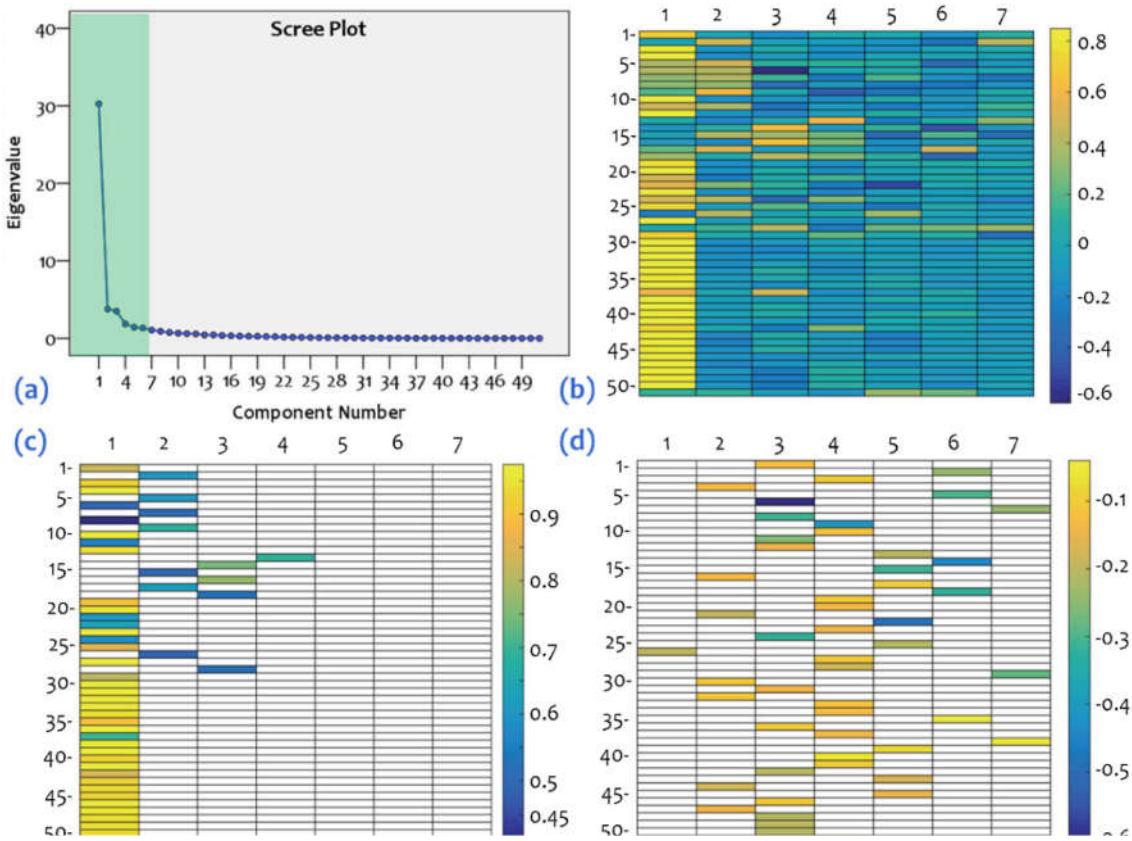
Figure 2. Line plots of all available 51 seasonal variables shown in (left) metric and (right) log scale. Each variable represents a seasonal pattern of tourism overnight stays for a Greek prefecture. Seasonal variables include 252 monthly scores for the period from Jan 1998 to Dec 2018. The available data were granted upon request by the Hellenic Statistical Authority (ELSTAT, 2019a) to be used under an exclusive license, for the purpose of this study



In particular, the first principal component (PC#1) includes maximum coefficients of the prefectures of Rodopi (1), Evros (3), Kavala (4), Thessaloniki (6), Kilkis (8), Pieria (10), Chalkidiki (12), Thesprotia (19), Fthiotida (25), Evoia (27), Fokida (29), Rethymno (50) (prefectures names and coding is shown in the Appendix). These prefectures are distributed throughout the country (except the north-west part of Greece), as it is shown in Fig.4. In particular, the spatial distribution of the prefectures composing PC#1 forms a cluster at the

north-east country, another one at the north, one more at the coastal central part of Greece, another one at west Greece, and a major island cluster at the Aegean sea (at the east part of the country). On the other hand, the prefecture with the minimum (and negative) coefficient included in the first principal component is Viotia (26) located in central Greece. At next, for standardization purposes, principal components defined by the max-value filter of Fig.3 will be denoted as PC#*i*(+), with *i*=1,…,5, whereas those defined by the max-value filter of Fig.3 will be denoted as PC#*i*(-), where *i*=1,…,7.

Figure 3. Results of the principal component analysis (PCA) applied to the socioeconomic and geographical variables of Table A2, where (a) is the scree plot showing the eigenvalues in accordance to the principal components, (b) is the heat-plot with the total PCA coefficients, (c) is the heat-plot with the maximum PCA coefficients, and (d) is the heat-plot with the minimum PCA coefficients. Columns in cases (b), (c), and (d) express the (6) principal components, whereas rows the available variables

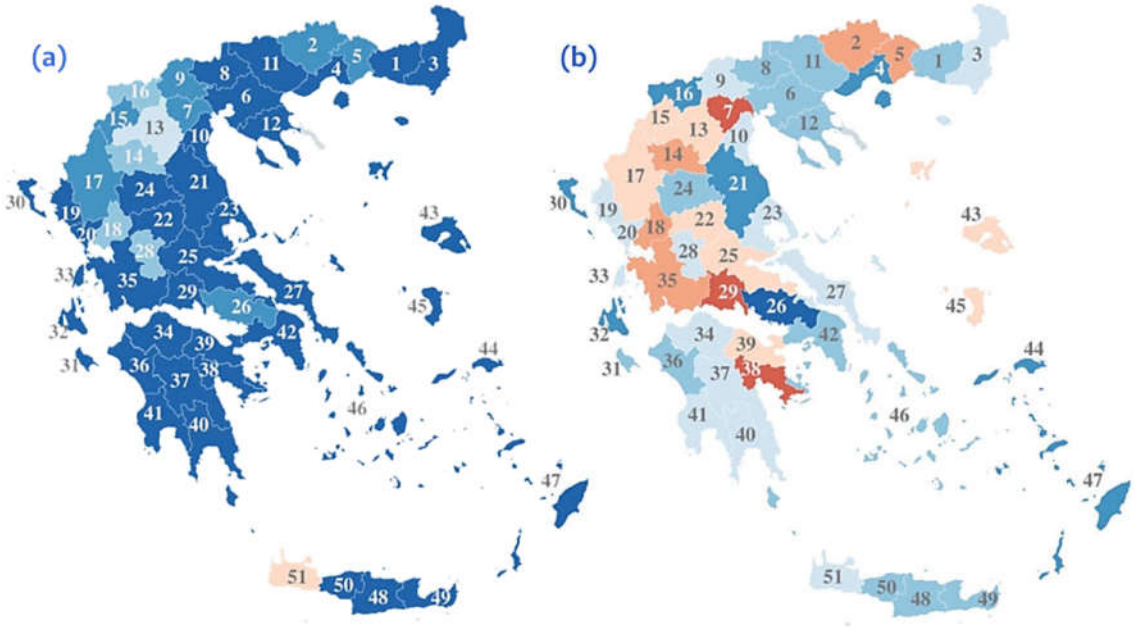


The second principal component (PC#2(+)) includes maximum coefficients (Fig.3c) of the prefectures of Drama (2), Xanthi (5), Imathia (7), Pella (9), Kastoria (15), Ioannina (17), and Viotia (26), as it is shown in Fig.4. These prefectures form three clusters located in the border-arc of the country extended from the west to the east part of Greece, whereas the prefecture of Viotia (26) is located in the central Greece. On the other hand, the prefectures with the minimum coefficients (Fig.3d) included in this component (PC#2(–)) are Kavala (4), Florina (16), Larissa (21), Kerkyra (30), Kefallonia (32), Samos (44), and Dodecanese and they are distributed throughout the Greek periphery.

Next, the third principal component (PC#3(+)) includes maximum coefficients (Fig.3c) of the prefectures of Grevena (14), Florina (16), Arta (18), and Evrytania (28), which are located at the north-west part of the country (Fig.4). These prefectures form a cluster located in the north-west country, another one in the north, whereas the prefecture of Viotia (26) is located in the central Greece. On the other hand, the prefectures with the minimum coefficients (Fig.3d) included in this component (PC#3(–)) are Thessaloniki (6), Kilkis (8), Serres (11), and Chalkidiki (12), at the north, Rodopi (1), at the north-east, Trikala (24), at the central, Zakynthos (31) and Ilia (36), at the west, Attiki (42), Cyclades (46), at the central Aegean, and Heraklion (48) and Rethymno (50), at the island of Crete.

The fourth principal component (PC#4(+)) includes maximum coefficient (Fig.3c) of the prefecture of Kozani (13), at north-west Greece (Fig.4), whereas the prefectures with the minimum coefficients (Fig.3d) included in this component (PC#4(–)) are Evros (3), Pella (9), Pieria (10), Thesprotia (19), Preveza (20), Karditsa (22), Magnessia (23), Evia (27), Evrytania (28), Lefkada (33), Achaia (34), Arkadia (37), Lakonia (40), Mesinia (41), and Chania (51). The geographical distribution of these prefectures forms a heterogeneous pattern scattered throughout the Greek domain.

Figure 4. Regions with the maximum (positive) and minimum (negative) coefficients included in each component



Principal Component	Participation to components' variability	
	Maximum (positive values)	Minimum (negative values)
PC#1	1,3,4,6,8,10-12,19-25,27,29-50	26
PC#2	2,5,7,9,15,17,26	4,16,21,30,32,44,47
PC#3	14,16,18,28	1,6,8,11,12,24,31,36,42,46,48-50
PC#4	13	3,9,10,19,20,23,27,28,33,34,37,40,41,51
PC#5	51	13,15,17,22,25,39,43,45
PC#6	-	2,5,14,18,35
PC#7	-	7,29,38

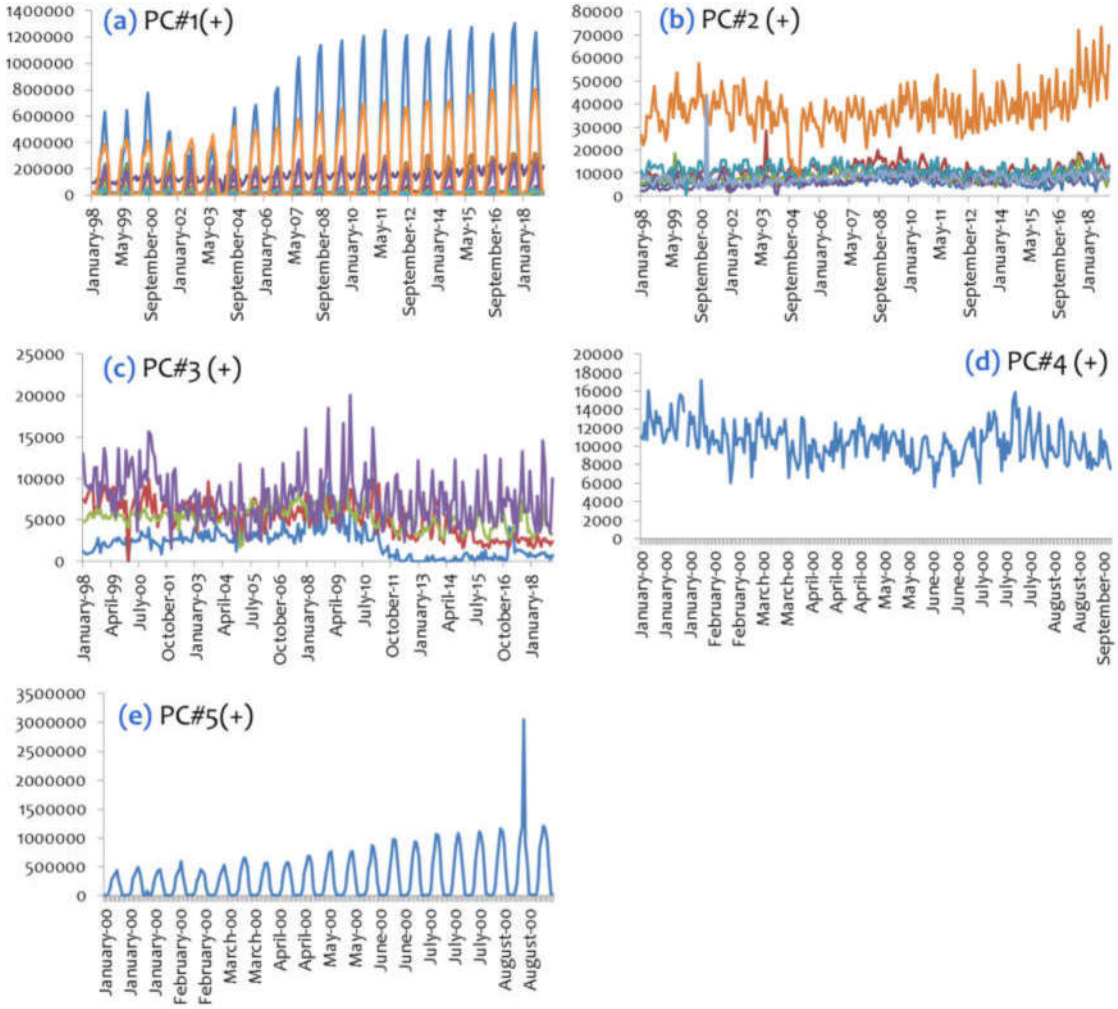
Nomenclature of prefectures shown in the Appendix

Next, the fifth principal component (PC#5(+)) includes maximum coefficient (Fig.3c) of the prefecture of Chania (51), located in the island of Crete (Fig.4), whereas the prefectures with the minimum coefficients (Fig.3d) included in this component (PC#5(–)) are Kozani (13), Kastoria (15), and Ioannina (17), at north-west Greece, Karditsa (22) and Fthiotida (25), at central Greece, Korinthia (39), at the region of Peloponnesus, and Lesvos (43) and Chios (45) and the east Aegean sea. Next, the sixth (PC#6) and seventh (PC#7) principal components do not include maximum coefficients (Fig.3c). The prefectures with the minimum coefficients (Fig.3d) included in PC#6(–) are Drama (2) and Xanthi (5), at the north-east, and Grevena (14), Arta (18), and Aitoloakarnania (35), at central-west Greece. Finally, the prefectures with the minimum coefficients (Fig.3d) included in PC#7(–) are Imathia (7), at the north, Fokida (29), at coastal central Greece, and Argolida (38), at the region of Peloponnesus.

To examine the seasonal patterns of these principal components, we construct the line-plots shown in Fig.5 and Fig.6. The first of these figures (Fig.5) shows the seasonal patterns'

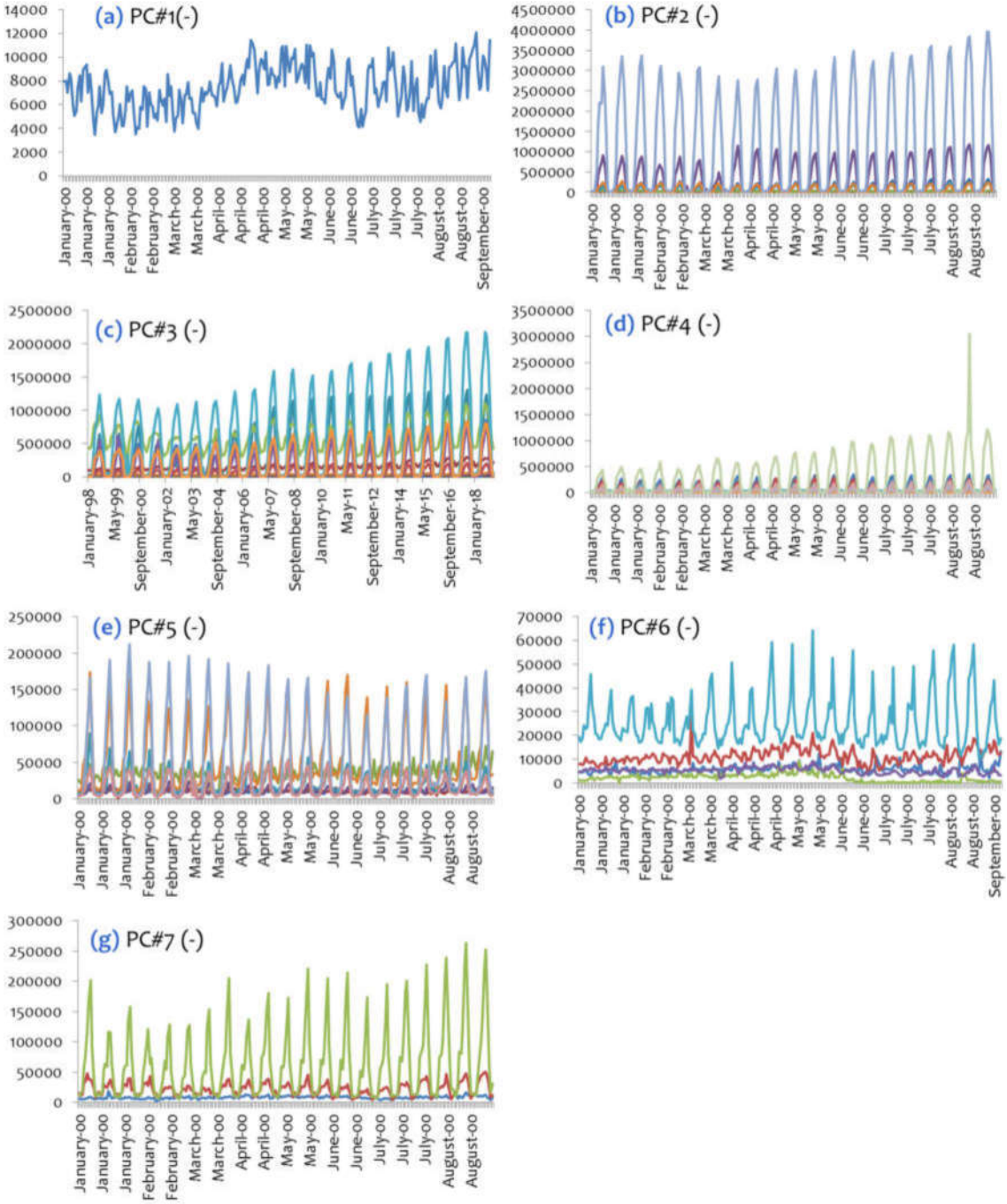
grouping according to the maximum-value filtering (Fig.3c), whereas the second is constructed in accordance with the minimum-value filtering shown in Fig.3d.

Figure 5. Line plots with the available 51 seasonal patterns of the Greek prefectures that are related positively (+) to principal components PC#*i*, with *i*=1,…,5. All displayed components are defined by the max-value filter grouping of Fig.3c



As it can be observed in Fig.5, principal components PC#1(+) and PC#5(+) include prefectures with more discrete periodical (cyclical) patterns, whereas prefectures included in the other components (PC#2(+), PC#3(+), and PC#4(+)) have more noisy patterns. Further, according to Fig.6, principal components PC#2(–), PC#3(–), PC#4(–), PC#5(–), and PC#7(–) include prefectures with more discrete periodical (cyclical) patterns, whereas prefectures included in components PC#1(–) and PC#6(–) have more noisy patterns.

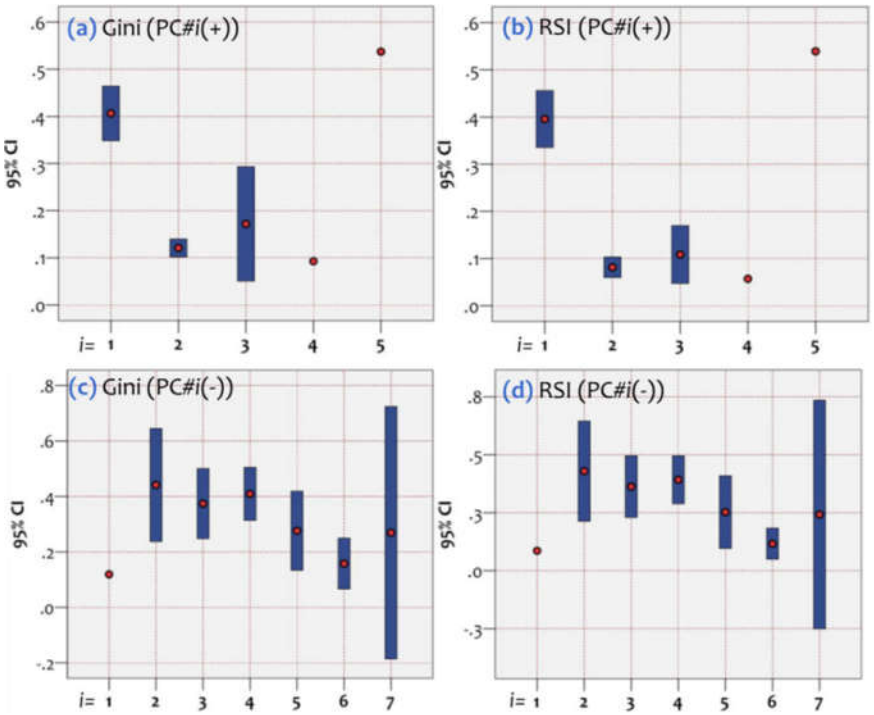
Figure 6. Line plots with the available 51 seasonal patterns of the Greek prefectures that are related negatively (+) to principal components PC#*i*, with *i*=1,…,5. All displayed components are defined by the min-value filter grouping of Fig.3d



Further, in order to examine the seasonal patterns of these principal components in a less complex way, we construct the error-bars shown in Fig.7. These plots show comparative 95% confidence intervals (CIs) for the mean-values of the available principal components that are computed on the scores of the Gini coefficient (Duro, 2016; Porhallsdottir and Olafsson, 2017) and the Relative Seasonal Index (RSI) (Lo Magno et al., 2017; Ferrante et al., 2018), as they were previously described and defined in relations (1) and (2). As it can be observed in Fig.7a and Fig.7b, principal component PC#5(+) defined by the max-value filter (including the prefecture of Chaneon - 51) has the highest seasonality captured by both indices. The component with the second maximum seasonality is PC#1(+), whereas the pairs of components PC#2(+)-PC#3(+) and PC#3(+)-PC#4(+) are considered to have statistically equal seasonality. This result is in line with Fig.5, where it was observed that principal components PC#1 and PC#5 include prefectures with more discrete cyclical patterns.

On the other hand, none of the principal components PC#*i*(–), *i*=1,…,7 shows a statistically significant max value, in terms of the min-value filter defined in Fig.3d. This observation illustrates that the max-value filter defined in Fig.3c is more determinative than the max-value filter defined in Fig.3d, in the description of the seasonal patterns of the Greek prefectures. Finally, error-bars in Fig.7 may provide loose and indirect insights about the performance of the two examined indices in capturing seasonality. As it can be observed, the RSI produces CIs of shorter length than the Gini coefficient. Within the context that both seasonality indices are lie on the same scale, this observation implies that the variability within each interval is smaller in the case of RSI and therefore this composite index is capable of producing more homogenous measurement. Consequently, the RSI can be loosely considered as a more effective measure of seasonality than the Gini coefficient.

Figure 7. Error-bars of 95% confidence intervals (CIs) showing the mean-values of (a) the Gini coefficient and (a) the Relative Seasonal Index (RSI) of Lo Magno et al. (2017), both defined by the max-value (+) filter of Fig.3, and (c) the Gini coefficient and (d) the RSI, both defined by the min-value (–) filter of Fig.3



3.2. Socioeconomic determination of seasonal profiles

At this step of the analysis, the principal components resulted from the PCA are compared in socioeconomic and geographical terms. Comparisons build on error-bars of 95% confidence interval for the mean-values, which are constructed for each principal component (similarly to the analysis shown in Fig.7). The results of this comparative approach are shown in detail in the Appendix, where statistically "minimax" performance is illustrated for each component. To facilitate conclusion making, the available variables (see Appendix) are organized into the thematic categories "Geographical", "Seasonality", "Transport Infrastructures", "Demographics", "Productivity", "Tourism", "Environmental", and "Cultural".

According to this analysis, the prefectures that are positively related (1,3,4,6,8,10-12,19-25,27, and 29-50) to the first principal component PC#1, have rich coastal configuration (as denoted by the max-value in variable SE.7/COASTAL), high seasonality profile (max in variables SE.3/RSI and SE.4/GINI), high transport integration (maximums in variables SE.5/ROAD DENSITY, SE.6/ROAD LENGTH, and SE.12/AIRPORTS), high specialization in the primary sector (max in variable SE.18/A_{SEC}), specialization in winter tourism activities (max-values in variables SE.34/SKI CENTERS and SE.35/SKI ROUTES LENGTH), and

high environmental and cultural resources profile (max-values in variables SE.38/PARKS, SE.42/BEACHES, SE.50/BEACHES LENGTH, SE.43/ANC MONUMENTS, SE.44/UNESCO MONUMENTS, and SE.49/CULTURAL RESOURCES). On the other hand, the prefecture that is negatively related (26) to the first component has rich geomorphological configuration (max-values in variables SE.7/COASTAL, SE.9/INLAND, SE.13/AREA, SE.22/TILLING LAND, SE.24/INLAND WATERS, SE.26/LAND AREA, SE.27/SEMI MOUNTAIN AREA), low seasonality profile (min-values in variables SE.3/RSI and SE.4/GINI), rich land transport background (max-values in variables SE.5/ROAD DENSITY, SE.6/ROAD LENGTH, and SE.10/RAIL). Due to the negative contribution of prefecture 26 (Viotia), this component has a poor demographic profile (min-values in variables SE.15/URB and SE.17/HUMAN CAPITAL), high income (max in SE.16/GDP), high secondary sector specialization (max in SE.19/B_{SEC}), low tourism profile (min-values in variables SE.39/HOTELS, SE.45/HOTEL BEDS, SE.46/ROOMS, SE.47/ROOMS BEDS, SE.48/ACCOMMODATION BEDS, SE.40/CAMPING, SE.36/RESTAURANTS, SE.29/MOUNT ACTIVITIES, SE.30/CLIMB FIELDS, SE.31/MOUNT ROUTES, SE.32/RAFTING POINTS, and SE.33/CANYONING POINTS), specialization in winter tourism activities (max in variables SE.34/SKI CENTERS and SE.35/SKI ROUTES LENGTH), high woodland parks capacity (max in variable SE.38/WOODLANDS PARKS), and high cultural resources profile (max-values in variables SE.44/UNESCO MONUMENTS and SE.49/CULTURAL RESOURCES).

Next, the prefectures that are positively related (2,5,7,9,15,17, and 26) to the second component (PC#2) have (on average) a northern location (max in variable SE.1 - LAT), high forest coverage (max in variable SE.23 - FORESTS), poor transport integration (min in variables SE.5/ROAD DENSITY and SE.11/PORTS), specialization in winter tourism activities (max in variables SE.34/SKI CENTERS and SE.35/SKI ROUTES LENGTH), and low cultural resources profile (min values in variables SE.43/ANC MONUMENTS and SE.49/CULTURAL RESOURCES). On the other hand, prefectures that are negatively related (4,16,21,30,32,44, and 47) to the second principal component have rich island configuration (max-values in variable SE.8 -ISLAND), high seasonality profiles (max-values in variables SE.3/RSI and SE.4/GINI), poor rail transport background (min-value in variable SE.10/RAIL), low income (min-value in variable SE.16/GDP), high primary (max-value in SE.18/A_{SEC}) and tertiary sector specialization (max-value in SE.20/C_{SEC}), and high rooms capacity (max values in SE.46/ROOMS and SE.47/ROOMS BEDS).

The prefectures that are positively related (14,16,18,and 28) to the third principal component (PC#3) have northern location (max in variable SE.1 - LAT), mainland geomorphology (max in variable SE.9/INLAND), low seasonality (min in variables SE.3/RSI and SE.4/GINI), poor transportation configuration (min recorded for all variables in this category), low income (min in SE.16/GDP), tourism specialization (min in SE.21/TOURISM GDP) and tourism resources background (min in variables SE.39/HOTELS, SE.45/HOTEL BEDS, SE.46/ROOMS, SE.47/ROOMS BEDS, SE.48/ACCOMMODATION BEDS, SE.40/CAMPING, SE.36/RESTAURANTS, SE.29/MOUNT ACTIVITIES, SE.30/CLIMB FIELDS, SE.31/MOUNT ROUTES, SE.32/RAFTING POINTS, and SE.33/CANYONING POINTS) Also, prefectures contributing positively (14,16,18,and 28) to this principal component have low beach environmental wealth (min in variables SE.41/BLUE FLAG BEACHES, SE.42/BEACHES, SE.50/BEACHES LENGTH, and SE.51/SAND BEACHES LENGTH) and cultural resources profile (min in variables SE.43/ANC MONUMENTS, SE.44/UNESCO MONUMENTS, and SE.49/CULTURAL RESOURCES). On the other hand, prefectures that are negatively related (1,6,8,11,12,24,31,36,42,46, and 48-50) to the third principal component (PC#3) have rich island configuration (max in SE.8/ISLAND), high seasonality (max in variables SE.3/RSI and SE.4/GINI), poor rail transport background (min in SE.10/RAIL), and low income (min in SE.16/GDP). However, they have high primary (max in SE.18/A_{SEC}) and tertiary sector specialization (max in SE.2/C_{SEC}), high tourism performance (max in variables SE.39/HOTELS, SE.45/HOTEL BEDS, SE.48/ACCOMMODATION BEDS, SE.40/CAMPING, SE.36/RESTAURANTS, SE.29/MOUNT ACTIVITIES, SE.31/MOUNT ROUTES), high beach quality (max in SE.41/BLUE FLAG BEACHES) and length (max in SE.51/SAND BEACHES LENGTH).

Next, the prefecture that is positively related (13) to the fourth principal component (PC#4) has a northern location (max in variable SE.1 - LAT), rich geomorphological configuration (max in variables SE.13/AREA, SE.22/TILLING LAND, SE.23/FORESTS, SE.24/INLAND WATERS, SE.26/LAND AREA, and SE.27/SEMI MOUNTAIN AREA), rich rail transport background (max in variables SE.10/RAIL and SE.12/AIRPORTS), high income (max in SE.16/GDP) and secondary sector specialization (max in SE.19/B_{SEC}). However, the prefecture of Kozani (13) has low tourism profile (min values in variables SE.39/HOTELS, SE.45/HOTEL BEDS, SE.46/ROOMS, SE.47/ROOMS BEDS, SE.48/ACCOMMODATION BEDS, SE.40/CAMPING, SE.36/RESTAURANTS, SE.30/CLIMB FIELDS, SE.32/RAFTING POINTS, SE.33/CANYONING POINTS, SE.34/SKI CENTERS, SE.35/SKI ROUTES LENGTH), low environmental wealth (min-values in all variables of the relevant category), and low cultural resources profile (min-values in all variables of the relevant category). On the other hand, the prefectures that are negatively related (3,9,10,19,20,23,27,28,33,34,37,40,41, and 51) to this principal component (PC#4) have rich mountainous configuration (max in variables SE.23/FORESTS and SE.28/MOUNTAIN AREA), high seasonality (max in variables SE.3/RSI and SE.4/GINI), rich airport configuration (max in SE.12/AIRPORTS), high primary (max in SE.18/A_{SEC}) and tertiary sector specialization (max in SE.20/C_{SEC}), high tourism performance (max in variables SE.39/HOTELS, SE.45/HOTEL BEDS, SE.46/ROOMS, SE.47/ROOMS BEDS, SE.48/ACCOMMODATION BEDS, SE.40/CAMPING, SE.36/RESTAURANTS, SE.29/MOUNT ACTIVITIES, SE.30/CLIMB FIELDS, SE.31/MOUNT ROUTES, SE.32/RAFTING POINTS, and SE.33/CANYONING POINTS), high environmental wealth (max in all variables of the relevant category), and ancient monuments resources profile (max in SE.43/ANC MONUMENTS).

The prefecture of Chania (51), Crete, which is positively related to the fifth principal component (PC#5) suggests a unique mixture of the island and mountainous geomorphology (max in variables SE.7/COASTAL, SE.8/ISLAND, SE.9/INLAND, and SE.28/MOUNTAIN AREA), it has high seasonality (max in variables SE.3/RSI and SE.4/GINI), rich port configuration (max in SE.11/PORTS), high tertiary sector (max in SE.20/CSEC), tourism specialization (max in SE.21/TOURISM GDP), and overall tourism performance (max in variables SE.39/HOTELS, SE.45/HOTEL BEDS, SE.46/ROOMS, SE.47/ROOMS BEDS, SE.48/ACCOMMODATION BEDS, SE.40/CAMPING, SE.36/RESTAURANTS, SE.29/MOUNT ACTIVITIES, SE.30/CLIMB FIELDS, SE.31/MOUNT ROUTES, and SE.33/CANYONING POINTS), high environmental wealth (max in all variables of the relevant category), high cultural resources profile (max in variables SE.43/ANC MONUMENTS and SE.49/CULTURAL RESOURCES). On the other hand, the prefectures that are negatively related (13,15,17,22,25,39,43, and 45) to this principal component (PC#4) are northern-located (max in SE.1/LAT), they have high seasonality (max in variables SE.3/RSI and SE.4/GINI), rich airport configuration (max in SE.12/AIRPORTS), low income (min in SE.16/GDP), high primary (max in SE.18/A_{SEC}) and tertiary sector specialization (max in SE.20/C_{SEC}), and rich hotel-infrastructures background (max in SE.39/HOTELS).

The prefectures that are negatively related (2,5,14,18, and 35) to the sixth principal component (PC#6) are northern located (max in SE.1/LAT), they have low seasonality (min in variables SE.3/RSI and SE.4/GINI), poor transport background (min in variables SE.5/ROAD DENSITY and SE.12/AIRPORTS), low income (min in SE.16/GDP), high tertiary sector specialization (max in SE.20/C_{SEC}), rich rafting activities (max in SE.32/RAFTING POINTS), high woodland parks capacity (max in SE.38/WOODLANDS PARKS) and low cultural resources profile (min in variables SE.44/UNESCO MONUMENTS and SE.49/CULTURAL RESOURCES). Finally, the prefectures that are negatively related (7,29, and 38) to the seventh principal component (PC#7) have poor geomorphological configuration (min in variables SE.8/ISLAND, SE.13/AREA, and SE.27/SEMI MOUNTAIN AREA), poor transport background (min in SE.5/ROAD DENSITY, SE.6/ROAD LENGTH, and SE.12/AIRPORTS), low income (min in SE.16/GDP) and industrial specialization (min in SE.19/B_{SEC}), high tertiary sector specialization (max in SE.20/C_{SEC}), and low tourism profile (min in SE.39/HOTELS, SE.32/RAFTING POINTS, SE.33/CANYONING POINTS, and SE.35/SKI ROUTES LENGTH). The previous

observations are summarized in Table 1, which configures the socioeconomic and geographical semiology of the principal components resulted from the previous PCA.

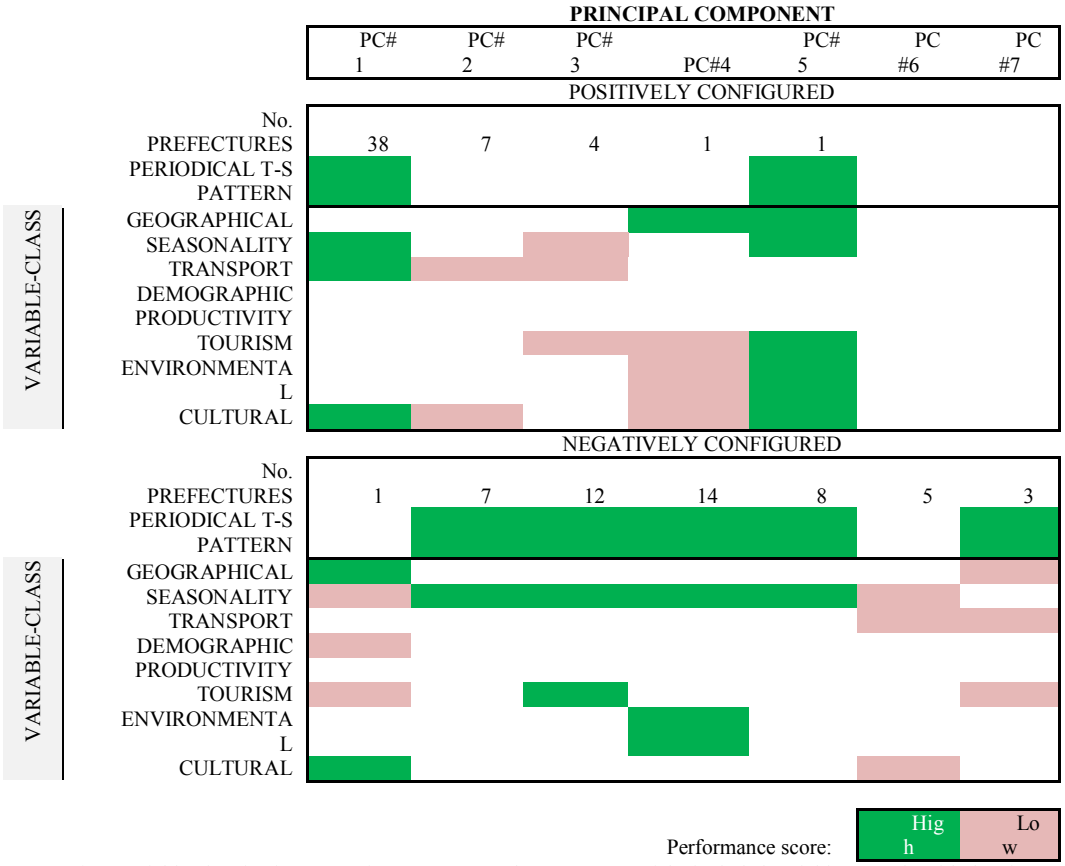
Table 1. The socioeconomic and geographical semiology of the principal components resulted from the PCA

Principal Component	SOCIOECONOMIC AND GEOGRAPHICAL SEMIOLOGY	
	POSITIVELY RELATED[(a)]	NEGATIVELY RELATED[(b)]
PC#1	Rich coastal configuration; High seasonality; High transport integration; High primary sector specialization; Specialization in winter tourism activities; High cultural resources profile.	Rich geomorphological configuration; Low seasonality; Rich land transport background; Poor demographic profile; High income; High secondary sector specialization; Low tourism profile; Specialization in winter tourism activities; High woodland parks capacity; High cultural resources profile.
PC#2	Northern location; High forest coverage, Poor transportation integration; Specialization in winter tourism activities; Low cultural resources profile.	Rich island configuration; High seasonality; Poor rail transport background; Low income; High primary and tertiary sector specialization; High rooms capacity.
PC#3	Northern location; Mainland geomorphology; Low seasonality; Poor transportation configuration; Low tourism resources profile; Low beach environmental wealth and cultural resources profile.	Rich island configuration; High seasonality; Poor rail transport background; Low income; High primary and tertiary sector specialization; High tourism performance; High beach quality and length.
PC#4	Northern location; Rich geomorphological configuration; Rich rail transport background; High income; High secondary sector specialization; Low tourism profile; Low environmental wealth; Low cultural resources profile.	Rich mountainous configuration; High seasonality; Rich airport configuration; High primary and tertiary sector specialization; High tourism performance; High environmental wealth; High ancient monuments resources profile.
PC#5	Mixture of island and mountainous geomorphology; High mountainous coverage; High seasonality; Rich port configuration; High tertiary sector and tourism specialization; High tourism performance; High environmental wealth; High cultural resources profile.	Northern located; High seasonality; Rich airport configuration; Low income; High primary and tertiary sector specialization; Rich hotel-infrastructures background.
PC#6	n/a[(c)]	Northern located; Low seasonality; Poor transport background; Low income; High tertiary sector specialization; Rich rafting activities; High woodland parks capacity; Low cultural resources profile.
PC#7	n/a	Poor geomorphological configuration; Poor transport background; Low income and industrial specialization; High tertiary sector specialization; Low tourism profile.

a. Defined by the max-value (+) filter of Fig.3
b. Defined by the m-value (+) filter of Fig.3
c. Not applicable

Further, to facilitate an overall assessment of the semiology of each principal component, we construct Table 2 summarizing the seasonal, geographical, and socioeconomic attributes of the principal components resulted from the PCA. In this table, a (high or low) performance score is given when over 50% of the included variables comply with the given performance. It can be noted that the discrete periodicity observed in line graphs of Fig.5 and Fig.6 is captured by the seasonal measures (RSI and Gini coefficient) used in the analysis. Further, Table 2 allows filtering the major aspects of the socioeconomic attributes describing the principal components.

Table 2. Summary of seasonal, geographical, and socioeconomic attributes(*) of the principal components resulted from the PCA



*. A variable-class is given a performance score when over 50% of the included variables comply with the given performance

Within this context, the first principal component (PC#1) is a component of high seasonality that mainly builds on transport integration (according to the high-performance observed in positively-configured variables) and on cultural characteristics (prefectures that are positively and negatively related to this component have high-performance observed in both positively-configured and negatively-configured variables). The PC#1 does not benefit from demographics and tourism activity (according to the low-performance observed in negatively-configured variables). The second principal component (PC#2) has low transport integration and cultural characteristics (according to the low-performance observed in positively-configured variables) and is competitive to seasonality (according to the high-performance observed in negatively-configured variables). The third principal component (PC#3) is described by low seasonality (according to the low-performance observed in positively-configured and to the high-performance observed negatively-configured variables) and transport integration (according to the low-performance observed in positively-configured variables), and it has low tourism performance (according to the low-performance observed in positively-configured and to the high-performance observed in positively-configured variables). The fourth principal component (PC#4) enjoys rich geomorphology (according to the high-performance observed in positively-configured variables), it is competitive to seasonality (according to the high-performance observed in negatively-configured variables), but it has low environmental (according to the low-performance observed in positively-configured and to the high-performance observed negatively-configured variables), cultural and tourism (according to the low-performance observed in positively-configured variables) performance. The fifth principal component (PC#5) is the privilege to enjoy rich geomorphology, environmental, and cultural welfare (according to the high-performance observed in positively-configured variables) and high tourism activation (according to the high-performance observed in positively-configured variables). The prefectures related to this component are also of high-seasonality (according to the high-performance observed in

positively-configured and the high-performance observed in negatively-configured variables). Finally, the sixth (PC#6) and seventh (PC#7) principal components are competitive to low transport integration (according to the low-performance observed in negatively-configured variables). Component PC#6 is also competitive to seasonality and to cultural features, whereas component PC#7 is competitive to geographical and tourism characteristics (according to the low-performance observed in respective negatively-configured variables). These competitive trends can interpret opposite dynamics in the configuration of the respective components.

4. Conclusions

This paper provided a methodological framework for classifying temporal patterns of tourism seasonality into regional groups. The proposed method built on principal component analysis (PCA) to classify (according to their variability) seasonal patterns of tourism demand of the Greek prefectures into regional groups, for the period 1998-2018,. The resulting groups (principal components) were examined in terms of their geographical and socioeconomic characteristics aiming to configure distinguishable seasonal profiles. The analysis resulted in seven principal components and it showed that they are mainly described by distinguishable socioeconomic characteristics. In particular, the first principal component relates its seasonality to high transport integration and cultural resources, whereas the profile of the second component is an inverse (i.e. low transport integration and cultural resources) to the first one. The third principal component relates its seasonality-pattern to low transport integration and tourism activation, whereas the fourth to geomorphological privileges but to low tourism, environmental, and cultural resources. The fifth component relates its seasonality to a privilege mixture of rich geomorphology, environmental, and cultural welfare, whereas the sixth and seventh components relate their seasonality to their competitive profile to transport integration and to cultural (PC#6) and tourism resources (PC#7). The overall analysis can propose a useful tool for tourism management and regional policy, in the context that it deals with complexity in three different dimensions; one temporal related to the seasonality of tourism demand, another related to the geographical diversity of seasonal demand, and a final related to the socioeconomic determinants driving the previous dimensions. The proposed method advances PCA to be used as a tool of regional classification based only on temporal data and incorporates a multivariate consideration based on the socioeconomic evaluation applied to the resulting principal components. The proposed methodology develops an integrated framework dealing with complexity describing socioeconomic research and particularly the seasonality in tourism.

Acknowledgments

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Appendix

Table A1. The seasonal variables participating in the analysis correspond to the 51 Greek prefectures

Variable Code	Prefecture	Var. Code	Prefecture	Var. Code	Prefecture	Var. Code	Prefecture
1	RODOPI	14	GREVENA	27	EVIA	40	LAKONIA
2	DRAMA	15	KASTORIA	28	EVRYTANIA	41	MESEENIA
3	EVROS	16	FLORINA	29	FOKIDA	42	ATTIKI
4	KAVALA	17	IOANNINA	30	KERKYRA	43	LESVOS
5	XANTHI	18	ARTA	31	ZAKEENTHOS	44	SAMOS
6	THESSALONIKI	19	THESPOTIA	32	KEFALONIA	45	CHIOS
7	HMATHIA	20	PREVEZA	33	LEFKADA	46	CYCLADES
8	KILKIS	21	LARISSA	34	ACHAIA	47	DODECANESE
9	PELLA	22	KARDITSA	35	AITOLOAKARNANIA	48	HERAKLION
10	PIERIA	23	MAGNESIA	36	HELEIA	49	LASITHI
11	SERRES	24	TRIKALA	37	ARKADIA	50	RETHYMNO
12	CHALKIDIKI	25	FTHIOTIDA	38	ARGOLIDA	51	CHANIA
13	KOZANI	26	VIOTIA	39	KORINTHIA		

Table A2. The socioeconomic and geographical variables participating in the analysis

Code	Variable's Symbol	Description	Source
SE.1	LAT	The latitude of the geographical center of the region.	(Google, 2020)
SE.2	LONG	The latitude of the geographical center of the region.	(Google, 2020)
SE.3	RSI	The Relative Seasonal Index of each prefecture computed according to relation (2)	(own elaboration)
SE.4	GINI	The Gini coefficient of each prefecture computed according to relation (2)	(own elaboration)
SE.5	ROAD DENSITY	The road density of each prefecture, defined by the fraction road length/area (km/km^2).	(Tsiotas, 2017a)
SE.6	ROAD LENGTH	The road length of each prefecture (measured in km).	(Tsiotas, 2017a)
SE.7	COASTAL	Indicator variable, returning one (1) to coastal regions and zeros (0) elsewhere.	(ELSTAT, 2020)
SE.8	ISLAND	Indicator variable, returning one (1) to island regions and zeros (0) elsewhere.	(ELSTAT, 2020)
SE.9	INLAND	Indicator variable, returning one (1) to inland (mainland) regions and zeros (0) elsewhere.	(ELSTAT, 2020)
SE.10	RAIL	The length of the rail network included in each prefecture.	(Tsiotas, 2017b)
SE.11	PORTS	The number of ports included in each prefecture.	(ELSTAT, 2020)
SE.12	AIRPORTS	The number of airports included in each prefecture.	(ELSTAT, 2020)
SE.13	AREA	The geographical area of each prefecture (km^2).	(ELSTAT, 2020)
SE.14	POP	The population of each prefecture, according to the 2011 national census.	(ELSTAT, 2020b)
SE.15	URB	Level of urbanization of each prefecture, defined by the proportion of the capital city's population to the total population of the prefecture.	(ELSTAT, 2020b)
SE.16	GDP	The Gross Domestic Product of each prefecture.	(ELSTAT, 2020b)
SE.17	Human Capital	Indicator defined by the proportion of labor force (between 18 and 65 years old) to the total population of the prefecture.	(Polyzos, 2019)
SE.18	A_{SEC}	The prefecture's specialization to the primary sector (% of the GDP).	(ELSTAT, 2020c)
SE.19	B_{SEC}	The prefecture's specialization to the secondary sector (% of the GDP).	(ELSTAT, 2020c)
SE.20	C_{SEC}	The prefecture's specialization to the tertiary sector (% of the GDP).	(ELSTAT, 2020c)
SE.21	TOURISM GDP	The prefecture's specialization to tourism sector (% of the GDP).	(ELSTAT, 2020c)
SE.22	TILLING LAND	The proportion of the tilling land's area to the total area of the prefecture.	(ELSTAT, 2020d)
SE.23	FORESTS	The proportion of the forests' area to the total area of the prefecture.	(ELSTAT, 2020d)
SE.24	INLAND WATERS	The proportion of the inland waters' area to the total area of the prefecture.	(ELSTAT, 2020d)
SE.25	INDUSTRIAL AREA	The proportion of the industrial areas to the total area of the prefecture.	(ELSTAT, 2020d)
SE.26	LAND AREA	The proportion of the land (non-mountainous) areas to the total area of the prefecture.	(ELSTAT, 2020d)
SE.27	SEMI MOUNTAIN AREA	The proportion of the semi-mountain areas to the total area of the prefecture.	(ELSTAT, 2020d)
SE.28	MOUNTAIN AREA	The proportion of the mountain areas to the total area of the prefecture.	(ELSTAT, 2020d)
SE.29	MOUNT ACTIVITIES	The number of mount activities (walking paths, mount sports, climb fields, etc.) in each prefecture.	(ELSTAT, 2020d)

Code	Variable's Symbol	Description	Source
SE.30	CLIMB FIELDS	The number of climb fields in each prefecture.	(ELSTAT, 2020d)
SE.31	MOUNT ROUTES	The number of mountain routes in each prefecture.	(ELSTAT, 2020d)
SE.32	RAFTING POINTS	The number of rafting points in each prefecture.	(ELSTAT, 2020d)
SE.33	CANYONING POINTS	The number of canyoning points in each prefecture.	(ELSTAT, 2020d)
SE.34	SKI CENTERS	The number ski centers in each prefecture.	(ELSTAT, 2020d)
SE.35	SKI ROUTES LENGTH	The length of the ski routes in each prefecture (measured in km).	(ELSTAT, 2020d)
SE.36	RESTAURANTS	The number of restaurants in each prefecture.	(ELSTAT, 2020d)
SE.37	NATURA AREA	The geographical area of Natura parks (areas) in each prefecture.	(ELSTAT, 2020d)
SE.38	WOODLANDS PARKS	The number of woodland parks in each prefecture.	(ELSTAT, 2020d)
SE.39	HOTELS	The number of hotels in each prefecture.	(ELSTAT, 2020c)
SE.40	CAMPING	The number of camping sites in each prefecture.	(ELSTAT, 2020c)
SE.41	BLUE FLAG	The number of beaches granted a blue flag in each prefecture.	(ELSTAT, 2020c)
SE.42	BEACHES	The number organized beaches in each prefecture.	(ELSTAT, 2020c)
SE.43	ANC MONUMENTS	The number ancient monuments sites in each prefecture.	(ELSTAT, 2020c)
SE.44	UNESCO MONUMENTS	The number of UNESCO monuments sites in each prefecture.	(ELSTAT, 2020c)
SE.45	HOTEL BEDS	The number of hotel beds (bed capacity) in each prefecture.	(ELSTAT, 2020c)
SE.46	ROOMS	The number of rooms to let (non-hotel accommodation) in each prefecture.	(ELSTAT, 2020c)
SE.47	ROOMS BEDS	The number of rooms' beds (non-hotel accommodation capacity) in each prefecture.	(ELSTAT, 2020c)
SE.48	ACCOMODATION BEDS	The number of other type of accommodation beds in each prefecture.	(ELSTAT, 2020c)
SE.49	CULTURAL RESOURCES	The number of cultural resources sites in each prefecture.	(ELSTAT, 2020d)
SE.50	BEACHES LENGTH	The length of beaches in each prefecture.	(ELSTAT, 2020d)
SE.51	SAND BEACHES LENGTH	The length of sand beaches in each prefecture.	(ELSTAT, 2020d)

*. All variables have length 51, including scores corresponding to the Greek prefectures

Table A3. "Minimax" comparative table showing the principal components' performance, according to the available socioeconomic and geographical attributes

		PRINCIPAL COMPONENTS											
		POSITIVELY DEFINED[a]					NEGATIVELY DEFINED[b]						
Code	Variable	PC#1	PC#2	PC#3	PC#4	PC#5	PC#1	PC#2	PC#3	PC#4	PC#5	PC#6	PC#7
						GEOGRAPHICAL							
SE.1	LAT		MAX	MAX	MAX	MIN	MIN				MAX	MAX	
SE.2	LONG			MIN	MIN	MAX							
SE.7	COASTAL	MAX	MIN	MIN	MIN	MAX	MAX				MIN	MIN	
SE.8	ISLAND		MIN	MIN	MIN	MAX	MIN	MAX	MAX			MIN	MIN
SE.9	INLAND		MAX	MAX	MIN		MAX	MIN	MIN	MIN			
SE.13	AREA	MIN		MIN	MAX	MIN	MAX						MIN
SE.22	TILLING LAND				MAX	MIN	MAX			MIN			
SE.23	FORESTS		MAX		MAX	MIN	MIN			MAX			
SE.24	INLAND WATERS				MAX	MIN	MAX			MIN			
SE.26	LAND AREA	MAX		MIN	MAX	MIN	MAX			MIN	MIN	MIN	
SE.27	SEMI MOUNTAIN AREA		MIN	MIN	MAX	MIN	MAX	MIN		MIN			MIN
SE.28	MOUNTAIN AREA	MIN				MAX	MIN			MAX		MAX	
						SEASONALITY							
SE.3	RSI	MAX		MIN	MIN	MAX	MIN	MAX	MAX	MAX	MAX	MIN	
SE.4	GINI	MAX		MIN	MIN	MAX	MIN	MAX	MAX	MAX	MAX	MIN	
						TRANSPORT							
SE.5	ROAD DENSITY	MAX	MIN	MIN	MIN	MAX	MAX					MIN	MIN
SE.6	ROAD LENGTH	MAX		MIN		MAX	MAX						MIN
SE.10	RAIL				MAX	MIN	MAX	MIN	MIN	MIN	MIN		
SE.11	PORTS		MIN	MIN	MIN	MAX							
SE.12	AIRPORTS	MAX		MIN	MAX	MAX	MIN			MAX	MAX	MIN	MIN
						DEMOGRAPHIC							
SE.14	POP			MIN		MAX							
SE.15	URB	MAX		MAX	MIN	MAX	MIN	MAX					
SE.17	HUMAN CAPITAL	MAX		MIN		MAX	MIN			MAX	MAX		
						PRODUCTIVITY							
SE.16	GDP			MIN	MAX		MAX	MIN		MIN	MIN	MIN	MIN
SE.18	A_{SEC}	MAX			MIN	MIN	MIN	MAX	MAX	MAX	MAX	MAX	
SE.19	B_{SEC}				MAX	MIN	MAX	MIN	MIN	MIN	MIN	MIN	MIN
SE.20	C_{SEC}				MIN	MAX	MIN	MAX	MAX	MAX	MAX	MAX	MAX
SE.21	TOURISM GDP			MIN		MAX	MIN			MAX			
SE.25	INDUSTRIAL AREA	MIN		MIN	MAX	MIN	MAX						MIN

Code	Variable	PRINCIPAL COMPONENTS											
		POSITIVELY DEFINED[a]					NEGATIVELY DEFINED[b]						
		PC#1	PC#2	PC#3	PC#4	PC#5	PC#1	PC#2	PC#3	PC#4	PC#5	PC#6	PC#7
	TOURISM												
SE.39	HOTELS		MIN	MIN	MIN	MAX	MIN		MAX	MAX	MAX		MIN
SE.45	HOTEL BEDS		MIN	MIN	MIN	MAX	MIN		MAX	MAX		MIN	
SE.46	ROOMS		MIN	MIN	MIN	MAX	MIN	MAX		MAX	MIN	MIN	
SE.47	ROOMS BEDS		MIN	MIN	MIN	MAX	MIN	MAX		MAX	MIN	MIN	
SE.48	ACCOMODATION BEDS		MIN	MIN	MIN	MAX	MIN		MAX	MAX	MIN	MIN	
SE.40	CAMPING	MAX	MIN	MIN	MIN	MAX	MIN		MAX	MAX	MIN	MIN	
SE.36	RESTAURANTS		MIN	MIN	MIN	MAX	MIN		MAX	MAX		MIN	
SE.29	MOUNT ACTIVITIES	MIN		MIN		MAX	MIN		MAX	MAX			
SE.30	CLIMB FIELDS				MIN	MAX							
SE.31	MOUNT ROUTES	MIN		MIN		MAX	MIN		MAX	MAX			
SE.32	RAFTING POINTS	MAX			MIN	MIN	MIN	MIN		MAX		MAX	MIN
SE.33	CANYONING POINTS		MIN	MIN	MIN	MAX	MIN	MIN		MAX			MIN
SE.34	SKI CENTERS	MAX	MAX		MIN	MIN	MAX	MIN	MIN	MIN			
SE.35	SKI ROUTES LENGTH	MAX	MAX		MIN	MIN	MAX	MIN	MIN	MIN	MIN	MIN	MIN
	ENVIRONMENTAL												
SE.37	NATURA AREA				MIN	MAX	MIN			MAX			
SE.38	WOODLANDS PARKS	MAX	MAX		MIN	MAX	MAX					MAX	MIN
SE.41	BLUE FLAG BEACHES		MIN	MIN	MIN	MAX	MIN		MAX	MAX		MIN	
SE.42	BEACHES	MAX	MIN	MIN	MIN	MAX	MIN			MAX			
SE.50	BEACHES LENGTH	MAX	MIN	MIN	MIN								
SE.51	SAND BEACHES LENGTH		MIN	MIN	MIN	MAX	MIN	MAX	MAX	MAX			
	CULTURAL												
SE.43	ANC MONUMENTS	MAX	MIN	MIN	MIN	MAX	MIN			MAX			
SE.44	UNESCO MONUMENTS	MAX		MIN	MIN	MIN	MAX		MIN	MIN	MIN	MIN	
SE.49	CULTURAL RESOURCES	MAX	MIN	MIN	MIN	MAX	MAX					MIN	

a. Defined by the max-value (+) filter of Fig.3 b. Defined by the m-value (+) filter of Fig.3

EFFECTS ON EMPIRICAL ECONOMIC PERFORMANCE IN PROVINCIAL CLUSTER OF THE SOUTHERN SHORE OF THE GULF OF THAILAND

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Abstract

The aim of this paper are analyze the role of spatial concentration of economic activities and estimate the effect of provincial cluster in the Southern shore of the Gulf of Thailand on economic growth. Panel data from the years 1995-2015 are data that collected for all 4 provinces in provincial cluster. The result show the value of LQ that more than 1 reveal in agricultural ($LQ_{Agricultural}$) and industry sector ($LQ_{Industry}$). While, the analyzed the effect of spatial concentration of economic activities in provincial cluster present agricultural sector ($LQ_{Industry}$) and service sector ($LQ_{Service}$) variables significant on economic performance. The case of hotels and restaurants (LQ_{Hotel}) which is sub economic activities of service sector be significant on economic growth. These results presence the role of externalities as the factor component in the operation of the economic activities in provincial cluster of the Southern shore of the Gulf of Thailand.

Keywords: Agglomeration economies, Spatial concentration, Provincial cluster
JEL classification: R11, R12, R58

1. Introduction

Thailand has focused on spatial development as played an important part in national development plans that started under the Third National Economic and Social Development Plan (1972–1976). The ninth plan (2002–2006), focused on a holistic approach and the goal of the plans is decentralisation, to encourage a fair distribution of economic power and resource allocation. On 22 July 2002, the Cabinet approved the guidelines for administration in the strategic provinces. Therefore, a policy maker proposed the idea of provincial cluster that is an approach towards implementation for public administration. The declaration of the Regulation of the Prime Minister's Office (2002) Article 4 establishes definitions of provincial cluster with the means for provinces and territories to support the economic and social development of the country and its relationship to economic production, trade, and investment, touching upon the specific problems in areas requiring cooperation between the provinces.

The important characteristics in the economic context to identify cluster mostly focus on three aspects the proximity, the linkage, relationship, or network and the externalities of economic activities or industry. The co-existence of economic activities in the area will take advantage from externalities such as access to skilled labor, labor pooling, low supply costs and etc.; known as the agglomeration effect. Cluster in the context of spatial proximity of economic activity can be described as specialization, diversity, and Urbanisation economies. New Economic Geography (NEG) also demonstrates the role of micro foundation as a factors that driving force by agglomeration effect on cluster. Endogenous Growth Theory support to explain the role of economies of scale by externalities influencing and effect on economic performance.

The Office of the National Economic and Social Development Board (NESD) prepared and supported the strategic framework for provincial cluster and declared group of provinces into 18 provincial clusters. Southern provinces of Thailand defined into three groups. Group 1 is the Southern shore of the Gulf of Thailand consisting of Chumphon, Surat Thani, Nakhon Si Thammarat, and Phatthalung. Group 2 is the Southern shore of Andaman contains Ranong,

Phang Nga, Phuket, Krabi, and Trang. Group 3 is the Southern border compose of Songkhla, Satun, Pattani, Yala, and Narathiwat. This paper emphasize only group 1.

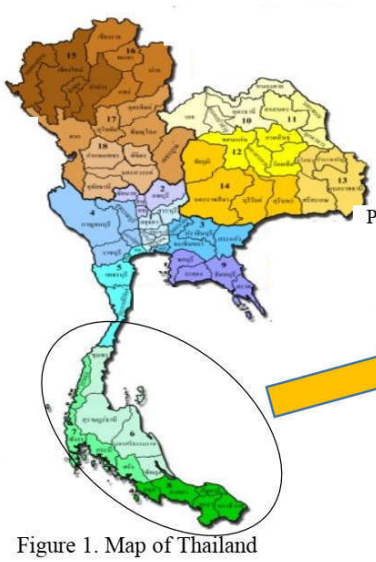

Figure 1. Map of Thailand

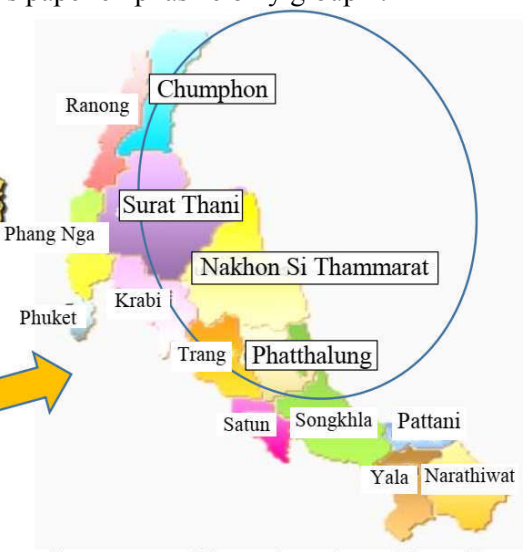

Figure 2. Map of the Southern Shore of the Gulf of Thailand

Spatial concentration of economic activities as the concept of regional economic analysis which present the role of externalities has been an interesting phenomenon to analyze and may give the impact for local, regional and national economic development level. Thailand, there are lack of studies about the effect of spatial concentration on local economies growth especially in form of provincial cluster. Therefore, the objective of this paper is to analyze the effect of spatial concentration of economic activities in provincial cluster of the Southern shore of the Gulf of Thailand.

As mention above, this paper emphasize to analyze the effect of spatial concentration of economic activities on local economy in provincial cluster. Associated with the objective, this paper have to answer the main question as "Do spatial concentrations on economic activities give the significant effects to the local economic growth in provincial cluster of the Southern Shore of the Gulf of Thailand? The reason for this question is that economic activities concentrations will suggest to policy maker to improve economic sector with program of policy for example to increase knowledge spillover of labor, increase demand for labors and industry productions which finally will lead provincial cluster and each province economic to enhance.

2. Literature Review

2.1. Concept of cluster and contributes of cluster on economic development

Term of cluster is often used similar in literature, such as industrial district, industry cluster, agglomeration economies, and others. The academic term industrial cluster with popularity and favor proposed by Porter (1990) that defined industrial cluster in terms of a concentrated area with interconnections between business units and institutions linked by commodities and complements as. This term imply grouping of economic activities associated with linkage to each other. The wide range of ideas and definition from academic persons captured the attention and is applied in different contexts of terminology to expand and clarify the different meanings of cluster such as Marshall (1890), Krugman (1991), Saxenian (1994), Van den Berg, Braun and van Winden (2001), Rosenfeld (2005), Cortright (2006), and Glaeser and Gottlieb (2009). Generally, an idea depends on different terminology to expand and clarify the different meanings and also focus on objectives, methodology, and unit of analysis in each studies. Nonetheless, literature and empirical research capture the broad definition of cluster to provide three key consistent characteristics comprising proximity, linkage, and externalities. Kiatkajon, Sumalee, and Supachart (2013a) investigated the concept of cluster and proposed indicators based on three major concepts: spatial, functional, and micro-foundational. This paper applies spatial concepts and considers the role of spatial concentration which location quotient (LQ) as variables to use for analysis.

Cluster contributes to the regional economy by understanding the effect of externalities to benefit economic activity in an area as a key driver of economic growth. Externalities can occur within or between industries. Meade (1952), Scitovsky (1954), and Stewart and Ghani (1991) explained externalities in two forms: real (technology) and pecuniary externalities. Real externalities involve the firm's environment that Meade (1952) defined such real externalities as property production functions that also consider the output from other firms. Stewart and Ghani (1991) describe real externalities as push factors relating to economic growth which are changing attitudes and motivation; human capital; and changing technological and market knowledge and division of labor as part of the mechanism of production implies specialist economies that relate to the size of the market, thus providing accessibility to a sufficiently large demand for localised economic agents. Pecuniary externalities occur when economic activities interact with other trades that interactions leading to diffusion of knowledge play a role in technology change within or between agents, and encourage greater local linkage and specialisation. A particular firm can then take advantage of the location and internal economies that imply an increasing return to scale and playing an important role in production and an increase in productivity in space.

The effects of spatial concentration of industry activity and their advantages to regional growth have been studied over the past years Such as Bernat, G.A.Jr (1999), Gabe, T. (2004) Mitra and Sato (2006), Carroll, M. C., N. Reid, and B. W. Smith. (2008) and Meliciani, V., and M. Savona. (2014). These working studied and others present the effects of concentration or cluster or others that similar as variable on growth indicators such as firm location, employment growth and earnings. These study also verifies agglomeration effects are in terms of higher growth indicator and may conclude the various mechanisms in terms of which agglomeration effects into higher economic growth.

2.2. Spatial Concentration as Agglomeration economies

Spatial concentration is defined as a group of economic activities spatially in the certain location and they have a highly interdependent in trade activities. The decision for industries to form cluster together in one place actually is driven by 1) the availability of resource endowments, 2) the existence of input suppliers and 3) the existence of output buyers. Marshall (1920) who had proposed the source of spatial concentration on economic activities and agglomeration economies argued that firms within the same industry continue to cluster if they can achieve the increasing return to scale through that cluster. This economic of scale can be achieved through knowledge spillovers, localization and a local skilled labor pooling.

Agglomeration economies can be classify into three types which was first employed by Ohlin (1933) and Hoover (1937) as: 1) Internal return to scale gained because the large level of quantity of capital and labor force to be located in the similar place 2) Localization economies can be achieved through the agglomeration of firms within the same sector that are located close to their customer firms and also benefit from specialist non- traded local service and a local skilled labor pool. 3) Urbanisation economies may also achieved from the agglomeration of firms and various activities across different sector. This term of knowledge spillover refers to the spread of information about technology or one firm to another. At this point, Krugman (1991) defined that spatial concentration which is a very important aspect to industry location decision. His view emphasized the interaction among economic scale, transportation costs, and local demand on spatial concentration that decision to enhance economic scale and industries tend to concentrate and serve the market from certain area.

These the reasons to cluster above just mentioned positive externalities that can increase the functions and the size of the cluster. However clustering can generate both positive and negative externalities. The negative externalities can be generated from the increased costs due to increased competition among firms in cluster for getting the additional land and labor and increased costs associated with congestion.

2.3. Economic Growth in term of Agglomeration

The Solow Model (1957), as with most fundamental models, emphasized on the role of saving and investment as a source of economic growth and proposes the description of economic growth into two assumptions: perfect competition, and economies of scale. The

model of growth starts with an aggregate production Cobb-Douglass function that formed as follows:

$$Y_{it} = K_{it}^{\alpha} L_{it}^{\beta} \qquad 0 < \alpha, \beta < 1 \qquad \text{----- (A1)}$$

Where Y_{it} is denotes as total product of province *i* at time *t*. K_{it} and L_{it} are the capital and labor of province *i* at time *t*. α and β are share of capital and labor of production.

Solow (1957) shows that the growth of output is due to capital accumulation and technological progress, but he did not give more explanation about this function. In this model, technology is a key factor variable determines total output and productivity as a measure of economic growth. Therefore, the limitation of the Solow Model is the rate of technological progress in the process of economic growth, which is not a significant explanatory variable in the model.

Romer (1986), Lucas (1988), Grossman and Helpman (1991) proposed a new theory of economic growth known as a New Growth Theory or Endogenous Growth Theory.

$$Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{\beta} \quad ; \; 0 < \alpha, \beta < 1 \qquad \text{----- (A2)}$$

Where A_{it} is is the level of technology of province *i* at time *t*

According of them, they proposed the importance of knowledge as an endogenous determinant of economic growth and economic growth depends on productivity that depends on the level of technological progress. If the factors of production become more efficient, then the level of technological progress is high and productivity will increase then the growth rate of output will also increase. This theory introduced variables such as education, human capital, research, development and etc. These variables are used to describe changes in technology, innovation, and learning as the positive external impact factors that affecting economic growth. Therefore, the role of positive external effects is important for the implementation of public policies.

Endogenous growth model has incorporated human capital as a source of skills and knowledge that affect the economic productivity. This has been the main motivation companies and government gave the huge expenses on education and research and development (R&D) purposing at upgrading the level of domestic knowledge and improve the efficiency of factor inputs. Thus, these factors play as the role of externalities that affecting economic growth. Therefore, this model can be used to determine the externalities such as knowledge spillover of industrial cluster.

The theory of Solow and the New Growth Model are essential to be able to explain agglomeration as the cluster of economic activity in the area. Provincial cluster can explain the role of economies of scale from an externalities perspective. Following the work of Romer (1986) and Lucas (1988), the role of externalities have been associated with local economic growth. Therefore, this paper expect provincial cluster can take advantage of externalities and analyse the results of provincial cluster in Southern Thailand affecting economic development.

3. Methodology and Estimation Model

This research analyze some data quantitatively and qualitatively methods to determine the effect of spatial concentration of economic activities on economic growth.

3.1. Data

For this purpose, we need to observe labor, capital, and output data related to economic activities. Therefore, panel data from the years 1995-2015 are data were collection for all 4 provinces in provincial cluster in the Southern Shore of the Gulf of Thailand. We use secondary data for these models consists of gross provincial product (GPP) (obtained from 16 major sectors of economic activity), capital, labor, in each province according to the office of the National Economic and Social Development (NESD) and National Statistical Office (NSO) and LQ (which computed as concentration variable). This research emphasize only group 1 and focus on 3 sectors which are: 1) agricultural 2) industry and 3) service sector.

3.2. Concentration Index

Spatial concentration in this paper is represented by location quotients index (LQ) which is one of the most-often used measurement of concentration and specialization of industry. The LQ can examine the relative concentration of industry employment in a particular area relative to another larger or base area. Location Quotient (LQ) is commonly used to assess industry concentration by dividing the employment shares of each industry in a particular region to employment share of the same industry based on a larger reference region such as a state or nation.

The value of LQ greater than one for a particular industry in an area indicates that the percentage of people employed in that industry in the area is greater than that for the base area. This study suggests the industry may be a "basic" industry that is important to the economic base of the area. Location Quotient index can be computed as follows:

$LQ = S_i / \chi_i$ or $LQ = (E_{ir} / E_r)/(E_{iN} / E_N)$

Where: S_i = share of sector i in province; χ_i = share of sector i in aggregate level

E_{ir} = sector i in province r; E_r = total in province r

E_{iN} = sector i in reference area (aggregate level); E_N = total in the aggregate of provincial cluster level

Quantitative method is used to measure the spatial concentration index of economic activities in each province by using location quotient (LQ) formula. The LQ index is also used as an independent variable to determine the effect of spatial concentration on regional economic in the econometric model with panel data.

3.3. Model Specification

Specification indicators are needed in order to determine which variables are important in explaining the model that we will construct. Since the objective of this study is to analyze the effect of spatial concentration on local economy growth so we only focus on the spatial concentration variable and other variables which affect to the economic activities directly. Externalities are the key component measurement in the operation of the economic activities. In order to examine the effect of spatial concentration on local economic growth, we applied the Cobb Douglass production function that we add concentration index into the Cobb-Douglas production function. Therefore, this paper decide by using 5 models to examine the effect of spatial concentration on local economic growth, consisting of:

Model 1: The production Function model is a Cobb-Douglas model without spatial concentration index (LQ).

$$Y_{it} = K_{it}^{\alpha} L_{it}^{\beta} \quad ; \ 0 < \alpha, \beta < 1 \qquad \text{----- (1)}$$

Model 2: The production function model is a Cobb-Douglas model with spatial concentration index ($LQ_{Agri,t}$) of agricultural sector province i at time t.

$$Y_{it} = K_{it}^{\alpha} L_{it}^{\beta} LQ_{Agri,t}^{\gamma} \quad ; \ 0 < \alpha, \beta, \gamma < 1 \qquad \text{----- (2)}$$

Model 3: the production function model, is a Cobb-Douglas model with spatial concentration index ($LQ_{Indus,t}$) of industrial sector province i at time t.

$$Y_{it} = K_{it}^{\alpha} L_{it}^{\beta} LQ_{Indus,t}^{\gamma} \quad ; \ 0 < \alpha, \beta, \gamma < 1 \qquad \text{----- (3)}$$

Model 4: The production function model, is a Cobb-Douglas model with spatial concentration index ($LQ_{Service,t}$) of service sector province i at time t.

$$Y_{it} = K_{it}^{\alpha} L_{it}^{\beta} LQ_{Service,t}^{\gamma} \quad ; \ 0 < \alpha, \beta, \gamma < 1 \qquad \text{----- (4)}$$

Model 5: The production function model, is a Cobb-Douglas model with spatial concentration index of agricultural ($LQ_{Agri,t}$), industrial ($LQ_{Indus,t}$) and service ($LQ_{Service,t}$) sector.

$$Y_{it} = K_{it}^{\alpha} L_{it}^{\beta} LQ_{Agri,t}^{\gamma} LQ_{Indus,t}^{\delta} LQ_{Service,t}^{\theta} \quad ; \ 0 < \alpha, \beta, \gamma, \delta, \theta < 1 \qquad \text{----- (5)}$$

4. Results

4.1. Spatial concentration of each province and provincial cluster

In Table 1, we present the quantitative results of calculation average GPP and spatial concentration (LQ) for the different economic sector across the provincial cluster. The value of average GPP show Service and trade sector that highest while, average LQ that more than one reveal in agricultural and industry sector.

Table 1. GPP and Location Quotient (LQ) in each provinces and provincial cluster

Province / Economic Sector	Average GPP 2006-2015	Δ	Average LQ 2006-2015	Δ
Chumphon				
- Agricultural	29,629.82	62.53	1.39	14.17
- Industry	9,578.71	78.97	0.88	19.72
- Service and Trade	23,000.87	59.72	0.95	-6.67
Aggregate	62,209.39			
GPP per Capita	131,534.51			
Population (1,000)	472.22			
Surattani				
- Agricultural	53,573.48	29.40	0.99	-5.62
- Industry	30,524.00	21.58	1.10	-4.91
- Service and Trade	71,346.87	101.79	1.19	8.74
Aggregate	155,444.35			
GPP per Capita	153,752.64			
Population (1,000)	1,007.47			
Nakon Si Thammarat				
- Agricultural	50,074.68	10.74	1.09	0.98
- Industry	29,402.84	26.21	1.26	10.48
- Service and Trade	53,266.28	40.72	1.04	-4.17
Aggregate	132,743.80			
GPP per Capita	89,633.41			
Population (1,000)	1,481.61			
Phattalung				
- Agricultural	12,363.89	-13.54	1.11	11.93
- Industry	4,720.26	38.75	0.85	34.38
- Service and Trade	14,725.90	31.32	1.20	-1.82
Aggregate	31,810.04			
GPP per Capita	64,786.90			
Population (1,000)	491.22			
Provincial cluster				
- Agricultural	145,641.86	24.23	1.22	11.43
- Industry	74,225.81	30.34	1.21	2.68
- Service and Trade	162,339.91	67.64	0.98	-4.40
Aggregate	382,207.58			
GPP per Capita	110,582.82			
Population (1,000)	3,452.52			

Source: Calculation**; Remark:** Δ: Change between period 2006 - 2015

4.2. Effect of spatial concentration on economic growth

Table 2 shows estimate of each provincial cluster on economic growth in the equation (1) – (5). All of model appropriate with fixed effect. This result presents all model that the estimated coefficient is significant in the capital and labor, implying that capital and labor make an important contribution to economic growth in the Southern shore of the Gulf of Thailand. In the case of model (3) and (4) where examine the effect of spatial concentration (LQ) on economic growth of provincial cluster, there are $LQ_{Industry}$ and $LQ_{Service}$ variables significant on economic performance. Furthermore, the case of model (5) shows only $LQ_{Service}$ variable effect in economic growth. The result presence the role of externalities as the key component measurement in the operation of the economic activities especially service sector. However, the sign of coefficient of $LQ_{Service}$ is negative and have to remarkable to consider and explore the cause as mentioned.

Table 2. The result of effect of spatial concentration on economic growth

Variable / Model	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	- 5.499 * (0.000)	- 5.606 * (0.000)	- 5.791 * (0.000)	- 5.011 * (0.000)	- 5.268 * (0.000)
K	0.908 * (0.000)	0.901 * (0.000)	0.898 * (0.000)	0.883 * (0.000)	0.863 * (0.000)
L	0.424 * (0.001)	0.439 * (0.001)	0.458 * (0.001)	0.410 * (0.001)	0.449 * (0.000)
$LQ_{Agricultural}$		0.053 (0.401)			0.071 (0.382)
$LQ_{Industry}$			0.110 *** (0.089)		0.064 (0.431)
$LQ_{Service}$				- 0.368 * (0.004)	- 0.412 * (0.003)
Adjust-R^2	0.9708	0.9705	0.9664	0.9731	0.9696
F-statistic (Prob.)	381.13 (0.000)	917.60 (0.000)	944.85 (0.000)	1015.75 (0.000)	626.90 (0.000)
Hausman's Test Chi2 (Prob.)	10.63 * (0.0049)	11.05 * (0.0115)	13.49 * (0.0037)	18.03 * (0.0004)	21.76 * (0.0006)

Source: Calculation; **Remark**: *, ** and *** Significant at 1%, 5% and 10% respectively

4.3. Case study: Some Empirical service sector

As mentioned above, we investigate the effect of 3 sub economic activities of service sector which are 1) hotel and restaurant 2) Community service and 3) private household. The Production function model is a Cobb-Douglas model with spatial concentration index ($LQ_{i,t}$) that present with model 6 – 8 at table 3.

$$Y_{it} = K_{it}^{\alpha} L_{it}^{\beta} LQ_{i,t}^{\gamma} \quad ; \ 0 < \alpha, \beta, \gamma < 1 \qquad \text{----- (6)}$$

Where $LQ_{i,t}$ is concentration index (LQ) of 3 sub economic activities of service sector of province i at time t which compose of: Hotels and Restaurants ($LQ_{Hotel,t}$), Other Community, Social and Personal Service Activities ($LQ_{Community,t}$) and Private Households with Employed Persons ($LQ_{Private,t}$).

Table 3 presents the estimated coefficient to be significant in the capital and labor especially concentration of hotels and restaurants ($LQ_{Hotel,t}$) that was only sub economic activities of service sector, and sign of $LQ_{Hotel,t}$ is positive. The result implies the hotels and restaurants sector make contribution to economic growth in the Southern shore of the Gulf of Thailand.

Table 3. The result of effect of spatial concentration on economic growth

Variable / Model	Model 6	Model 7	Model 8
Constant	- 5.890 * (0.000)	- 5.812 * (0.000)	- 5.481 * (0.000)
K	0.946 * (0.000)	0.904 * (0.000)	0.908 * (0.000)
L	0.425 * (0.001)	0.453 * (0.001)	0.423 * (0.002)
LQ_{hotel}	0.058 ** (0.030)		
$LQ_{Community}$		- 0.083 (0.457)	
$LQ_{Private}$			- 0.005 (0.802)
Adjust-R^2	0.9705	0.9727	0.9726
F-statistic (Prob.)	917.60 (0.000)	915.75 (0.00)	909.72 (0.00)
Hausman's Test Chi2 (Prob.)	11.05 * (0.0115)	11.12 * (0.0012)	9.96 * (0.0189)

Source: Calculation; **Remark:** *, ** and *** Significant at 1%, 5% and 10% respectively

5. Conclusion and Recommendation

Economic activities in provincial cluster of the Southern shore of the Gulf of Thailand have grown rapidly since 2000, after the huge economic crises in 1997. Along with their

growth, economic activities tend to locate spatially close one to another to achieve external economic advantages that present the value of LQ that more than one present in agricultural ($LQ_{Agricultural}$) and industry sector ($LQ_{Industry}$).

These spatial concentrations have created product specialization in some provinces. However, the benefits of spatial concentration from these industries are difficult to capture and measure directly, and indicators on the spatial concept of cluster show debated between specialization, diversity, and Urbanisation, so that future research should investigate an economic pattern for each provincial cluster and understand the conditions for development specific to each phenomena.

This study also aims to analyze the effect of spatial concentration of economic activities on local economic growth in provincial cluster. There are industry ($LQ_{Industry}$) and ($LQ_{Service}$) variables significant on economic performance. The case of hotels and restaurants (LQ_{Hotel}) which is sub economic activities of service sector be significant on economic growth. The result presence the role of externalities as the key component measurement in the operation of the economic activities especially service sector. There are no studies about the effects of economic activities concentrations on local economic growth in provincial cluster, so that the study of the impact of economic activities concentration is necessary to determine whether it can generate positive or negative effect on local economic growth. Since the clusters have different types, the government should support them in different ways and investigate the classification of provincial cluster economies and government policy interventions encouraging formation of different provincial cluster. Therefore, policy perspective implies the policymakers need to be aware of the difference in provinces to the extent that economies define provincial cluster and implement policy.

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FIRM SIZE AND LOCATION CHOICE OF FOOD INDUSTRY: IZMIR/TURKEY CASE

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Abstract

Purpose of the current study is to analyze the determinants of firm location in Izmir's food industry. The dataset covers 734 firms in 2018. The analyses particularly focus on the impact of experience and size of the firms, the effects of which are not yet adequately analyzed by the existing literature. In terms of methodologies, initially, explorative maps are used to illustrate the data. Then, linear regression analyses are applied to analyze the location behavior determinants. Spatial autocorrelation test is applied to as a robustness test. Our findings point to three main results. First, firm size is not statistically a significant determinant of firm location. So, big firms may locate in/around or out of cities, whereas, also small firms may locate close to or distant from city centers Second, the influence of the experience variable is rather definite; earlier founded firms naturally locate closer to CBD. Third, with regard to results regarding sub-sectors, firms in packaged food and bakery sectors locate nearby CBDs where, in contrast, firms in animal products sector tend to locate in rural areas. Overall, the key lesson that we learn from the analysis is that concentration of large firms around urban areas should be avoided so to cope with environmental problems and to maintain fair competition between big and small firms. Moreover, younger firms should be subsidized (through tax exemptions, rental aid, export and employment subsidies) so that their capital structure remains strong even if they are not able to place close to the market.

Keywords: Location Choice, Food Industry, Determinants, Firm Size
JEL classification: D22, R3

1. Introduction

In the literature on urban economics, location choice of industries is increasingly becoming a subject of substantial interest.[1] Although there exist a number of theories on this issue, empirical studies investigating the location preferences are rather limited (O'Sullivan, 2012; Weber, 1929; Thunen, 1966). In fact, these location choices are quite crucial for the performance, productivity and growth of the firms as they are directly related to the transportation costs, procurement and output distribution. (O'Sullivan, 2012; Sridhar and Guanghua, 2010; Balchin, Bull and Kieve, 1995; Marshall, 1920).

Proximity to big markets, agglomeration, accessibility, availability of qualified labor force nearby (human capital), closeness to raw materials, access to input supplies, social, physical, technology infrastructure and knowledge spillovers are referred to as important drivers of location choice in the literature (Tümertekin ve Özgüç, 2016; Cieslik, 2013; O'Sullivan, 2012; Sridhar and Guanghua, 2010; Domanski, 2004; Arauzo-Carod and Manjo-Antolin, 2004; Dumais, Ellison and Glaeser, 2002; Fujita, Krugman and Venables, 1999; Head and Ries, 1996; Fujita and Thisse, 1996; Venables, 1996; Head, Ries and Swenson 1995; Krugman, 1991; Marshall, 1920)

There are numerous empirical studies that tried to investigate the location choice of firms. Some examples of these studies are worth spending few words on.

[1] This article is a product of Nilnaz Akbaşoğulları (2019)'s Master Thesis which Assoc.Prof.Dr. Hasan Engin Duran has supervised.

Agglomeration is one of the important driver. Head, Ries and Swenson (1995) discuss the relationship between agglomeration and the geographical location. They analyze more than 751 Japanese companies and find firms that are involved in the same industry are generally concentrated in the same region, possibly due to benefits of economies of scale and positive externalities (Fujita, Krugman and Venables, 1999; Fujita and Thisse, 1996; Venables, 1996; Krugman, 1991).

Other several factors such as human capital, population and proximity to raw materials are emphasized as important factors by the literature in location preferences. In other words, firms seek to maximize the profits and minimize the costs by locating as close as possible to markets, low cost-site areas, closer to human capital, productive labor force base and low cost inputs. (Tümertekin ve Özgüç, 2016; Cieslik, 2013; O'Sullivan, 2012; Sridhar and Guanghua, 2010; Domanski, 2004; Arauzo-Carod and Manjon-Antolin, 2004; Dumais, Ellison and Glaeser, 2002; Fujita, Krugman and Venables, 1999; Head and Ries, 1996; Fujita and Thisse, 1996; Venables, 1996; Head, Ries and Swenson 1995; Krugman, 1991; Marshall, 1920)

Despite the long standing discussions, the impact of size of the firms on the location choice has not yet been adequately analyzed in this manner (Arauzo-Carod and Manjon-Antolin, 2004; Cieslik, 2013; Meester, 2000; Callejon and Costa, 1996).

In the literature, two opposite effects are discussed in the literature. On the one hand, it is expected that bigger firms might locate far away from the city centre (market) as they need large production spaces and low cost of site. On the other hand, it is argued in the literature that big firms may use the power of having extensive capital structure and locate just in the periphery of the cities. They might want to take advantage of benefits of agglomeration such as well-established infrastructure in cities, knowledge flows, human capital availability etc. (Tümertekin ve Özgüç, 2016; Cieslik, 2013; O'Sullivan, 2012; Sridhar and Guanghua, 2010; Domanski, 2004; Arauzo-Carod and Manjon-Antolin, 2004; Dumais, Ellison and Glaeser, 2002; Fujita, Krugman and Venables, 1999; Head and Ries, 1996; Callejon and Costa; 1996 Fujita and Thisse, 1996; Venables, 1996; Head, Ries and Swenson 1995; Krugman, 1991; Marshall, 1920)

Actually, there is scant empirical evidence on this issue. Callejon and Costa (1996) has for instance analyzed the firms in Barcelona and found that there is a positive relationship between firm size and population of the area. Moreover, Cieslik (2013) has analyzed the relationship between firm size and location determinants for Polish regions. They found that firms have quite distinguished location determinants depending on their size. Arauzo-Carod and Manjon-Antolin, (2004) has analyzed the relationship between location choice and firm size in 942 Spanish co-marques and municipalities. They found that large and small firms have different location choices. Labor intensive firms tend to locate close to market area (Barcelona).

Similarly, experience of firms is another explanatory factor that may influence the location choices (Tripathi and Kumar, 2017). It is argued in the literature that the more experienced firms are those which were founded earlier, and thus, they are expected to choose their location close to the market. (Tümertekin ve Özgüç, 2016; Cieslik, 2013; O'Sullivan, 2012; Tripathi and Kumar, 2017; Sridhar and Guanghua, 2010; Domanski, 2004; Arauzo-Carod and Manjon-Antolin, 2004; Dumais, Ellison and Glaeser, 2002; Fujita, Krugman and Venables, 1999; Head and Ries, 1996; Callejon and Costa; 1996 Fujita and Thisse, 1996; Venables, 1996; Head, Ries and Swenson 1995; Krugman, 1991; Marshall, 1920) .

Overall, all these variables need to be empirically verified but they are paid less attention compared to the traditional variables in the literature.

Hence, the purpose of the current study is to analyze the determinants of firm location in Izmir's food industry. The dataset covers 734 firms in 2018. The analyses particularly focus on the impact of experience and size of the firms.

The food industry is a special sector where inhabitants consume frequently and its quality must always be always high for the health and well-being of the society. Izmir is also a relevant place for study as food products have been traded massively throughout its history. Indeed, there is an extensive number of food manufacturers and traders around the port of Izmir. All these make our study more interesting.

The rest of the paper is structured in the following way: In the second part, data and methods, in the third part, empirical results are presented; in part 4, the summary, discussion and policy outcomes are included.

2. Data and Methods

In terms of empirical methodology, this study follows several steps. Firstly, dataset covering location, firm size, experience and firms' surrounding population is collected for 734 firms (for the year 2018) in Izmir's food industry by using the registry dataset of EBSO (Aegean Region Chamber of Industry, Turkey).[2]

Second, the location of firms on maps is illustrated as an explorative analysis. It is provided three different maps. First, geographical distribution of firms together with city centers, second, distribution of firms together with their employment size and, third, distribution of firms together with capital size are illustrated. The maps are produced in ArcMap 10.6 program.

Third, simple linear regression analyses are performed that help investigating the location choice determinants. To do so, the following linear regression modal is used:

$$distance\ to\ Izmir\ CBD\ (or\ local\ CBD)_i = \alpha + \beta_1 employment\ size\ (or\ capital\ size)_i + \beta_2 experience_i + \beta_3 population_i + ds_i + e_i \quad i=firms, \quad i=1,\ldots\ldots 734 \quad (1)$$

The variables to be analyzed in regression (in equation 1) are summarized in Table 1. The dependent variable is the location choice of firms, measured (in kilometers) by their travel **distance to Izmir's CBD** (Konak District) or alternatively the **distance to local CBD** (sub-provincial city center). These two dependent variables are alternatively used in the regression analyses.

The distance measurements are implemented in ArcMap 10.6 Program.

In terms of independent variables, there are three types. The first one is the **firm size** measured either by employment or capital size. Both variables are expressed in categories (e.g. category 1,2,3,4). With regard to **employment size** variable, category 1 represents the smallest firms which employ 5-24 workers, whereas category 4 represents the biggest firms which employ above 200 workers. Similarly, **capital size** variable is expressed also in categories. Category 1 represents the smallest firms which have 1-24.999 Turkish Liras capital, whereas category 4 represents the biggest firms which have capital above 1.000.000 Turkish Liras. These two variables are alternatively used in the regression analyses to avoid multi-collinearity problem. The second independent variable is the **experience** of the firms. It is measured by the number of years passed since the foundation of the firm. The last independent variable is the **population** of the sub-province that the firm belongs to. It proxies the market size nearby the firm. Finally, *ds* represents the dummy variables for 5 different sub-sectors (Bakery Food, Animal Food, Packaged Food, Herbal Food sectors, Drink and Tobacco Sector).

The regressions are estimated by using a linear OLS technique for the aggregate data and also for 5 different sub-sectors (Bakery Food, Animal Food, Packaged Food, Herbal Food sectors, Drink and Tobacco Sector).

[2] The empirical analysis in this article is implemented in Eviews 4, R 5.53 SPDEP package

Table 1. Definition of Variables

Variable Definition	Definition	Measure	Spatial Units	Data Source
Experience	Experience of firms since foundation	years	734 firms	Aegean Region of Chamber Industry database
Employment Size	Firms in which 5- 24 workers employed take value (1), 25-49 workers employed take value (2), 50-199 workers employed take value (3), above 200 worker employed take value (4)	Intervals	734 firms	Aegean Region of Chamber Industry database
Capital Size	Firms which have capital size between 1-24.999₺ take value (1), capital size between 25.000-99.999₺ take value (2), capital size between 100.000-249.999₺ take value (3), capital size between 250.000-999.999₺ take value (4), capital size above 1.000.000₺ take value (5)	Intervals	734 firms	Aegean Region of Chamber Industry database
Population	Population of districts in which the firm is located	number of people	734 firms	Aegean Region of Chamber Industry database
Distance to Izmir CBD	Linear Distance to Konak (centre of Izmir)	kilometres	734 firms	Aegean Region of Chamber Industry database
Distance to local CBD	Linear Distance to Sub-provincial Centre	kilometres	734 firms	Aegean Region of Chamber Industry database

As a last method, Moran I's test of spatial dependence is applied to the independent variables to ensure inferential robustness. Classical estimates of OLS might be biased and provide misleading results in case there exists spatial dependence in data (Anselin, 1988).

To do so, we apply a spatial dependence test to our independent variables that examines whether similar (or dissimilar) values are geographically concentrated significantly or not (Rey and Montouri, 2001; Moran, 1950).

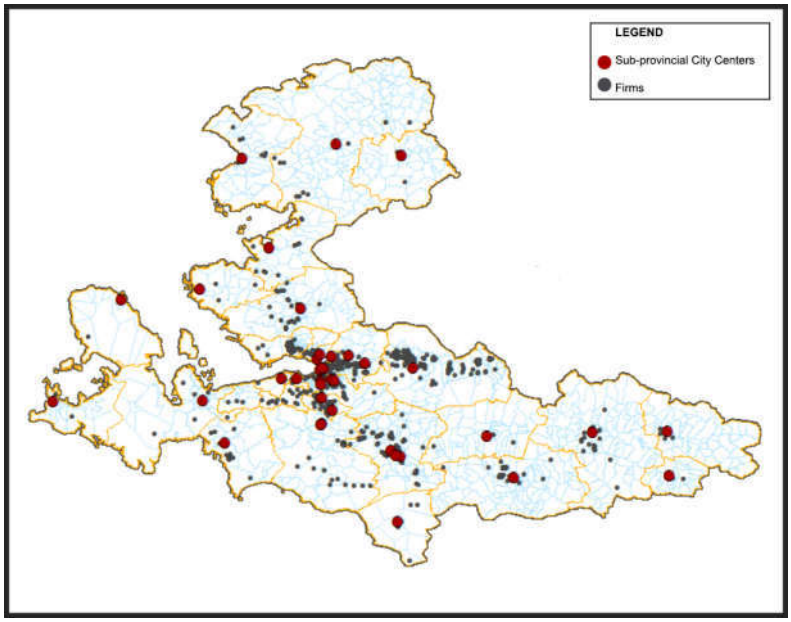
Spatial dependence is tested by examining the statistical significance of Moran *I* test statistics (Anselin, 1988; Moran, 1950). Spatial Weight Matrix, which is an important element of the test, is calculated in a 734x734 firms form. It includes the raw standardized inverse distance across firms.

Applying these methods, the results are figured out which are explained in the next section.

3. Empirical Results

Firstly, illustrative maps are demonstrated. In Figure 1, geographical location of firms and the centers of sub-provinces are shown. It is normally observed the concentration of firms around the city centers. It seems plausible as firms naturally would like to place nearby the big markets.

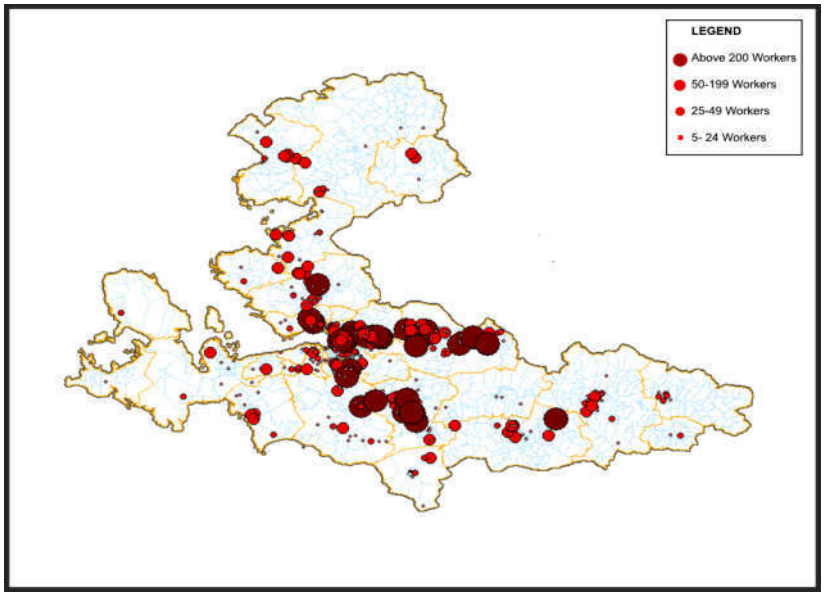
Figure 1: Geographical Distribution of Firms and Sub-Provincial City Centers, 2019



Source: Own Map, 2019

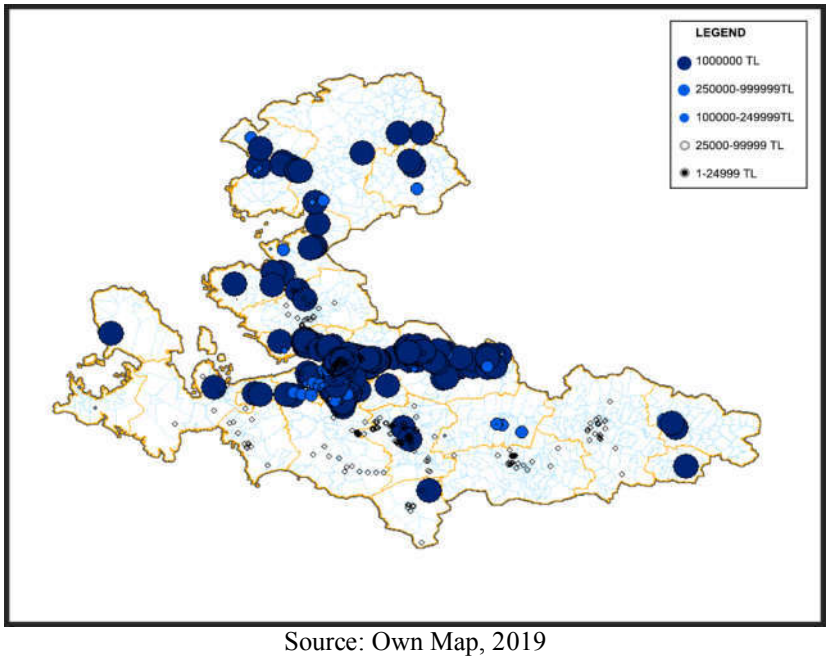
However, the picture in Figure 1 does not tell any story related to the location behavior of big/small and experienced/unexperienced firms. However, Figure 2 and 3 show the distribution of firms together with their employment and capital size respectively. At a glance, it visually seems a random distribution. Hence, big firms and small firms seem to locate randomly. There is no distinct pattern that shows the systematic closeness of big firms/small firms to the CBDs.

Figure 2: Geographical Distribution of Employment Size, 2019



Source: Own Map, 2019

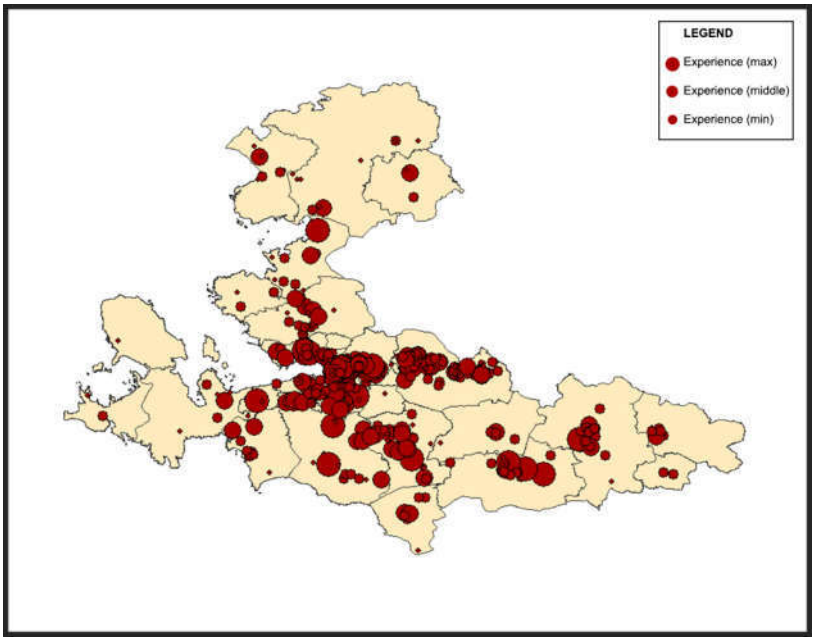
Figure 3: Geographical Distribution of Firms by Capital Size, 2019



Source: Own Map, 2019

On the contrary, the location of firms seems to be well associated with their experience in Figure 4. Such that the more experienced firms seem to have located closer to CBDs. This is reasonable as the earlier founded establishments tend to place nearby big markets.

Figure 4: Geographical Distribution of Firms by Experience, 2019



Source: Own Map, 2019

However, none of the above mentioned descriptive facts provide statistical evidence on the location choice and its determinants. To pursue such an analysis, we present the results of the regression in equation (1) for the aggregate data in Table 2 and Table 3 in which distance to Izmir's main CBD and distance to local sub-provincial CBDs is taken as two different dependent variables respectively.

At a glance, the both tables tell somewhat similar story. With regard to the impact of firm size, it is found in most of the cases as an insignificant variable. Such that firm size in not statistically a significant determinant of firm location. Big firms may locate around or out of cities, whereas, small firms may also locate close to or distant from CBDs. Only in Table 3, capital size variable's coefficient is found positive and significant. It, thus, indicates that the firms which are bigger in capital size are likely to locate closer to local (sub-provincial) CBDs.

The interpretation of the ambiguous impact of firm size on the location choice is twofold. On the one hand, big firms need large production space and urban areas are too costly in that manner (Hence, they might locate in distant areas. On the other hand, big firms have strong capital structure which are capable of locating nearby markets. They possible prefer to take the advantage/benefits of agglomeration economies' benefits. (Tümertekin ve Özgüç, 2016; Cieslik, 2013; O'Sullivan, 2012; Sridhar and Guanghua, 2010; Domanski, 2004; Arauzo-Carod and Manjon-Antolin, 2004; Dumais, Ellison and Glaeser, 2002; Fujita, Krugman and Venables, 1999; Head and Ries, 1996; Callejon and Costa; 1996; Fujita and Thisse, 1996; Venables, 1996; Head, Ries and Swenson 1995; Krugman, 1991; Marshall, 1920). The two forces might have neutralized each other and insignificant effect of firm size arise.

The influence of the experience is rather definite. In tables, 2 and 3, it has consistently negative and significant coefficient. It, thus, means that earlier founded firms naturally locate closer to CBD. This seems plausible as they take advantage of having long standing experience and early establishing the companies.

With regard to the sub-sectoral dummies, some interesting patterns of location appear. For instance, firms in packaged food and bakery products sector locate nearby CBDs, regardless of Izmir's main or local (sub-provincial) CBDs. In contrast, firms in animal products sector tends to locate in rural areas which are away from CBDs These patterns are statistically significant in all regressions. Finally, firms in Herbal, Drink and Tobacco goods production sector tend to locate away from local (sub-provincial) CBDs.

To investigate the effect of the firm size and experience for the sub-sectors, we run the regression in equation 1 for 5 subsectors, excluding sub-sectoral dummies. The results are presented in table 4. The results are quite consistent with the previous findings. Such that

firms size variable (regardless of employment or capital size) does not have significant coefficient in the major part of the regressions. There are some significant cases in packaged and drink and tobacco sectors but the signs of the coefficients are inconsistent. Hence, there is no robust evidence in that manner.

Similar to what is observed in tables 2 and 3, experience variable has consistently negative and significant coefficient in almost all sub-sectors and specifications, with the only exception of Bakery goods production sector.

The last analysis concerns a robustness check. The empirical analyses on urban/regional studies are commonly subject to spatial dependence. Hence, ignorance of spatial autocorrelation might induce serious bias and misleading results. Therefore, we apply a Moran's I spatial dependence test on the independent variables. The results are presented in Table 5. In none of the variables, spatial dependence is found evident, that is a result confirming the reliability of OLS estimates.

Table 2. Regression Results, OLS, Dependent Variable: Distance to Izmir CBD, Data Source: Own Estimation

Dependent Variable: Distance to Izmir CBD										
Independent Variables:	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Constant	2,92E+01***	2,88E+01***	28,34***	2,72E+01***	23,92***	23,23771***	27,98***	26,84***	29,28***	28,93***
Employment Size	6,68E-01		0,47		0,62		0,36		0,10	
Capital Size		4,54E-01		5,81E-01		0,46		0,52		0,23
Experience	-2,27E-01***	-2,27E-01***	-0,17***	-1,79E-01***	-0,13**	-0,13**	-0,18***	-0,19***	-0,19***	-0,20***
Population	-7,16E-04***	-7,14E-04***	-0,00***	-7,37E-04***	-0,00071***	-0,0007***	-0,00***	-0,00***	-0,00***	-0,00***
Dummy Packaged Food	-1,09E+01***	-1,10E+01***								
Dummy Herbal Food			-1,11239	-1,19E+00						
Dummy Animal Food					11,09***	11,23***				
Dummy Drink and Tobacco							3,62	3,53		
Dummy Bakery Food									-9,09***	-9,57***
R-Square	0,1									
N=734	734	734	734	734	734	734	734	734	734	734

Notes. *** denotes 1 % statistical significance, ** at 5 %, * at 10.

Table 3. Regression Results , OLS, Dependent Variable: Distance to local CBD, Data Source: Own Estimation

Dependent Variable: Distance to local CBD										
Independent Variables:	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Constant	7,85E+03***	8,13E+03***	7,22E+03***	73,57***	8,08E+03***	8,15E+03***	7,74E+03***	7,42E+03***	7,79E+03***	8,07E+03***
Employment Size	5,25E+02*		4,59E+02*		4,41E+02		-3,16E-01*		3,75E+02	
Capital Size		1,27E+02*		0,13*		1,67E+02*		8,38E+01		7,64E+01*
Experience	-9,50E+01***	-8,09E+01***	-8,69E+01**	-0,07**	-8,94E+01**	-7,80E+01**	-1,12E+02***	-1,11E+02***	-8,52E+01**	-7,43E+01**
Population	-1,43E-01**	-1,45E-01**	-1,37E-01**	-0,00**	-1,49E-01**	-1,50E-01**	-1,26E-01**	-1,21E-01**	-1,10E-01*	-1,08E-01*
Dummy Packaged Food	-3,29E+03**	-3,26E+03**								
Dummy Herbal Food			6,18E+02*	0,70*						
Dummy Animal Food					-1,74E+03*	-1,86E+03*				
Dummy Drink and Tobacco							1,68E+04***	1,67E+04***		
Dummy Bakery Food									-2,26E+03*	-2,43E+03*
R Square	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,1	0,0	0,0
n=732	732	732	732	732	732	732	732	732	732	732

Notes.*** denotes 1 % statistical significance, ** at 5 %, * at 10 %.

Table 4. Regression Results, Location Choice in Subsectors, Data Source: Own Estimation

Dependent Variable; Distance to	**Packaged Food**				**Herbal Food**			
	Izmir CBD	Izmir CBD	Local CBD	Local CBD	Izmir CBD	Izmir CBD	Local CBD	Local CBD
Independent Variables:	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	7,18E-11	1,10E-10	7,76E-12	8,70E-12	-2,29E-11	5,12E-11	-1,20E-12	1,95E-11
Employment Size	2,94E+03***		8,22E+01		-3,93E+02		1,59E+03	
Capital Size		-6,02E+02**		9,85E+01		4,15E+01		2,09E+02
Experience	-5,04E+02***	-3,54E+02***	-3,90E+01	-2,78E+01	-1,77E+02**	-2,08E+02***	-1,06E+02**	-7,32E+01
Population	-1,88E-01***	-1,94E-01***	8,63E-02***	8,36E-02***	-3,39E-01**	-3,33E-01**	-1,11E-01	-9,69E-02
N=732	73	73	73	73	310	310	310	310
Dependent Variable; Distance to	**Drink and Tobacco**				**Bakery Food**			
	Izmir CBD	Izmir CBD	Local CBD	Local CBD	Izmir CBD	Izmir CBD	Local CBD	Local CBD
Independent Variables:	Model 5	Model 6	Model 7	Model 8	Model 1	Model 2	Model 3	Model 4
Constant	9,41E-12	-1,12E-12	2,72E-11	9,15E-12	5,13E-11	2,35E-11	1,66E-11	-1,28E-11
Employment Size	-1,80E+03***		-1,17E+04***		1,10E+03		3,07E+01	
Capital Size		2,02E+03***		-5,13E+03***		-1,94E+02		1,60E+02
Experience	-2,96E+02***	-3,69E+02***	-4,29E+02***	-7,18E+02***	-4,92E+01	9,88E+00	2,77E+01	2,91E+01
Population	-1,14E+00***	-9,40E-01***	-1,64E+00***	-1,13E+00***	-3,96E-01***	-4,02E-01***	-5,70E-02***	-4,99E-02***
N=732	35	35	35	35	113	113	113	113
Dependent Variable; Distance to	**Animal Food**							
	Izmir CBD	Izmir CBD	Local CBD	Local CBD				
Independent Variables:	Model 1	Model 2	Model 3	Model 4				
Constant	-6,80E-12	4,97E-11	-5,61E-12	4,60E-12				
Employment Size	8,12E+01		4,31E+02					
Capital Size		3,08E+02		1,89E+02				
Experience	-1,97E+02**	-1,93E+02**	-8,20E+01***	-7,90E+01***				
Population	-1,18E+00***	-1,16E+00***	-2,62E-02	-1,80E-02				
N=732	198	198	198	198				

Notes.*** denotes 1 % statistical significance, ** at 5 %, * at 10

Table 5. Spatial Dependence Test, Data Source: Own Estimation

Variable Analyzed	Test Statistics	Variance	P Value
Experience	-1,74E+03	2,44E+01	0,5302
Employee	-2,65E+03	0,6021	2,45E+01
Capital	-1,11E+03	2,45E+01	0,4792
Population	2,24E+03	2,44E+01	0,2325

Notes.*** denotes 1 % statistical significance, ** at 5 %, * at 10 %.

4. Discussion

All the results explained previously provide important insights about the future urban/rural planning, policies and applications on food industry in Izmir.

The finding that **firm size** does not matter for firm location implies the following: big firms are able to locate close to urban areas. This might bring negative environmental externalities, air pollution, water pollution, traffic congestion, hazardous waste, etc. Therefore, policy appliers should be aware of this fact and they should either not allow anymore the foundation of large scale industries nearby urban areas or should set up efficient monitoring and regulating mechanisms. Moreover, one other problem with the placement of large industries close to the CBD is that it reduces their distribution cost. Therefore, small firms can hardly compete with the big ones. Therefore, it deteriorates the competitive structure of food industry.

Regarding the impact of experience variable, it follows that earlier founded firms are able to locate close to CBDs. Put it differently, newly founded "unexperienced" firms can only place in more distant areas. In case these firms are market oriented, the distribution costs of products become high and this distorts their capital structure (O'Sullivan, 2012).

Overall, the key lesson that we learn from the analysis is that concentration of large firms around urban areas should be avoided so to cope with environmental problems and to maintain fair competition between big and small firms. Moreover, younger firms should be subsidized (through tax exemptions, rental aid, export and employment subsidies, etc.) so that their capital structure remain strong even if they are not able to place close to market.

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EXPERT ANALYSIS AND IMPACT ASSESSMENT OF THE CONSTRUCTION SECTOR ENTERPRISES ON THE ECONOMY: THE EXPERIENCE OF UKRAINE

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Abstract
The aim of the article is to establish the impact of construction sector enterprises on the economy. Using dynamic cross-sectional balance regression, it is determined that gross domestic product, the level of budget revenue, volume of capital investment, the level of employment, the coefficient of coverage of imports by exports and volume of innovative realized products depend on the development of the of enterprises in the construction sector. The model of social and economic participation of the construction sector in the economic system of the country is developed, which on the basis of dynamic cross-sectional balance regression allows to determine ranges of values of influence of the main indicators of functioning of the enterprises of the construction sector on the gross domestic product; the level of budget revenues; volume of capital investments; employment rate; coefficient of coverage of imports by exports.

Keywords: enterprises of construction sector, construction, impact, economy, development, dynamic cross-sectional balance regression.
JEL classification: L74, C61, D60, E23

1. Introduction

The current economic conditions in the period of significant macroeconomic imbalances and accumulated problems against the background of an unprecedented combination of financial, economic, banking and political crises require activation of the development of enterprises of dominant industries and sectors of the national economy.

The construction industry includes a combination of many types of economic and other activities. They ensure the implementation of the investment process from the pre-project stage to the commissioning of the object. A building complex is a collection of diverse but interconnected industries and organizations. They are characterized by a combination of interests, interconnected close and stable economic, organizational and technological ties. The main thing in the activity of these enterprises is to obtain the end result – to obtain profit in order to ensure the reproduction of fixed assets and the growth of their assets. Such interconnectedness and interdependence affects not only the activity of these enterprises, but also the economy of the country and its gross domestic product.

The construction sector of the economy has a special role in the social and economic development of each country, because with its participation, the primary physiological needs of society in housing and protection are realized; provided with fixed assets (land, buildings and structures) all activities of the private, budgetary and communal spheres; capital markets, goods and services, labour resources are formed; infrastructure is developed; a base is formed for the development and concentration of productive forces; economic activity is activated;

housing opportunities for migration and the spatial concentration of an efficient working population are provided. The share of the construction sector in the gross domestic product of the countries of the world is quite significant.

A large number of able-bodied citizens are involved in the sphere of construction industry (production of building materials and other products to support the construction process), construction, activities of professional real estate agencies, design, development, mortgage, appraisal and other construction-related companies. Therefore, the issues of development of the construction sector of the national economy and research of its influence on the economic system of the country are especially relevant.

We propose the following hypotheses in order to address the basic idea of our study – assumptions that we will test experimentally for a possible solution to the problem. Firstly, is it true that the gross domestic product (Y1), the level of budget revenues (Y2), the volume of capital investments (Y3), the level of employment (Y4), the coefficient of coverage of imports by exports (Y5), and the volume of sold innovative products (Y6) depends on the development of the construction sector enterprises and if so, to what extent. Secondly, is it possible to determine the range of values of the influence of the main indicators of functioning of construction sector enterprises on the gross domestic product; the level of budget revenues; volume of capital investments; employment rate; the coefficient of coverage of imports by exports and volume of sold innovative products?

2. Literature review

There are many approaches in the economic literature to the definition, organizational structure, functioning of construction and its relationship with the economic system of the country. Approaches to the interpretation and formulation of its essence differ among researchers. Researchers of industry associations in construction, in particular Fedorenko V. (2000), Bohdan N.(2012), Chekulaieva O. (2014), Asaul A. (2001) and others have substantiated the concept of "building complex". In spite of various interpretations, the basis for it was laid the sign of the complexity (systematic) of economic, technical and technological, organizational links between enterprises and organizations of different industries related to the creation of construction products. Each of them within the limits of the research areas substantiated its functioning at different levels – meso and macroeconomic.

In our opinion, the concept of "building complex" should be considered through the prism of regional development, since the specifics of its functioning are inherently clearly expressed regional aspect, which is confirmed by the results of thorough research (Pynda, Yu.V. (2009)).

We consider the category "construction sector" much broader as a set of interrelated sectoral, technical, technological, organizational and legal, institutional characteristics, economic goals and functions of the components of the national economy involved in the formation of construction products (buildings and structures) of residential, social and cultural, commercial, industrial, agricultural and infrastructural purposes.

The problems of accessibility and security of citizens are classified in the strategy of national security of Ukraine as priority and those that need priority. At the same time, in the context of strengthening the economic security of the state in the medium term, it is of particular importance to increase the competitiveness of industries and economic complexes important for the development of the national economy, to expand the use of public-private partnership mechanisms and to create a reliable production, energy, transport, information and military infrastructure, that objectively impossible to implement without the involvement of construction (Pynda, Yu.V. (2009)).

In the context of the study of strategically important industries and sectors of the national economy, scientists mainly focus on two important aspects: 1) the range of current problems of the industry itself (economic sector; economic complex); 2) the place and influence of the industry on the real sector of the economy. Considering the significant participation of the construction sector in the formation of competitive positions of the national economy and the significant social effect of its development, we consider it relevant to study the impact of the functioning of construction sector enterprises on the economy of Ukraine.

Substantiation of the place of the construction sector of the Ukrainian economy in the process of strengthening the economic security of the state – the task of the highest level of priority and complexity, should be based on the conceptual basis of the latter with its functional and structural components, the study of the factors that determine it and features of construction, as a complex multifaceted sector and functioning of which different industrials and sectors of the national economy are involved (Vasyltsiv, T.H. (2010)). Thus, using the example of the five-sector model proposed by scientists Kuzmin A. and Pyroh O.(2013), we note the link between industries and economic sectors with construction (Table 1).

Table 1. **Relationship between the sectors of the national economy with construction ***

Name of Sector (S)	Types of economic activity	Characteristics of sector	Relations with the construction sector
Primary (S_1)	- the mining industry; - agriculture; - hunting and forestry; - fishing and fish farming;	The kinds of activities of the sphere of material production, providing extraction of raw materials and their processing into semi-finished products, are mainly the raw material base for processing industry and construction. It dominates in the countries with industrial economies. Within the sector, agriculture is considered to be the most important sector.	Relations with the construction sector; Extraction of raw materials for construction and production of building materials; Provision of fixed assets.
Secondary (S_2)	- processing industry; - production and distribution of electricity, gas and water; - construction	The kinds of activities of the sphere of material production. The basis for ensuring a stable life of society. It dominates in the countries with industrial economy. It has the most significant impact on the economy of Ukraine.	Manufacture of building materials, metal and reinforced concrete elements (parts, structures), production of woodworking and other industries intended for construction; Construction activities; Provision of fixed assets.
Tertiary (S_3)	– transport and communication activities; - trade; - repair of motor vehicles, household goods and items for personal consumption;	The kinds of activities of sphere of intangible production, service activity. One of the key sectors in industrialized countries. It has a significant impact on the development of national economies.	Wholesale and retail trade in building materials, metal and reinforced concrete elements (parts, structures), products of woodworking and other industries intended for construction; Provision of fixed assets.
Quaternary (S_4)	- provision of utility services; - the activity of hotels and restaurants; - financial activity; - real estate transactions; - renting, engineering and providing services to entrepreneurs; - providing individual services.	The kinds of activities of the sphere of intangible production that shape the knowledge economy. One of the major sectors in post-industrial economies. It provides specialized luxury services that provide prestige and social status.	Services relating to investment and construction activity, engineering, rental and sale of real estate (including premium classes); Provision of fixed assets.
Fifth sector (S_5)	- public administration; - education and science; - health care and social assistance; - cultural and sports activities	The kinds of activities of the intellectual sphere. Services of a professional and personal nature. The dominant sector in the post-industrial economies, in Ukraine is at the stage of formation	Scientific and research activity in the field of construction: search, development and implementation of innovations in projects, models of cooperation with counterparties, technologies, materials, elements (details, designs) for construction on the basis of socially oriented principles of environmental friendliness, energy, and resource conservation; Provision of fixed assets.

* Source: it is modified by [17; 18; 28]

Construction provides each branch and sector of the economy with fixed assets (buildings and structures); in addition, within each sector (sectoral model of the national economy), it is possible to distinguish an industry, type of activity or services directly operating within the construction sector, or providing and servicing it and has an impact on the value of final products (buildings, structures):

primary sector – extraction of raw materials for construction and production of building materials;

secondary sector – construction activity; production of building materials, metal and reinforced concrete elements (parts, structures), production of woodworking and other industries intended for construction;

tertiary sector – wholesale and retail trade in building materials, metal and reinforced concrete elements (parts, structures), products of woodworking and other industries intended for construction;

quaternary sector – services related to investment and construction activity, engineering, rental and sale of real estate (including premium class);

five-sector – research and development activity in the field of construction: search, development and implementation of innovations in projects, models of cooperation with contractors, technologies, materials, elements (details, structures) for construction on the basis of socially-oriented principles of environmental friendliness, energy, and resource saving.

Olufemi Adedamola Oyedele proposed the Hypothesis of Establishing a Link between the Construction Industry and Social and Economic Development on the example of Nigeria (2016). The author noted that construction projects have great potential to promote the social and economic development of any nation as a driver of growth. However, in most developing countries with huge infrastructure deficits, the construction industry is underdeveloped. A researcher has applied a metadata-based approach in this article in order to assess the impact of the construction industry on social and economic development.

Construction and construction activities are considered to be one of the main sources of growth, development and economic activity aimed at GDP growth. Raza Ali Khan (2008) holds this opinion. The article examines and reflects the contribution of the construction sector to the economy on the example of Pakistan. The relationship between the construction sector and economic growth is identified. It is also determined whether there is unidirectional or bi-directional causation.

The author points out that construction and engineering services play an important role in the economic growth and development of the country. This can be seen as a mechanism for creating employment and providing employment opportunities for millions of unskilled, semi-skilled and skilled workforce. It also plays a key role in generating revenue in both the formal and informal sectors. This is complementary to the foreign exchange proceeds from the trading of building materials and mechanical engineering services. The author also investigated the impact of the construction industry on wages.

The purpose of the article according to Weisbrod Glen (2007) is to identify the methods used to evaluate the economic impact of the construction of transport projects over the long term. Given the fact that once they largely focused on the economic benefits of time and cost savings, they can now include broader factors such as the availability of roles in the supply chain, expanding labour market, the growth of global trade and the consequences of their economic development.

This article critically examines the coverage of impacts on access to different classes of forecasted models of economic impact, and then describes new trends in applied models to assess the regional impact of transportation projects on business productivity, growth and attractiveness. The author outlines a new structure of analysis that aims to facilitate the use of advanced modelling techniques to assess the economic impact of regional investment levels.

Bellù Lorenzo Giovanni and Pansini Rosaria Vega (2009) explored analytical approaches in their article for qualitative analysis of social and economic policy implications. The authors describe the use of counterfactual analysis to analyse the impact of social and economic policies, quantitative analytical approaches that are often used to evaluate policy impact, such as Value Chain Analysis (VCA), Multiple Market Models (MMM), Calculated General Equilibrium Models (CGE), etc.

Ryan Y.C. Fan, S. Thomas Ng, James M.W. Wong (2011) consider that forecasting the construction market is an important topic for policy development and implementation, as the importance and impact of the industry for the economy and GDP are indisputable. However, little attention has been paid to the creation of construction demand forecasting models in the economic literature to predict the growth of the construction market, except for those using uniform time series methods. Given the close link between the general economy and the construction industry, it is necessary to understand the structure of the construction market and, therefore, to develop a vision for the future development of the industry. Modelling technique of vector error correction (VEC) for estimating medium-term total construction demand in Hong Kong is used in this study.

The results show that VEC models can provide a reliable forecast of about 3% in terms of the average absolute error of a percentage over ten quarters of the time. The regression model is also designed to test the reliability of the VEC model. Using the VEC model, stakeholders and policy makers can predict the medium-term trend in demand for construction and, therefore, formulate appropriate strategies to meet the challenges facing them. The obtained results and methodology of econometric modelling of this study are valuable for both developed and developing countries in exploring the future construction market.

Green Richard K. (2003) examines the impact of different types of investments on the business cycle. In particular, the impact of residential and non-residential investment on GDP, and whether each of these types of investment causes GDP growth. The survey results also allow to suggest that policies aimed at raising capital from the housing construction can lead to serious short-term GDP growth.

The main contribution of Shahandashti S. M., Ashuri B. (2013) research is to create multivariate time series models that are more accurate than modern one-dimensional time series models for forecasting. This work is expected to contribute to the development of the construction engineering and management community by helping design engineers and construction planners to prepare more accurate cost estimates and budgets for capital projects and their impact on the economy.

Researchers Ryan Y.C. Fan, S. Thomas Ng, James M.W. Wong (2010) strongly argue that the construction industry plays an important role in the country's economic development process as a driver for its growth. Despite this, the industry is vulnerable to cyclical fluctuations and at times more dramatic changes in workload. It is affected by unforeseen events as a regional or global economy. A model has been proposed in order to formulate appropriate policies and guidelines to help mitigate the fluctuating volume of construction work. Such model can reliably anticipate the work of the various construction sectors following any economic turmoil.

This study uses the Box-Jenkins approach, which is used to develop the model due to its simplicity and grounded theoretical basis. The results illustrate that Box-Jenkins models can reliably forecast medium-term overall construction and housing demand, capturing a tumultuous period of rising and falling construction demand and its impact on the economy. A multiple regression model was also developed in order to compare the reliability of the Box-Jenkins model simulation.

Chun-pong Sing, Peter E. D. Love and C. M. Tam (2012) argued in their article that, it is worth developing a mathematical model using a distributed lag model and a multiplier approach to better manage and forecast labour demand in the construction industry. The model is tested using economic statistics and labour data. This model can be used by public and private sectors to forecast future labour demand for optimal labour supply.

Despite the considerable scientific achievements of researchers, a number of issues regarding the development of construction sector enterprises in the context of macroeconomic development remain unresolved. This, in turn, actualizes the need for forming tools to determine the dependence of key macroeconomic indicators as a function of various indicators of the functioning of construction sector enterprises and to evaluate their impact in quantitative terms.

3. Methodology

The methods of induction, deduction, comparison, systematization, multifactorial regression analysis are used in the process of writing the article. Methodologically, our thoughts are presented in the following order. Firstly, we list the common starting points of our arguments – the preconditions and conditions of our vision. In the final phase, we settled on a model of a possible solution to the problem and tested the developed theoretical and methodological material to verify the above proposal.

The presented research problem, the need to test the hypotheses accepted in the study, the need to develop a model have led to the division of the research process into specific stages and the choice of appropriate methods in each of them. Initially, we used the following scientific methods: literature review and analysis, direct observation, documentary method. In the future, we used such research methods as surveys and interviews. The obtained information and knowledge were processed using comparison methods (sample analysis, retrospective analysis). The collected quantitative and qualitative empirical data were processed using: statistical calculations, significance tests, correlations between estimates.

A systematic approach was applied in the process of writing the work as one of the main methods of scientific research. Techniques of economic and mathematical modelling, regression dependencies, methods of analogies, retrospective analysis and classical method of hypotheses were used in this article.

4. Research methods

Let's analyse the multi-vector impact of main indicators on their functioning on key macroeconomic aspects to reflect the participation of the construction sector enterprises in the process of developing the state's economy.

The main indicators for characterizing macroeconomic aspects through expert analysis are: gross domestic product (Y1), the level of budget revenue (Y2), volume of capital investment (Y3), the level of employment (Y4), the coefficient of coverage of imports by exports (Y5) and volume of sales of innovative products (Y6) (all metrics per person).

The use of this toolkit, including dynamic cross-sectional balance regression, allowed us to form a large-scale general sample of (6480 observations). Statistica 10.0 software was used for the calculations. All metrics were logarithmic before loading the data set.

Let's use the method of multivariate dynamic regression modelling to identify the dependence of Y_1, Y_2, Y_3, Y_4, Y_5, Y_6 on a number of different indicators of the functioning of construction sector enterprises and evaluate their impact in quantitative terms:

$$Y = a_0 + a_1x_1 + a_2x_2 + \dots a_nx_n,$$

where a_1, …, a_n – parameters of model; x_1, …, x_n – indicators for functioning of construction sector enterprises

5. Research results

The use of dynamic cross-sectional balance regression allowed us to form a large-scale general sample of (6480 observations) and obtain relevant models:

$Y_1 = 8{,}195 + 0{,}148x_2 + 0{,}155x_3 + 0{,}222x_5 + 0{,}206x_9 + 0{,}381x_{11} - 0{,}146x_{13} - 0{,}299x_{14} - 0{,}403x_{15} + 0{,}122x_{16} + 0{,}161x_{17} - 0{,}077x_{18} - 0{,}198x_{25} - 0{,}085x_{26} + 0{,}212x_{29} + 0{,}240x_{31} + 1{,}220x_{32} - 0{,}250x_{33} + 0{,}218x_{34} - 1{,}4x_{35} - 0{,}118x_{36}$ *(1)*

$Y_2 = 4{,}387 + 0{,}117x_3 + 0{,}389x_{11} - 0{,}075x_{13} + 0{,}173x_{14} - 0{,}156x_{15} + 0{,}068x_{16} + 0{,}108x_{17} - 0{,}104x_{18} + 0{,}158x_{19} + 0{,}214x_{22} - 0{,}336x_{26} + 0{,}287x_{29} + 0{,}14x_{31} + 0{,}821x_{32} - 0{,}136x_{33} + 0{,}339x_{34} - 1{,}023x_{35} + 0{,}278x_{36} + 0{,}295x_{40}$ *(2)*

$Y_3 = 2{,}304 + 0{,}176\,x_2 + 0{,}474x_4 - 0{,}341x_5 + 0{,}709x_6 + 0{,}2x_9 + 0{,}12x_{11} - 0{,}82x_{15} - 0{,}094x_{16} + 0{,}159x_{19} - 0{,}076x_{23} - 0{,}06x_{24} + 0{,}13x_{25} + 0{,}314x_{26} - 0{,}101x_{28} + 0{,}168x_{30} - 0{,}06x_{38} - 0{,}071x_{39} - 0{,}364x_{40}$ *(3)*

$Y_4 = 4{,}166 + 0{,}23x_1 - 0{,}227x_6 + 0{,}332x_7 + 0{,}631x_8 + 0{,}424x_{11} + 0{,}555x_{12} - 0{,}252x_{14} + 0{,}262x_{18} - 0{,}267x_{19} + 0{,}306x_{20} - 0{,}109x_{21} + 0{,}187x_{22} - 0{,}154x_{24} + 0{,}143x_{25} + 0{,}133x_{28} - 0{,}418x_{30} - 0{,}265x_{31} + 0{,}01x_{37} + 0{,}111x_{38} + 0{,}196x_{41} - 0{,}205x_{42} + 0{,}210x_{43}$ *(4)*

$$Y_5 = -4{,}248 + 0{,}162x_2 - 0{,}47x_6 - 0{,}184x_7 + 0{,}192x_8 + 0{,}343x_{11} - 0{,}131x_{13} - 0{,}283x_{14} - 0{,}105x_{16} - 0{,}266x_{19} + 0{,}187x_{20} - 0{,}122x_{21} + 0{,}428x_{22} - 0{,}107x_{27} - 0{,}227x_{30} + 0{,}5x_{32} - 0{,}633x_{35} + 0{,}237x_{36} + 0{,}133x_{37} + 0{,}133x_{40} + 0{,}142x_{43} \quad (5)$$

$$Y_6 = 31{,}969 - 0{,}539x_4 + 0{,}697x_6 + 0{,}51x_{11} - 0{,}35x_{13} - 0{,}15x_{21} - 0{,}301x_{22} - 0{,}315x_{23} + 0{,}151x_{27} - 0{,}671x_{29} + 0{,}667x_{34} - 0{,}365x_{35} - 0{,}356x_{36} + 0{,}315x_{39} \quad (6),$$

where: x_1 – volume of completed construction works for the construction of residential buildings for 1 person (UAH); x_2 – volume of completed construction works for construction of non-residential buildings for 1 person (UAH); x_3 – volume of completed construction works for the construction of engineering structures for 1 person (UAH); x_4 – commissioning of housing in urban settlements per 1000 people (m² of total area); x_5 – commissioning of apartments for 10,000 persons (units); x_6 – commissioning of rural housing per 1000 people (m² of total area); x_7 – the number of people employed in construction of the 1,000 residents of existing population (persons); x_8 – the number of employed population in the field of real estate transactions per 1000 persons of the existing population (persons); x_9 – average monthly nominal wage of employees in construction (UAH); x_{11} – urban housing stock per 1 person of existing population (m² of total area); x_{12} – rural housing stock per 1 person of existing population (m² of total area); x_{13} – share in the structure of monetary expenditures of households for housing construction, personal subsidiary farm (%); x_{14} – share in the structure of total household spending on housing, utility products and services (%); x_{15} – share of capital investment in construction (% to total volume of investments); x_{16} – share of capital investment in real estate transactions (% to total volume of investments); x_{17} – production of non-refractory ceramic building brick per 1000 persons (m³); x_{18} – production of blocks and bricks of cement, concrete or stone artificial for construction per 10,000 persons (t); x_{19} – production of prefabricated structural elements for construction of cement, concrete or artificial stone per 1000 persons (t); x_{20} – production of concrete solutions ready for use per 1000 persons (t); x_{21} – extraction of natural sands per 1000 persons (t); x_{22} – production of pebbles, gravel, rubble and crushed stone per 1000 persons (t); x_{23} – production of wooden windows, doors, their frames and thresholds for 10,000 persons (pieces); x_{24} – exports of stone, plaster, cement products per 1,000 persons (US $); x_{25} – imports of stone, plaster, cement products per 1,000 persons (US $); x_{26} – export of construction services per 1,000 persons (US $); x_{27} – import of construction services per 1,000 persons ($ US); x_{28} – real estate prices in the regional centre ($ US); x_{29} – loans provided by deposit-taking corporations to construction corporations in national currency per 1 person (UAH); x_{30} – loans provided by deposit-taking corporations to construction corporations in foreign currency for 1 person (UAH); x_{31} loans provided by deposit-taking corporations to households for the purchase, construction and reconstruction of real estate in national currency for 1 person (UAH); x_{32} – loans provided by deposit-taking corporations to households for the purchase, construction and reconstruction of foreign currency real estate for 1 person (UAH); x_{33} – loans provided by deposit-taking corporations to non-financial corporations for the purchase, construction and reconstruction of real estate for 1 person (UAH); x_{34} – loans provided by deposit-taking corporations to non-financial corporations for mortgage loans for 1 person (UAH); x_{35} – loans provided by deposit-taking corporations to households for mortgage loans for 1 person (UAH); x_{36} – interest rates on loans from deposit-taking corporations to non-financial corporations (annual average weighted interest rates,%); x_{37} – interest rates on loans from deposit-taking corporations to households (annual average weighted interest rates,%); x_{38} – coefficient of availability of residential real estate; x_{39} – the level of industry production in the construction sector; x_{40} – export orientation of the construction sector; x_{41} – financial result (balance) of activity of construction enterprises per person (UAH); x_{42} – financial result (balance) of activities of enterprises specializing in real estate transactions per person (UAH); x_{43} – profitability of operating activities of construction enterprises (%).

The results of the regression models (1-6) are statistically significant, as evidenced by the corresponding indicators of Table. 2.

Table 2. **Dynamic cross-sectional balance regression results**

Models	Correlation coefficient R	Adjusted coefficient of determination R^2	Fisher's test at p<0.0000	Standard error
Gross Domestic Product (per 1 person, UAH) (Y_1)	0.9604	0.9225	F(20.123)=73.241	0.1036
Average level of budget revenues (per 1 person, UAH) (Y_2)	0.9577	0.9173	F(19.124)=72.356	0.9153
Capital investment (per 1 person, UAH) (Y_3)	0.965	R2=0.932	F(18.125)=94.599	0.1278
Employment rate (per 1000 persons) (Y_4)	0.926	0.857	F(22.121)=32.958)	0.0485
The coefficient of coverage of imports by exports (Y_5)	0.904			
Volume of realized innovative products, which is new in the market (per 1 person, UAH) (Y_6)		0.817	F(20.123)=27.527	0.2716

Model (1) shows that the largest impact on GDP during 2013-2018 is characterized by the volume of credit resources provided by depository corporations (except the National Bank of Ukraine) to households for the acquisition, construction and reconstruction of real estate in foreign currency (x_{32}=1.22), which confirms the significant role of construction sector enterprises in the formation of channels for foreign exchange flows into the economy due to the multiplier effect. This means that by increasing their volumes by 1 UAH (per person), GDP will increase by UAH 1.22 (per person) (it is calculated in national currency).

The urban housing stock (0.381) has a moderate impact on GDP, which emphasizes the important role of housing in the social and economic processes of the state, in particular in the opportunities for migration and spatial concentration of the efficient working population.

The volume of credit resources provided by deposit-taking corporations to households for mortgage loans (x_{35}= –1.4) is characterized by the strong impact on the economy. This can be explained by the "nature" of the real estate market and the specificity of mortgage lending mechanisms, which contributes to an increase in the share of real estate purchased for credit, activating market demand. And this, in turn, brings active capital out of the economy.

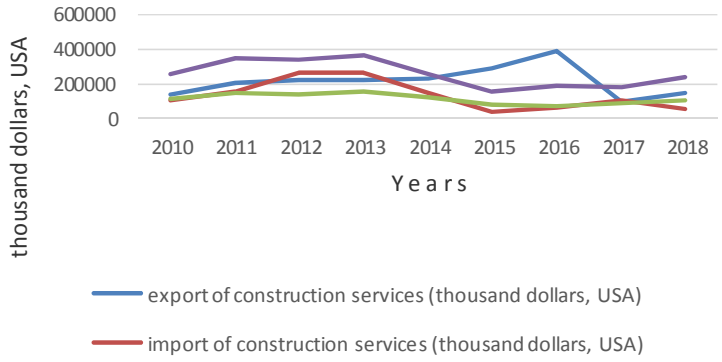
The import of building materials (stone, plaster, cement) (x_{25} =0.198), also has a negative impact on GDP, which confirms the urgency of the development of the domestic construction industry.

Model (2) shows that the formation of budget revenues also indicates the rate of crediting of the population for the purposes of construction in foreign currency (x_{32} =0.821) and the reverse effect – the volume of credit funds for mortgage lending to the population (x_3 = – 1.023). The indicator of export orientation of construction sector enterprises (ratio of exports to output of construction products (x_{40} =0.3) is characterized by moderate positive value.

The reverse effect on the level of budget revenues of some types of construction industry products, in particular blocks and bricks made of cement, concrete and stone, is remarkably striking. It can be explained by the presence of many shadow schemes used by manufacturers of these types of building materials, in particular to avoid tax.

Export of construction services (x_{26} = –0.336) also inversely affects the state budget. The level of budget revenues per person will decrease by 0.34 UAH increasing this figure by $ 1 US (per 1000 people). Despite its relatively small volumes, its dynamics from 2010 to 2016 were positive, but in 2017 there was a sharp decline in exports of construction services with further growth (Figure 1).

Figure 1. Dynamics of foreign economic activity of enterprises of construction sector in Ukraine*



* Source: it is calculated and generated by [39]

The largest impact on capital investment (***3***) among the studied indicators is the volume of commissioning of housing in urban (x_4 = 0.474) and countryside (x_6 = 0.709), as well as the volume of exports of construction services (x_{26}=0.314). The export performance of construction sector enterprises (x_{40} = –0.364) is indicated by the reverse effect.

The state of urban (x_{11} = 0.424) and rural (x_{12} = 0.555) housing stock naturally influences the increase in employment of population ***(4)*** in the state. Moderate and medium impacts are on the development of the construction industry, including the production of concrete (x_{20} = 0.306), blocks and bricks of cement, concrete or artificial stone for construction (x_{18} =0.262) and minor impact – the extraction of pebbles, gravel, crushed stone and crushed stone (x_{22}=0.187).

The inverse effect on the employment of production volumes of prefabricated structural elements for building (x_{19}= –0.267) and the extraction of natural sands (x_{21} = –0.109) can be explained by the informal employment practiced at the enterprises of these areas of specialization.

The inverse dependence of the employment rate can also be traced from loans to construction corporations in foreign currency (x_{30}= –0,418) and loans to households for the acquisition, construction and reconstruction of real estate in national currency (x_{31}= –0,265).

The largest impact of the studied indicators on the coefficient of coverage of imports by exports ***(5)*** is made by loans granted by deposit-taking corporations to households for the purchase, construction and reconstruction of foreign currency real estate (x_{32}=0,5). This dependence is associated with the multiplier effect of "spraying" of currency flows through the needs of the construction related industries. Instead, the significant reverse effect is characterized by loans to mortgage loans from deposit-taking corporations to households (x_{35} = –0,633). This can be explained by the relatively large volumes of imported building materials used for the renovation of their new premises and the aforementioned specifics of mortgage lending. Production of pebble, gravel, crushed stone and crushed stone (x_{22} = 0.428), has a moderate influence on the dependent variable, confirming the main policy of raw material orientation of export in the foreign economic activity of enterprises of the construction sector.

Mortgage loans provided to non-financial corporations specializing in the production of innovative products (x_{34} = 0.667) have an impact on the volume of realized innovative products. However, high interest rates on loans to deposit-taking corporations by non-financial corporations have the opposite effect (x_{36}= –0,356). As a result, loans to construction corporations in the national currency (x_{29} = –0,671) and households for mortgage loans (x_{35} = –0,365) are characterized by the reverse effect.

There is also a significant effect on the dependent variable (Y_6) of rural housing commissioning (x_6 =0,697). In our opinion, this is due to the fact that the construction and commissioning of housing in rural areas against the backdrop of the trend of de-urbanization is to some extent an indicator of the solvency of the population in the respective settlements and the increase of potential for the organization of production in those or other territories and

sales of innovative products. Instead, the inverse effect of housing commissioning in urban settlements (x_4= –0,539) is a reflection of the process of investing in urban real estate as a means of saving savings.

The considerable participation of the construction sector enterprises in the formation of the macroeconomic system is substantiated.

6. Discussion of the results

The conducted study made it possible to detect that the construction sector is a key factor in the impact on the economy. Using dynamic balance cross-sectional regression, it is determined that gross domestic product (Y1), the level of budget revenue (Y2), volume of capital investment (Y3), the level of employment (Y4), the coefficient of coverage of imports by exports (Y5) and volume of realized innovative products (Y6) depend on the development of the enterprises in the construction sector.

Therefore, the use of the outlined above tools made it possible to determine the dependence of key macroeconomic data selected for analysis, which were considered as functions of different indicators of the functioning of construction sector enterprises and to evaluate their impact in quantitative terms.

7. Conclusions

Summarizing the above-indicated, we can conclude that there is a close correlation between the state of development of the construction sector enterprises and the social and economic development of the country. Accurate identification of the impact of construction on the economic system will make it possible to predict macroeconomic trends and identify possible changes in the world economy. This, in turn, will provide an opportunity to apply an appropriate system of economic, financial and institutional measures to enhance social and economic development and create a favourable investment climate.

The following scientific results were obtained at the theoretical level:

It is substantiated that the construction sector is a significant component of economic development, has a significant impact on the economic security of the state and, at the same time and becomes a significant source of danger in the period of negative tendencies of its main performance indicators. The current stage of development of enterprises in the construction sector of the economy is characterized by compliance with the macroeconomic trends in the country.

We consider practical the following results:

The model of social and economic participation of the construction sector in the economic system of the country is developed, which on the basis of dynamic cross-sectional balance regression allows to determine the ranges of values of influence of the main indicators of functioning of the enterprises of the construction sector on the gross domestic product; the level of budget revenues; volume of capital investments; the level of employment; the coefficient of coverage of imports by exports and volume of realized innovative products.

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INFLATION AND UNEMPLOYMENT IN SOUTHEAST ASIAN COUNTRIES: A PANEL GMM APPLICATION ON PHILLIPS CURVE

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Abstract

This study aims to analyze the relationship between inflation and unemployment in 10 Southeast Asian from 1996 to 2016 using 210 data samples. The estimation results, using the GMM panel method, showed that the use of Instrument Variables (IV) is valid for the model and the results show a negative and significant relationship between inflation and unemployment. The optimal value of inflation and unemployment for the Southeast Asian Region were found to be 4 percent and 8 percent respectively. This means that a trade-off has taken place. Thus, the existence of the Phillips Curve in Southeast Asian countries during the period of 1996-2016 can be proven. In accordance with the Phillips Curve review, if the trade-off occurs, the government cannot resolve both problems simultaneously. In other words, policy makers must be able to choose the problem to be addressed first, either by implementing monetary policy, fiscal policy or both, so that economic stability and public welfare are maintained.

Keywords: Inflation, Unemployment, Phillips Curve, Panel GMM, Southeast Asia.
JEL classification: E24, E31, C23, J01

1. Introduction

Inflation and unemployment are two things that have always been problems in countries' economies. Ideally these two problems should be overcome simultaneously, so that the amount of inflation and unemployment in a country can be minimized simultaneously. But both of these macroeconomic problems are very complicated. If the government wants to reduce inflation, then at the same time it will cause the number of unemployed people to increase. Conversely, if we want to reduce unemployment, then at the same time we will increase inflation.

Even though the problems of inflation and unemployment are two important issues, the priorities of countries in solving these two problems are different. A study conducted by Inoue et al. (2012), about several Southeast Asian countries including Indonesia, Thailand and the Philippines, showed that those countries prioritized overcoming inflation problems (Inflation Targeting) even though the unemployment rates in Philippines and Indonesia were still quite high (International Labor Organization, 2014).

The relationship between inflation and unemployment was introduced by Phillips (1958), who argued that there was a trade-off between inflation and unemployment in the UK. Since then, the inverse relationship between inflation and unemployment has been known as the *Phillips Curve*. The original Phillips curve showed a negative and non-linear relationship between unemployment and inflation. This allows policymakers to choose between the combinations of unemployment or inflation that they need most. However, several recent empirical studies showed that the relationship between unemployment and inflation may not always be able to be determined by the Phillips Curve. In fact, inflation and unemployment

can occur in a negative or positive relationship in the same period in one country (Al-Zeaud & Al-Hosban, 2015).

The existence of Phillips curves in various countries has been widely shown, Panel data has been used in OECD countries (Bhattarai, 2004), (DiNardo & Moore, 1999), (Turner & Seghezza, 1999), and several other studies have used time series data (Alisa, 2015) (Dritsaki & Dritsaki, 2013), (Dammak & Boujelbène, 2009). Meanwhile, a study of Southeast Asian countries has been conducted by Furuoka & Munir (2009), but it was limited only to 5 countries. Therefore, this study included all countries in the region of Southeast Asia, namely Brunei Darussalam, the Philippines, Indonesia, Laos, Cambodia, Malaysia, Myanmar, Singapore, Thailand, and Vietnam in order to analyze the relationship between inflation and unemployment, with an overview of the existence of the Phillips Curve in Southeast Asia in the period of 1996-2016.

2. Literature Review

The term inflation refers to an increase in the level of prices of goods and services as a whole in an economy which causes a decrease in household purchasing power. Whenever prices rise, the value of money will depreciate and finally real household income will drop (Singh & Verma, 2016). According to Al-Zeaud & Al-Hosban (2015) inflation is an upward movement in the average price level, while deflation is a downward movement in the average price level. Inflation can occur due to an increase in the money supply, a decrease in demand for money, a decrease in the supply of goods and services, or a combination of those various factors.

According to Al-Zeaud & Al-Hosban (2015) unemployment has always been a major issue for many economies in various countries, especially in times of recession in which work must be sought to increase the aggregate demand (AD) and aggregate supply (AS). However, unemployment can be controlled to a certain extent, depending on the type and causes of unemployment in each country.

Many studies have been undertaken since the end of the 1960s either to support or to refute the results of Phillips's research. Two American economists, Samuelson and Solow (1960), supported Phillips's hypothesis by examining the relationship between the two macroeconomic variables and concluded that there is an inverse relationship between inflation and unemployment in the United States. Furthermore Solow (1970) and Gordon (1971) confirmed the existence of a negative trade-off relationship between inflation and unemployment, which known as "*Solow-Gordon Affirmation"* (Furuoka & Munir, 2009).

Chletsos et al. (2016) conducted a study about the ability of the Phillips Curve to predict inflation during the great recession in the United States and Canada, with the results showing that the Phillips Curve could help improve predictive accuracy for the US, but not for Canada. Then, DiNardo & Moore (1999) conducted research in 9 OECD countries, and proved the existence of the Phillips Curve in these countries. Furthermore, Turner & Seghezza (1999) also used panel data to examine 21 OECD countries from 1970 to 1997 using the SURE (Seemingly Unrelated Estimation) method and obtained strong support for the existence of the Phillips Curve in 21 OECD countries.

In line with the studies above Bhattarai (2004) has also conducted research on the trade-off between inflation and unemployment using quarterly panel data from 1970:4 to 2002:1 that shows a trade-off between inflation and the unemployment rate in accordance with the provisions of the Phillips Curve in a number of countries including Great Britain, Italy, Norway, the Netherlands, New Zealand and the US. Furthermore Bjornstad & Nymoen (2008), examined the Phillips Curve with panel data using the New Keynesian Phillips Curve (NKPC) model approach including an Econometric for Assessing Economic Models.

Furuoka & Munir (2009) studied the existence of the Phillips Curve in Southeast Asia by examining the relationship between the rate of inflation and the unemployment rate for the period of 1982-2004 using a Pooled Least Square (PLS) analysis method. This research was only limited to 5 countries in ASEAN (Malaysia, Singapore, Indonesia, Thailand and the Philippines). The results of the study found that there was no trade-off relationship between inflation and unemployment in these ASEAN countries.

Studies using time series data in several Southeast Asian countries have also been conducted. Among them, Furuoka (2007) chose Malaysia as the focus of research on the

empirical relationship between the rate of inflation and the unemployment rate for the period 1973-2004 using the OLS and GLS methods. Furuoka & Munir (2010) also examined the validity of the Phillips Curve in Brunei Darussalam, with results showing that it was valid. Then, Furuoka et al. (2013) also examined the existence of the Phillips Curve in the Philippines in the period of 1980-2010 and found evidence of the existence of the Phillips Curve in the Philippines. Furthermore, Solikin (2004) used Indonesian quarterly data in (1974:4-2002:1) and tested the classical regression model variation with the State-Space-Time Varying Parameter model using the OLS, GMM, and MLE methods and the KF Algorithm. The results of this research showed that the Phillips Curve phenomenon exists in the Indonesian economy. In line with this research, Maichal (2012) also examined the existence of the Phillips Curve in the Indonesian Economy in the period of 2000.Q1-2010.Q3 using the GMM method for Hybrid models and the NKPC, indicating that the Phillips Curve phenomenon exists in the Indonesian economy.

Another study was also carried out by Stimel (2009) which tested non-linear models based on U.S. data from 1960:1 to 2006:1, using an STR nonlinearity testing strategy. This study found evidence that the U.S. Phillips curve is nonlinear, with the result indicating that the nonlinearity is tied to the business cycle. Dammak & Boujelbène (2009) found that there was a long-term trade-off relationship between inflation and unemployment in Tunisia, thus proving the existence of the Phillips Curve in the period of 1962-2004. Then, to explore the existence and stability of the Phillips Curve in North Cyprus, Shahbaz, et al. (2012) conducted research and found that the Phillips Curve was stable both in the short and long term. Furthermore, the relationship between inflation and unemployment in Greece was examined by Dritsaki & Dritsaki (2013), with results showing a long-term and causal relationship between inflation and unemployment in the period of 1980-2010.

Furthermore, the existence of the Phillips Curve in Jordan for the period of 1976-2013 was scrutinized by Al-Zeaud & Al-Hosban (2015), who showed a negative and non-linear correlation between inflation and unemployment which proves the existence of the Phillips Curve in the Jordanian economy and also showed the amount of inflation and optimal unemployment during this period. Finally, Alisa (2015) examined the relationship between inflation and unemployment in Russia by analyzing the opinions of economists during the period of 1994-2015, ultimately obtaining significant results.

Based on the consideration that the previous research was limited to only a few countries, this study of the existence of the Phillips Curve is significant because it covers all countries in the region of Southeast Asia.

3. Research methods

This study used secondary data with inflation variables and unemployment rates obtained from the World Bank, the Asian Development Bank (ADB), The International Labor Organization (ILO), and other institutions. The data collected is time series 1996-2016 panel data with cross-sections of 10 countries in the region of Southeast Asia that have different socio-economic characteristics, namely: Brunei Darussalam, the Philippines, Indonesia, Cambodia, Laos, Malaysia, Myanmar, Singapore, Thailand, and Vietnam. There was a total of 210 data samples used.

Two approaches were taken in this study, a linear and a nonlinear approach. The linear approach used dynamic panel data models, which were estimated using the Generalized Method of Moments or GMM method (Arellano & Bond, 1991). The GMM panel method is the best estimation method for dynamic panel data models involving lagged variables. Therefore, in this study, in order to determine the trade-off relationship between inflation and unemployment, the model created by Furuoka & Munir (2009) included the lagged value of inflation as expressed in the following equation:

$$INF_{it} = \alpha + \beta_1 UN_{it} + \beta_2 INF_{it-1} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where INF_{it} is the inflation rate in country i in the year t; The UN_{it} is the unemployment rate in the country i in the year t; INF_{it-1} is the value of the lag inflation for year t in country i; α is the intercept; β_1 and β_2 are slope parameters, and ε is the error term.

The non-linear approach was used to calculate the optimal rate of inflation and unemployment. The non-linear model created by Al-Zeaud & Al-Hosban (2015) was developed in this study into a quadratic equation in order to find the optimal value of inflation and unemployment. This quadratic function was also used to determine the shape of an inverted U or U curve with the following equation:

$$Y_{it} = B_0 + B_1 X_{it} + B_2 X_{it}^{\ 2} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where Y_{it} is the independent variable; B_0 is the scale of the constant; B_1 and B_2 are the elasticity of X to Y; X_{it} is the dependent variable; and ε_{it} is the error term.

Equation (2) was estimated using the Panel Least Square (PLS) method, then the optimal inflation and unemployment rate were calculated using the following optimization formula:

$$\frac{d\,Y_{it}}{d\,X_{it}} = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

4. Empirical Findings

A summary of descriptive statistics for inflation and unemployment variables in Southeast Asian countries can be seen in Table 1, where the variable of inflation has an average value (mean) of 6.93 and a standard deviation of 13.31. The mean value is smaller than the standard deviation, indicating that the linearity is not ideal due to its large deviation. Conversely, the average value (mean) obtained for the unemployment rate was 4.30, with a standard deviation of 3.60, which shows that the unemployment rate variable data is normally distributed because the mean value is greater than the standard deviation. The range of values of the two variables (inflation and unemployment rate) are completely different from each other, which can be seen from the minimum values of -2.31 and 0.58, respectively, while the maximum values are 125.27 and 14.97, respectively.

Table 1. Summary Description of Statistics

Criteria	Inf	Un
Mean	6.937735	4.306242
Median	3.820324	2.885000
Maximum	125.2721	14.97627
Minimum	-2.314972	0.580000
Std. Dev.	13.31040	3.605312
Skewness	5.462280	1.144098
Kurtosis	40.71468	3.220436
No. of Observations	210	210

Sources: Estimated Results, 2019.

Before the estimation was carried out, the stationary test was first conducted, because the data exhibited time periods (T) > number of regions (N). The stationary test was carried out with the LLC (Levin, Lin, & Chu), IPS, (Im, Pesar, & Shin), ADF, and PP approaches.

The results of stationary testing can be seen in Table 2, in which shows that because inflation (INF) does not have a unit root at level it is stationary. As with the LLC, IPS, ADF, and PP approaches, each value had a significance value smaller than 1 percent. The same results with individual intercept and trend conditions show results obtained for inflation. These results do not have a unit root and are stationary with a significance level of 1 percent. Whereas for the variable of unemployment (UN), testing showed stationary results, with a 1 percent significance levels for LLC, while IPS, ADF, and PP had 5 percent significance levels. Therefore, the INF and UN variables are integrated in I (0).

Table 2. Panel Unit Root

Variable	At-level		First-difference	
	Individual Intercept	Individual Intercept and trend	Individual Intercept	Individual Intercept and trend
Inflation (INF)				
LLC	-5.611**	-6.977**	-	-
IPS	-3.921**	-4.338**	-	-
ADF	49.975**	56.294**	-	-
PP	69.861**	68.859**	-	-
Unemployment (UN)				
LLC	-3.396**	0.789	-3.767**	-3.489**
IPS	-1.768*	-0.215	-4.974**	-3.842**
ADF	31.764*	38.41**	85.416**	60.502**
PP	33.997*	29.57	144.094**	110.608**

Sources: Estmated Results, 2019. Represents *5%, **1%.

The estimation results of the Phillips Curve with a linear approach can be seen in Table 3. To determine the best estimation method to use, three analytical methods namely OLS / PLS, GMM 2SLS and GMM First-Difference (GMM FD), were compared.

An Instrument Variable (IV) method was used to estimate the GMM Panel in accordance with estimation variables, namely inflation (INF) and unemployment (UN), by assuming that the past effects of these two variables have an effect on predictions of the future. While the use of variable exchange rates (ER) was treated as an exogenous IV, because ER can create imported inflation.

The results of the estimation of the three methods above showed a negative relationship between inflation and unemployment, but the use of the PLS method showed insignificant results. The estimation with the GMM 2SLS Panel method that used an endogenous IV: C, UN (-1), INF (-1), UN (+1), and an exogenous ER, ER (-1), produced 6 instrument ranks with a J-stat probability value of 0.000, meaning that this data is invalid, and the model is not appropriate. Then, proceeding using the GMM First-Difference Panel (GMM FD) method using an endogenous IV: @DYN (INF, -2), UN (+1), UN (-1) and exogenous: ER, ER (-1), resulted in 10 rank instruments with a J-Stat probability value of 0.419> 0.05, which means that the use of IV in this model is valid.

In the measurement of the GMM model, R-square was not used as a standard statistic to determine whether or not a model is appropriate. Instead the value of the J-Stat used in the model (Solikin, 2004) was used to assess the validity of the Variable Instrument (IV). The estimation results with a GMM FD panel showed a negative and significant relationship between inflation and unemployment. An increase of 10 percent in unemployment will cause inflation to decline by 0.3 percent. This shows that the trade-off between inflation and unemployment does occur, and thus the Phillips Curve is proven to exist in the economies of Southeast Asian countries.

The findings of this study contradict the previous study conducted by Furuoka & Munir (2009), who found no trade-off between inflation and unemployment in five Southeast Asian countries, which indicated the absence of the Phillips Curve in the economies of these countries. This may be due to the number of countries studied and the use of different methods. Then, several results of similar studies with time series data found a trade-off between inflation and unemployment, in effect confirming the existence of the Phillips Curve in several Southeast Asian countries (Furuoka, 2007), (Furuoka & Munir, 2010) (Solikin, 2004), (Furuoka et al., 2013), (Maichal, 2012).

Table 3. Linear Estimation of Phillips Curves

Variable	OLS/PLS	GMM	
		2SLS	First-Difference
Constant	3.396	3.553	-
	(2.555)**	(2.515)*	
UN	-0.16	-0.17	-0.356
	(-0.733)	(-1.852)	(-7.551)**
INF(-1)	0.594	0.59	0.488
	(10.29)**	(2.663)**	(2163.6)**
R-Square	0.358	0.354	-
R-Square Adjusted	0.351	0.348	-
F-Stat	54.471	-	-
	[0.000]**		
DW	1.81	1.81	-
AR(1)			-1.898
			[0.057]
AR(2)			-1.484
			[0.137]
Instrument Rank	-	6	10
J-Stat	-	43.76	8.139
		[0.000]**	[0.419]

Sources: Estimated Results, 2019. () t-stat, [] prob., *5%, **1%. GMM exogen instrument: ER, ER(-1).

Table 4 shows the estimation of the quadratic non-linear model regression applied to the unemployment variable (UN). The estimation results explain that the effect of unemployment on inflation is negative, but not significant, where an increase in unemployment of 1 percent will reduce inflation by 1.8 percent.

Table 4. Non-Linear Estimation of Phillips Curves

Variable	Coefficient	T-Stat	Prob.
Constant	11.236	4.962	0.0000**
UN	-1.801	-1.833	0.0682
UN^2	0.112	1.511	0.1322

Sources: Estimated Results, 2019. Represents *5%, **1%.

To calculate optimal inflation and unemployment in the region of Southeast Asia, an optimization formula d (INF) / d (UN) = 0 was used:

$$INF = 11.236 - 1.801UN + 0.112UN^2 \quad \text{.....(4)}$$

$$\frac{d(INF)}{d(UN)} = -1.801 + 0.224UN \quad \text{.....(5)}$$

$$UN = \frac{1.801}{0.224} = 8.04 \quad \text{.....(6)}$$

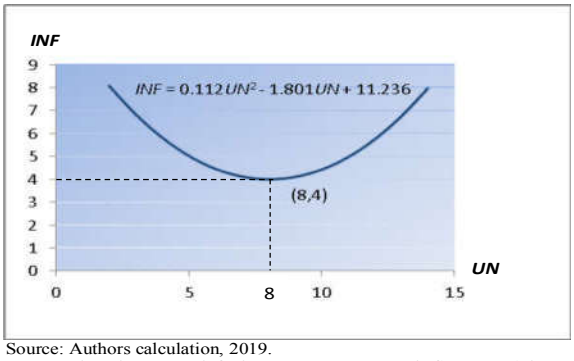
$UN \approx 8$ Percent

The UN result of 8.04 percent was substituted into Equation (4); in order to obtain the optimal INF number:

$$INF = 11.236 - 1.801\,(8.04) + 0.112\,(8.04)^2$$
$$= 11.236 - 14.48 + 7.239$$
$$= 3.995$$

$INF \approx 4$ Percent

Based on these findings, the relationship between inflation and unemployment in the countries of Southeast Asia can be described as follows:

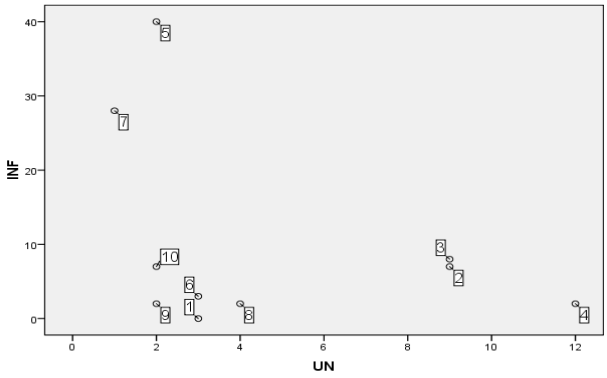


Source: Authors calculation, 2019.

Figure 1. The relationship between inflation and unemployment in Southeast Asia

The optimal inflation limit in the region of Southeast Asia obtained in this study was 4 percent, approaching the inflation limit obtained by Al-Zeaud & Al-Hosban (2015), which

was 3.779 percent. While the optimal unemployment rate obtained, 8.04 percent was as much as 8 percent lower than the result obtained for Jordan, was 11.077 percent. This is possible because both Jordan and countries in Southeast Asia have small and open economies, and this can also occur because of the use of different methods and data.



Note : 1. Brunei Darussalam (3,0); 2. Filiphina (9,7); 3. Indonesia (9,8); 4. Kamboja (12,2); 5. Laos (2,40); 6. Malaysia (3,3); 7. Myanmar (1,28); 8. Singapura (4,2); 9. Thailand (2,2);10. Vietnam (2,7)

Source: Authors calculation based on estimated results, 2019.

Figure 2. The relationship between inflation and unemployment in 10 Southeast Asia Countries

The relationship between inflation and unemployment in Southeast Asian countries can be seen in Figure 2. Out of ten countries in Southeast Asia, 5 have trade-off values that meet the criteria of optimal unemployment and inflation in the region namely, countries where the unemployment value (X) is higher than the inflation value (Y). These five countries are Brunei Darussalam (3,0), Philippines (9,7), Indonesia (9,8), Cambodia (12,2), and Singapore (4,2). While Laos (2,40), Myanmar (1,28) and Vietnam (2,7) have different trade-off values, where the unemployment values are much lower than the optimal inflation values. Then as Malaysia and Thailand have the same values of unemployment and inflation, namely (3,3) and (2,2), they exhibit no trade-off.

This occurred because during the period of around 1997-1998 there was a global crisis that affected the economies of countries in Southeast Asia, and each country had a different level of resilience to the crisis.

5. Conclusion

From analysis of the results of the relationship between inflation and unemployment in Southeast Asian countries, it can be concluded that through a linear approach, the estimation results of dynamic panel data models with the GMM / DPD panel method show that inflation and unemployment have a negative and significant relationship. Thus, the trade-off between inflation and unemployment occurs, and the Phillips Curve is proven to exist in Southeast Asian countries. With a non-linear approach, estimates were made using the Panel Least Squared (PLS) method with a quadratic equation model, from which an inflation value of 3.996 percent ≈ 4 percent and unemployment of 8.04 percent ≈ 8 percent were obtained. These values are thus the optimal inflation and unemployment values for Southeast Asian countries.

Based on the Phillips Curve review, the trade-off between inflation and unemployment in Southeast Asian countries indicates that these two problems cannot be addressed simultaneously. Governments and policy makers must choose to address the issues that are most urgent, either by applying monetary policy, fiscal policy, or both. Then, every country in Southeast Asia can determine the optimal level of inflation and unemployment and also try to reduce inflation and unemployment as much as possible in order to maintain economic stability and public welfare.

In this study, only the original Phillips Curve Model was used, because the variables studied were limited, as it only focused on the problems of inflation and unemployment. Further research could be done using the Hybrid Phillips Curve model and the New Keynesian Phillips Curve (NKPC) model, so that more accurate results can be obtained with a broader scope of research.

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HUMAN CAPITAL AND HIGHER EDUCATION AS DRIVERS OF ECONOMY IN ALBANIA

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Abstract

Education is a strong pillar for the qualitative growth and improvement of human capital. Appropriate and necessary education of people will enable business employees to have the necessary knowledge for the activity. The growth of businesses will have its impact on the growth of the country's economy. People are turning to higher education more and more as a way to enhance their personal wellbeing. Higher education is seen by people as the best way to enable the employment and higher salary in the future. For this reason the focus of this paper is education. The main objective is to understand the impact of higher education in economic growth. This paper analyzes the impact of education through several variables on economic growth in Albania, focusing more on the impact of higher education. The independent variables considered in this paper as representatives of education are mean years of schooling, enrollment in primary education, enrollment in secondary education, enrollment in higher education, while as a representative of growth is used dependent variable Gross Domestic Product (GDP) per capita. From the model we found the variables mean years of schooling and enrollment in higher education are significant and positively related with GDP per capita. The analysis is based on model building with secondary data using the method of least squares.

Keywords: human capital, higher education, school enrollment, GDP per capita
JEL classification: I23, O15, H52

1. Introduction and literature review

1.1. Introduction

Higher education is very important for its impact on the development of human capital, technology and economic growth. After the change of political system, there was an opportunity to graduate to all those who sought to study in higher education. The country's socio-economic changes highlighted the need for increased human capital through education. People were free to attend higher education. They were eager for knowledge and headed to the universities making the demand for higher studies to grow. The demand for studies in the last three decades has been increased, a demand that led to the opening of private institutions of education.

The market needed contemporary professionals and thus universities opened the new study programs to suit the economic changes, which increased government spending to universities.

The Albanian economy did not always perform well. The country has more imports than exports and the growth rate of the Gross Domestic Product (GDP) has had fluctuations. The growth rate of GDP is very important because it is a strong determinant of the growth rate of all economic activities which is important for employment of people.

The 2008 financial crisis did not leave without affecting Albania's GDP growth rate. Economic development in Albania fell after the financial crisis of 2008, even though not immediately. In recent years, the growth rate of Gross Domestic Product (GDP) has been positive and this is expected to increase youth employment opportunities.

The focus on education in this paper is for the simple fact that we believe that education is an essential element for poverty reduction and economic growth. Undoubtedly this does not imply that economic growth depends solely on education but the purpose of this paper is to find out whether there is a direct link between education and economic growth in the country

and if so, to recognize this link and use it for further economic growth. Poverty is income poverty, lack of qualitative material goods, deprivation of physical or non-self esteem and self respect in society. They are result of training, intelligence, experience, etc. (UNDP, 2006). An individual with high school education is able to find a job in a shorter timeframe and with a higher wage than a person with no higher education (Zimmer, 2016). So, a way to reduce unemployment and poverty is through the growth of number of educated people and government's strategies and spending in this regard are essential.

In recent years there has been a slight decline in secondary and tertiary education enrollment. Albania has also been experiencing high emigration in recent years and this may be one of the reasons for the decline in secondary and tertiary education enrollment.

Another reason may be the economic situation of Albanian families and the employment of young people instead of studying. The desire of Albanians to live in developed countries and especially in European Union (EU) countries has contributed to the increase in the number of young people studying at abroad universities. This will cause a shortage of specialists in various fields in the future if graduates do not return to their home country. Businesses may not meet the needs for qualified employees and it will bring a slowdown or interruption of their growth and development and economies country as a whole. Immigration and family planning has had the effect of increasing the average age of the population in Albania. The decline in the number of students attending secondary and tertiary education is the incentive for this paper to understand the importance of education in economic growth. The level of education of a country's population is very important because it is one of the important indicators in determining the development of human capital. The development of human capital is one of the main factors influencing the development of an economy. One of the most well-known models of factors affecting economic growth is The Solow Growth Model which analyzes the impact of factors such as population growth rate, the rate of technological progress and the savings rate on economic growth. There are many authors who have emphasized the enormous impact of human capital on economic growth and added to the model to study the impact of human capital on the economy or have analyzed in particular the impact that human capital has on economic growth in a direct or indirect way. The impacts are different because the impact of human capital is very complex.

Human capital has been widely regarded by various authors as very important influencers in technology development and consequently in economic growth. Human capital also influences the saving rate because the more educated an individual, the smarter he will be at the investments he will make as well as the savings rate. Mankiw, Romer and Weil (1992) showed that the human capital has a significant role in the economic growth. The authors introduced human capital measured through education as a new variable in the model in the Solow growth model and this variable is important for explaining deference in income per capita among countries.

Many authors have studied human capital for its impact on the economy through human capital education. We are aware that human capital is much more than years of education. Human capital is also expanded and enriched by studies independently whenever an individual needs certain information or methodologies. He uses these studies throughout his life to be more efficient in his work. Human capital is also enriched by learning from each other, acquiring knowledge that someone else has and then using it in their activity or work.

1.2. Overview of previous studies on the link between education and growth

The literature suggests that the best way to calculate human capital and analyze its impact on the economy is through education. Various authors have used education-related variables to explain economic growth. Different authors have used indicators like school enrollment rates, years of education, educational attainment, etc. to understand the effect of human capital. Barro and Lee (2013) investigate the relation between output and human capital stock, measured by educational attainment. They found that schooling has a significant positive effect on the level of income.

According to Pelinescu (2015) there is a positive, statistically significant relationship between GDP per capita and innovative human capital capability and qualification of employees and specifically those with secondary education, while there is a negative relationship between education spending in GDP and GDP per capita. Investing in human

capital is essential to the economic growth of a country. Education enhances human productivity, social benefits and financial benefits by strongly influencing the household (Ozturk, 2001). The analysis conducted by Odit, Dookhan and Fauzel (2010) concluded that human capital does lead an increase in the output of the economy and facilitates the implementation of new technology in the country.

Bils and Klenow (2000) estimated the growth in human capital from 1960 to 1990 for a cross section of countries and they concluded that growth in human capital accounts only for less than one-third of observed relation between schooling and income growth. High school enrollment maybe associated with faster growth because increased human capital facilitates adoption of technology. An economy that has a stock of human capital will experience rapid growth and international trade will have a positive impact in this direction resulting in economic growth (Romer, 1990). He used as a representative of human capital, years of education.

In the long run economic growth, education and technology are like two engines. However, it should be kept in mind that human capabilities cannot grow indefinitely as technology that can be improved without limit (Gomes, 2002).The effects of education are not immediate, they even last in time. In the simulation developed by Appiah and McMahon (2002) many of the effects on economic growth are indirect and delayed, including the effects of education. The education of the population results in the strengthening of institutions which in turn contribute to a higher rate of private investment. They used variable gross enrollment rates because this variable indicates the level of investment invested in education.

Education is expected to reduce poverty but also the mobility of employees from one place to another is influenced by education. According to Lucas (1988) if labor mobility is possible and benefits can pass from one person to another, then the labor wage rate in any given skill level will be increased by increasing the wealth of the country in which he is employed. Since the labor movement normally occurs from poor countries to rich countries then the poor countries don't benefits. In a model human capital accumulation was represented by schooling and in the other model specialized human capital accumulation was represented from learning-by-doing. The results of the study of Gocer and Erdal (2015) showed that to cut down youth unemployment rate to a reasonable level recommend job training and learning skill developments, etc., because even an exclusive economic growth will not be enough to reduce the youth unemployment rate if youth unemployment is quite severe.

One of the problems of young people is the unemployment created as a result of the inconsistency of education and qualification with the labor market demands. To help young people create opportunities for employment, the Albanian government is orienting them towards vocational education. Kruss et al., (2015) emphasize the importance of linking education and economic development. Universities should focus strongly on their specialties. They need to develop their specialties by focusing their programs on priority sectors related to their expertise. This requires a clear strategy of cooperation between universities, businesses and government.

According to Breton (2012) the evidence for education returns shows that investment in schooling is subject to reduced returns, but the macro benefit of all education is substantial in highly-educated countries. In less educated countries marginal returns are much higher but this return is generally indirect and marginal returns to education are generally not appreciated. These very high macro-marginal returns to education would lead to rapid growth in poorer countries if they would focus on raising the average level of education.

Gyimah-Brempong, Paddison and Mitiku (2006) found in their study that the effect of higher education on the growth rate of per capita income is significant statistically and more important than physical capital investment. All levels of education have positive effects on income growth

According to Sapir et al. (2004) the basic requirement for an innovation-driven economy is higher education. The US has grown faster than the EU because of its investment in education. Total public and private spending on education in the USA is twice the EU average and still more than any Member State. The percentage of the population with higher education and post-secondary education is high compared to EU countries. The impact of higher education on economic growth depends on whether the economy is based on an innovative industry or on the production of imitation. Thus, innovation makes intensive use of highly

educated workers while imitation relies more on combining physical capital with less educated labor (Aghion et al., 2009).

Activities of higher education institutions, in addition to other influences, impact positively GDP per capita and reduce unemployment in the long run (Schubert and Kroll, 2016). Government policies have a major impact on higher education and higher education has an impact on the economy by creating a lasting link between higher education and the business environment by creating different approaches especially for universities (Untaru, 2012).

According to Summers (2011) most evidence would suggest that the current world economy is going to be a knowledge economy to a much greater extent than we have ever seen. Economic differences have greatly expanded. The salaries between the trainees at the best higher education institutes and those at the second-hand institutes vary widely. Salaries among high school graduates also vary among college graduates. (Kimenyi, 2011) primary and secondary education is very necessary for economic development but not sufficient. Data show that the differences between countries in higher education (enrollments in tertiary education) can explain the differences in economic development. A particular focus should be on the quality of higher education. Mariana (2015) showed that the number of students attending higher education has positive effect on economic growth.

Government support is very important for the development and encouragement of education. There are many forms of government support but direct support is through spending on education.

The starting amount of human capital (represent by school-enrollment rates) is positively correlated with growth in real per capita GDP. While that the ratio of government expenditure to GDP is negatively related to GDP per capita (Barro, 1991). Mosikari and Marivate, (2013) show in their study that student financial aid is an international problem but it is worth considering because in the long run student financial aid increases enrollment in higher education.

Investing in education is very important for a country's economic growth. The increase of government spending in education by 1 percent point will result in GDP growth by approximately about 0.3 percent points (Konopczyński, 2014).There is a negative relationship between educational expenditure, unemployment rate and Gross Domestic Product even thought with no significance (Agboola, Musa and Ibrahim, 2018).

This paper is structured in three parts. The first section describes the importance of human capital in economic growth and the importance of education for the development and advancement of human capital. The second section outlines the attitude of the government towards education through budget funds towards education. This section also deals with the financial problems of young people, especially those studying in higher education. The third section provides the analysis of the research of this paper through linear regression analysis.

Limitations of the paper are the lack of data for the entire period studied for other indicators related to education, in particular the quality of teaching.

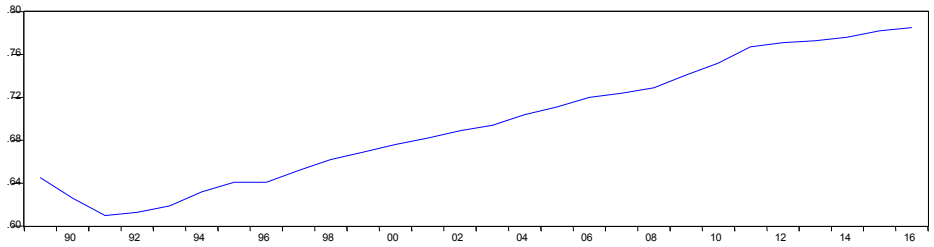
2. Education in Albania and Government Funds towards it

The importance of education and higher education in particular is indisputable for every state. The Albanian government is paying more and more attention to education. The attention to primary and secondary education consists in both attendance and increasing quality. Quality improvement consists of curricula as well as infrastructure. Many schools have been restored aiming to improve living and teaching conditions. School curricula have been and are changing with the aim of adapting best international practices. In recent years elementary school students have been given free textbooks.

The population of the country is relatively young. Primary education is compulsory and has enrollment levels above 100%. Secondary education enrollment rates are satisfactory at around 95.43% (World Bank, 2019), but a satisfactory figure that leaves room for improvement. If we compare the 1990 level of 90% with the 2018 level, it looks like the difference has been small, but there have been years with very low registration levels. After 1992, enrollment levels in secondary education dropped to about 70%, and only in 2013 it exceeded 90%.

Enrollment rates in higher education or university are around 55%. The enrollment rate in higher education has increased significantly from 8% in 1990 to 15.5% in 2000 and to 55% in 2018. This increase is very important because, first of all, the high percentage of the population in this age necessitates their orientation towards higher education or vocational education in order to qualify and enable employment. Second, the qualification enables them to adapt as closely as possible to the requirements of private businesses activities, thus increasing the productivity of these businesses and consequently increasing productivity throughout the country. Albania's human development index has grown especially since '97. One of the major determinants of this index is the education index, which has also been increasing over the years.

Figure 1. Theperformance of Human Development Index in Albania

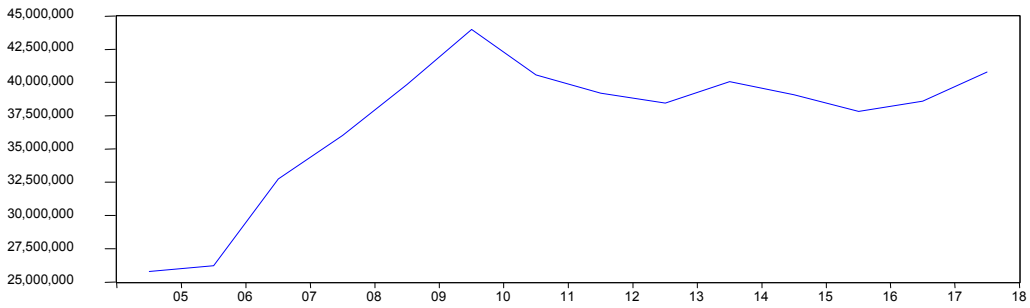


Source: UNDP 2019

It is very important to understand the government's vision of education and especially of higher education. The number of higher education quotas has always been increasing and this has facilitated and encouraged higher studies.

From the expenses that the Albanian government has realized for education, we understand that education has not been a priority, Figure 2. Expenditure on education is about 8 percent of all public spending in the last three years. Regarding the third level of study or university, besides government funding, they also have financial autonomy (depending on the number of students). However, the limited public spending is as well a result of low revenues in the state budget from corruption and mismanagement. Mismanagement is affecting all public sectors by limiting public spending.

Figure 2.Evolution of total expenditure on education



Source: Ministry of Finance, 2019

In terms of expenses that government directs toward education we are focused in spending on higher education. Expenditure on higher education, at best in the last two years, is 20 percent of total education spending; to be exact is 20 percent of 8 percent of all expenditures. But if we consider increased government spending towards students raising funds for scholarships for excellent students, for student's aid, government spending on youth education is higher.

The low level of economic development and lack of jobs combined with graduate and postgraduate study fees has made financial difficult for youth.

To facilitate studies, the personal income tax recognizes as deductible from income the interest of student loan and student scholarships. However, this is not enough because it creates uncertainty for the future. Because students who create financial obligations during their studies and face an uncertain job market would undertake financial risk if they would

finance studies with credit. Both economic theory and international experience suggest that a well-designed system require an important and sustainable government role to provide service itself, to ensure quality, to regulate levels of fees, etc. (Barr, 2011) .

Today's students will be the future economists, doctors, engineers, teachers, etc., and their work will promote economic development of the whole country.

The largest number of employees in Albania is in the private sector. The development of industries creates sustainability in employment but also changes in the skills of employees. Technology has evolved and more and more businesses are looking for up-to-date knowledgeable employees. Faculties open many new branches of study to adapt to changes and respond to new demands of the labor market.

From official statistics it turns out that unemployment has fallen but if we see growth in businesses this is not justified. However, the growth rates of the economy are positive and will thus have an impact on the opening of new jobs.

Students attending higher education must pay the tuition fee. The fee for public studies is low at Bachelor level and increases at Master level. Meanwhile students studying at private universities have high fees at both levels of study. Many students study away from family, in another city, and in addition to the expenses of living they rent out an apartment where they will live, increasing the cost of living. So, the most concern essential issue for students is cost of living and studying.

Even though a part of the students work, it is a concern that they do not all work in the same direction with the study profile. Working in any sector is important because it is an opportunity to meet the expenses, but if is worked for years in a job that has nothing to do with the qualification, it distorts formation and creates the lack of experience so much needed to move to the labor market.

The universities have included in their curricula the practices and this helps students to be close to businesses or jobs and create employment opportunities. In Albania there are not much employment opportunities for young people. In the summer period, job vacancies are opened in tourism, and this can provide income even though low and short term income.

However, a major problem is the lack of part time jobs. A student pursuing studies cannot work full time because it limits the time of learning as it limits the time for any other activity because simply the day would be insufficient. Employment is important for meeting the costs from the students' point of view but from the perspective of the economy is very important for the development. So the policies built regarding labor market should take into account the impact on economic development.

In terms of employment in 2018, the overall employment rate was 52.1 percent. People with higher education had the highest rate of employment with 62.3 percent, while those with only primary education had the lowest rate of employment, presented in Table 1.

Table 1.Employment rate by education, in percent

Years	2010	2011	2012	2013	2014	2015	2016	2017	2018
Higher education	66.9	62.9	61.6	62.5	61.3	59.2	61.6	63.3	62.3
Midlle education	50.1	56.9	54	47.8	46.7	47.9	51.5	53.5	54
Primary education	43	47.1	45	38.2	38.9	41.4	43.5	44.4	47.3

Source: INSTATb 2019

Institute of Statistics (INSTAT) data on the structure of the population outside the labor force is dominated by students. The unemployment rate in the country has decreased. During 2018 the unemployment rate in the Albanian labor market fell to 12.3%. The biggest impact on the unemployment rate are young people aged 15 -24 (INSTATa, 2019). The unemployment rate among the 15 -24 year olds in 2018 dropped to 28.3% from 31.9% in 2017. Unemployment among the 15 -24 year olds with higher education was33,8% in 2018 meanwhile in 2017 was 33.1% (INSTATb, 2019).Other levels of education also have costs for families but we are focused on higher education.

3. The analyze of the relation of higher education in economic growth, the model

3.1. Data and Methodology

In our paper we use a quantitative research method based on a regression model. The model is build with secondary data. We will test the nature of relationships between a dependent variable which is GDP per capita and some independent variables related to education using the method of the ordinary least squares method.

To determine the independent variables we consult the literature review and find that the most commonly used variables as the most determinant indicators of education are gross enrollment rates, educational attainment and years of schooling. Due to the inability to find the data we do not include education attainment. We include in the study as independent variable gross enrollment rates as a variable widely supported by studies. This variable is important to assess how education affects economic growth because according to previous studies, this variable determines in a way investment in education. The purpose of investing in education is to increase the income of individuals represented by GDP per capita.

A large number of authors support GDP per capita, which is why in this paper economic growth is analyzed through GDP per capita. For this reason, in this paper we will analyze the impact of education on economic growth represented by GDP per capita, which in our model will represent the dependent variable y_t.

The independent variables x_{it}= for $i = 1, 2, 3,4$ will be mean years of schooling, enrollment primary education (% gross), enrollment in secondary education (% gross) and enrollment in higher education (% gross). So our model is linear:

$$y_t = b_0 + b_1*x_{1t} + b_2*x_{2t} + ... + b_n*x_{nt} + \varepsilon_t \quad (1)$$

To explain the impact of education on GDP we used annual variables due to the availability of data. Time series data is selected for 28 years, from 1990 to 2017. All indicators mentioned are economic indicator for Albania, and are collected from World Bank through the World Development Indicators database and United Nations Development Programme.

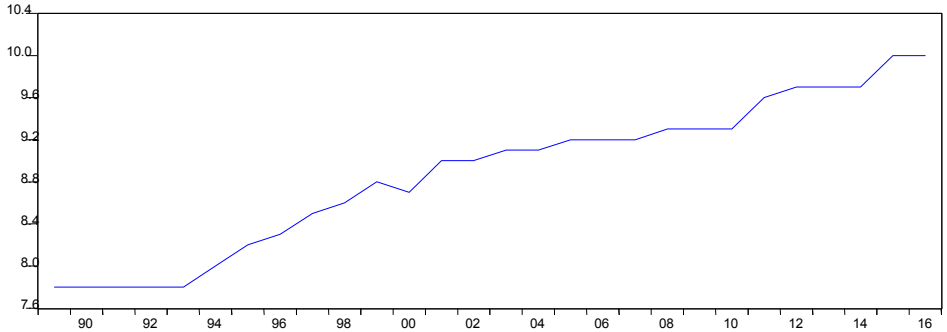
3.2. The model

To analyze the relationship between education and GDP we examined some variables that were also supported by previous studies by other authors. We found the connection between education and economic growth by examining the GDP per capita not only because it is supported by studies but also because it fits the purpose of the study.

Anyone who invests in studies spends not only financially but also their time, years. The purpose of this is to provide high income during his lifetime. Undisputed that any person has different incomes, but since the goal of the paper is to study the link of education with the economic growth for all individuals within the economy, the best dependent indicator is GDP per capita.

In terms of the variables used for education we have used mean years of schooling, an variable that has been steadily increasing with the exception of '90 -'94, 2002-2003, and the last two years when there were no change, as is indicated in the figure 3.

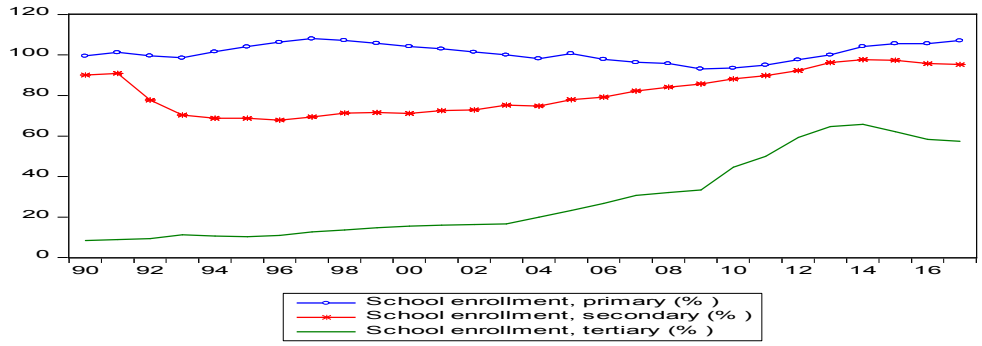
Figure 3. Mean years of schooling



Source: Authors

Other variables are enrollment primary education (%), enrollment in secondary education (%), enrollment in higher education (%). Enrollment in primary education, (%) has had steady ups and downs. Primary education (nine years) is compulsory and it explains the values around 100%. School enrollment, in secondary education (%) is an indicator that has declined sharply after '90. Economic and political changes have greatly influenced this variable. In these years, young people of this age addressed the labor market both at home country and abroad, reducing the number of students in this studies cycle. School enrollment, tertiary (%) has been increasing with the exception of the last two years, but the decline of the last two years remains to be seen, whether this is casual or due to the increase the grade level admission in universities, Figure 4.

Figure 4. The evolutions of enrollments



Source: Authors

The dependent variable and the independent variables are summarized in the Table 2.

Table 2. Dependent and the independent variables

Variable	Definition
y	GDP per capita
X1	Mean years of schooling
X2	Enrollment in primary education
X3	Enrollment in secondary education
X4	Enrollment in higher education

Source: Authors

We analyzed the relation between the independent variables and the dependent variable by the least squares method and the results of the model tested by EViews 10, are summarized in Table 3.

Table 3.The results of the model

Variables	**coefficient**	**Std error**	**t-statistic**	**probability**
b_0 = constant coefficient model	-4324.496	1575.612	-2.744646	0.0115
Mean years of schooling	1033.038	111.7679	9.242708	0
Enrollment in primary education	-32.57698	8.725054	-3.733728	0.0011
Enrollment in secondary education	10.60939	6.906222	1.536208	0.1381
Enrollment in higher education	13.30026	5.506987	3.323099	0.003
R^2	0.978995			
Adjusted R^2	0.975341			
F-statistic	267.9886			
Prob (F-statistic)	0			
Durbin-Watson stat	1.172479			

Source: Authors

The model has been subject of some econometric tests. To test homoscedasticity, we test the model with the Breusch-Pagan-Gogfrey Test. In this test the Obs * R-squared is 4.437898

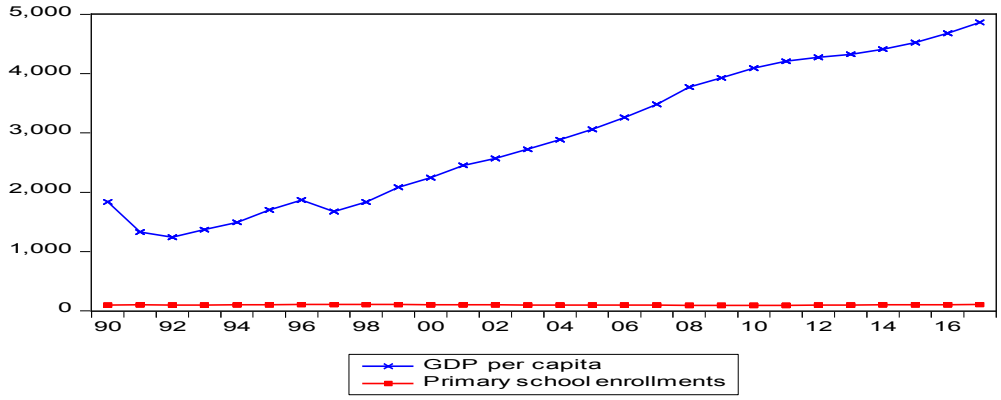
while Prob. Chi-Square 0.1087> 5%, which means that we fail to reject the null hypothesis and that the model is not heteroscedastics but homoscedastics and the model is very good there is no serial correlation.

Then we analyzed the distribution of values by the normality test and it turns out that the values are normally distributed. With probability 0.4615> 5% variable are normally distributed.

From testing the model is showed that higher education is very important for economic growth. Secondary education has a positive but not significant relationship while primary education is with opposite sign. After the '90s, higher education was the focus of people who didn't have the opportunity to study before the' 90s. They continued their studies and even directed their children to higher education. The increase in enrollment in higher education affects the creation of experts. Prob (F-statistic) is 0.0000 meaning that F statistic is significant. It means that all independent variables jointly can influence dependant value.

The percentage of enrollment in primary education has slightly fluctuated over 28 years, while GDP per capita with the exception of '92 and '97 has increased. If we look only at GDP values for capita and enrollment in primary education, the performance of which is shown in the following chart, the values do not have the same trend as presented in Figure 4.

Figure 4. The evolutions of enrollments in primary education and GDP per capita



Source: Authors

Years of falling GDP per capita do not coincide with the peak of enrollment in primary education, even the opposite may have happened. Primary education is compulsory and figures have varied from 93% in the year with the lowest enrollment in primary education up to 107% at the highest. So, since the rate of enrollment in primary education has been steady all the time, while GDP per capita has steadily increased has given the result of a negative relationship. However we have not analyzed the quality of teaching at this level of study or at all levels of study to understand the total effect of primary education on economic growth.

4. Results and discussions

According to statistical analysis of the model we came to the conclusion that education is very important for the economic growth of the country. The variables mean years of schooling, enrollment in secondary education and enrollment in higher education are found to be positively correlated with GDP per capita, this relation is especially important for independent variables mean years of schooling and enrollment in higher education which are statistically important. This result is supported from other authors. According to activities of higher education institutions, impact positively GDP per capita and reduce unemployment (Schubert and Kroll, 2016). This result is also supported by the paper by Gyimah-Brempong, Paddison and Mitiku (2006), where the effect of higher education on growth per capita income is positive and statistically significant. This is very important for future economic growth because according to Aghion et al. (2004) the basic requirement for an innovation-driven economy is higher education. Education is the foundation of human capital development and in this regard it is important to increase the number of years of education. According to (Romer, 1990) an economy that has a stock of human capital will result in economic growth.

As the number of unemployed young people with higher education is high, the government should provide fiscal incentives to businesses so that they can provide part time jobs for students and this will lead to increased enrollment in higher education.

Enrollment in primary education has a negative relationship with economic growth. However, we cannot say that elementary education has negative impact on economic growth because everyone who studies in secondary and tertiary education has undoubtedly completed primary education. Enrollment in secondary education has a positive relationship with economic growth but this relationship does not appear statistically significant. Many of the effects on economic growth are indirect and delayed, including the effects of education (Appiah and McMahon 2002). However, the fluctuating level of enrollment in secondary education highlights the needs of government policies for growth of enrollment in secondary education and the impact on economic growth will be higher, supported by the literature review. According to (Kimenyi, 2011) primary and secondary education is very necessary for economic development but not sufficient, only higher education (enrollments in tertiary education) can explain the differences in economic development.

In conclusion, mean years of schooling and enrollment in higher education have a positive and significant relationship with GDP per capita. Both variables emphasize the need to increase the number of years of study in general by emphasizing the importance of higher education. The government should use different incentives to increase enrollment in higher education. The government should support students financially, a suggestion that is also supported by Mosikari and Marivate (2013) that show in their study that in the long run student financial aid increases enrollment in higher education. It is necessary to lower Master level fees to make it possible for graduates of previous years to attend Master degree in order to acquire the necessary knowledge for current market and thus lower the unemployment and increase employment of higher education graduates.

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TERRITORIAL DIFFERENTIATION OF LABOR AS A FACTOR IN THE SUSTAINABILITY OF REGIONAL ECONOMIES

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Abstract

One of the factors influencing the sustainability of economic processes is the level of labor force territorial differentiation across the country. In locations with high employment rate among the working-age population, as a rule, the indicators of economic efficiency and sustainability are high. The outflow of labor, in its turn, contributes to a shortage of personnel, a reduction in production and an influx of migrants. Therefore, despite the replaceability of the labor force by robotics and digital technologies, for Russia with its vast space, studying the consequences of interregional inequality can identify strategic areas for economic development. Thus, the purpose of the research is to assess the degree of inter-regional inequality in the provision of the country's regions with labor as one of the economic sustainability factors. The study of territorial inequalities in the economic space promotes the understanding of the importance of the strategic tasks in economic development of a complex, subordinate and multicomponent regional system of the Russian Federation. The processes of territorial inequality are greatly influenced by the migration flows, expressed in the outflow of the population mainly from the eastern regions. Significant migrations are common among rural migrants from the Far Eastern, Siberian and Urals Federal Districts. Therefore, the main influx of migrants is characteristic of the Central, North-Western and Southern districts. The contribution of the present research to economic science consists in justifying the prioritized support and development of the territories that are losing population and, accordingly, labor force.

Keywords: region (RF subject), territorial differentiation, labor force, development factors.

JEL classification: R23, J610

1. Introduction

Most countries across the world with a relatively large territory are characterized by regional differentiation. Reasons for it are quite various: the geographical location of the territory, natural and climatic conditions, the specifics of the demographic potential, natural resources, the history of the region and many others. In addition to these factors of regional heterogeneous development, there are others that can be adjusted, leveled out, or even eliminated. For example, the success level of regional management, the efficiency of using production factors such as labor and material resources, development of innovation clusters in the region. (Napolskikh D., et al. 2019). Therefore, the manifestation of territorial inequality can be both long-term and relatively short-term. Thus, scientists and practitioners focus on these issues.

The system of disproportion factors leads to uneven socio-economic development of cities and regions according to such important quantitative and qualitative parameters as the living standards, contribution to the country's economy, investment and innovation activity, industrial, infrastructural and other potentials, level of development of the digital economy (Gretchenko A.I., et al. 2018, Ivanov O.B., et al. 2018). This is related to the relevance of interregional differentiation as an integral feature of the Russian Federation, which determines the specifics of spatial development.

Territorial differentiation in the socio-economic aspect is the division of the country's regions into groups that differ in the level of socio-economic development as well as in terms of population and labor resources provision. These specific features are connected with the development of the territorial division of labor. One of the main reasons for its development are the differences between territories in natural conditions (Gubanova E., et al. 2019). With the development of productive forces and interregional connections, the growth of the urban

population, agglomeration factors began having an increasing impact on the scale and dynamics of territorial heterogeneity, leading to the localization of production and economic activity in several regions of the country, as well as to differences in the availability of transport infrastructure (Friedmann J. 1966).

The factors of natural territorial differentiation include the nature of population distribution and the demographic situation, which undergo changes in the course of time (Arkhipova L.S., et al. 2019). The nature of the population density of a territory is changing as a result of the economic structure transformation, the development and deployment of new types of economic activity. Such a transformation takes place over a long time period and involves huge expenditures of public resources.

There are economic factors of territorial differentiation connected with the results of resources allocation and their efficient use: the structure of production and employment, the level of infrastructure development, improving the quality of social capital (Papadaskalopoulos A., et al. 2018). Such changes are relatively slow.

Russian and foreign scientists offer different methodological approaches to the assessment of territorial socio-economic differentiation. They have common approaches to assessing the differentiation of the territory, as well as its role in the regional economy (Granberg, 2003, Zubarevich N.V., 2014, Nikolaev I., et al. 2011, Porter, 2001, Krugman P., 1994, and etc.).

2. Materials and Method

The research methodology includes an analysis and assessment of processes that determine the density of economic activity in the regions experiencing labor shortage or, on the contrary, labor surplus.

The research is based on such scientific principles as objectivity and comprehensive analysis of the problem. An objective study of territorial differentiation allows us to define it as a natural and regular process that arose amid uneven population of the territory, various socio-economic potential of the territories. Objective laws rely on real factors in the assessment of the regional provision with such a production factor as labor.

The main research methods are comparative (to assess the labor force participation rate, employment and unemployment by macro-regions of the Russian Federation), analytical (during the assessment of inter-regional differentiation of territories), historical (study of processes retrospectively from 2000 to 2018), statistical (in calculating the coefficients of territorial differentiation), and logical (building the research from analyzing the degree of territorial differentiation to identifying its impact on the sustainability of the country's economy).

3. Analysis and results

The research assesses the level of territorial differentiation of labor force, being one of the main indicators of the economic space polarization. According to the methodology of the Federal State Statistics Service of the Russian Federation (Rosstat), economically active population (or labor force) is the part of the population that ensures the supply of labor for the production of goods and services. In terms of numbers, it consists of the employed and the unemployed (Federal State Statistics Service, 2018).

The main indicators used in the research are those published annually by Rosstat: labor force participation rate, labor force size, employment rate, unemployment rate, and population density.

To assess variabilities in regional differences of territorial inequality indicators, the following parameters were analyzed:

1) the range of variability, which is calculated as the difference between the maximum and minimum indicators.

2) the differentiation coefficient which is the ratio of the maximum indicator to the minimum indicator.

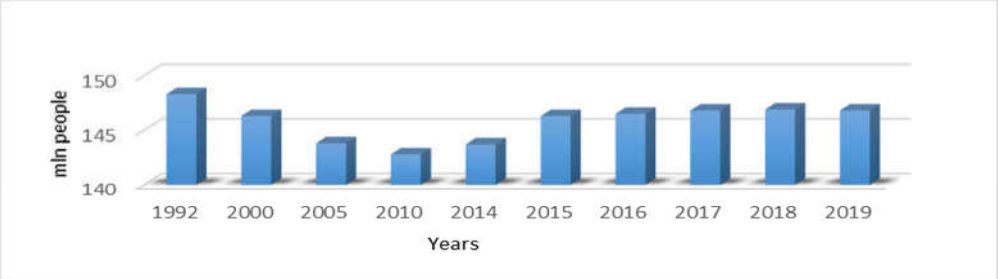
The use of these indicators makes it possible to assess the dynamics of the socio-economic space development and its differentiation during 2000-2018. This period was marked by important events: the 2008-2009 crisis, the introduction of sanctions against Russian

companies. The Russian economic space experiences instability of external and internal factors that influence socio-economic sustainability (Gagarina G. Yu., et al. 2019).

The uneven distribution of labor on the country's territory primarily depends on the demographic situation, the state of its main indicators, and as a result, the population density throughout the country in general.

One of the main indicators is the population size that does not show a positive upward trend (Fig. 1). It declined significantly over the last decade of the twentieth century and demonstrates weak growth dynamics. If in 1992, 148.3 million people lived in the Russian Federation, then by 2019 this figure dropped to 146.8 million people. Certainly, for such a vast territory of the country (17.125 million sq. km), this indicator is insufficient for its economic development and advance.

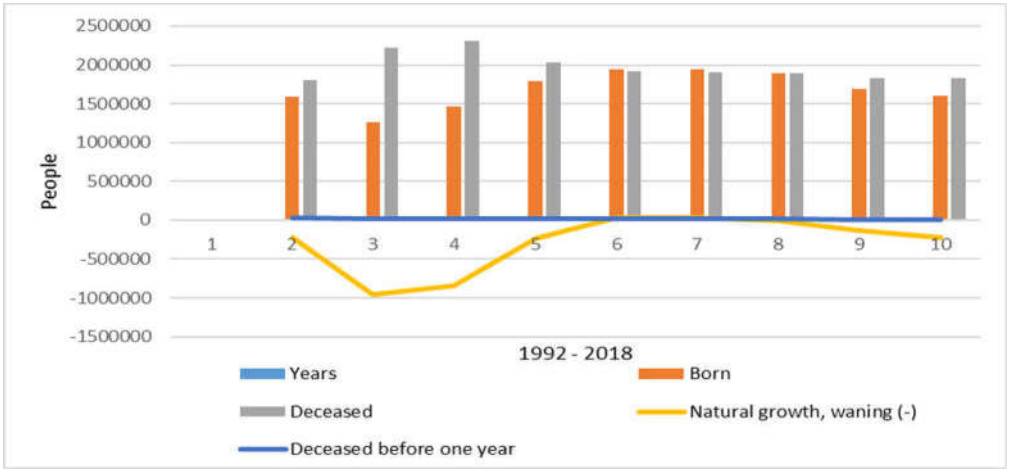
Image 1: Dynamics of population size in the Russian Federation.



Source: compiled by the authors according to the calculation results

During the twentieth century as well as today, Russia suffers very large demographic losses, which are expressed in negative natural growth (depopulation). A particularly high population decline was observed in the mid-2000s, then, following the improvement of the overall macroeconomic situation and the national demographic policy, the natural increase became positive. However, by the end of the second decade of the 21st century, the demographic situation is worsening again, a natural population decline is observed (Image 2).

Image 2. Dynamics of natural population changes, people

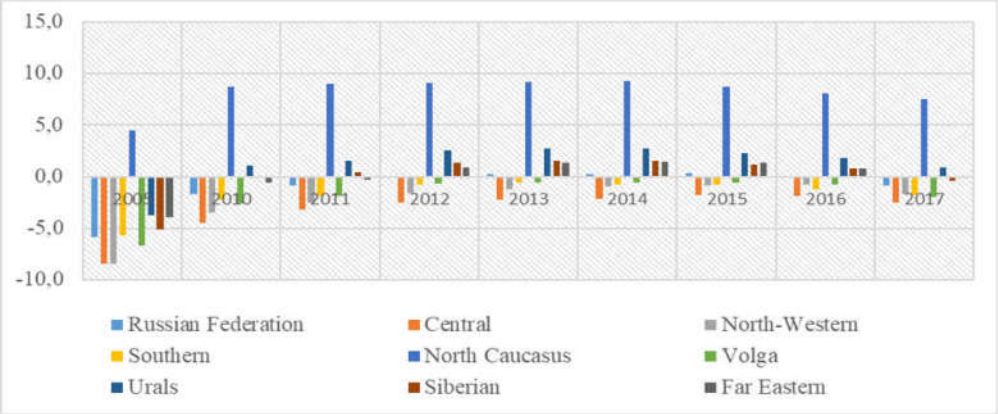


Source: compiled by the authors according to the calculation results

In the territorial context, the natural population decline, calculated using the coefficient of natural growth per 1 thousand inhabitants (or in ‰), is characterized by a negative tendency to decrease to the level of the early 2010-2011 (Image. 3).

The only exception among all macro-regions is the North Caucasus Federal District, where natural growth is persistently high, which is connected with historical traditions and the mentality of the population. There is a slight increase in the Urals District as well. In general, the demographic situation negatively affects the development of human potential, and its differentiation is formed in favor of a small number of regions in the southern and eastern parts of the country.

Image 3. Dynamics of natural growth/decline by federal districts, ‰



Source: compiled by the authors according to the calculation results

However, even if it is possible to maintain a low positive population growth, in the coming decades Russia will not see population growth due to its natural reproduction. The most significant source of growth or stabilization of the population in Russia, as well as in many European countries, can be migration inflow. However, in general across the country it is decreasing and in a number of macro-regions a sustainable trend towards an outflow of the population has developed. Negative migration growth rate is observed in such federal districts as the North Caucasus District – 26, the Volga District – 12, the Siberian District – 16 and the Far East District – 28 (Fig. 3). The European part of the country remains attractive for migrant workers, while the Asian part loses its working population, with the exception of the Urals Federal District, with a large supply of jobs in the extractive industries.

Another factor for the improvement of the demographic situation is the social policy of the state, which affects the quality of the human capital of the territories (Fedotova, et al. 2018) and involves such tools as monthly baby bonus payout, promotion of the employment of women with children, targeted assistance in social security.

The demographic situation affects the population density of the country and subsequently the density of economic activity. So, the population density of the Russian Federation as of 2018 was 8.6 people/sq. km., with the maximum figure in the Central Federal District reaching 60.5 people/sq. km. The minimum is 1.2 in the Far East (Table 1).

Table 1. Population size by territorial entities of the Russian Federation and density

Russian territorial entity	Populations size, thousand people		Change %	Population density, people/sq.km.		Net migration rate per 1000 people
	Year of 2000	Year of 2018		Year of 2000	Year of 2018	Year of 2018
Central	37 920,0	39 318,1	+ 3,7	58,2	60,5	+ 4,7
North-Western	15 237,0	13 955,7	- 8,4	9,1	8,3	+ 3,6
Southern	12 930,0	16 437,1	+ 27,1	31,7	36,7	+ 3,0
North Caucasus	7 606,0	9 821,8	+ 29,1	44,6	57,9	- 2,6
Volga	31 785,0	29 540,1	- 7,1	30,6	28,3	- 2,2
Urals	12 526,0	12 355,5	- 1,4	7,0	6,8	- 0,5
Siberian	21 068,0	19 286,5	- 8,5	4,1	3,9	- 1,7
Far East	7 950,0	8 371	+ 5,3	1,3	1,2	- 4,0

Source: Authors' calculations based on data from information portals

Moscow and St. Petersburg stand out as absolute leaders, while the Nenets and Chukotka Autonomous Districts – as outsider regions. The decile ratio of differentiation is 44 times.

The fact that in five federal districts the size and density of the population decreased is essential for the diagnosis of differentiation of the country's space. This is a negative factor indicating the problems in spatial development of Russia. Given the fact that the Far Eastern and the Siberian Federal Districts occupy 66.5% of the country's territory and are of crucial strategic importance, the decrease in the size and density of the population becomes not only a geographical, but also a geopolitical factor of socio-economic development.

Labor force participation rate is a relevant indicator of territorial differentiation. According to the methodology of the Federal State Statistics Service, this indicator is the ratio

of the labor force size (employed and unemployed) of a certain age group to the total population size of the corresponding age group, calculated as a percentage.

It reflects the share of the country's working-age population, which is actively involved in the labor market. This indicator reveals the size of the labor supply, seeking to participate in the production of goods and services, relative to the working-age population. Labor force participation rate plays a significant role in the study of factors affecting the development of the labor market (LOSTAT. Geneva).

The classification of labor by macro-regions and regions of the country allows us to assess its distribution depending on the comfort level of the territory and, thus, analyze the features of territorial differentiation. Table 2 presents the dynamics of the labor force participation rate by federal districts of the Russian Federation.

Table 2. Labor force participation rate of the population aged 15-72, in %

Federal districts/Russian Federation	2000	2018	Change
Russian Federation	65,5	68,9	+ 5,2%
Central	65,9	71,3	+ 8,2%
North-Western	66,4	70,5	+ 6,2%
Southern	62,8	66,8	+ 6,4%
North Caucasus	61,2	66,2	+ 8,2%
Volga	65,9	67,7	+ 2,7%
Urals	66,6	69,0	+ 3,6%
Siberian	65,2	66,9	+ 2,6%
Far Eastern	67,0	69,4	+ 3,6%
Max	67,0	71,3	
Min	61,2	66,2	
Range of variability, units	5,8	5,1	
Differentiation coefficient, times	1,09	1,07	

Source: Authors' calculations based on data from information portals

Over 2000-2018, there were significant changes in the spatial distribution of labor:

- while at the beginning of the current century the maximum labor force participation rate in the labor market was observed in the Far East, now Central Russia is becoming more efficient, as there is a high level of demand for labor and a large number of vacancies;
- the labor participation rate in the macro-regions where the main type of economic activity is mining is increasing: the Urals Federal District – the share in the gross added value of this sector is 35%; the Far Eastern and Siberian Districts, respectively, 28.2% and 15.6%. These macro-regions demonstrate the highest supply of jobs and high wages;
- despite the positive increase in labor force participation in the economy in all the federal districts, the European part of Russia is the most attractive territory. Its economic space is characterized by a high level of development, diversified economy, a developed service sector and, thus, high living standards;
- the South of Russia – the North Caucasus – has traditionally been characterized by a low level of labor force participation in the regional economy;
- indicators of territorial inequality show a slight decrease in differentiation: if in 2000 the range of variability was 5.8 units, then in 2018 it decreased to 5.1. The differentiation coefficient underwent less significant changes, decreasing from 1.09 to 1.07 times. These trends are associated with a general increase in employment and a decrease in unemployment in most constituent entities of the Russian Federation.

The next indicator is the *labor force size* which includes the population employed in the production of goods and services, and temporarily unemployed. Labor force, being the main condition for production, reflects the degree of regional development and largely depends on the population size of the territory. Thus, the Central Federal District, which is the leader by the number of inhabitants (39.4 million people), has about a third of the country's workforce. The second place is taken by the Volga Federal District (29.4 million people), which concentrates 20% of the country's labor force. The third place is occupied by the Siberian Federal District (17.2 million people) with 11.3% (Table 3).

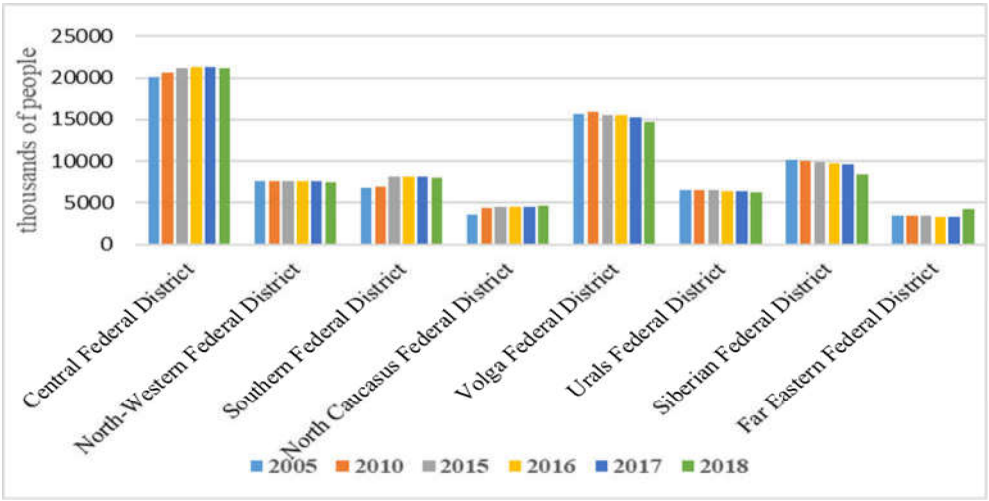
Table 3. Dynamics of labor force size (thousand people)

Federal districts / Russian Federation	Year of 2000	Year of 2018	Labor force size change	Population size change
Russian Federation	72 769,95	76 011,38	+ 4,5%	+ 1,2%
Central	19 530,8	21 337,634	+ 9,3%	+ 3,5%
North-Western	7 394,627	7 499,7	+ 1,4%	+ 0,15%
Southern	6 720,8	8 206,708	+ 22,1%	+ 17,6%
North Caucasus	3 272,3	4 639,1	+ 41,8%	+ 9,9%
Volga	15 785,39	15 041,906	- 4,7%	- 5,2%
Urals	6 359,554	6 358,7	- 0,01%	- 0,15%
Siberian	9 057,7	8 618,12	- 4,9%	- 3,9%
Far Eastern	4 648,7	4 309,5	- 7,3%	- 7,9%
Max	19 530,8	21 337,634		
Min	4 648,7	43 09,5		
Range of variability, units	**14882,1**	**17028,134**		
Differentiation coefficient, times	**4,20**	**4,95**		

Source: Authors' calculations based on data from information portals

The change in labor force size geographically coincides with the dynamics of the population size by region of the country. With population growth in the European regions (without the Volga Federal District), an increase in the labor force size was observed. And, on the contrary, a decrease in the population size in the eastern regions (including the Volga Federal District) is accompanied by a decrease in the labor force size. These trends clearly indicate the negative factors of spatial development of Russia (Image 4).

Image 4. Dynamics in labor force size by federal districts of the Russia, thousand people



Source: compiled by the authors according to the calculation results

An indicator of *population employment* is also of interest. It reflects the number of the employed in the total population aged 15 years and older.

In general, the employment rate in the Russian Federation and federal districts is increasing, which is a consequence of state implementation of its main social goals in the labor market (Table 4). The employment rate in the North Caucasus Federal District increased most significantly (by 10.5%), which is connected with unemployment reduction measures.

Despite the positive facts, differences between macro-regions persist. The maximum employment rate is observed in the European part of Russia in the Central and North-Western Federal Districts, where the employment rate is higher than the average Russian level. The minimum employment rate remains in the North Caucasus.

Table 4. Employment rate of population aged 15-72

Federal districts/Russian Federation	Year of 2000	Year of 2018	Change
Russian Federation	58,5	65,6	+ 12%
Central	60,7	69,3	+ 14%
North-Western	60,0	67,8	+ 13%
Southern	54,7	63,1	+ 15%
North Caucasus	48,7	59,2	+ 22%
Volga	59,5	64,7	+ 9%
Urals	59,9	65,8	+ 10%
Siberian	57,1	62,6	+ 10%
Far Eastern	57,9	65,1	+ 12%
Max	60,7	69,3	
Min	48,7	59,2	
Range of variability, units	**12**	**10,1**	
Differentiation coefficient, times	**1,25**	**1,17**	

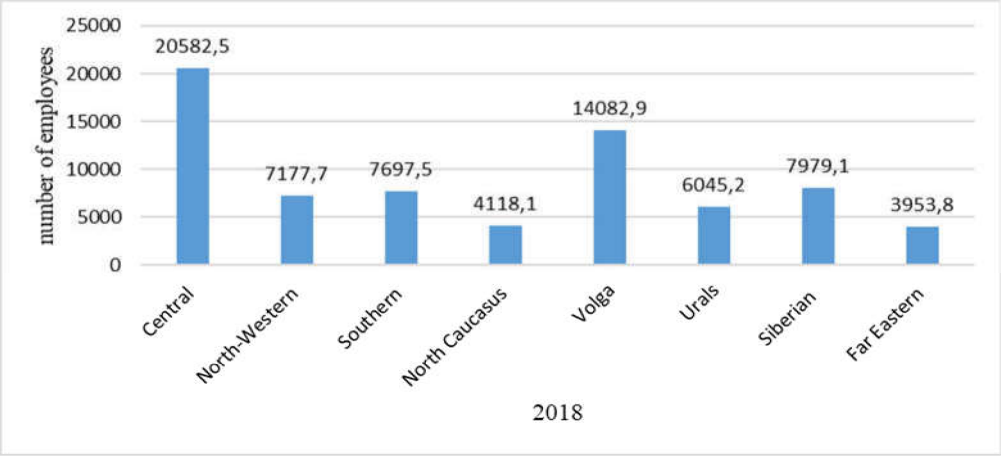
Source: Authors' calculations based on data from information portals

The Urals Federal District also stands out as the employment rate is higher there than the figure for the Russian Federation, which is connected with high demand for labor in the extractive and manufacturing economic sectors.

The growth of the employment rate in the macro-regions of the country positively affected the decrease in territorial differentiation. A decrease in the range of variability (from 12 times in 2000 to 10 times in 2018) and the differentiation coefficient (1.25 in 2000 to 1.17 in 2018) indicate that the country's economic space according to this indicator is becoming more homogeneous and of high quality.

However, in terms of the absolute number of the employed, differentiation exceeds 5 times. According to the population distribution, the maximum number of the employed is observed in the Central and the Volga districts (Image 5).

Image 5. Differentiation by the number of the employed aged 15-72, thousand people



Source: compiled by the authors according to the calculation results

Differentiation by *the unemployment rate* makes it possible to register high figures in the southern regions and in the Far East (Table 5). Reducing unemployment in these macro-regions of the country is a state strategic task. Nevertheless, the unemployment rate in these territories remains one of the highest ones, exceeding the figure for the Russian Federation as a whole.

Table 5. Unemployment rate

Federal districts	2000	2018	Change
Russian Federation	10,6	4,8	- 55%
Central	7,8	2,9	- 63%
North-Western	9,6	3,9	- 59%
Southern	12,9	5,6	- 57%
North Caucasus	20,4	10,6	- 48%
Volga	9,8	4,4	- 55%
Urals	10,1	4,7	- 53%
Siberian	12,4	6,5	- 48%
Far Eastern	13,5	6,3	- 53%
Max	20,4	10,6	
Min	7,8	2,9	
Range of variability, units	***12,6***	***7,7***	
Differentiation coefficient, times	***2,6***	***3,7***	

Source: Authors' calculations based on data from information portals

If the difference between the highest and lowest unemployment rates in the Russian Federation in general has significantly decreased, then territorial inequality has increased.

This indicates the persistence of significant spatial differences in the labor market, where this problem remains one of the most important ones. If in the center of the country the unemployment rate (2.9%) is lower than the figure for the Russian Federation (4.8%), then in the North Caucasus it is the highest and equals 10.6%. The reasons for the negative situation on the labor market are traditionally historical in nature, as a significant part of the population prefers to develop their own households and be employed in trade. Apart from that, shadow employment remains, resulting in a distortion of statistical information.

A significant role in the differentiation of the country's territory is played by *migration*. The five most attractive regions include territorial entities of the Russian Federation with a developed labor market, favorable climatic conditions and high living standards. The capital city of Moscow occupies the 7th place. The city of Sevastopol leads by the influx of migrants into the cities (Table 6).

Table 6: Regions that are leaders in positive migration balance, 2018

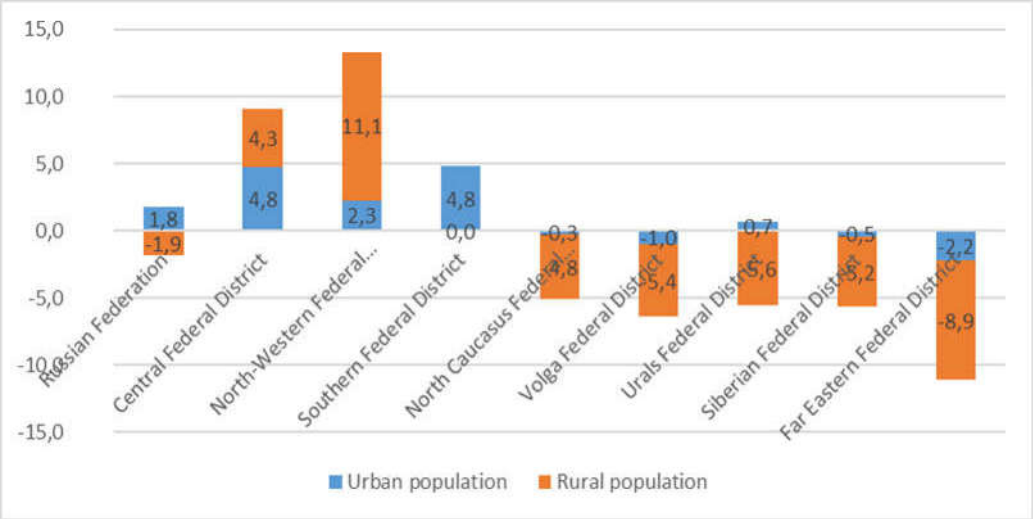
	Net migration rate per 1000 people			Ranks of net migration rates among all territorial entities of the Russia	
	Total population	urban	rural	urban	rural
Leningrad Region	23,9	6,1	55,6	9	2
City of Sevastopol	17,6	18,8	1,4	1	14
Moscow region	14,0	12,3	21,5	5	3
Kaliningrad region	9,5	12,3	-0,4	3	18
Krasnodar Krai	8,5	12,3	3,7	4	10

Source: Authors' calculations based on data from information portals

It is important that this group of territorial entities features the Leningrad and Moscow regions that occupy, respectively, the 2nd and 3rd places by the influx of migrants into the rural areas. This is definitely connected with the proximity of the capitals with a large supply of labor. Moscow takes the first place by the migration influx of the rural population. This fact confirms the current trend of the population leaving the rural areas.

The impact of migration flows on the differentiation of the territory is expressed in the outflow of the population mainly from the eastern regions (Image 6). Moreover, significant indicators are characteristic of rural migrants from the Far Eastern, Siberian and Urals Federal Districts. Thus, the main influx of migrants is characteristic of the Central, North-Western and Southern districts. The first two mainly receive rural migrants. Therefore, the rural areas are losing population, i.e. future generations who could have worked in the agricultural sector.

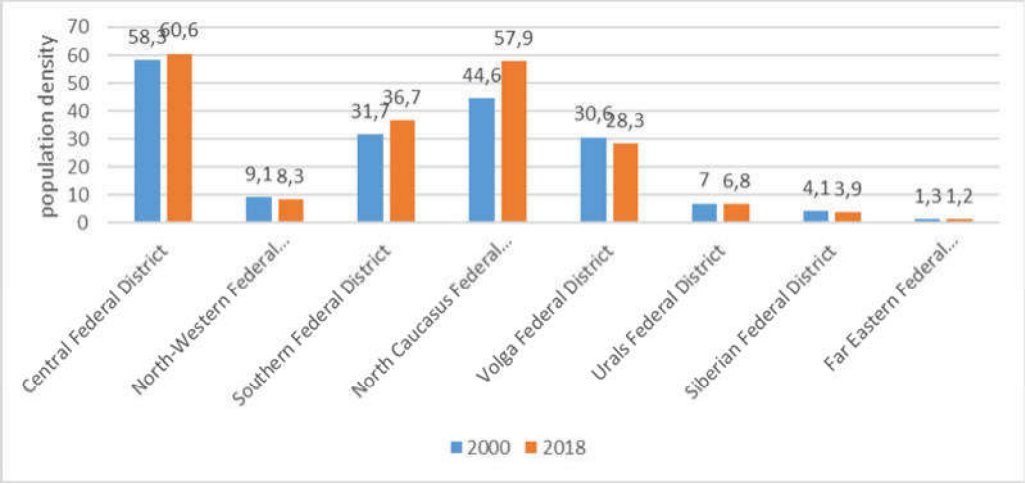
Image 6. Differentiation of federal districts migration balance (per 1000 people)



Source: compiled by the authors according to the calculation results

This conclusion is confirmed by the interconnection of a decrease in the average population density and migration movement. In five districts with a significant outflow of the population, the average population density decreases (Image 7). The exception is the North Caucasus, where, despite the increase in population and average density, there is a large outflow of the population, which is associated with the desire of people to live and work in those regions where there is a supply of labor and high living standards.

Image 7. Dynamics of population density by federal districts of the Russia, million people



Source: compiled by the authors according to the calculation results

The bulk of the population of the Russian Federation lives in four federal districts (Central, Volga, Southern and North Caucasus), their area being approximately 1.9 million square km or 11.1% of the country. The average population density here is 54.5 people/km², which is significantly higher than in the Urals, Siberia and the Far East of Russia, where the average population density is 9.4 people/sq. km (Sorokina, Gubarev, 2019). The solution to the problem of uneven distribution of population and employment in the medium term is almost impossible and irrational due to objective reasons such as differences in climatic conditions and living standards. Therefore, differentiation according to these indicators is an integral quality of the Russian space.

The population of the Russian regions and its labor resources to a large extent determine the *sustainability of the domestic economy*. Rosstat data on the production indices for the selected types of economic activity for 2018 were analyzed as sustainability parameters and the correlation between labor market parameters and industrial production indices, including manufacturing industries, was calculated.

Table 7. Correlation between labor market parameters and sustainability of economy

	Employment rate	Unemployment rate	Industrial production index	Manufacturing index
Labour force participation rate	85%	- 21%	19%	10%
Employment rate	1	- 69%	20%	-4%
Unemployment rate		1	- 12%	20%
Industrial production index			1	57%
Manufacturing index				1

Source: Authors' calculations based on data from information portals

High correlation between the labor force participation rate and the employment rate is obvious and amounts to + 85% (Table 7). A weak, but still existing correlation was formed between labor force participation rate and the employment rate, and the industrial production index while the inverse relationship was formed with the unemployment rate. The higher the labor force participation rate and the employment rate, the higher the indices of industrial production (+19% and +20%). And the lower they are, the higher the unemployment rate (-12%). Manufacturing indices are interconnected with indices of industrial production - +57%. Thus, the development of the labor market, the increase in the employment rate have a positive impact on the development of such economic activities as industrial production, which significantly affects the sustainability of the Russian economy.

Sustainability of the region's economy involves ensuring economic growth in order to increase the level and quality of life. Territorial differentiation influences the implementation of these goals both in terms of labor supply and indicators of economic development. Negative trends can lead to economic instability of society, which means such a state when there is a decrease in the rate and dynamism of economic development and stagnant processes. Therefore, the research analyzed the main indicators characterizing the sustainable development of regions, namely, indices reflecting annual changes in gross regional product, industrial production in manufacturing industries, labor force, and average annual number of employees. It was identified that they influence the economy.

Favorable factors for enhancing stability of the Russian economy in recent years include the growth of such macroeconomic indicators as the labor force participation rate, employment rate and labor force size.

Labor force participation rate has increased, both generally across the country (+ 3.4%) and in macro-regions (Table 8). Moreover, as noted above (Table 2), the differentiation between regions according to this indicator is reducing. The indicator is growing in regions specializing in mining. This area of activity is the main factor in the growth of gross regional product and, accordingly, the index of its physical volume.

Table 8. Labor force participation rate of the population aged 15-72, %

Federal districts /Russian Federation	2000	2010	2014	2015	2016	2017	2018	in % to 2000
Russian Federation	65,5	67,7	68,9	69,1	69,5	69,1	68,9	+ 3,4
Central	65,9	68,3	70,6	70,7	71,5	71,4	71,3	+ 5,4
North-Western	66,4	70,8	70,7	71,3	71,6	71,3	70,5	+ 4,1
Southern	62,8	64,5	65,7	66,4	66,9	66,8	66,8	+ 4,0
North Caucasus	61,2	63,9	66,1	65,3	65,6	65,5	66,2	+ 5,0
Volga	65,9	67,8	68,4	68,9	69,2	68,3	67,7	+ 1,8
Urals	66,6	69,1	70,0	70,4	70,1	69,4	69,0	+ 2,4
Siberian	65,2	67,2	67,6	67,9	68,2	67,1	66,9	+ 1,7
Far Eastern	67,0	67,3	68,8	69,0	69,2	69,3	69,4	+ 2,4

Source: Authors' calculations based on data from information portals

An increase in the employment rate (+ 7.1%) has a positive effect on the economy. The North Caucasus region is especially distinguishing as it saw an increasing interest in the work of the population previously employed in the informal sector. Employment in the Central and Southern Federal Districts (Table 9) increased considerably. An increase in the indicator in the Far East, where an unfavorable demographic situation has developed and an outflow of

the population is observed, is also worth noticing. Thus, in general, the population able to work is increasingly striving for work due to the motivation to improve the quality of life.

Table 9. Employment rate of the population aged 15-72

Federal districts /Russian Federation	2000	2010	2014	2015	2016	2017	2018	in % to 2000
Russian Federation	58,5	62,7	65,3	65,3	65,7	65,5	65,6	+ 7,1
Central	60,7	65,1	68,4	68,2	69,0	69,0	69,3	+ 8,6
North-Western	60,0	66,6	67,8	67,9	68,3	68,2	67,8	+ 7,8
Southern	54,7	59,6	61,6	62,0	62,6	62,8	63,1	+ 8,4
North Caucasus	48,7	53,3	58,7	58,0	58,3	58,3	59,2	+ 10,5
Volga	59,5	62,7	65,3	65,6	65,9	65,1	64,7	+ 5,2
Urals	59,9	63,6	66,0	66,0	65,8	65,6	65,8	+ 5,9
Siberian	57,1	61,5	63,1	62,9	62,9	62,4	62,6	+ 5,5
Far Eastern	57,9	61,2	63,9	64,2	64,5	64,7	65,1	+ 7,2

Source: Authors' calculations based on data from information portals

Unlike the two indicators mentioned above, an analysis of the dynamics of the labor force size showed that, if generally across the Russian Federation there is an increase of 4.5%, then in half of the macro-regions there is a decrease to the level of 2000 (Table 10). These are the eastern macro-regions of the country where the total population has declined. Therefore, the labor force size decreased. The Far East stands out, as despite the increase in the number of territorial entities (since 2018, the Republic of Buryatia and Zabaykalsky Krai have been included in its structure), the decrease in the labor forces size has reached 7.3% there. As mentioned above (Table 3), the differentiation between regions according to this indicator has increased significantly.

Table 10. Dynamics in the labor force size, thousand people

Federal districts /Russian Federation	2000	2010	2014	2015	2016	2017	2018	in % to 2000
Russian Federation	72770	75478	75428	76588	76636	76109	76011	104,5
Central	19531	20677	21126	21108	21282	21282	21337	109,2
North-Western	7395	7641	7535	7604	7608	7557	7499	101,4
Southern	6721	6968	6952	8180	8166	8178	8206	122,1
North Caucasus	3272	4358	4544	4492	4535	4559	4639	141,9
Volga	15785	15863	15516	15502	15457	15185	15042	95,3
Urals	6360	6524	6508	6509	6448	6385	6359	99,9
Siberian	9058	10010	9835	9816	9785	9621	8618	95,1
Far Eastern	4649	3437	3412	3376	3355	3340	4309	92,7

Source: Authors' calculations based on data from information portals

From 2000 to 2018, the average annual employed population decreased, which is also directly proportional to the total population and labor force. These indicators had a negative influence on the economic stability of Siberia and the Far East.

An analysis of the average annual number of employed indices shows that in almost all macro-regions of the country, the values of employment indices are reducing compared to the previous year (Table 11). The only macro-region with an increase in the average annual number of employees is the North Caucasus Federal District, where the increase was 101.9% in 2018 compared to 2017. However, it did not reach the values of 2000. This situation does not meet the criteria of labor market stability.

An unfavorable demographic situation and difficulties in regional labor markets have led to an increase in inter-regional differentiation. It can be stated that the influence of the analyzed indicators has a significant impact on the main economic indicators of the Russian economy – the index of GRP physical volume, the index of industrial production, especially in the manufacturing sector.

Table 11. Change in the average annual number of employees, in % to the previous year

Federal districts /Russian Federation	2000	2010	2014	2015	2016	2017	2018	in % to 2000
Russian Federation	100,6	100,2	99,9	99,1	99,5	99,7	99,6	-1,0
Central	100,7	100,1	100,6	99,0	100,0	100,4	99,7	-1,0
North-Western	101,5	100,0	99,6	99,5	99,4	98,8	98,9	-2,6
Southern	100,3	99,6	99,1	99,7	99,5	100,7	99,9	-0,4
North Caucasus	102,4	101,9	100,8	100,1	100,9	101,6	101,9	-0,5
Volga	100,2	99,7	99,6	98,4	99,3	98,1	98,8	-1,4
Urals	99,6	100,4	99,7	99,4	98,8	100,3	99,8	-0,2
Siberian	100,6	100,8	99,4	98,7	98,2	99,3	99,8	-0,8
Far Eastern	101,5	100,3	99,1	98,8	100,4	99,3	99,8	- 1,7

Source: Authors' calculations based on data from information portals

The dynamics of GRP physical volume indices for 2000-2017 shows that the economy did not fully recover (Table 12). However, after a difficult period during the crisis of 2014-2015 (the imposition of Western sanctions, the instability of global markets), there has been a trend towards an increase in GRP in all macro-regions except the Far East.

Table 12: Index of gross regional product physical volume, in % to the previous year

	2000	2010	2011	2012	2013	2014	2015	2016	2017
Russian Federation	110,6	104,6	105,4	103,1	101,8	101,3	99,4	100,8	101,8
Central	114,9	103,0	104,8	103,7	101,6	100,8	99,3	101,3	101,9
North-Western	109,7	104,4	106,1	103,8	100,3	100,9	101,5	101,7	100,5
Southern	111,7	105,4	106,5	103,7	104,0	102,1	99,5	101,3	103,0
North Caucasus	110,9	103,5	106,5	103,4	103,6	104,6	99,8	100,9	101,1
Volga	108,4	105,5	106,8	104,1	102,4	102,0	98,7	100,0	101,4
Urals	110,1	106,8	104,6	101,5	102,2	99,0	98,8	100,3	103,0
Siberian	107,5	104,4	105,0	103,0	102,1	101,6	98,8	100,3	102,3
Far Eastern	103,1	106,8	105,3	98,6	99,1	101,9	100,7	100,3	99,8

Source: Authors' calculations based on data from information portals

Following the results of 2017, the socio-economic development of Russia as a whole can be considered positive, since the decline in the gross regional product in 2014-2015 was changed to growth, although small, corresponding to 1.0% (Table 11). An increase in the indices of GRP physical volume is characteristic of five out of eight macro-regions, which is a positive trend that demonstrates the stability of the economy of territories.

Industrial production in the manufacturing sectors where high value-added products are manufactured has shown positive dynamics in recent years – production growth in 2017 amounted to 2.6% in general across the country (Table 13).

Table 13. Indices of industrial production by type of economic activity "Manufacturing"

	2005*	2010	2011	2012	2013	2014	2015	2016	2017
Russian Federation	107,6	110,6	108,0	105,1	100,5	102,1	94,6	100,1	102,6
Central	113,8	105,3	107,8	106,7	102,3	101,7	97,4	104,8	109,9
North-Western	108,8	112,5	113,6	104,7	100,2	96,6	94,4	102,0	104,1
Southern	111,9	109,3	110,5	108,4	103,9	105,2	109,9	105,0	105,6
North Caucasus	120,8	105,9	113,5	109,9	110,3	99,8	104,0	109,1	103,6
Volga	104,9	114,2	114,5	106,7	102,4	103,8	96,5	101,4	102,0
Urals	106,3	111,2	108,2	107,6	104,1	103,5	98,9	101,4	107,2
Siberian	104,2	108,5	105,0	103,0	103,1	102,6	97,5	97,3	103,8
Far Eastern	111,0	114,5	121,3	108,9	104,9	102,7	91,1	100,1	101,9

* - no data for 2000. Source: Authors' calculations based on data from information portals

The maximum indicator – 109.9% – is in the Central Federal District, which concentrates 27% of the country's population and 29% of highly skilled workforce. The minimum indicator is in the Far East, where there is a natural and mechanical decline in the working-age population.

The index of the physical volume of investments in fixed assets also shows positive dynamics. After the recession in 2014-2016, investment growth rates are recovering to the level of 2013.

Table 14. Index of physical volume of investments in fixed assets, in % to the previous year

	2000	2010	2011	2012	2013	2014	2015	2016	2017	2018
Russian Federation	117,4	106,3	110,8	106,8	100,8	98,5	89,9	99,8	104,8	104,3
Central	113,5	104,4	107,2	112,9	105,2	102,8	94,1	98,7	108,4	108,9
North-Western	107,0	115,5	110,0	104,0	90,6	95,7	90,8	113,4	105,0	104,4
Southern	155,6	119,2	110,3	107,4	114,6	88,3	85,6	84,9	120,3	91,1
North Caucasus	136,5	111,8	103,3	112,2	107,8	104,2	87,5	96,4	98,8	102,4
Volga	125,0	108,1	110,1	109,5	106,9	100,1	93,1	92,9	96,7	98,3
Urals	153,4	109,1	114,2	106,4	101,4	103,2	89,7	107,1	102,0	104,5
Siberian	118,4	113,5	116,2	111,8	94,1	99,2	83,4	98,5	102,3	105,5
Far Eastern	98,4	106,1	126,5	88,1	83,2	93,4	98,9	98,8	110,8	102,6

Source: Authors' calculations based on data from information portals

However, in the Southern and Volga federal districts, there was no recovery, which indicates an insufficiently active modernization of fixed assets, the use of obsolete equipment. (Table 14). The priorities of the state and business can be seen in the growth of investment in fixed assets in such strategically important macro-regions as the Urals, Siberia and the Far East

4. Conclusions

One of the main reasons for territorial differentiation are the differences between the regions in natural conditions: the character of the population distribution and the demographic situation, which undergo changes over time. The economic factors connected with the results of resource allocation and their effective management also have an impact.

Working-age population actively participating in the labor market has been moving from the regions of the Far East to Central Russia since the beginning of the 2000s. Differentiation between the regions by employment rate persists, however, general trends indicate its decrease.

The difference between macro-regions with high and low unemployment rates in the Russian Federation in general has substantially decreased, but territorial inequality has increased, i.e. significant spatial differences in the labor market persist.

The population density, reflecting the degree of population of the country and regions, has changed significantly since 2000. Three federal districts (Central, South and North Caucasus) observed the population size growth and, thus, the average density increased.

The processes of territorial inequality are greatly influenced by the migration flows of the population, expressed in the outflow of the population mainly from the eastern regions. Significant migrations are characteristic of rural migrants from the Far Eastern, Siberian and Urals Federal Districts. Therefore, the main influx of migrants is characteristic for the Central, North-Western and Southern districts. As a result, rural areas are losing population, i.e. future generations who could have worked in the agricultural sector.

A correlation has developed between the employment rate, a decrease in the labor force size and industrial production indices.

Thus, despite the measures of state policy aimed at the reduction of regional inequality, polarization and differentiation in terms of provision with the population, labor resources and labor force are preserved, which negatively affects the sustainability of the economy in the eastern regions of Russia. Nevertheless, the positive dynamics of recent years is characteristic of such macroeconomic indicators as the employment rate, the labor force size, the labor force participation rate. Indices of growth in the sustainability of the regional economies include the indices of the physical volume of gross regional product, the index of industrial production of manufacturing industries, and the index of the physical volume of investment in fixed assets. Therefore, we can state that territorial differentiation of labor influences the stability of the regional economies in a relatively narrow aspect, namely, the more successful development of the western territories of the country where human capital is concentrated.

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SPATIALLY INDUCED EFFECTS AND SUSTAINABILITY FOR SPECIAL ECONOMIC ZONES: IMPLICATIONS FOR ZONES IN PAKISTAN UNDER CHINA PAKISTAN ECONOMIC CORRIDOR

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Abstract
The China Pakistan Economic Corridor (CPEC) is one of the Belt and Road Initiative projects. Nine special economic zones (SEZs) are proposed under the CPEC and the aim of establishing SEZs is to support and promote local industry as well as other dimensions such as improving energy generation and political stability in Pakistan. The CPEC will facilitate close proximity and collaboration between Pakistan and China, Pakistan can learn from China's successful experience in SEZs. As this concept zone is 'regional' in itself, it is important to analyze this policy from the point of the "New economic geography" theory. This paper explores the existing literature on SEZs in order to identify the role of sustainable development goals (SDGs) in the perspective of spatially induced effects of a zone and their implications for SEZs under the CPEC.

Keywords: Special economic zones (SEZs), Sustainability; Sustainable Development Goals (SDGs), China Pakistan economic corridor (CPEC), spatially induced effects; geographical agglomeration
JEL classification: R12, R11

1. Introduction

Today's globalised and well integrated world is the result of collective and individual efforts of all countries around the globe for over six decades. These efforts intend to promote trade liberalisation through various channels, including Free Trade Agreement (FTA), Economic Corridors, Most Favoured Nation (MFN) status arrangements, and an SEZ. The term can be defined in two perspectives; geographically speaking, SEZ is a limited area in a country where certain kind of economic activities, performed by certain economic agents, are favoured by a certain set of policy tools that are not applicable to the rest of the country. Secondly, in the context of institutions, a SEZ is demonstration of discrimination applied by the host government in favour of certain economic activities, for a certain group of economic agents (Ge, 1999; Tyler and Negrete, 2009; Crane, Albrecht, M. Duffin and Albrecht, 2018). Using economic zones as a policy tool has been supported by international institutions such as World Bank and Asian Development Bank because they also believe in free trade and industrialisation. Moreover, these economic enclaves and open door trade policy are considered by many to be responsible for the rapid economic growth of East Asian Tigers (Hong Kong, Singapore, South Korea and Taiwan) and newly industrialized south East Asian economies (Malaysia, Indonesia and Thailand) (Anwar 2014).

The main objective or aim behind establishing these enclaves is similar for different countries,unlike the taxonomy of the terminology that differs from country to country. It has several names such as Free Zones (South America, Spain & France), Special Economic Zones (China, India, Russia, Ukraine, and Pakistan), Economic & Technological Development Zones (China), Foreign Trade Zones (USA, Canada), Industrial Development Zones (South Africa), Trade Development Zones (Australia), and Maquiladoras (Mexico). All these zones with different terminologies refer to a similar concept, i.e. to promote duty free and smooth import of intermediate goods that are required for the production of export commodities (Tyler and Negrete 2009), to promote labor-intensive manufacturing for exports to advanced

developed countries (Anwar, 2014) , to attract local and foreign investment, create employment opportunities (Alkon 2018) or with a slight variation in the policy objectives (Jayanthakumaran 2003). Moreover, these enclaves are considered as a policy instrument to achieve economic transition from a less integrated economy to an open and regulated economy (Palit 2009). Thus, this paper uses SEZ interchangeably with all these terms as it is the one officially used in CPEC project.

In the modern world, the first industrial enclave was established in Shannon, Ireland in 1959 (Anwar 2014; Moberg 2015; Amirahmadi and Wu 1995). These enclaves or zones that were established in 1960s in inward-looking countries, pursued export-oriented policies (Palit 2009). Initially, most of the Export Processing Zones (EPZs) were established with the mutual objective of attracting FDI to the manufacturing sectors in the host country that are labor-intensive in nature (Farole 2011; Makabenta 2002). This was an alternative of traditional import-substitution policy. However, over time, policy makers realized that EPZs have a limited role that is not efficient under the changing global regulatory and economic situation. This limitation is due to the following factors: strict custom-controls, around 80% of the products have to be exported, not being able to create linkages with the rest of the economy and dependent on fiscal incentives. However, over time the limited role of these zones was expanded into much bigger and wider range of targets including economic reforms and development policies (Amirahmadi and Wu 1995). Consequently, the focus shifted to SEZs that are multifunctional in terms of policy objectives, less reliant on fiscal incentives, creating more backward and forward linkages, and they are wider in size (Zeng 2015). SEZs are built not just for manufacturing exports but also to promote regional development (Anwar, 2014). In last two decades, the popularity of SEZs increased; according to international labor organization there were 3,500 SEZs in 130 countries in 2006 as compared to 176 zones in 1986 (Frick, Rodríguez-Pose, and Wong 2018).

Pakistan, like many developing countries, on the one hand, is establishing SEZs in cooperation with China under China Pakistan Economic Corridor (CPEC), which is one of the six corridors of Belt & Road Initiative (BRI).On the other hand, it is also prioritizing sustainable development goals (SDGs) as it is a part of Pakistan Vision 20205 policy and Agenda 2030. Table 1 shows the link between Pakistan's Vision 025 and SDGs.

Table 1. The link between Pakistan's Vision 2025 and SDGs

	Pillar	Links with SDGs
1.	**People First**: Developing social and human capital and empowering women	SDGs 1 (poverty), 3, (health) 4 (education), and 5 (gender)
2.	**Growth**: Sustained, indigenous, and inclusive growth	The target is virtually identical to SDG 8, and also to SDGs 10, 12, 13, 14, 15
3.	**Governance**: Democratic governance: institutional reform and modernization of the public sector	Again, the language is similar to that of SDG 16
4.	**Security**: Energy, water, and food security	Linked to SDG 2 (zero hunger), 6 (water security), 7 (energy security), and 11 (urban)
5.	**Entrepreneurship**: Private Sector and entrepreneurship-led growth	This is linked to SDG 9 (foster innovation)
6.	**Knowledge Economy**: Developing a competitive knowledge economy through value addition	SDG 9 (innovation), and 4 (education)
7.	**Connectivity**: Modernizing transport infrastructure and regional connectivity	SDG 9 (infrastructure), and 17 (global partnership)

Note: Extracted from Pakistan Vision 2025 One Nation-One Vision

Although, Pakistan has a history of poor performance in both developing SEZs and SDGs, policy makers are still ambitious and looking forward to change the course by learning from a close alliance with China. Over the time of the past three decades, several export processing zones (EPZ) were established in Pakistan, however, only four of these EPZ are functional now. Work environment, inappropriate location, inadequate facilities, safety and security issues, inadequate skill enhancement, inadequate trainings, bhatta culture and high inflation are the major impediments in the performance of EPZs(Mukhtar et al. 2013). The functional EPZs are located in Karachi, Saindak, Risalpur and Sialkot("Export Processing Zones Authority" 2019).Government and policy makers need to be diligent and avoid those mistakes which they have made before. The existing research work on SEZ in Pakistan, mainly focuses on bureaucratic and institutional failures of the existing system and to the best knowledge of the authors, a comprehensive study of spatial and sustainable aspect of SEZ is still lacking. After analysis and synthesis of available existing literature on SEZs, this paper proposes a policy design that incorporates SDGs into spatial mechanism of SEZs at the initial stage of developing SEZs. It could help Pakistan and other developing countries in the process of establishing a SEZ and achieving sustainability. According to Word Investment Report 2019, sustainable development imperative is one of the new challenges faced by SEZs("World Investment Report 2019 - Special Economic Zones" 2019). Therefore, the policy mix of spatial impact of SEZs and SDGs is a rather new phenomenon. According to the best knowledge of authors, this concept is yet to be explored.

2. China's Experience

The outcome of establishing SEZs depends on the prime instrument that is used to convince investors to invest in a particular SEZ. For Pakistan this instrument is tax exemption like many other countries for instance Poland. However, once the final effects of using this instrument varies from country to country; in case of India, growth in exports and net foreign exchange are the main outcomes of SEZs. However, in China, it resulted in a big inflow of FDI, high export growth and increase in employment (Ciżkowicz et al. 2017). This variation also depends on the need of the host country; for instance, one of the aims of zones in Thailand is to decentralize the industries in Bangkok because they wanted to solve the issue of congestion and pollution. Similarly, the outcome or the consequence of these zones also vary from country to country; international and domestic integration are the well understood objectives of such zones; and export processing zones in South Korea went so far in domestic integration that they were no longer enclaves (Jayanthakumaran 2003).

The development of SEZs that is part of long term plan of CPEC depends heavily on the coordination and planning of both countries. And given that China represent the most successful case of building industrial and trade enclaves, Pakistan, like many other developing countries (India, Vietnam, Thailand), can learn from Chinese experience. According to a report by the World Bank, besides boosting the industrialization, modernization and urbanization, SEZs in China have a share of 22% in China's GDP, 45% in total foreign direct investment (FDI), and 60% in exports. These zones have increased the income of participating farmers by 30% and created more than 30 million jobs("China's Special Economic Zpnes" 2015).

Here, Pakistan has the privilege to not just learn from distance and historical evidences but from economic collaboration and institutional coordination. China adopted an "open door" policy in 1978 and by 1980it had developed first four economic zones (Shenzhen, Zhuhai, Shantou and Xiamen). In case of China's SEZs, the targeted goals of high FDI, expansion in exports and technology diffusion were achieved by implementing a set of favorable policies (government support, land reforms, flexible labor laws, fiscal incentives and technological upgradation) and the right mix of production factors (low cost of labor and skilled workers). The rationale of establishing SEZs was to develop forward linkages with capitalist countries through trade liberalization and backward linkages with domestic markets. During 1980-84 when China's GDP grew at 10 percent per year, Shenzhen special economic zone experienced phenomenal growth rate of 58%, whereas, Zhuhai, Xiamen and Shantou grew at 32, 13 and 9 percent respectively (Yeung, Lee, and Kee 2009). These zones were deliberately located far away from Beijing in order to avoid political interference and in just five years China experienced unprecedented economic growth (Zeng 2016). The success story of these first four economic zones lead to further opening up the economy and China embarked on establishing several economic enclaves, including Economic and Technological Development Zones. It is important to highlight the factors or particular characteristics of China's "open door" policy that made this success possible. Other the locational advantage, below follow some significant common elements discussed by (Zeng 2016; Nallathiga 2007) .

• Determination and support of both central and local government

Commitment and a gradualist approach of government didn't let the initial uncertainties and temporal setbacks to hinder the process. On the one hand, Central government tried to decentralize the power and prevented political opposition to create an inclusive and open legal and policy environment. On the other hand, local governments facilitated the economic zones with quality infrastructure including transportation networks, supply of water and gas, and telecommunication services along with efficient regulatory and administrative support.

• Land Reforms

China adopted land reforms to start market-based land distribution. In the 1980s, they allowed local as well as foreign investors to apply for land lease and also to participate in "open-bidding". This practice was opposed to the land ownership system of China before 1981 which postulated that all land belonged to the state.

• Flexible Labor Laws

China opted for flexible labor laws, accompanied with MNCs best management strategies and wages linked with productivity and enhanced production capacity of labor.

• Fiscal Incentives with Clear Objectives

Legislative authorities helped SEZs in achieving political & economic autonomy by developing municipal laws and regulations in line with national laws and regulations for the administration of SEZs. This institutional autonomy was further supported by fiscal incentives, including export tax exemption, fast custom clearance, favorable import duties, depreciation allowance, low uniform indirect taxes, numerous special tax holidays, flexible labor laws, and ability to send back profit to home countries by foreign firms. Furthermore, the government set clear objectives and benchmarks to evaluate the performance of rapidly increasing number of SEZs. GDP growth, rise in export, employment and revenue generation are the significant ones.

• Technology Adoption and Innovation

SEZs have become a hub for innovation, R&D and skilled labor which generates and adapts technology. Moreover, it protects intellectual property rights by setting up policies and regulations along that are to be followed by intellectual property rights office (Liuhto 2009).

In the case of Pakistan, SEZs have both a policy and infrastructure rationale. The government is trying to liberalize trade and attract foreign investment while creating job opportunities for locals, providing adequate logistics and having environmental controls. While it is important to learn from the success story of China, it is even more important to learn from the mistakes Pakistan itself has made in the past. Above mentioned factors are crucial in making a policy success but it takes some pre-requisite conditions to implement them successfully. China announced a SEZ in Kashgar region that is a less developed region in China and it connects China with Pakistan. If China tries to implement the model of Shenzhen SEZ in Kashgar, it will not work because both regions are totally different in terms of economic, social and ethnic conditions. Shenzhen is a coastal area, neighboring Hong Kong and Taiwan, whereas, Kashgar is suffering from ethnic and social conflicts (Chou and Ding 2015). Furthermore, the size of a zone is also one of the most important feature that must be considered here. In other words, the distinction between national-level and provincial-level zones is essential. This implies that Pakistani zones in size might be equivalent to provincial zones in China, so we should not follow Shenzhen or other big zone's framework blindly. What needs to be understood here is that each and every SEZ has its own set of characteristics and along with a general framework, they need a personalized policy design as well (Herlevi 2017).

China has been facing challenges on the front of green development, innovation, social justice and economic sustainability. According to recent statistics, a major portion of the population is exposed to low quality of air, water and soil; 25 percent of the population does not have access to clean water. SEZs can be used a prototypes to ensure sustainable social and economic practices within the geographical area of the zones but later can be expanded to the country (Mohiuddin et al. 2014). However, as Pakistan is in the initial phase of SEZ development, it should ensure economic and social sustainability from this point in order to avoid to future setbacks.

3. 3. Geographical Distribution of SEZs in Pakistan

The geographical distribution of SEZs reflects that they are more popular in developing countries as compared to developed ones. With establishment of SEZs, it is possible for developing economies to invite foreign investors to work within an enclave that is free of control, without having to subject whole economy to a liberalized and deregulated system.

The location choice of a SEZ is decided according to two criteria; the first one depends on the development features of the region which include: 1) Market-related factors such as GDP of the state, population and population density of the state. 2) Labor-related factors including availability of labor, wage rate, quality and skills of workforce. 3) Infrastructure and Logistics services, namely, transportation networks, telephone density, distance from the ports, airports and highways, and warehousing (Chakraborty, Gundimeda, and Kathuria 2017).

The second one is a rather precautionary criterion; according to a report by United States Institute of Peace, most of the countries around the world are establishing SEZs in order to address one or more of the following issues:

- A weak policy framework and a poor investment climate
- Compensating for inadequate infrastructure facilities in the country
- Providing a kick-start to under-developed and neglected regions and industries

Nine zones are proposed under the CPEC and their geographic distribution is a mix of above mentioned two criteria. Zones like ICT Islamabad and Allama Iqbal city are being established considering the first criterion, whereas other zones are located in under-developed regions (Baluchistan, FATA and Gilgit Baltistan) of the country as per the second criterion of location choice. Figure 1 shows the geographical distribution of nine SEZs in Pakistan. Although Pakistan is in the initial phase of establishing these economic zones and there are only nine SEZs, the map shows an equal geographical distribution in terms of provinces, as these zones are not clustered in a certain region or province. India, on the other hand, despite having many successful SEZs, portrays a poor picture of zone distribution. 73 percent of the zones are located in the Southern and Western states which are already developed states as compared to Northern states and this resulted in economic regional disparity (Anwar 2014). Whereas most of SEZs in China are located in coastal areas and near metropolitan cities on purpose. This provided them with better connectivity and access to quality infrastructure (Zeng 2015).

Image 1. SEZs in Pakistan.

Source: Illustrated by the author using Geographical Information System data of Pakistan openly available at http://www.diva-gis.org/datadown. District level data is used as an approximation of SEZ location.

According to Ishida (2009), SEZs can be divided into four categories acoording to location, namely metropolitan, port or costal, junctions and border area zones (Ishida 2009). From Table 1, it can seen that three of the zones could serve as junstions, whereasthere are two zones for both costal and metropolitan types. There are three potential candidates of border area zones but in reality it might not be possible as Islamabad's strategic and trade relations with Afghanistan and India are not friendly.

Table 2. Identification of SEZ type.

SEZ	Type
Rashakai Economic Zone , M-1, Nowshera	Junction between Mardan and Nowshera
China Special Economic Zone Dhabeji	Port or coastal zone, 25.4km from Port Qasim
Bostan Industrial Zone	Junction between Quetta and Ziarat or between Quetta and Chaman.
Allama Iqbal Industrial City (M3), Faisalabad	Metropolitan zone
ICT Model Industrial Zone, Islamabad	Metropolitan zone
Development of Industrial Park on Pakistan Steel Mills Land at Port Qasim near Karachi	Port or coastal zone
Special Economic Zone at Mirpur, AJK	No certain type
Mohmand Marble City	Border zone as distance to Torkham is around 70KM. Junction between FATA and KPK province
Moqpondass SEZ Gilgit-Baltistan	No certain type

Source: Author's compilation using geographical distance data from google map.

Rashakai lies at the distance of around 9.6km from Mardan and 14km from Nowshera. Bostan Industrial zone could provide a junction between Quetta and Ziarat, and between Quetta and Chaman. It lies at a distance of around 34.5km from Quetta, around 88km from Ziarat and around 95Km from Chaman. On the other hand, Moqpondass SEZ in Gilgit Baltistan may also serve as a border junctio between Pakistan and China. Given the georaphical location, it lies closest to China;therefore, it could play a very important role in cross border trade. The ICT zone is located in Islamabad that is the capital of Pakistan and Allama Iqbal Industrial City is being dveloped in Faisalabad that is third biggest city of Pakistan and already an industrial hub. The identification of these types is important to build backward and forward linkages with domestic and foreign market respectively. Therefore, the institutional and regulatory framework of each special economic zone must be designed in accordance with these types.

Several other characteristics of each SEZ are summarized in Table 3, such as, the type of industry, total area dedicated to the zone, and infrastructural connectivity. These characteristics along with identified zone type in this section could be a helpful for the potential industries in terms of their strategic and operational policies.

Table 3. Characteristics of SEZs.

SEZ	State	Area (Acres)	Industries	Connectivity
Rashakai Economic Zone , M-1, Nowshera	KPK	1000	Fruit Food Packaging Textile Stitching Knitting	Airport 50 KM Dry port 65 KM Railway Station 25 KM Motorway 0 KM Highway 5 KM City Center 15 KM
China Special Economic Zone Dhabeji	Sindh	1000	To be determined during feasibility stage	Airport 80KM Seaport 85KM Railway Station 5KM Highway 4.5KM (N-5)
Bostan Industrial Zone	Baluchistan	1000	Fruit Processing Agriculture machinery Pharmaceutical Motor Bikes Assembly Chromites Cooking Oil Ceramic industries Ice and Cold storage Electric Appliance Halal Food Industry	Airport 23KM (Quetta) Sea-port 713KM (Karachi) & 976KM (Gwadar) Dry Port (Quetta) 32KM Highway (N-50) 0KM
Allama Iqbal Industrial City (M3), Faisalabad	Punjab	3,000	Textile Steel Pharmaceuticals Engineering Chemicals Food Processing Plastics Agriculture Implements	Airport around 52KM (Faisalabad) Dry Port 20KM (Faisalabad) Highway 0KM

ICT Model Industrial Zone, Islamabad	Islamabad	200-500	Steel Food Processing pharmaceutical & Chemicals Printing and Packaging	Not decided as the identification of land is under-progress
Development of Industrial Park on Pakistan Steel Mills Land at Port Qasim near Karachi	Sindh	1500	Steel Auto & allied Pharma Chemical Printing and Packaging Garments	Airport 19KM Bin Qasim Port 10 Km Bin Qasim Railway 12KM
Special Economic Zone at Mirpur, AJK	AJK	1078	Mix industry	Airport 130Km Highway 22KM (GT Road) Railway track 2KM Dry Port 5KM (Mirpur proposed dry port)
Mohmand Marble City	FATA	300	Marble Industry Stone Industrie	Airport 29KM Dry port 29KM Railway Station 28KM Motorway 33KM
Moqpondass SEZ Gilgit-Baltistan	Gilgit-Baltistan	250	Marble / Granite Iron Ore Processing Fruit Processing Steel Industry Mineral Processing Unit Leather Industry	Airport 35KM (Gilgit) & 160KM (Skardu) Dry port 200KM (sust) Highway 4KM

Source: ompiled by author using the information from (Abbas and Ali 2017; "DistancesFrom.Com" 2018; "FATA Development Authority » Marble City in Mohmand Agency" 2018; "Progress Update | China-Pakistan Economic Corridor (CPEC) Official Website" n.d.; "Google Maps" n.d.; "Rome2rio: Discover How to Get Anywhere" n.d.)

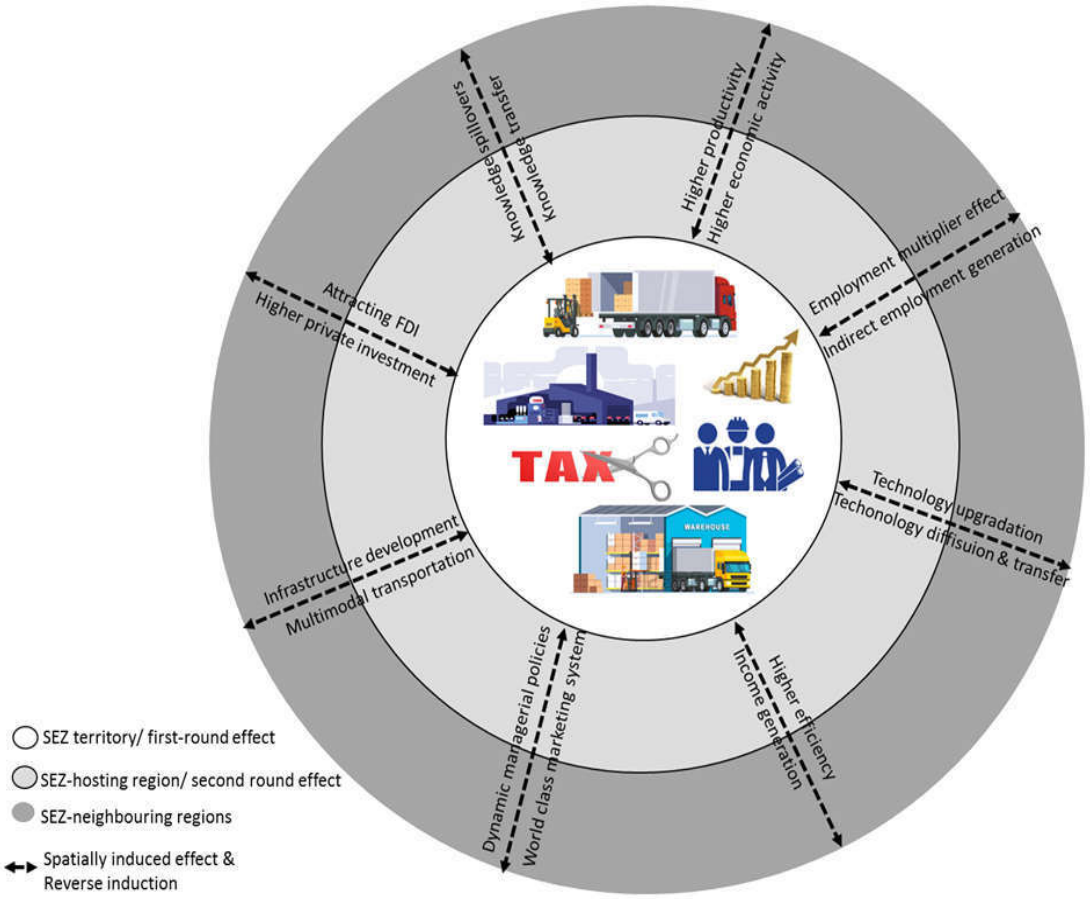
4. Spatially Induced Effects and Externalities

The idea of economic agglomeration have been with us since the era of industrialization. It was discussed by Marshall, one of the pioneers of economics, as "industrial districts". He described how industry and labor specialization, knowledge sharing, pooling of inputs and outputs generate economic benefits for member firms as well as externalities (Marshall 1890). SEZs provide a conducive environment to industries that generates externalities flowing "forward, backward and horizontally". In the middle of twentieth century, the concept of SEZ or EPZ were analyzed using an orthodox approach. This approach examines the possible outcomes of a SEZ in terms of static economic indicators, such as direct impact on employment, investment, and foreign exchange earnings. However, in late 1980s, researchers shifted their focus from a static approach to a heterodox approach. The latter one focuses on dynamic implications of a SEZ in terms of policy design and targets. It is based on endogenous growth theory, hence it aims at achieving sustainable economic growth by developing human capital, technological advancement and institutional reforms. Recently, the focus has been shifted to new economic geography theory, where spatial and agglomeration economies are the focal point (Cheesman n.d.; Aggarwal 2010). Therefore, this paper focuses on developing a link between spatial implication of SEZs and sustainable development goals,

it is explained in two steps. First, this section illustrates the mechanism of spatial effects of SEZs. Second, this mechanism will be linked with SDGs in the next section.

The new economic geography theory emphasizes on cumulative and circular process stating that agglomeration of trade oriented manufacturing firms in one region can affect the neighboring region outside the concentration of firms. Hence, the geographic proximity of firms will take the economy out of 'vicious circle' of investment to 'virtuous circle' of investment (Aggarwal 2011). The one important feature of new economic geography theory is that the agglomeration is attributed to increasing returns of scales that are a result of knowledge spillovers, market demand and cost of trade. Other incentives for agglomeration could be infrastructure quality, collaboration of enterprises and better technical and business environment (Ambroziak and Hartwell 2018; Aggarwal 2011).

Image 2. Synthesis of Spatially induced effects of SEZs available in literature.



Source: Author's' illustration using (Ciżkowicz et al. 2017; Aggarwal 2007; Palit 2009; Ambroziak and Hartwell 2018)

In this section we incorporate these three approaches and describes how, initially, the impact of a SEZ is limited to static direct effects within the geographical territory of a SEZ as illustrated in Figure 2. Nevertheless, this limited direct impact leads to more dynamic and indirect implications on a regional level. According to(Ciżkowicz et al. 2017), this mechanism is divided into four main rounds or channels:

4.1. First-round effect

A company's decision to invest in a SEZ creates direct and static job opportunities, brings in FDI within the geographical territory of an SEZ. The business enterprises working within a SEZ territory are believed to be equipped with high quality infrastructure, favorable tax policy, and lesser restrictions by government. These factors help in bringing in more companies to the zone which gives a kick-start to first round affects.

4.2. Second-round or induced effects

These effects are induced by the functioning of an SEZ-based companies in the region of SEZ but actually occur outside the territory of SEZ. The SEZ region could be defined as the surrounding geographical area, it could be one whole city or multiple cities depending on the specific location of a SEZ. Most of the SEZs attract companies belong to one industry, for instance, IT zones in India. This will result in industrial agglomeration and hence in agglomeration economies which may be attributed to second round induced effects.

The second-round effects or catalyst effects of SEZs are not limited to spillover effects of employment and investment but they also generate backward and forward linkages between SEZ-based firms and domestic economy. For instance, firms in SEZ sell their products in local market (forward link) and they purchase raw materials from local suppliers (backward link). Firms working in SEZs are equipped with advance technology, superior knowledge and outclass managerial skills; Active association and interaction between local labor force and domestic corporate sector and firms in SEZs also lead to technology and skills diffusion. These knowledge-based and technological spillovers could result into upgrading of domestic technology by demonstration effect, learning-by-doing and on-the-job training (Ciżkowicz et al. 2017).

Other than spillover effects in the domestic market, the trade-oriented manufacturing firms in SEZs will become highly competitive due to high standards in international markets. Which in effect will stimulate a growth process that is accelerated, circular, cumulative, self-reinforcing, innovative and efficient (Aggarwal 2011).

4.3. Spatially induced effects

Once the second round effects have been active, agglomeration have taken place, economic activities in the region of SEZ generates externalities for the neighboring regions. The important factor here is the geographical or spatial closeness of the area.

4.4. Reverse induction or feedback loop effect

Several economic, social and political association between two variables are known to be bi-directional. Similarly, the above mentioned spatially induced effects can occur in the reverse direction; economic performance of the neighboring region of a SEZ can affect the economic situation of the SEZ region. This stage works in a loop, one direction will feed off the other one, making it a circular process.

Till now most of the studies that have been done on SEZs or EPZs in Pakistan are descriptive in nature due to lack of data availability. The last report published by Export Processing Zone Authority in Pakistan was in 2010. However, the concept of SEZs is rather new and nine zones mentioned in section 2, are still under development process so it is not possible to carry out quantitative or econometric analysis. The existing literature mostly focuses on direct or first round effects of SEZs in Pakistan, on the other hand, this paper analyzes parameters that are more dynamic and spatial in nature. The above described spatial induced mechanism will not only generate investment and employment opportunities within the zone's territory, it will also affect neighbor regions that in turn will produce reverse induction effects. For instance, Bostan Industrial Zone in Baluchistan will not only have direct effect within 1000 acres of the zone territory, it will also boost economic activity in the neighboring region (that in this case is the capital of Baluchistan province). The efficiency of spatially induced effects highly depends on the linkages of SEZ with local economy. The costal location of Chinese SEZs is considered to be the key of success; however, we argue that success also depends on the ability of SEZs to generate agglomeration and spatial induced economies. Being the most deprived province of Pakistan, Baluchistan needs policy reforms that would give a push to the economic activity. The success of this economic zone will assist in bringing this change. Similarly, the functioning of rest of the eight economic zones will prove to be an important policy tool for economic growth. Nevertheless, the political instability and corruption might hinder this process, which needs to be avoided.

5. Spatial Distribution of Sustainable Development Goals around SEZs

The initial emergence of Sustainable Development Goals (SDGs) in the early 1980s was in the context of climate change and economic and social sustainability were added later in 1990s and early 2000s (Hák, Janoušková, and Moldan 2016). Currently, there are 17 SDGs which are divided into three categories of economic, environmental and social sustainability. However, the distribution is collectively exhaustive but not mutually exclusive; a few goals fall in two categories. In this section, we expand the distribution in the context of spatial impact for SEZs. The same geographical design of SEZs and neighboring regions is used here as in the previous section.Figure 3 shows the economic, environmental and social aspects of sustainability that should be incorporated into SEZ policy framework. The first rectangle refers to geographical territory of a SEZ. And the SDGs falling in this region are the ones that will should be considered while designing the infrastructure inside the SEZs or they can be promoted from the economic activities happening in the territory. For instance, SDG number 8, decent work and economic growth can be achieved through a successful industry working in the zone. However, as mentioned in the previous section, this effect will have spill-over effects on the hosting and neighbouring region of the zone. As it can be seen from the Figure 4, most of the economic and environmental SDGs can directly be dealt with from the zone territory, however, most of the social SDGs need to be addressed outside the zone. For example, if government improves the third SDG i.e., good health and wellbeing, this will positively affect the productivity of labour force working in the zone. Moreover, industries functioning inside the zone need to adapt sustainable production practices which will work towards environmental sustainability. SEZs should be model territories for neighbouring regions and they may follow suit.

Pakistan's agenda 2030 aims to explore avenues for international collaboration by establishing national incubation centers but if they redesign the policy and include SEZs as one of the avenues, the consequences will be more wide-spread. But it is important to design and plan SEZs in such a way that they support SDGs, otherwise, this time of establishing SEZs will not any different from the previous failed attempts at EPZs. They can target SDG 9 ("Industry, Innovation and Infrastructure") and 11 ("Sustainable Cities and Communities")(Government of Pakistan 2019). Moreover, the SDGs initiated in the zones will have far reaching spatial effects. Moreover, the size of this impact depends on the degree of integration with domestic markets and fiscal agenda or plan of the host economy (Akinci and Crittle 2008; Ciżkowicz et al. 2017) . This connection with domestic market is known as backward linkages, and in the context of success of SEZs it is as important as the forward linkages that are developed with international market (Ambroziak and Hartwell 2018; Ciżkowicz et al. 2017; Farole and Akinci 2011; Ge 1999).

Figure 3. SEZs and Sustainable Development Practices.

Source: Adapted by authors from the Report on Fostering Sustainable Development through Chinese Overseas Economic and Trade Cooperation Zones along the Belt and Road (2019).

6. Conclusion & Policy Recommendations

The fate of a particular zone depends on policy framework, available incentives, infrastructure quality, location, logistics and other supply chain services (Dorożyński, Świerkocki, and Urbaniak 2017). The practice of establishing SEZs in low-income and developing Asian and African economies resulted in limited success due to several factors. Most important factors are political influence, rent seeking unfavorable business conditions, and less effective institutional framework. Pakistan, like other developing countries, is

embarking on this mission of establishing SEZs in order to support and promote local industries. However, special care and diligence is required to make this policy a success. With a right mixture of institutional policies and infrastructure system that promotes sustainable practices, SEZs are expected to succeed and boost economic growth. One the contrary, a zone developed amidst unfavorable conditions will result in resource misallocation and rent seeking. Given the weaknesses of political and bureaucratic systems of Pakistan, the risk of poor development zone practices and uncompetitive policies could cause these SEZs to be a burden on the economy. Bad policy decisions which are crucial to the failure of a zone are a major detrimental factor and it is recommended to avoid these mistakes. Such mistakes could include poor location selection, inadequate infrastructure facilities, poor labor policies, rigid performance requirements, heavy reliance on fiscal incentives, poor integration with local market, and unsustainable business practices within the zone. In case of Pakistan, the nine zones are still still in the initial phase of development, however, some of the institutional policies are already decided according to special economic zone act 2012 as amended in december 2015. However, these proposed nine SEZs are a joint venture of China and Pakistan, and China is a role model for SEZs and free trade zones. Pakistan could use China's assistance and experience, which will consequently be better for the regions where SEZs exist as well as for the neighboring regions due to spatially inducedeffects. Therefore, it would be advisable to incorporate sustainable development goals into zone development policy at this stage instead of forcing them later when the zone will be fully functional. It will not only benefit the industries working inside the zone but it will also promote sustainable practices outside the zone.

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Conflicts of Interest

The authors declare no conflict of interest.

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DOES ZAKAT MATTER FOR HUMAN DEVELOPMENT? AN EMPIRICAL EVIDENCE FROM INDONESIA

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Abstract

This study aims to empirically measure and analyze the contribution zakat to human development and, consequently towards the achievement of the Sustainability Development Goals (SDGs) program in Indonesia. Specifically, this study intends to measure the differences in the Human Development Index (HDI) of zakat recipients before and after receiving zakat and measure the effect of zakat on the HDI and its components. The response to these issues, the study estimates the value of the Human Development Index (HDI) at a minor level; the individual and household levels. 100 recipients of zakat (mustahik) from the three programs of zakat distribution by the zakat institution of Aceh Province, Indonesia (Baitul Mal Aceh - BMA) were selected as the sample of the study using a combination of purposive and proportionate stratified random samplings. These zakat programs include zakat for cancer and thalassemia patients, zakat for one family one undergraduate scholarship, and zakat for buying working capital for the poor families. The paired t-test is adopted to assess the differences in HDI of zakat recipients before and after receiving zakat, while the multiple linear regression is used to measure the effect of zakat on the HDI and its components. The study found that, after receiving zakat, the HDI of zakat recipients is higher than before. Zakat is also recorded to have a significant positive effect on the HDI, while the family size affected negatively the HDI and the types of zakat and profession of zakat recipients have an insignificant effect on the HDI. These findings suggest the positive role of zakat in improving human development and it could be used as one of the instruments to accelerate the achievement of the SDGs agenda in Indonesia.

Keywords: Education, Health, Human Development, Welfare, Zakat
JEL classification: D64, O15, Q01, I15, I25, I38

1. Introduction

Human development can be defined as a multi-dimensional concept that is enlarging people's choices. It believed that this theory would be strengthening the capability of human life physically, mentally, and spiritually in which led to a decent living. Although this may be true, the individual choices will always be varied and unlimited. Therefore, the United Nations Development Program (UNDP) introduced the Human Development Index (HDI) concept in 1990 to measure the level of human welfare. Moreover, this concept focuses on three essentials of people's choices as it components that lead to longevity, access the knowledge, and secure the resources to reach a decent standard of living. Based on this, the concept of human development can also be determined as the concept of human welfare.

Conceptually, the HDI offered as an alternative and more comprehensive way of measuring the success of human development, especially in efforts to improve the prosperity and the quality of human life as a whole. According to Klugman (2011), the concept of the HDI was a result of dissatisfaction with Gross Domestic Product (GDP) per capita to be a standard measurement of human welfare and economic development. This skepticism occurs

based on the omission of the poor population growth that led to a large discrepancy regarding income inequality.

There have also been skeptical arguments assuming that measuring human well-being altogether through the traditional GDP estimation may not be an accurate method (Sampath, 2014). In the same way, Stiglitz (2010) asserts that the GDP can create a disparity within the average and median income in which one can increase, while the other decreases. Furthermore, this economic behavior results in several problems such as unemployment, poverty, and inequality. Therefore, the concept that introduced by Ul Haq (1995) expected to enhance the quality of human life that was not only elaborating on the commodities and wealth but also reflected the expanding of human choices widely.

From the above, the previous concept explained by UNDP acts closely to the theory of welfare in the Islamic perception, which is also known as *maqashid shari'a* (objectives of *shari'a*), the rules or the doctrines established by the *shari'a*, which aim to *maṣlaḥa* (public welfare and interest) for humankind (Ibn' Ashour, 2006). Moreover, Al-Ghazali (1993) added that *maqashid shari'a* strengthens the identification of human welfare, which includes religion (*ad-din*), life (*an-nafs*), intellect (*al-'aql*), posterity (*an-nasl*), and wealth (*al-mal*).

Following this idea, Islam designated *zakat* as one of five pillars that essential for every Muslim to obeyed and obligated. *Zakat* also interprets as one of the most prominent concepts which have a strong correlation to human development. For example, poverty alleviation, an equal income distribution, and harmony creation in a society, which further organizes into sustainable development goals (SDGs)? To put it in another way, the perception of human welfare in Islam also considered being the major implication of the *maqashid shari'a*.

In the Islamic context, a Muslim whose property and wealth have reached a minimum level (*nisab*) set by the Holy Qur'an, he/she should pay 2.5% *zakat*. Considering Indonesia as the largest Muslim populous country in the world, thus *zakat* has great potentials to promote the welfare of the poor. As reported by the Bogor Institute of Agriculture and BAZNAS, the potential of *zakat* in Indonesia reached IDR217 trillion in 2010 and IDR286 in 2015. This is in line with the prediction of Kahf (1989) where Muslim countries, including Indonesia, their potential yield of *zakat* revenue could reach 2% of the national GDP. Although the realization of *zakat* collection was still very low compared to the existing potential, *zakat* is significant in the midst of the poor Indonesian economy.

Unlike other 33 provinces in Indonesia, Aceh is the only province that has been granted by the central government of Indonesia to implement Islamic law in all aspects of life. Thus, the potential for *zakat* in the province, as the case of our study, is larger as compared to other provinces in Indonesia. The joint study by the Research and Publishing Center, Research Institute and Community Service of the Ar-Raniry State Islamic University and Baitul Mal Aceh reported that the potential *zakat* in the province reached IDR1.3 trillion in 2016 (Majid, 2017).

Realizing the great potentials of *zakat* to the economic development throughout the Muslim countries, studies focusing on the role of *zakat* as part of Islamic economic and financial institutions have recently been increasing. For example, Kahf and Yafai (2015) analyze the difference between the *zakat* system and the modern social security system that is practiced today. Shirazi (1996) describes the conditions of education, health, poverty and their relationships to *zakat* without showing quantitatively the impact of the distribution of *zakat* on the level of education, health, and poverty in Pakistan. Sudarlan (2015), in his research on the contribution of HDI in poverty alleviation, explains that per capita income and education had a positive influence on poverty reduction, although health has not been able to positively influence poverty reduction. However, Sudarlan (2015) fails to link the contribution of *zakat* to the HDI. More specifically, Suprayitno et al. (2017) examined the effect of *zakat* on economic activity and human development. In their research, Suprayitno et al. (2017) focuses only on the distribution of *zakat* on education and the empowerment of human resources but ignores the components of human health development. Finally, Beik and Arsyanti (2016) and Nurzaman (2016), respectively examined the effectiveness of the distribution of productive *zakat* on welfare and HDI of the poor. Former study finds productive *zakat* has improved the welfare of the poor, while later study finds the insignificant effect of *zakat* on HDI of the poor.

These previous studies have generally focused its analysis more on the potential of *zakat* and its relationship with various other economic problems, but there are still few studies explore *zakat* as an instrument that plays a role in human development. The contribution of *zakat* to human development has also not been studied from all aspects of HDI (i.e., income, education, and health), and they have only focused on certain HDI components. As a result, these previous studies have failed to provide comprehensive empirical evidence about the role of *zakat* in promoting human development. In addition, studies on the role of productive *zakat* on welfare and HDI found mixed findings.

This is what drives this present study to fill up the gap of previous studies, aiming at comprehensively examine the effects of *zakat* on all components of HDI, including aspects of income, health, and education in the province of Aceh, Indonesia. More specifically, this study intends to empirically examine more deeply the influence of the distribution of *zakat* on sectors directly related to human development through the programs of the utilization and distribution of *zakat*. The findings of this study are hoped to be a guide in determining the strategic distribution of *zakat* that is more effective in improving human development.

The rest of the study is structured in the following manner. Section 2 highlights the potency of *zakat* in human development and reviews relevant selected previous studies, followed by the research methods in Section 3. Meanwhile, findings and discussion are provided in Section 4. Finally, Section 5 concludes the study.

2. Literature Review

2.1. The Dynamic Potential of *Zakat*

In its basic principle, *zakat* described as a mandatory, obligation, and absolute order for every Muslim (*muzakki*) to pay 2.5% of their wealth to assist the needy (*Mustahik*). It is one of the fundamental pillars of Islam which closely related to the economic and financial system. Even though *zakat* was only a religion instrumental for the Muslim community concerning human welfare, it has tremendous potential not only for its followers but also for humanity in broader perception. Consequently, it is not surprising to witness *zakat* performances in several practices, such as State primary sources of income or alternative funding for the assistance of social and economic factors. Nevertheless, there was research stated that *zakat* has excellent potential as the source of income, funding assistance, and alternative solution for many economic activities shaped by social processes (Majid, 2017).

In the beginning, the issues concerning *zakat* at a macro level only considered as unaccustomed discussions. However, the world's attention on this subject gradually changes over time, including in Indonesia. It also becomes a new issue and popular topic for the practitioners, researchers, academicians, and many other parties, particularly after the findings concerning the enormous potential of *zakat*. In Indonesia, Firdaus et al. (2012) estimated the potential of *zakat* to reach IDR217 trillion, equivalent to 3.4% of Indonesia's total GDP in 2010. Kahf (1989) also revealed that the potential of *zakat* in several Muslim countries, as well as Indonesia, could reach 2% of the total GDP.

In addition to this, the promising contribution of *zakat* is not limited at these levels of the framework alone. Although Stirk (2015) claims that there is no accurate or reliable data for the global financial estimation of *zakat* collection, still, there is countless empirical evidence through numerous studies conducted by many experts or institutions. Stirk (2015) even figured that the previous evaluation of *zakat* collected across the world has varied enormously – ranged from US$200 billion to US$1 trillion annually. Using the calculation of *zakat* as a percentage of GDP at the number of *zakat* received among some countries in the Organization of Islamic Cooperation (OIC), Shaikh (2016) states that it had reached US$187 million. Then, BAZNAS (2017) also provides the information regarding *zakat* acquisition led by state authorities over IDR3.6 trillion in 2015, which included *infaq* and *shadaqah* (voluntary donations), and 63% of it, designated as *zakat* (obligatory donation).

However, based on numerous data collected, it can be argued that despite *zakat* has enormous potential, it does not guarantee the collection of *zakat* would also be higher. This claim supported by the data shown in Table 1, which provides information about *zakat* collection in Indonesia in the years 2002 to 2019 that did not even reach 1% of the total it's

potential, although its accumulation has, on average, increased by 36.24% over the period. Majid (2017) explains that this situation occurs due to several factors such as cultures, regulations, motivations, and lack of understandings regarding *zakat* obligation, which is directly and significantly affecting *muzakki*'s decision to pay *zakat*.

Table 1. Trends of *Zakat*, *Infaq* and Shadaqah (ZIS) Collection in Indonesia, 2002 – 2016

Year	Total of ZIS (IDR Billion)	Growth (%)
2002	68.39	-
2003	85.28	24.70
2004	150.09	76.00
2005	295.52	96.90
2006	371.17	26.28
2007	740.00	98.30
2008	920.00	24.32
2009	1,200.00	30.43
2010	1,500.00	25.00
2011	1,729.00	15.27
2012	2,212.00	27.94
2013	2,639.00	19.30
2014	3,300.00	25.05
2015	3,653.37	10.71
2016	5,017.29	37.34
2017	6,224.37	24.06
2018	8,100.00	30.13
2019	10,070.00	24.31
	Mean	**36.24**

Source: Pusat Kajian Strategis – Badan Amil *Zakat* Nasional - Puskas BAZNAS (2017).

2.2. *Zakat* and Human Development

The current realization of the collection of *zakat* funds remains yet insignificant compared to its potential. However, it is also essential toward the understanding of how researchers and practitioners decide to develop the current *zakat* practice upon the focus and organization of joint work. This effort can be seen through *zakat* utilization and distribution programs conducted by *zakat* management institutions such as BAZNAS, Baitul Mal, and other organizations starting to unveil a substantial return on the economy of poor (*Mustahik*). The findings gradually show its impact on poverty alleviation, income distribution, improving the quality of education, and many other socio-economic arrangements, which regularly classified into two types of *zakat* distribution schemes, i.e., consumptive and productive.

Generally, *zakat* consumptive nature, limited only to cover *mustahik* daily needs, such as foods, clothes, health, and so on. However, this scheme is less helpful in the long term, assuming the support provided will be soon run out. Therefore, the distribution must be effectively utilized and avoiding the overly used for simply consumptive usage that can lead to the ineffective of *zakat* applications and systems. Meanwhile, the assistance of *zakat* productive is also supposed to increase the wealth of the poor through generating economic, education, and social security. In other words, this method considered capable of producing new *zakat* payers (*muzakki)*, which means this kind of distribution plot holds a critical responsibility toward the development of *mustahik* welfare.

Important to realize, these two methods are trying to make the *zakat* distribution more flexible. This innovation purposes to improve *zakat* roles for greater use and attempt to lead the results according to its fundamental objective, the concept of maqashid sharia, which improving the quality of human life. Therefore, the utilization of the *zakat* fund following those methods gradually led the advantages to the growth of the economic and social security of the *muzakki* over time, particularly for the poorest or most vulnerable category.

It can be seen in Table 2, which explains the example comparison regarding the distribution sectors of *zakat* by BAZNAS in the years 2015 and 2016. Overall, the total amount of *zakat* distribution increased from IDR2,251 trillion in 2015 to IDR2,694 trillion in 2016. To put it in more detail, the concentration toward the economic sector slightly increases from 15.01% in 2015 to 18.30 % in 2016. On the other hand, the health and social sectors suggested the reduction of *zakat* allocation in 2016. Correspondingly, the education sector

hints to hold the most prominent part of all *zakat* allocating funds, which significant boost from 2015 by 20.35% to 31.28% in 2016. These facts might indicate that the distribution of *zakat* on each Human Development Index (HDI) component positively affects human welfare.

Table 2. Distribution of *Zakat* by Sector in Indonesia (IDR Billion)

Sector	2015	%	2016	%
Economy	338.03	15.01	493.07	18.30
Education	458.19	20.35	842.98	31.28
Dakwah (Islamic Preaching)	334.74	14.87	418.45	15.53
Health	191.41	8.50	226.00	8.39
Social	929.23	41.27	714.26	26.51
Total	**2,251.63**	**100.00**	**2,694.78**	**100.00**

Source: Pusat Kajian Strategis – Badan Amil *Zakat* Nasional – Puskas BAZNAS (2017).

It also believed the concept of *zakat* has a close affiliation to the UNDP through the SDGs program. This program started to display a global agenda of sustainable development from 2015 to 2030. The SDGs program committed facing overcoming several development problems in 193 member countries all over the world, including Indonesia. It also in line with the basic principles of *zakat* concerning human welfare, in addition to the 17 priority goals and targets to achieve. As a result, this program considered affiliated with the concept of *maqashid shari'a* in the Islamic economic perspective, as previously explained.

Numerous advanced studies discussed how to establish the concept of *zakat* to fulfill the basic need of societies. Although the findings vary depending on the captivating area of study to each contributor, the result still shows the significant role of *zakat* in all of the human development sectors related. For example, Shirazi (1996) investigated the relationship between *zakat* distribution and poverty alleviation using the Foster, Greer, and Thorbecke – FGT's (2010) index. However, in this research, Shirazi only provided a brief review of *zakat* distribution effects on education and health areas, which supports the poverty reduction.

There has also been empirical evidence covering the enormous impact of *zakat* distribution, which creates the bridge to the success of the SDGs program. This achievement explicated by many studies conducted with various methods and approaches. For example, Suprayitno et al. (2017) discovered that *zakat* could direct impact on the economic activity of *mustahik*. Not to mention, it also can be used as an essential instrument to increase the quality of human development in the form of *mustahik* welfare. Similarly, Stirk (2015) revealed the crucial role of *zakat* in dealing with the poverty level. The result shows it level is generally higher in most of the countries resided by large Muslim populations, especially those located in Africa and South-East Asia.

In more organized methods, Kusuma and Sukmana (2010) segregated the classifications of *zakat* based on the Islamic point of view concerning distributional schemes toward the socio-economic framework. Therefore, the order divides into three stages as pre-production distribution, post-production distribution, and redistribution itself. In those events, they found two critical issues concerning income inequality. First, the equitable distribution of *zakat* to the poor and needy could appear to be an audible opportunity for economic growth. Second, the power of *zakat* has a positive impact on succeeding in dealing with income inequalities that arise by the increasing of *mustahik* purchasing power parity (PPP).

These findings also corroborated to the classical economic theory of Keynes regarding the impact of *zakat* distribution toward the marginal propensity to consume (MPC). In more detail, Yusoff (2010) stated that *zakat* possesses the ability to raise the consumption of the poor following the MPC of the *zakat* payers (*muzakki*) is lower compared to the *zakat* recipients (*mustahik*). For the same reason, Metwally (1983) found the ability of *zakat* to increase the aggregate consumption of *mustahik*. Consequently, the PPP of the *mustahik*, which is used to measure the standard of living increases. In addition to this, Yusoff (2011) also suggested for Muslim countries to give priority to distribute *zakat* toward the education sector as the most effective development strategy. This idea emerges in effect to build up the quality of human resources expected to achieve sustainable economic development.

Zakat, which is supposed to be an obligation for every Muslim, holds the role of being a new economic power toward the world's economy. Noor dan Pickup (2017) revealed that

zakat has now converted to be the largest source of wealth and funds in the world distributed to the poor in the socio-economic aspect. Moreover, *zakat* also transforms to be a significant concern of many organizations engaged in human development, such as UNDP, due to its extraordinary potential. Therefore, the subject concerning *zakat* is no longer an unfamiliar issue discussed only in the Muslim countries internally, but also has presented as global anxieties.

Supported by empirical evidence, Beik and Arsyanti (2016) and also Nurzaman (2016) explained that the funds sourced from *zakat* distribution could directly affect the HDI of *mustahik*. Despite that, the findings consider ineffective due to its particular focus on the distribution of productive *zakat* only. Consequently, future studies need to extend a longer time to get a satisfactory result in their studies.

The above-reviewed studies show the potential role of *zakat* in promoting human development in Muslim countries. *Zakat* provides an alternative source of funds toward the realization of the SDGs agenda. Considering the crucial role of *zakat* in an Islamic economy, thus, it is timely, to analyze the effect of the distribution of *zakat* on the HDI of the individual and households. Moreover, to provide comprehensive empirical findings, our study focuses on the variety of *zakat* distribution schemes provided to the poor by the Baitul Mal Aceh, Indonesia.

3. Research Method

The population of this study is the poor who are the recipients of various schemes of zakat provided by the Baitul Mal Aceh, Indonesia. This study selects 100 *zakat* recipients as the sample of the study. Based on the report of Baitul Mal Aceh, there were 504 recipients of *zakat* for three different schemes (i.e., *Zakat* for patients of cancer dan thalassemia, scholarship, and working capital from the poor family), as illustrated in Table 3. 100 of them were proportionately selected as the sample of the study following the schemes of *zakat*, thus using the proportionate stratified random sampling technique. Of 100 respondents selected, 10 of them were the recipients of *zakat* for the schemes of cancer and thalassemia, 18 were the recipients of *zakat* for the scholarship, and 77 were the *zakat* recipients for working capital. To gather the data, 100 questionnaires were distributed to them and all were returns and fully filled up by the respondents (100% response rate).

Table 3. Population and Sample of the Study

No.	Scheme of *Zakat*	Population	Sample
1.	*Zakat* for patients of cancer dan thalassemia from the poor family	50	10
2.	*Zakat* for 'one scholarship for one family' of the poor	91	18
3	*Zakat* for providing working capital for the poor family	363	72
	Total	**504**	**100**

The study measures human development using the Human Development Index (HDI) and indices of its components comprise of education, health, and income. Specifically, to determine the level of the HDI, the range of values uses is between "0" to "100". This specified limit patterns the area of variation between upper and lower limits on a particular scale of the HDI levels. Following Anand and Sen (1994), the study measures the HDI using the following formula:

$$HDI = \frac{HI + EI + II}{3} \qquad (1)$$

The Equation (1) suggests that the method to identify the HDI value in this study does not appear to have many changes comparing to the general standard applied by the UNDP and Statistics Indonesia or *Badan Pusat Statistik* (BPS). In this research, the standard formula utilizes to estimate the HDI values are not in the scope of the regional or international level. However, it holds a different approach and a slight modification on the original formula following Nurzaman's (2010) estimation on HDI by obtaining the data at a micro level, household, and individual.

In the same fashion, the estimation requires the HDI data a part of the *zakat* support, and also the data involving *zakat* assistance to compare its level in both situations. However, the

model will form after analyzing each of its components; *HI* (Health index), *EI* (Education index), and *II* (Income index). Hence, the detailed estimations for each HDI component at this level can be assessed as follows:

3.1. Health Index (Life expectancy of Mustahik)

The current life expectancy index or health index (HI) used by UNDP and BPS to estimate HDI levels at the national or international level tend to consider people's condition at birth. Likewise, the standards also applied for more modest areas such as at the provincial and district level. However, in this study, the method will be modified by considering variations in the distribution of the population (Nurzaman, 2010). Consequently, obtaining the HDI data at a lower level, certainly not something impracticable any longer.

Necessarily, an initial follow-up expected to quantify the estimation of HDI is to analyze the *mustahik* life expectancy index, which represented by the head of households. However, the data of *mustahik HI* difficult to be evaluated without standard data uses to compare. Therefore, the international standard of life expectancy for maximum and minimum; *Ex.a,g,(max)* and *Ex.a,g,(min)*, from reliable sources such as UNDP and BPS adopted. As a result, the following processes in the estimation method will appear as:

$$HI(m) = \frac{Ex.a,g.(m) - Ex.a,g.(min)}{Ex.a,g.(max) - Ex.a,g.(min)} \quad (2)$$

Moreover, the number of family members for each household holds an important part resembling the basis for estimating the average value of *mustahik* household's life expectancy index. Therefore, the formula modified as follows:

$$\text{H-Index (h)} = \sum (\text{HI (m)/n}) \quad (3)$$

3.2. Education Index

The measurement of the education index (*EI*) is not much different compared to national or international standard formula. Moreover, despite each component has its particular approach and different kinds of data as the source, the standard used for the measurement also originated from UNDP and BPS. However, the method to estimate *mustahik* household *EI* in this paper is following Nurzaman (2016) through incorporating informal education as an additional indicator for those who did not attend regular schooling. Also, the average length of study in this form of school will start at the age of 7 following the latest method of BPS in 2014 for a national standard of beginning years for formal education. Eventually, the data obtained then inserted into the following formula:

$$EYS\text{-}Index = \frac{EYS - EYS\,(min)}{EYS(max) - EYS\,(min)} \quad (4)$$

$$MYS\text{-}Index = \frac{MYS - MYS\,(min)}{MYS(max) - MYS\,(min)} \quad (5)$$

Furthermore, the result of both of Expected years of schooling (EYS) and Mean years of schooling (MYS) of the head of *mustahik* households and all of the family members will be the basis to analyze the *EI* value in the formula as follow:

$$E\text{-}Index = \frac{EYSI + MYSI}{2} \quad (6)$$

3.3. Income Index

According to the previous explanation, the income index (IE) represents a complicated term for a decent standard of living. It is the level of welfare, which is enjoyed by the people as a result of developing in the economy (BPS, 2014). In order to determine the human standard of living through the estimation of IE, the first method will directly use the adjusted

real per capita expenditure. The estimation of the real per capita expenditure measured in a medium of the monthly expenditure and income of each household of *mustahik* following government standard method, which based on 27 commodities, despite having not been able to provide an accurate explanation. However, Nurzaman (2010) offers an alternative approach by simplifying the commodities above to represent all costs for the *mustahik* needs in one month in the area of study.

Moreover, for additional methods, UNDP is also adjusting the purchasing power parity (PPP) at the household level expenditure into a unit of international dollars. PPP is one of the popular analysis metrics on macro-economic, which also has a role as the primary indicator to determine the value of the income index (II). This method also frequently applied by many countries to adjust the gross domestic product (GDP) on an international scale. Therefore, the formula will appear as follow:

PPP(Xmh) = Annual households expenditure x (Indonesia GDP deflator/US GDP deflator)(7)

In this model, we assume that the PPP metrics have adjusted to the household level. Moreover, both of the X(min) and X(max) are PPP per year at the international level set by UNDP, which are the minimum at the US $100 and the maximum at the US $40,000. Next, in order to obtain the *II* value, the result of PPP (*Xij*) will be embedded into the following formula:

$$I\text{-}index = \frac{Ln\ Xij - Ln\ X\ (min)}{Ln\ X\ (max) - Ln\ X\ (min)} \quad (8)$$

To put it simply, to estimate the HDI value of mustahik households will be directed by combining the three of its components into the Equation (1), as explained. Meanwhile, obtaining the value of HDI before and after receiving *zakat*, the method utilized through paired t-test. Hence, the result of the estimation could decide whether the distribution of *zakat* has a positive result or not.

Apart from the number of *zakat* distribution, other independent variables of family size, *zakat* scheme, and type of profession of the *zakat* recipients were included in the analysis. Thus, to analyze the impact of *zakat* distribution on HDI, the following multiple linear regression model is estimated.

$$HDI = \alpha + \lambda_1 ZK + \lambda_2 FS + \lambda_3 ZS + \lambda_4 PT + \varepsilon \quad (9)$$

To have a greater picture of the effect of *zakat* on human development, the study estimates the effect of *zakat* on all dimensions of human development, comprising health, education, and income. Thus, the following equations are proposed to measure the effect of *zakat* on the development of health, education, and income of the poor (*zakat* recipients).

$$HI = \alpha + \lambda_1 ZK + \lambda_2 FS + \lambda_3 ZS + \lambda_4 PT + \varepsilon \quad (10)$$
$$EI = \alpha + \lambda_1 ZK + \lambda_2 FS + \lambda_3 ZS + \lambda_4 PT + \varepsilon \quad (11)$$
$$II = \alpha + \lambda_1 ZK + \lambda_2 FS + \lambda_3 ZS + \lambda_4 PT + \varepsilon \quad (12)$$

where HDI is the human development index, ZK is the total of *zakat* distribution, FS is the family size, ZS is the *zakat* scheme, PT is the profession type, HI is the health index, EI is the education index, II is the income index, α is the constant term, λ_i are the estimated coefficients of each independent variables, and ε is the error term.

Prior to estimate the proposed model, the classical assumption tests of normality, multicollinearity, and heteroscedasticity are firstly performed to ensure the validity and accuracy of the data to provide robust findings.

4. Findings and Discussion

As mentioned earlier, 100 *zakat* recipients of several programs of *zakat* utilization at the Baitul Mal Aceh, Indonesia were selected as the sample of the study. In particular, there are three major welfare programs systematically analyzed, namely: *zakat* for cancer and

thalassemia patients, *zakat* for one family one undergraduate scholarship, and *zakat* for buying working capital for the poor families. Even though each of these programs has originated from different sectors, it has a strong correlation to the human development components of health, education, and income.

The respondent's characteristics in these programs are illustrated in Table 4, which represents the data of an independent variable as the basis for estimating the value of the HDI at the *mustahik* level. Generally, the data in the table shows the personal information of *mustahik*, such as age, number of a family member, educational level, and average income after *zakat*.

Furthermore, the health index as one of the HDI components is measured considering age and family size, which is one of the HDI components. The data shows that the age of 10 *mustahik* is over 55 years old, while 21 respondents between 46 to 55 years old. In contrast, 39 of them are between 36 to 45 years old, and 30 remaining respondents are under 35 years old. With this in mind, the data suggest that the majority of *mustahik* are still of productive age. Therefore, the *zakat* distribution for the group of *mustahik* believes to be a devastating way to increase the HDI-value.

Table 4. The Characteristic of Respondents

Characteristic	Frequency	Percentage
Age:		
< 35	31	30
36-45	39	39
Family Size:		
0	0	0
1-3	28	28
4-5	68	68
> 6	4	4
Educational Level:		
Elementary school	5	5
Junior high school	21	21
Senior high school	71	71
Bachelor degree	3	3
Monthly Income:		
< 1.000.000	7	7
1.000.000-2.000.000	65	65
>2.000.000	28	28
Total	**100**	**100**

Another variable that considered to affects the HDI-value is the family size. Furthermore, out of 100 respondents, 65 of them have 4 to 5 family members, and 29 respondents had the size of family members between 1 to 3 people while the rest of the respondents have 6 people or more in their family. The study found that all of the 100 respondents surveyed had attended school and completed an elementary school. In more detail, 71 *mustahik* successfully completed senior-high-school, while the remaining 21 people completed junior high school, and the other three reaching up to college as the highest level of all.

The information above indicates that there were no illiterate respondents without any educational background. Moreover, the majority of respondents managed to fulfill the twelve years of a compulsory education program. This program is launched by the Ministry of Education and Culture of the Republic of Indonesia, which consists of six years at the elementary level, and three years each at junior and senior high school levels.

The findings also show that about 65% of respondents as the majority of *mustahik* to earn IDR1-2 million income after receiving *zakat*, 28% have a monthly income above IDR2 million, and the rest 7% was only earning under IDR1 million. According to the BPS (2019), the majority of *mustahik* monthly income supposes to meet the regional and provincial minimum wage standards after receiving the *zakat*.

Table 5, in turn, reports the changes in *mustahik* HDI and its components before and after receiving *zakat*. In other words, this table reports the effectiveness of *zakat* on improving HDI and its components.

Table 5. The Changes of HDI Value and Its Components before and after *Zakat*

Variables	Before *Zakat*		After *Zakat*		Changes
	Value	Index	Value	Index	%
Health index (HI)	24	24	0,25	25	1,74
Education Index (EI)	64	64	0,70	70	8,90
Income index (II)	55	55	0,75	75	26,53
Human development index (HDI)	46	46	0,57	57	19,38

As illustrated in Table 5, the *mustahik* HDI level increased by 19.38 percent after receiving *zakat* from the level of 46 to 57. These results indicate that the value of *mustahik* HDI has improved comparing before *zakat* distribution. Notwithstanding, the level of HDI still much lower compared to the national level of Indonesia HDI in 2015, which was at 68. Nevertheless, the HDI growth suggests that the *zakat* might have a significant influence on the HDI improvement and also on the success of the SDGs program.

Table 5 also suggests that the imbalance between HDI components causes the trifling on the level of *mustahik* HDI. Furthermore, the value of average life expectancy, which refers to the health index estimation after *zakat*, found at 0.24. This result suggests that the average life expectancy of babies born in that year was around 24 percent and has probabilities of surviving until the age of 24 years. Similarly, Murniati and Beik (2014) found its rate at 0.34, which also indicates the average life expectancy index in the year is 34 percent. They can survive to live until 34 years old. However, according to empirical data, and supported by the census conducted by BPS (2019), the average life expectancy could reach over 75 years old. In this case, the estimation of the life expectancy index seems to be unsuitable for the essential measurement of human welfare toward the health sector.

Table 6. Paired t-Test Before and After *Zakat*

HDI Changes		Paired Differences					t-value	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Difference (5%)			
					Lower	Upper		
Pair 1	HDI after-before	0.109	0.073	0.007	0.095	0.124	14.903	0.000
Pair 2	HI after-before	0.004	0.003	0.000	0.003	0.004	13.713	0.000
Pair 3	EI after-before	0.063	0.074	0.007	0.048	0.077	8.501	0.000
Pair 4	II after-before	0.199	0.138	0.014	0.171	0.226	14.366	0.000

Furthermore, the effectiveness of *zakat* on the HDI of *zakat* recipients after and before receiving *zakat* based on the paired t-test is reported in Table 6. The mean of HDI-value before and after *zakat* was equal to 0.109. This condition indicates that there is a positive tendency for HDI-value growth. Moreover, the table shows the sig < 0.05, suggesting that there are differences in *mustahik* HDI before and after receiving *zakat*. This result indicates that the *mustahik* HDI level after *zakat* distribution is higher compared before receiving it. The significant effect of *zakat* on HDI and its components is also illustrated in Table 7. Therefore, the distribution of *zakat* funds to *mustahik* has improved their HDI level and its components, health, education, and income indices.

Table 7. The Effects of *Zakat* on HDI and its Components

Variables	HDI	HI	EI	II
Constant	-1.0770***	-0.7248***	-0.9943***	-1.5086***
	(-4.3214)	(-2.9617)	(-2.7318)	(-3.5950)
Zakat	0.1131***	0.0914***	0.1170***	0.1312***
	(7.5270)	(6.1949)	(5.5328)	(5.1828)
Family size	-0.0292***	-0.1015***	-0.0208**	0.0337***
	(-4.7285)	(-16.705)	(-2.3077)	(3.2425)
Zakat Scheme	0.0186	0.0023	0.0029	0.0488**
	(1.5686)	(0.2030)	(0.1677)	(2.4315)
Work Type	-0.0079	-0.0204***	-0.0129	0.0111
	(-1.4758)	(-3.8606)	(-1.6494)	(1.2314)
R^2	0.6139	0.8758	0.4349	0.2905
Adjusted R^2	0.5976	0.8705	0.4111	0.2606
Durbin-Watson	1.5610	1.4065	1.5687	1.6856
F-Statistic	37.779***	167.489***	18.284***	9.726***

Note: *** and *** indicate the 1% 5% levels of significance.

The findings of our study are also corroborated by previous studies conducted by Murniati and Beik (2014), which states that the *zakat* plays a decisive role in increasing the *mustahik* HDI level. In more detail, they found that the value of *mustahik* HDI increased by 4.1% from levels 47 to 49, even though the status of the HDI level did not change significantly. Still, these findings become evidence that *zakat* has perfect control over the HDI level enhancement. Puskas BAZNAS (2017) also found that the distribution of *zakat* toward education and health sectors showing positive effects. Similarly, De La Torre and Moreno (2013) confirmed the outcomes of this analysis regarding the HDI improvements. Correspondingly, it found that the oil and gas revenue sharing carried out by the Mexican government was effective in boosting the income of the deprived people in the area of research. Finally, Syechalad et al. (2013) also explained that government expenditure in health and education sectors held an essential role in increasing the HDI level. Therefore, advancing the concentration in these sectors, which led to human welfare improvement, should have remains the priority in *zakat* distribution.

As discussed earlier, a multiple linear regression analysis is performed to specify the accurate analysis of the *zakat* effect toward the HDI and the SDGs agenda success. However, it must first meet the classical assumption, as a requirement to verify the validity of the data used for the test. The study found that the *p*-value of the Jarque-Bera test, including R-square and Chi-Square on the Breusch-Pagan-Godfrey test was less than 0.05. At the same time, the value of the centered VIF recording between 10 and 0.1, which means all of the tests have met the assumption requirement for its validity.

Moreover, the analysis explicates the value of F-calculate > F-table with the significance of each dependent variable < 0.05 (Table 7). In this case, the simultaneous test procedures confirm the *zakat* distribution with significant results and positive effects toward the family size, types of *zakat* distributed, and *mustahik* professions. Besides, the result of this study also supported by Nurzaman (2016) and Murniati and Beik (2014), which obtained an identical conclusion on the distribution of *zakat*, which had a positive and significant effect on HDI along with the other three components.

Soares et al. (2007) supported through conditional cash transfer programs given to the family members of poor households in Brazil regarding education and health sectors. The assistance granted in the form of aid to maintain the school attendance for the children between 6-15 years old and routine health check-ups for pregnant women and the children up to six years old in needy families. This research explained the positive results of the program on the consumption expenditure of the poor, especially for food consumption, which indirectly influences the improvement of health quality. Furthermore, with the assistance provided to the education of children from low-income families, the dropout rate has diminished; in other words, the education level of the children of poor households has risen. Additional findings regarding the research are that the provision of allowance in both sectors helped to break the cycle of poverty that has occurred between generations in several households in Brazil, particularly the houses that exist below the poverty line.

Further analysis found that the impact of *zakat* not only related to the HDI but also expected to meet the *maqashid shari'a* criteria, which have more comprehensive viewpoints and does not restrain to these three sectors. Consequently, it is not surprising that the distribution of *zakat* manages to give a positive and significant effect on HDI and its components.

Instead, the family size exposes a negative and also significant effect on the HDI-value, likewise the health and education index. On the contrary, this variable precisely shows the different results on the income index. This circumstance indicates the larger the number of members in the household of *mustahik*, the higher the impact on the HDI impairment. However, the inequalities occur in each HDI components regarding the family size, considered to be a trigger for many socio-economic problems, mainly related to human development, which obliquely causes the negative impression on *mustahik* HDI-value.

According to this occurrence, Kiran and Dhawan (2015) explained that the increase in the number of members in a household, indirectly results in the transfer of income derived from savings; as a result, the ratio of a person's savings or families will continue to decrease in line with the increase of family members. In a few cases, the additional family members who have individual income could not affect the reduction of the savings ratio. On the contrary, it

causes the possibility of savings ratios owned by households that have many members who are much higher than the houses with a few members of the family. However, supported with many empirical findings, Bendig et al. (2009) revealed that most of the research conducted shows that the number of household members drains the savings, the more members in a household withdraw the savings, the tendency that occurs is the loss of savings from the individuals.

In the case of the distribution aspect, the variable of *zakat*-type that utilized shows irrelevant results on HDI-value and its components but not the income index. This outcome occurs because of the *zakat* given in the form of cash, which issued directly on the *mustahik* income but not for the ill-treatment or for the consumption of nutritious foods that affect health improvement. Furthermore, the transferred health funds tend to lead only as a support for *mustahik* families during the treatment period. Additionally, *zakat* utilization in the education sector requires a long period to reveal its capability. Consequently, the distribution of these sectors has not shown significant results, in contrast to the income-related area, which has a direct impact on HDI.

Besides, *zakat* distribution programs in the education sector conducted tend to lead to the formal education system, which progresses and shows the impact in a more prolonged period. In contrast, if *zakat* can distribute in the form of informal education such as training or improving work skills, which is also known as technical and vocational education and training, it will show immediate effects. According to Bagale (2015), such training plays a significant role in creating conditions for sustainable development. Besides, this kind of training and education is also qualified to provide opportunities to train skills and improve careers for students who do not want or incapable of advancing their education at a higher level.

The last variable examined in this study is the type of work. Works for people define as a tool to manifest the potential with various qualities and innovations owned with all their souls. Therefore, it could be interpreted as a method for accessing the product of development to meet their needs appropriately. Furthermore, the World Bank (2013) illustrates how types of work can affect development by creating a positive cycle. However, this study has a different result compared to what the World Bank found. This circumstance explains that *mustahik* current jobs are not feasible enough for them to meet basic human needs. Consequently, the *mustahik* needs to find a better job or to develop their existing works.

5. Conclusion

Zakat is one of the pillars in Islam that contains creed (*shahadah*), prayer (*salat*), fasting, and pilgrimage (hajj). The difference is that *zakat* not only being part of the routine of worship but also has a strong relationship with a social life that is directly related to socio-economic activities. *Zakat* originates of an obligation for every Muslim. It is a huge source of funds which is obtained from *muzakki* and distributed to *mustahik* with the particular provisions. In the economic world, *zakat* incarnate to be a new global phenomenon associated with the concept of human development. Therefore, the research and discussions regarding optimizing its roles, which have enormous potential, drastically increase over the decades, be it from the perspective of *zakat* collection or distribution.

In terms of *zakat* collection, there are not many discussions concerning its immense potential. Despite the fact that the research is limited, but most of the researchers admit that the collection of *zakat* could reach more than 2% of GDP. On top of that, UNDP even states that *zakat* is one of the most substantial sources of funds transfer to the poor and needy existence. Similarly, a large amount of literature and research focus on the discussion in terms of *zakat* distribution also expected to be a demanded topic by economists. Moreover, *zakat* has shown its strength to be an alternative toward human welfare by analyzing its impact on human development. Particularly, *zakat* can cover a number of important issues for the world such as eradicating extreme poverty, ensuring a healthy life, securing the quality of education, and reducing the inequalities, which also included in the 17th priority goals and targets in the SDGs program led by UNDP.

Nevertheless, it is unlikely to avoid criticism regarding SDGs. This is primarily because – the suspicious viewpoint of critics on the target quantities as a weakness, while others argue that these goals represent a critical reflection of the complexity of human life. In addition to

this, the Human Development Index (HDI) introduced by Ul Haq (1990) provides a single-number measure alternative capturing the development in three basic dimensions of human welfare: health, education, and decent living standards. However, there are also cynical arguments attracted regarding the HDI, which is a limited area measurement only to three indicators of human well-being.

Another finding appears to suggest that the imbalance between the levels of HDI and its components among the *mustahik*. This result contradicts the fundamental values of *zakat*, which can reduce socio-economic inequality in society. In contrast, the impartiality of *zakat* distribution through various well-directed and structured programs, expected to show a satisfying result. Hence, the issue concerning the inequality on three components of HDI and also social and economic factors in comprehensive perspectives can be solved.

Finally, in this study, we exposed another form of a solution in meeting the development challenges through the *zakat*, considering its potentials. Furthermore, supported by empirical evidence, *zakat* assumes to be an alternative factor for the socio-economic failures of human society. However, the significant gaps that occur between enormous *zakat* potential and its insignificant amount collected have created the dilemmas on the optimization of *zakat* roles. Correspondingly, its role in increasing the level of HDI, which represents the quality of human life, will be affected. It also will exacerbate the accomplishment of the SDGs program, which has a universal vision for ending poverty, protecting the planet, and ensuring everyone experience harmony and prosperity.

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FINANCIAL INCLUSION AND POVERTY REDUCTION IN ACEH PROVINCE: COMPARISON BETWEEN CORE REGION AND PERIPHERY REGION

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Abstract
This study analyzes the role of financial inclusion on poverty reduction in Aceh Province, the comparison between the core region (Banda Aceh) and periphery region (Aceh Besar). This study uses cross-sectional data from Banda Aceh and Aceh Besar with sample total of 598 and 686 households, respectively. The logistic model is used in this study. The results show that financial inclusion is negatively not significant in Banda Aceh but negatively significant in Aceh Besar. Meanwhile, sex and educational level are negatively significant in Banda Aceh and Aceh Besar, and family size is positively significant in both regions. The biggest marginal effect on poverty is sex in Banda Aceh and Aceh Besar regions. Female is more vulnerable to be poor compared to male in term of poverty

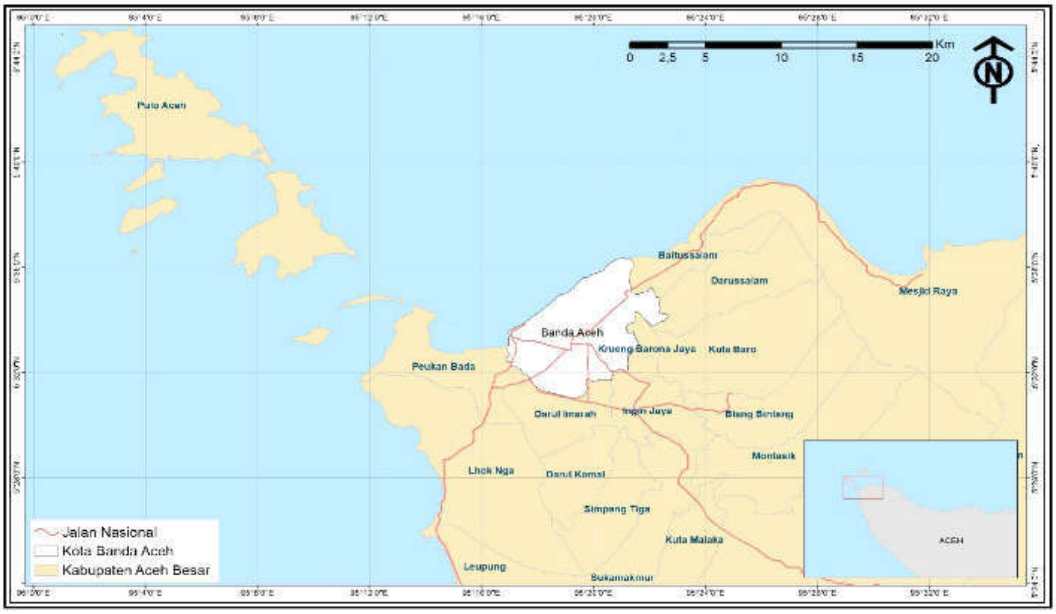
Keywords: financial inclusion, Aceh, poverty reduction, logistic
JEL classification: N95, B23, B26, I32

1. Introduction

Banda Aceh is capital of Aceh Province and it also the business center of the province, hence it becomes core region in this province and Aceh Besar is the periphery of Banda Aceh (Figure 1). Theoretically stated that at the beginning of development, the core region has back wash effect on periphery region because all of the potential resources will go to core region and at this stage the periphery region growth faster and catch up the core region. In the next step, when the core region become congestion, there will be a spread effect on the periphery region. Banda Aceh is more developed than Aceh Besar. According to the theory, Aceh Besar receives the spread effects from Banda Aceh, hence there is no different between Banda Aceh and Aceh Besar. This means that the development of Banda Aceh has a positive effect on Aceh Besar. At this point, there is no different between Banda Aceh and Aceh Besar because these regions have the same stage of development. There is no different in term of development in Banda Aceh and Aceh Besar if the spread effect works as stated by the theory.

Ideally, the development in these regions are in the same stage, however, the study of Wolff (2018) shows that the periphery area is losing importance. This means that there is a disparity between core and periphery regions. It is very interesting in analyzing the core and periphery regions relationship, especially in term of fiancial inclusion and poverty because the development of internet banking nowadyas, there is no different between these regions because the internet is avaiable every where and it supports digital finance.

Figure 1. The Map of Banda Aceh and Aceh Besar



Digital finance supports financial inclusion even though some experts are not supporting digital finance. Ozili (2018) states that digital finance has positive effects for financial inclusion and this digital finance provides to individuals with low and variable incomeis more valueable to them compared to conventional regulated banks. However, the work of Zins and Weill (2016) concludes that being man, richer, more educated and older favor financial inclusin with the higher influence of education and income. This means that education and income have an important role in financial inclusion even though there is a development of digital finance.

Financial inclusion is very important because it has positive on economic growth. This is supported by the work of Kim et.al (2018) finds that financial inclusion has a positive effect on economic growth in 55 countries of the Organization of Islamic Cooperation (OIC). If there is economic growth means there is a positive effect on income, hence poverty will decreas. The role of financial inclusion has been proven in some countries, but in this study it is very interesting in analyzing the effect of financial inclusion in core and periphery regions.

2. Theoretical Review

Kim et.al (2018) use VAR and Granger causality test show that financial inclusion has a positive effect on economic growth in 55 countries of OIC. Furthermore, they also find that economic growth has a positive effect on financial inclusion. Economic growth is very important to increase income and to reduce poverty and when income increase the people will use banking services to support their daily transaction. Income and financial inclusion have caulasity relationship. Increase in income will cause an increase in financial inclusion. In this case, there is a relationship between core and periphery regions because Wolff (2018) states that there is the interrelationship between the core region and hinterland. The growth in core region will cause the same growth in the hinterland. These results are suppoted by the work of Kim et.al (2017), where they find that there is a strong relationship between core region provinces with their hinterland in Korea.

Li (2018) confirms that financial inclusion has a positive effect on poverty reduction in China. However, Neaime and Gaysset (2018) find a different result, where financial inclusion has no effect on poverty reduction in MENA countries. Their results also show that financial inclusion decreses inequality, population size and inflation to increase income inequality. The studies of Zins and Weill (2016) and Lyons et.al (2018) find that there are some factors affecting financial inclusion such as man, richer, more educated, and older favor financial inclusion with higher education and income. Libois and Somville (2018) add another variable that has a positive and significant effect on poverty, the variable is the family size. Meanwhile, Swamy (2014) finds that the impact leaned positively toward women and is

noticed from the fact that the income growth of net inflation was of the order of bigger again men. This means that gender has a signifcant role in determining financial inclusion.

The increase of financial inclusion is determined by digital finance, where digital finance has a positive impact both in emerging market and developed market (Ozili, 2018). This means that financial inclusion will not be applicbale if it is not supported by digital finance. Furthermore, the role of banking is also significant to promote financial inclusion (Iqbal and Sami, 2017). In addition, Tchamyou et.al (2019) find that ICT reduces income inequlaity through formal financial development.

Financial development has also important to decrease poverty in the low–and midle–income income countries (Boukhatem, 2016). Financial development is beneficial for the poor by increasing their access to various funding sources. However, financial instability has negative effects on the poor. In addition, the poor have a low ability to loanable funds and the poor become vulnarable (Burlando and Canidio, 2017).

The proverty reduction is also related to educational level because educated men will find and create a good job and earn more money than uneducated ones. Mihai et.al (2015) document that education and welfare level are correlated and the latter decreasing substatially as educational level increases. Furthermore, they explain that the educational level and poverty have causal relationships on long-run or short-run. The most similar results also shown by the research of Kabakova and Plaksenkov (2018) that there are some factors affecting financial inclusin sucs as demographic, politic, economic development, technology, and social factors.

3. Research Method

This study is conducted in Aceh Province where Banda Aceh is capital for Aceh Province and Aceh Besar is periphery region. Theoretically stated that in the beginning, there is back wash effect on periphery region because all of the resources are concentrated in the core region. Furthermore, after the core region becomes more developed, there are spread effects on the periphery region, then this periphery region becomes more developed. So, this study is a comparison between the core region and the periphery region in term of financial inclusion and its effect on poverty.

3.1. Data

The data in this study are primary data that are collected directly from the household in Banda Aceh and Aceh Besar. Slovin model is used to determine the numbers of household samples in these regions as follows (Tejada & Punzola, 2012):

$$n = \frac{N}{1+Ne^2} \quad (1)$$

Where n is sample size, N is population, e is error term, in this study is set 5 percent. Based on equation (1), the numbers of samples are:

Table 1. Households and Sample Sizes in Banda Aceh and Aceh Besar

Items	Banda Aceh	Aceh Besar
Number of households	64,008	94,683
Sample size (e is 5 %)	395	398
Actual samples	598	686

Source: Field Research, 2019.

3.2. Model

The logistic model is used in this study, the model is a nonlinear model. The model is stated as:

$$Pov = \beta_1 + \beta_2 FI + \beta_3 EL + \beta_4 SEX + \beta_5 FS + \varepsilon \quad (2)$$

Theoretical coefficients: $\beta_2, \beta_3, \beta_4 < 0$ and $\beta_5 > 0$

Where *Pov* is poverty is proxied by a dummy variable, 1 for poor and 0 otherwise. This variable is measured by poverty line, USD 42 and USD 29, per month per capita, respectively. This poverty line is set by the government. In addition, *FI* is financial inclusion proxied by a dummy variable, 1 for households that have access to financial institutions and 0 otherwise, *EL* is educational level, 1 for higher educational level and 0 otherwise, and *FS* is the family size (persons), and *SEX* is 1 for male and 0 otherwise. The equation (2) is estimated by the maximum likelihood method.

4. Results and Discussions

4.1. Statistics of Respondents

Statistics of the respondents show that educational levels in the study show that most of the respondents have lower educational level both in Banda Aceh and Aceh Besar. The respondents in Banda Aceh that have a lower educational level total of 333 (55.7 percent) households meanwhile 541 (78.9 percent) households in Aceh Besar. This means that less than half of the respondents that have a higher educational level. The lowest age of respondent in Banda Aceh is 18 years old, meanwhile in Aceh Besar 17 years old. Meanwhile, the highest age of the respondents are 71 years and 85 years, respectively with the average age in each region is 33.98 years and 42.93 years, respectively.

The average income per month in Banda Aceh is USD 309.71 and in Aceh Besar is USD 188.42. The highest income in Banda Aceh is USD 12,413.79 and Aceh Besar is USD 6,896.55 with standard deviations are USD 651 and USD 289.45, respectively. This means that the bigger income in Banda Aceh than Aceh Besar but the higher income inequality in Banda Aceh because the standard deviation in Banda Aceh is bigger than in Aceh Besar (Table 2). Table 2 shows that educational level is better in Banda Aceh compared to Aceh Besar because the highest is the same but the standard deviation is bigger in Aceh Besar indicates that there is higher inequality in educational level in Banda Aceh.

These statistics indicate that there is a disparity between the core region (Banda Aceh) dan periphery region (Aceh Besar). This means that there is no spread effect happen between the core region and periphery region in this study because there is a big disparity in term of educational level and income as some of the economic indicators.

Table 2. Statistics of Respondents in Banda Aceh and Aceh Besar

Items	Banda Aceh			
	Minimum	**Maximum**	**Mean**	**Standard Deviation**
Age (years)	18	71	33.98	11.30
Income (USD)	20.69	12,413.79	309.71	651.00
Years of Schooling	0.00	23.00	13.28	2.80
	Aceh Besar			
Age (years)	17	85	42.93	12.26
Income (USD)	8.28	6,896.55	188.42	289.45
Years of Schooling	0.00	23.00	10.95	3.86

Source: Field Research, 2019.

4.2. Estimated Results

The logistic models of the role of financial inclusion on poverty reduction are estimated by using the maximum likelihood method for Banda Aceh as core region and Aceh Besar as periphery region. As mentioned in equation (2), there are four independent variables in the model i.e. financial inclusion (FI), sex of head of household (SEX), educational level (EL), and family size (FS). Theoretically stated that FI, SEX, and EL are negatively signed, whereas FS is positively signed. The estimated results are as follow:

Table 3. Estimated Results of Financial Inclusion Model of Core Region

Variable Name	Estimated Coefficient	T-ratio	Odds Ratio
FI	–0.1855	–0.3481	0.8307
SEX	–1.3048	–4.1953	0.2712
EL	–1.1299	–3.3661	0.3231
FS	0.7796	7.8141	2.1806
Constant	–3.1279	–8.7871	0.0438
Estrella R-Square	0.16923	Durbin–Watson	1.7744
Chow R-Square	0.20999	Log of Likelihood Function	-152.88

Source: Estimated Results, 2019.

Table 4. Estimated Results of Financial Model of Periphery Region

Variable Name	Estimated Coefficient	T-ratio	Odds Ratio
FI	-0.7661	-3.0112	0.4648
SEX	-0.8856	-3.6554	0.4125
EL	-0.5761	-1.5572	0.5621
FS	0.8634	10.0010	2.3712
Constant	-3.6193	-10.4230	0.0268
Estrella R-Square	0.2533	Durbin–Watson	1.7398
Chow R-Square	0.2594	Log of Likelihood Function	-235.07

Source: Estimated Results, 2019.

All of the variables in the estimated results of core and periphery regions are theoretically and statistically significant except the coefficient of financial inclusion in the core region model. The models reach stability because after five times iterations. This means that the models are suitable to be used in analysis and discussion.

4.3. Discussion

Financial inclusion is not significant in the core region (Banda Aceh) means that financial inclusion has no significant effect on poverty reduction even though the effect is negative. This variable is not significant in this region because only 41 respondents that have financial access both for digital finance and conventional banking system. It is surprising because this core region is located in the capital of Aceh Province where this region is also the business center of the province. The use of banking service is relatively limited in this region whereas banking offices are available almost in every corner. This result confirms the study of Neaime and Gaysset (2018) but it is not not consistent with the works of Kim et al (2018) and Li (2018).

Furthermore, other variables are theoretically, statistically, and negatively significant for sex and educational level and positively significant for family size. Female is more vulnerable in this case because the probability of being poor is bigger compared to male. Meanwhile, the lower educational level has a bigger probability of being poor than a higher educational level, because the educational level has negative and significant coeeficient. In addition, family size has positive and significant coefficient means that the increase in family size has the possibility to poor as much as two times (Table 3). This means that this

coefficient has the biggest effect on poverty. This study confirms the studies of Zins and Weill (2016), Libois and Somville (2018), Swamy (2014), and Mihai et al (2015).

For the periphery region, all of the estimated coefficients are theoretically and statistically significant. The biggest magnitude of coefficient in this region is sex, means that male has the biggest opportunity to not poor compared to female and female is more vulnerable in term of poverty. If the household is led by a female then the possibility that family becomes poor is bigger compared to male. The second is family size means that the bigger the size of the family then the bigger possibility to be poor. These results are consistent the works of Zins and Weill (2016), Libois and Somville (2018), Swamy (2014), and Mihai et al (2015).

Furthermore, financial inclusion has the third larger coefficient where this coefficient is negarive and significant. This means that if the households have financial access to bank and other financial institutions then the family become richer than the families have not financial access. The same effect is also found in the educational level variable where this variable is negatively sloped means that the higher educational level the bigger possibility to be rich. These results confirm the work of Kim et al (2018) and Li (2018) but not consistent to study of Neaime and Gaysset (2018).

The effect of each variable on poverty reduction can also be analyzed from odd ratios as presente in Table 3 and 4. Table 3 shows that family size has the biggest effect on poverty where this coefficient has 2.1806 times to be poor and followed by financial inclusion as the second variable. Financial inclusion has 0.8307 times to be not poor if the family has financial access. The almost the same results also found in Table 4, where the variable that has the biggest effect is the family size as 2.3712 times to poverty level. However, the second variable is the educational level has 0.5621 times to poverty reduction and the third variable is financial inclusion that has 0.4648 times.

Detail analyses of financial inclusion effect on poverty reduction are derived from the cross–tabulation statistics of the core region and periphery region. Table 5 is used to analyze the effect of financial inclusion on poverty reduction by sex in the core and periphery regions. Both female and male are more vulnerable as poor in the periphery region comaped to core region because the statistics are significant at 99 percent. Table 5 shows that families those have finacial inclusion in the periphery region have bigger poverty level than the core region. This means that the periphery region is more suffering in term of the poverty level.

Furthermore, financial inclusion effect on poverty reduction by educational level shows that female is more vulnarable than male both in the core and periphery regions. Female become more vulnarable become they have to fulfill all of the family expense alone, meanwhile male usualy is supported by a female in their daily life. For detail results of the statistics of the effect of financial inclusion on poverty reduction by educational level are presented in Table 6.

Table 5. Cross–Tabulation Statistics of Financial Inclusion Effect on Poverty Reduction by Sex in Core and Periphery Regions

Sex of Respondents	Pearson Chi–Square Values		df	Two–Sided Significant	
	Core Region	Periphery Regions		Core Region	Periphery Regions
Female	0.733	11.865	1	0.487	0.001
Male	0.729	16.198	1	0.694	0.000
Total	0.785	26.739	1	0.424	0.000

Source: Field Study (counted), 2019.

Table 6. Cross–Tabulation Statistics of Financial Inclusion Effect on Poverty Reduction by Educational Level in Core and Periphery Regions

Sex of Respondents	Pearson Chi–Square Values		df	Two–Sided Significant	
	Core Region	Periphery Regions		Core Region	Periphery Regions
Female	8.254	9.962	1	0.004	0.001
Male	2.930	2.675	1	0.114	0.115
Total	10.212	11.369	1	0.001	0.001

Source: Field Study (counted), 2019.

5. Conclusion

Conclusions of the study are: (i) financial inclusion has negative and significant effect on poverty reduction in the regions except for Banda Aceh as core region; (ii) female as head of household has bigger possibility to be poor in both regions; (iii) educational level has negative and significant effect on poverty reduction in core and periphery regions; (iv) family size has positive and significant effect on poverty reduction. Based on these results, the government should encourage banking and financial institutions to wider their services for all people in order to decrease the poverty level. In addition, household led by female should be guided by the government in order to reduce the poverty level. Furthermore, the educational level must be increased by providing financial supports and scholarships for poor people to pursue a higher educational level, hence the level of poverty could be decreased. Family size should be controlled to have a quality family and possibility to be poor is lower.

The effects of variables from odd ratios coefficients show that family size has the biggest effect on the poverty level. This variable has more than twice to increase the poverty level both in core and periphery regions.

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DYNAMIC CAUSALITIES BETWEEN WORLD OIL PRICE AND INDONESIA'S COCOA MARKET: EVIDENCE FROM THE 2008 GLOBAL FINANCIAL CRISIS AND THE 2011 EUROPEAN DEBT CRISIS

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Abstract

This study examines and analyzes the short- and long-run dynamic causal relationship between the prices of Indonesian and world cocoa beans during the 2008 global financial crisis and the 2011 European debt crisis. Time series analysis consisting of cointegration, Vector Error Correction Model (VECM) and Granger causality are used to test long-run equilibrium, short- and long-run relationships, and dynamic causalities between the Indonesian cocoa and world cooa prices. The study found a long-run equilibrium between Indonesian cocoa price, world cocoa price, exchange rate, and world oil price. The Indonesian and world cocoa markets have a mutually influential relationship. However, an inefficient transmission of corrective adjustments in the Indonesian cocoa prices was documented over the study period. The exchange rate consistently affected Indonesian cocoa prices, while fluctuations in world oil prices were independent to domestic and world cocoa markets over the study period. Overall, the study documented a long-run equilibrium between Indonesian and global cocoa markets at the different level of speed of adjustment of the world cocoa price towards long-run equilibrium between the two economic crises. The Indonesian government needs to enhance international trade cooperation and pricing policy harmonization among cocoa producing- and importing-countries.

Keywords: Cocoa price, Exchange rate, Oil price, World cocoa market, Economic crisis
JEL classification: C01, C23, O13.

1. Introduction

The export of cocoa beans to the global cocoa market has been dominated by the developing countries (The United Nations Conference on Trade and Development - UNCTAD, 2015), including Indonesia. Meanwhile, the developed countries, in general, become importers of cocoa raw materials for fulfilling the needs of their manufacturing industry sector. As the third-largest cacao producing country after Ivory Coast and Ghana, Indonesia has contributed 15% (4.251 million tons) to the total world cocoa production (UNCTAD, 2017; Dewanta, 2019). The national production of cocoa in Indonesia has been contributed 87% by smallholder farmers, while the state plantation and larger private estates only contributed 8% and 5%, respectively (Yasa, 2005). In Indonesia, cacao plants are dominantly owned by farm households located in Sulawesi Island (Hoffmann et al., 2020). A total of 1.1 million households have involved in cocoa farming with a production area of 1.69 million hectares (Central Statistics Bureau of Indonesia - BPS, 2019).

Amid an increasing demand in the world cocoa market, the margin price received by the cocoa smallholder farmers as the primary cocoa producers in Indonesia has been relatively

lower compared to prices on the international market (Ministry of Agriculture of the Republic of Indonesia, 2016). Thus, the issue of the level of welfare of cocoa smallholder farmers has been a long-standing unresolved issue in Indonesia. The low quality of non-fermented cocoa beans exported to various destination countries has contributed to a cheaper of Indonesian cocoa prices (Witjaksono and Asmin, 2016). Fermentation of cocoa beans is one of the most critical ways in realizing an increase in cocoa value added (Figueroa-Hernández et al., 2019). Nevertheless, with an increasing trend of Indonesian cocoa production and world cocoa demand, the Indonesian cocoa agricultural sector could continuously capture the potential global market if it can maintain a long-run equilibrium between prices in the domestic and world cocoa markets.

Furthermore, with a large amount of potential land available for the development of cocoa farming business, Indonesia can play a role as a major raw material provider for the global cocoa processing industry sector endlessly despite the relatively low margin price enjoyed by the smallholder farmers. In Indonesia, cocoa is categorized as the primary commodity exports and is relied upon as an essential contributor to the national income and economic growth (Bank of Indonesia-BI, 2019). Indonesian cocoa has been very instrumental in ensuring world food security (UNCTAD, 2017). Thus, ensuring the steady growth of cocoa production and its price equilibrium become an important topic to be studied from an economic, ecological and social perspective. The government and stakeholders need to design proper agricultural-related economic policies for the highest smallholder farmers' benefits by making Indonesian cocoa more competitive in the global market (Mofya-Mukuka and Abdulai, 2013; Olimpia and Stela, 2017).

Global economic cycles often lead to volatility and persistence over national cocoa commodity prices. Changing trends in world food prices endanger food security worldwide, particularly in developing and underdeveloped countries. The dynamics of the global economy influence the behaviour patterns of export cocoa commodity markets (Ivanic and Will, 2014; Ying et al., 2014). The 2008 global financial crisis and the 2011 European debt crisis have triggered changes in the prices of food commodities and crude oil. Commodity price movements become more volatile after the 2008 global financial turmoil (Zhang et al., 2019). Coinciding with the onset of the economic crisis, worldwide cocoa and crude oil prices declined and fluctuated, which then impacted the world food price index (Cabrera and Schulz, 2016). Upon entering 2016, the world price of cocoa beans dropped dramatically (International Cocoa Organization-ICCO, 2016). Since 2004, the global factors have been becoming more significant in determining integration among commodity markets (Yin and Han, 2015). This shows that the market's ability to achieve price balances in both the short- and long-run has different effects and speed of adjustments across episodes of economic crisis due to differences in their nature, causes, intensities, and consequences.

With a large amount of potential land for the development of cocoa farming business, Indonesia can play a role as a major raw material provider for the global cocoa processing industry sector despite the relatively low margin price. In Indonesia, cocoa is included in the category of commodity exports and is relied upon as a contributor to the country's foreign exchange, boosting the pace of the national economy (Bank of Indonesia-BI, 2019), and is very instrumental in meeting world food needs (UNCTAD, 2017). Farm households mostly own cacao plants in Indonesia. A total of 1.1 million households are involved in cocoa farming with a production area of 1.69 million hectares (Badan Pusat Statistik Indonesia, 2019). This cocoa business is a type of small-scale smallholder plant whose production is central in Sulawesi Island (Hoffmann et al., 2020). Therefore, this sector is considered to be very strategic to be studied and developed from an economic, ecological and social perspective. The government and stakeholders need to design agricultural economic policies that are more competitive in the global market (Mofya-Mukuka and Abdulai, 2013; Olimpia and Stela, 2017).

Previous studies documented that the price cycle of domestic cocoa beans tends to become more sensitive to shocks in world prices and their quality (Fernández et al., 2017; Dewanta, 2019). The integration of commodity prices between international and domestic markets has been symmetrical (Arnade et al., 2017). This shows that a long-run equilibrium of the Indonesian cocoa market is closely related to the world cocoa price, which then creates horizontal market integration. However, an imbalance between the quantity of demand and

supply of cocoa leads to price volatility and readjustment (Ahrens et al., 2017). Cocoa price transmission can be viewed through interactions from the international to the domestic markets (Ceballos et al., 2017). Thus, the high volatility of world cocoa prices makes the lives of cocoa farmers vulnerable to poverty as in Africa (Tothmihaly, 2018). If the level of income received by cocoa farmers is still overshadowed by uncertainty due to price changes, then as much as possible it needs to be overcome through trade policies designed based on price forecasts and its long-run equilibrium.

In addition to pricing factors, exchange rate volatility also contributes to shocks to cocoa commodity prices (Cozmanca and Manea, 2010). Exchange rate volatility among countries has asymmetrical behaviour, and it affects export expansion, in addition to the emergence of strong positive effects due to exchange rate risk (Volkov and Yuhn, 2016; Buffie et al., 2018). The financial crisis is among the most significant factors in influencing exchange rates (Nedeljkovic and Urosevic, 2012). Besides, the global price of crude oil also plays a vital role in determining the prices of other commodities, including the price of cocoa beans on the domestic and international markets. Empirical evidence provides strong evidence of the impact of changes in world oil prices on agricultural commodity prices (Nazlioglu and Soytas, 2012; Fowowe, 2016). Where, the elasticity of real oil prices, in the long run, is expected to have a negative slope to demand, especially when it reaches peak production (Haugom et al., 2016).

Moreover, Wang et al. (2014) state that the price of crude oil and agricultural commodities experienced a sharp movement from 2006 to mid-2008. Economic pressures, restrictions on world oil production, and political turmoil caused crude oil prices to become increasingly sensitive (Shirinbakhsh and Bayat, 2011; Evgenidis, 2018). Therefore, there is a need for economic policy to minimize the adverse effects of global oil price movements on agricultural commodities' prices (Bastianin et al., 2016).

Many previous studies have investigated the effects of world oil price and the impact of exchange on the agricultural commodities market. For example, Wang et al. (2014) found the significant impact of oil prices on the prices of selected agricultural commodities in the US using the Structural Vector Autoregression (SVAR) approach. Meanwhile, Giordani et al. (2016) found a relationship among the prices of 32 food products in 77 countries in the world using the Two-Stage Least Square (2SLS) equation model. Using the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) approach, Ceballos et al. (2017) found the transmission of grain prices from the international to the domestic markets of 41 food products in 27 developing countries.

Furthermore, Bahmani-oskooee and Aftab (2018) found the effect of changes in exchange rates on the Malaysia-China commodity trade using the Auto-Regressive Distributed Lag (ARDL) model. Nazlioglu and Soytas (2012) found links between oil prices, 24 agricultural commodity prices globally, and the exchange rate using panel cointegration and causality analyses. Volatility spillover was also found between the price of oil and the world price of wheat, corn, soybeans, and sugar using variance decompositions and impulse response functions techniques (Nazlioglu, Erdem, & Soytas, 2013). Finally, In the Indonesian context, Arsyad and Yusuf (2008) simulated that an increase in oil price causes cocoa exports to decline over 1983-2002.

The above reviewed previous studies generally examined the relationship of oil prices with prices of various agricultural commodities from various countries. They did not make specifications, both in terms of products and grouping data period based on the episodes of the economic crisis even though each economic crisis has different nature, causes, intensities, and consequences. In addition, although Indonesia is the third-largest cocoa producing country in the world, research on the effect of world oil prices on cocoa related-commodities in Indonesia is difficult to find published in international journals. Therefore, this research identifies agricultural commodities, specifically for Indonesian and world cocoa beans, to explore the behaviour of domestic cocoa prices and their short- and long-run relationships. This study also incorporates the exchange rate and West Texas Intermediate (WTI) oil variables into the time-series analyses using the Vector Error Correction Model (VECM), and multivariate Granger causalities approach. Besides, to offer detailed and accurate empirical findings of the impact of changes in oil prices on cocoa commodity prices across the

economic cycle periods, this study separates the analysis during the 2008 global economic crisis period and the 2011 European debt crisis.

The results of this study are expected to enrich the existing literature related to the interactions between world oil prices, exchange rates, and cocoa commodity prices from an Indonesian perspective. The results of this study will also be useful for policy-makers in designing cocoa commodity pricing strategies in Indonesia to improve the welfare of cocoa farmers. In addition, the results of this study also became an essential reference in formulating macroeconomic policy harmonization among global cocoa producers.

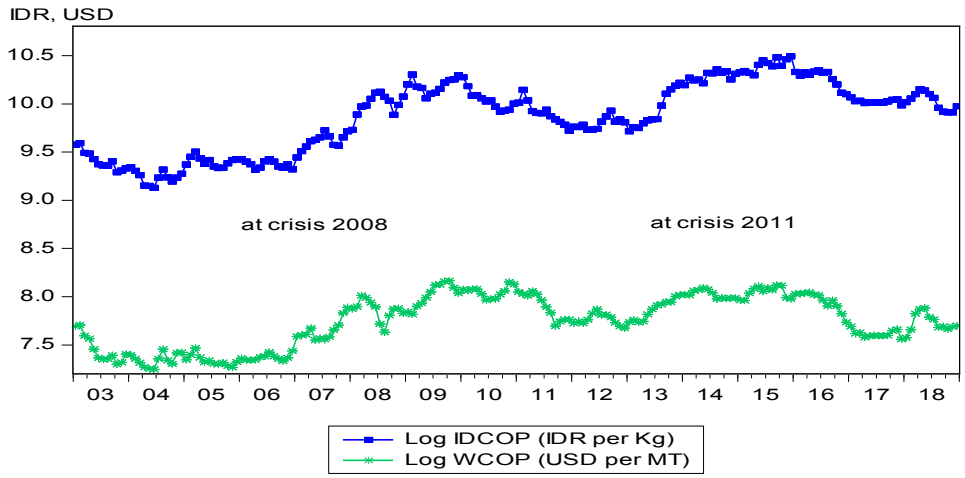
The rest of this study is structured in the following sequences. Section 2 presents the data and empirical research framework, followed by the findings, discussion, and implication of the study in Section 3. Finally, the conclusion is provided in Section 4.

2. Empirical Framework

2.1. Data

The main focus of this study is to highlight and measure the behaviour and short- and long-relationships between the price of Indonesian and world cocoa beans and their dynamic causalities during the 2003-2018 period. During the period of our study, the world cocoa bean market has been hit by two different economic crises, namely the 2008 global financial crisis and the 2011 European debt crisis. The extent of integration of the Indonesian and world cocoa prices, precisely the direction and pattern of price movements is illustrated in Figure 1.

Figure 1. Trends of Indonesian and world cocoa prices, 2003-2018



Sources: Central Bureau Statistics of Indonesia (BPS) and ICCO (2019).

To show changes in the growth of the cocoa beans prices, the data is transformed into the form of natural logarithms. As illustrated in Figure 1, the price movement of Indonesian cocoa beans (IDCOP) and the price of world cocoa beans (WCOP) show almost a similar pattern. This indicates that the international and domestic cocoa markets are symmetrically integrated (Arnade et al., 2017). The descriptive economic phenomenon which was passed by the economic crisis caused changes to prices quickly and had a profound impact. During the 2008 global financial crisis and the 2011 European debt crisis, the prices of cocoa beans in the Indonesian and global domestic markets show a declined trend.

Overall, IDCOP tends to move in parallel following the WCOP, especially when prices are experiencing an increase throughout 2003-2018 (ICCO, 2019). Meanwhile, the changes in the exchange rate of Indonesian Rupiah (IDR) to the US Dollar (USD) were still relatively stable before the 2008 global financial crisis. However, after passing through the 2008 economic crisis, the IDR depreciated sharply and fluctuated against the USD to the lowest level since 2003, amounting to IDR14,396.10 in September 2015, before returning to strengthen the following month (BI, 2019; IMF, 2019). Likewise, the world oil price of WTI type 2015 decreased to the lowest level in February 2016, amounting to USD30.35 per barrel (IMF,

2019). The phenomenon of volatile exchange rates and oil prices might have a negative influence on the cocoa market. Shah et al. (2019) stated that excessive economic uncertainty has a significant effect on economic activity and other macroeconomic variables.

This study utilizes monthly secondary time series data of Indonesian cocoa bean prices (IDCOP), world cocoa bean prices on the New York market (WCOP), the real exchange rate of IDR against USD (ER), and the world price of West Texas Intermediate (WOILP) crude oil over the period from January 2003 to December 2018. The data for IDCOP is gathered from the Central Bureau Statistics of Indonesia (BPS), while the WCOP is sourced from the International Cocoa Organization (ICCO). Furthermore, the ER is obtained from the Bank of Indonesia (BI) and the International Monetary Fund (IMF), and finally, the WOILP is collected from the International Monetary Fund (IMF).

Since the 2008 global financial crisis and the 2011 European debt crises have occurred during the study period, thus the analysis for each crisis period is performed to offer detailed empirical findings of the impact of changes in oil prices on cocoa commodity prices across the two economic crisis periods. The study then separates the data into three observational samples, namely:

i. Sub-sample 1: the 2008 global financial crisis period - covering January 2003 to December 2010 (89 observations);
ii. Sub-sample 2: the 2011 European crisis period - spanning from January 2011 to December 2018 (103 observations); and
iii. Full-sample: covering both Sub-sample 1 and Sub-sample 2 – spanning from January 2003 to December 2018 (192 observations).

2.2. Empirical model

The selection of variables used in the Vector Auto-Regressive (VAR) equation system is considered representative and relevant to answer the research objectives. Previous literature has explained the relationship between endogenous variables that influence each other (Nazlioglu and Soytas, 2012; Wang et al., 2014; Dewanta, 2019). First, what needs to be done in the identification and specification of the VAR model is the unit root test (Giuliodori and Rodriguez, 2015). The basic idea of the unit root test is represented in the following equations:

$$Y_t = \rho Y_{t-1} + \epsilon_t \quad \text{where, } -1 \leq \rho \leq 1 \tag{1}$$

$$Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + \epsilon_t \tag{2}$$

$$Y_t - Y_{t-1} = (\rho - 1) Y_{t-1} + \epsilon_t \tag{3}$$

$$\Delta Y_t = \phi Y_{t-1} + \epsilon_t \tag{4}$$

when $\phi = (\rho - 1)$ has an absolute value of $\rho = 1$, thus $\phi = 0$, indicating the stochastic variable Y has a unit root or random walk, and the data is non-stationary. Δ in the Equation (4) is the first difference of the variable. To arrive at the stationary data, the differencing process, I(d) is taken so that the $\phi \neq 0$ or $\rho < 1$ (Gujarati and Porter, 2009).

This study adopts the Augmented Dickey-Fuller (ADF), and Philips-Perron (PP) approaches to test the data stationarity for all data sub-samples. If the absolute value of ADF and PP t-statistics is higher than the critical value of MacKinnon, or the p-value is smaller than the assigned significance level; thus, the observation data is said to be stationary. Given that the optimal lag length strongly influences the ADF and PP test results, therefore, the optimal lag-lengths included in the ADF test are determined based on the smallest values of Final Prediction Error (FPE), Akaike Information Criteria (AIC), Schwarz information criterion (SC), and Hannan–Quinn information criterion (HQ). Meanwhile, to determine the optimal lag-lengths included in the PP test, the study uses the truncation lag q from the Newey-West approach.

Furthermore, the type of time series data can be called cointegrated if at a certain differentiated level, I(d), the data is stationary. To test the presence of cointegration, the Johansen Cointegration test (Asteriou and Hall, 2011) is utilized in the study. Cointegration values can explain cointegrating relations if the balance error fluctuates around zero. This

shows that there is a long-term equilibrium relationship between endogenous variables at an optimal lag (p) in the VECM equation system. In other words, the error term (ϵ_t) must be a time-series data that is stationary and cointegrated viewed from the Trace statistic value that is greater than its critical value obtained from the following Equation (5):

$$Q_t = -T\sum_{i=r+1}^{k}\log(1-\lambda_i) \quad \text{where } r = 0, 1, ..., k-1 \tag{5}$$

Cointegration can also be identified from the Max-Eigen statistical value if it is greater than its critical value obtained from the following Equation:

$$Q_{max} = -T(1-\lambda_{i+1}) = Q_t - Q_{t+1} \tag{6}$$

If the test documented cointegration at a certain lag length, the short- and long-run relationships among variables could be properly estimated using the VECM technique. Following Wang et al. (2014) and Asteriou and Hall (2011), the general form of the VECM Equation could be written as follows:

$$\Delta Z_t = a_0 + a_{ij} + \Pi Z_{t-1} + \sum_{i=1}^{p}\Gamma_i \Delta Z_{t-i} + \epsilon_{ti} \tag{7}$$

where Z_t is an endogenous variable vector (i.e., IDCOP, WCOP, ER, and WOILP) with an order (n x m). Where, $\Pi = \alpha.\beta'$, matrix β' is a cointegration vector, and α is an error correction parameter vector. Meanwhile, Γ is the matrix of the coefficient modifier in the short- and long-run, and p is the optimal lag length.

Furthermore, the estimated regression of endogenous variables across the different crisis periods of the 2008 global financial crisis and the 2011 European debt crisis are estimated using the following VECM Equation:

$$\Delta IDCOP_t = a_1 + \beta_1 ECT(1)_{t-1} + \beta_{11}\sum_{i=1}^{P}\Delta IDCOP_{t-i} + \beta_{12}\sum_{i=1}^{P}\Delta WCOP_{t-i} + \beta_{13}\sum_{i=1}^{P}\Delta ER_{t-i} + \beta_{14}\sum_{i=1}^{P}\Delta WOILP_{t-i} + \epsilon_{t1} \tag{8}$$

$$\Delta WCOP_t = a_2 + \beta_2 ECT(2)_{t-1} + \beta_{21}\sum_{i=1}^{P}\Delta WCOP_{t-i} + \beta_{22}\sum_{i=1}^{P}\Delta IDCOP_{t-i} + \beta_{23}\sum_{i=1}^{P}\Delta ER_{t-i} + \beta_{24}\sum_{i=1}^{P}\Delta WOILP_{t-i} + \epsilon_{t2} \tag{9}$$

$$\Delta ER_t = a_3 + \beta_3 ECT(3)_{t-1} + \beta_{31}\sum_{i=1}^{P}\Delta ER_{t-i} + \beta_{32}\sum_{i=1}^{P}\Delta IDCOP_{t-i} + \beta_{33}\sum_{i=1}^{P}\Delta WCOP_{t-i} + \beta_{34}\sum_{i=1}^{P}\Delta WOILP_{t-i} + \epsilon_{t3} \tag{10}$$

$$\Delta WOILP_t = a_4 + \beta_4 ECT(4)_{t-1} + \beta_{41}\sum_{i=1}^{P}\Delta WOILP_{t-i} + \beta_{42}\sum_{i=1}^{P}\Delta IDCOP_{t-i} + \beta_{43}\sum_{i=1}^{P}\Delta WCOP_{t-i} + \beta_{44}\sum_{i=1}^{P}\Delta ER_{t-i} + \epsilon_{t4} \tag{11}$$

where *ECT* (Error Correction Term) is the adjustment correction of each equation in the VECM system. The negative and significant estimated coefficient of *ECT* indicates a gradual corrective in realizing a balance relationship from short- to long-term.

In the next step, the Granger causality test is conducted to measure the causal dynamic relationship among variables in the multivariate framework (Rahman and Kashem, 2017). The findings from the Granger causality test provide information related to causality and the direction of influence among variables (Asteriou and Hall, 2011). The existence of multivariate Granger causality could be identified from the probability value of the Wald test results. The multivariate Granger causality equation in the VECM system can be written as follows:

$$X(t) = \sum_{i=1}^{p} A_i X(t-i) + \epsilon(t) \tag{12}$$

where $X(t) \in R^{dx1}$ for t = 1,..., is a multivariate time series at optimal lag (p), and $\epsilon(t)$ is a Gaussian random vector, while A_i is a matrix for every i. If all estimates of the independent variable have a probability value of less than 0.05, then there is a causal relationship between the independent variables and the dependent variable within a multivariate framework.

3. Findings and Discussion

3.1. Statistic Descriptive

Descriptive statistics are useful to provide an overview of initial information about the investigated variables before conducting estimation regression. Table 1 illustrates that the mean prices of the Indonesian cocoa beans (IDCOP), world cocoa bean (WCOP) and WTI oil (WOILP) experienced a relatively significant increase over the period from June 2010 to December 2018. However, the highest values of world cocoa prices (WCOP) and WTI oil (WOILP) recorded in the Sub-sample 1 period (2003-2010). Meanwhile, the maximum value of the Indonesian cocoa price (IDCOP) and the IDR exchange rate existed in the Sub-sample 2 period (2010-2018). The changes in IDCOP and WCOP are relatively stable between the sub-sample periods.

Table 1. Statistic descriptive of the variables

Variable	IDCOP	WCOP	ER	WOILP
Full-sample: 2003-2018				
Mean	20581.36	2404.374	10599.03	68.469
Maximum	36065.00	3525.12	15010.00	133.93
Minimum	9235.00	1404.71	8235.80	28.09
Std. Deviation	6963.400	608.646	1946.639	24.160
Observations	192	192	192	192
Sub-sample 1: The 2008 global financial crisis (2003-2010)				
Mean	16305.17	2097.021	9363.748	62.217
Maximum	29885.00	3525.12	11866.30	133.93
Minimum	9235.00	1404.71	8235.80	28.09
Std. Deviation	6212.857	640.822	734.865	24.137
Observations	89	89	89	89
Sub-sample 2: The 2011 European debt crisis (2011-2018)				
Mean	24276.32	2669.950	11666.41	73.872
Maximum	36065.00	3472.27	15010.00	110.04
Minimum	16575.00	1917.68	8550.30	30.35
Std. Deviation	5268.250	430.987	2036.672	22.952
Observations	103	103	103	103

Furthermore, the ER volatility is higher and depreciates sharply in the Sub-sample 2. The ER has been very sensitive to external factors, especially when the world economy is facing the European debt crisis in 2011. An extreme point is identified during the period from May to June 2010. Based on the report of IMF (2019), the WTI crude oil was at a price level of USD73.74 per barrel in May 2010. In addition, WOILP has a higher standard deviation in the full sample period (2003-2018), while on average, the prices during the Sub-sample 2 is relatively higher, reaching USD73,872 per barrel. Geo-political and security tensions in the Middle East region in mid-2015 have caused volatility and fluctuations in world oil prices (Haugom et al., 2016).

3.2. Stationarity of Data

Unit root testing is an essential initial step when using time series data. In a time-series data analysis, all variables should be in the form of stationarity. This test has higher power when the time series exhibits nonlinear behaviour (Khraief et al., 2018). The findings of stationarity tests based on the ADF and PP tests are presented in Table 1.

Table 2. Results of unit root tests

Variable	Level		First Difference	
	ADF	PP	ADF	PP
Full-sample: 2003-2018				
IDCOP	0.7917	0.6860	0.0000***	0.0000***
WCOP	0.5145	0.8069	0.0000***	0.0000***
ER	0.7137	0.6126	0.0000***	0.0000***
WOILP	0.3076	0.3990	0.0000***	0.0000***
Sub-sample 1: The 2008 global financial crisis (2003-2010)				
IDCOP	0.1922	0.4915	0.0000***	0.0000***
WCOP	0.0290**	0.1274	0.0000***	0.0000***
ER	0.5977	0.4265	0.0000***	0.0000***
WOILP	0.0170**	0.2630	0.0000***	0.0000***
Sub-sample 2: The 2011 European debt crisis (2011-2018)				
IDCOP	0.9223	0.9140	0.0000***	0.0000***
WCOP	0.6274	0.7361	0.0000***	0.0000***
ER	0.6299	0.6415	0.0000***	0.0000***
WOILP	0.3504	0.5882	0.0000***	0.0000***

Note: ***, **, * Significant at the level 1%, 5%, 10%, the figures show p-values.

Table 2 presents the stationary test results of all variables, which can be identified from the p-value of the ADF and PP tests (Giuliodori and Rodriguez, 2015; Syahril et al., 2019). The acquisition of ADF and PP p-values at a higher level at a significance level of 1%, 5% and 10% shows non-stationary data, except only for data of WCOP and WOILP using the ADF approach for the sub-sample period of 2003 to 2010 with a significance level of 5%. Therefore, it is necessary to transform data so that all data becomes stationary. Through the differentiation process, $I(1)$ for each sub-sample, it is found that the ADF and PP p-values are smaller at 1% significance level, which means that the absolute value of the ADF and PP t-statistics is higher than the critical value. This shows that all data in all sub-samples have become stationary or contained no unit roots, where $\phi \neq 0$ (Equation 4). Agricultural commodities are very vulnerable to price volatility and market risk and changes in economic patterns and behaviour. Market prices are sensitive in times of crisis (El-Khatib and Hatemi-j, 2018) and speculation activities have a relatively large role in determining new prices equilibrium (Bohl et al., 2019).

After confirming that all variables are stationarity at the first difference, the cointegration is then tested. Since the cointegration test considers past values, thus the lag-lengths included in the estimation. To determining the optimum lag-length, the FPE, AIC, SC, and HQ criterion is used. The study identified that the proper optimum lag length for all sub-samples is equal to two based on all the above optimal lag-length criteria.

3.3. Johansen cointegration test

Cointegration test is conducted to explore the existence of a long-run relationship between variables that are non-stationary but have a linear combination (Giuliodori and Rodriguez, 2015). Table 3 presents the Johansen's cointegration test results based on each sub-sample with the two optimum lag-lengths.

As observed from Table 3, the values of Trace statistics and Max-Eigen statistics for all sub-periods are higher than their critical values at least at the 5% significance level. This means that there existed a cointegrating relationship between the variables of IDCOP, WCOP, ER, and WOILP. This further implies that there is a tendency of the variables to move together towards a long-run equilibrium (Wang et al., 2014; Cabrera and Schulz, 2016). Thus, to predict the long-run co-movement of a variable such as Indonesian cocoa beans price, it

can be predicted by relying on other variables such as world cocoa beans prices, oil prices, and exchange rate.

Table 3. The results of the Johansen cointegration tests

Null Hypothesis	Trace Test			Maximum Eigenvalue Test		
	Trace statistic	0.05 critical value	Prob.	Max-Eigen statistic	0.05 critical value	Prob.
Full-sample: 2003-2018						
r = 0	290.834	63.876***	0.0000	150.584***	32.118	0.0000
r ≤ 1	140.249	42.915***	0.0000	66.585***	25.823	0.0000
r ≤ 2	73.664	25.872***	0.0000	38.372***	19.387	0.0000
r ≤ 3	35.291	12.517***	0.0000	35.291***	12.517	0.0000
Sub-sample 1: The 2008 global financial crisis (2003-2010)						
r = 0	170.523	63.876***	0.0000	96.729***	32.118	0.0000
r ≤ 1	73.794	42.915***	0.0000	34.571***	25.823	0.0027
r ≤ 2	39.222	25.872***	0.0006	25.261***	19.387	0.0062
r ≤ 3	13.961	12.517**	0.0285	13.961**	12.517	0.0285
Sub-sample 2: The 2011 European debt crisis (2011-2018)						
r = 0	162.238	63.876***	0.0000	76.190***	32.118	0.0000
r ≤ 1	86.047	42.915***	0.0000	37.749***	25.823	0.0009
r ≤ 2	48.298	25.872***	0.0000	34.510***	19.387	0.0002
r ≤ 3	13.787	12.517**	0.0305	13.787**	12.517	0.0305

Note: *** and ** shows significance at the 1% and 5% levels.

Having a cointegration among the variables, thus study could properly use the VECM approach to measure the short- and long-run relationships among the investigated variables.

3.4. Long-run effects of world cocoa and oil prices, and exchange rate on the Indonesian cocoa price

Table 4 illustrates the findings of the long-run relationship between world cocoa price (WCOP), the exchange rate (ER), world oil prices (WOILP), and the Indonesian cocoa price (IDCOP) across three sub-samples of the study.

Table 4. Findings of the long-run relationship

Variable	IDCOP	WCOP	ER	WOILP
Full-sample: 2003-2018				
IDCOP	-	-0.113 [-11.011]***	-0.386 [-11.301]***	-0.141 [-11.045]***
WCOP	-8.840 [-10.849]***	-	3.415 [10.743]***	1.248 [10.803]***
ER	-2.588 [-5.214]***	0.292 [5.031]***	-	0.365 [5.808]***
WOILP	-7.083 [-0.383]	0.801 [0.380]	2.736 [0.436]	-
Sub-sample 1: The 2008 global financial crisis (2003-2010)				
IDCOP	-	-0.114 [-7.890]***	-0.394 [-8.085]***	-0.219 [-8.034]***
WCOP	-9.040 [-8.233]***	-	3.510 [8.255]***	1.983 [8.308]***
ER	-2.906 [-4.416]**	0.321 [4.321]**	-	0.637 [5.397]***
WOILP	-4.558 [-0.192]	0.504 [0.190]	1.568 [0.236]	-
Sub-sample 2: The 2011 European debt crisis (2011-2018)				
IDCOP	-	-0.110 [-8.766]***	-0.553 [-9.114]***	0.121 [8.509]***
WCOP	-9.095 [-9.036]***	-	5.033 [8.719]***	-1.104 [-8.782]***
ER	-1.807 [-2.714]**	0.199 [2.519]**	-	-0.219 [-2.653]**
WOILP	8.238 [0.322]	-0.906 [-0.323]	-4.559 [-0.337]	-

Note: ***, **, and * show significance at the levels of 1%, 5%, and 10%, and [.] is the t-statistics.

As observed in Table 4, the study found a different size and direction of the long-run relationship between the variables. The WCOP has a significant negative effect on IDCOP at the 1% level, and vice versa. In a long-run, an increase in WCOP has led the IDCOP to decline. Similarly, an increase in WCOP has caused the IDCOP to fall. This negative bidirectional causal relationship is due to the nature of the Indonesian cocoa commodities as the complement for other cocoa suppliers. Lower cocoa beans have caused some cocoa farmers to plant corn, rubber, and palm oil (Permani, 2013), which caused the production of cocoa beans in the long-run to decline and consequently led to an increase in domestic cocoa prices in Indonesia.

Additionally, the low quality of the Indonesian cocoa (Dewanta, 2019) that failed to meet the international standard. As the price of the Indonesian cocoa increases, the consumer would demand more world cocoa commodities due to its lower price and high quality. To maintain its high demand, the world cocoa price remained lower in the long-run. Similarly, as the price of the world cocoa increases, the consumer would demand more cocoa commodities from Indonesia due to its lower price. To maintain its high demand, the domestic cocoa price in Indonesia remained kept lower in the long-run mainly due to its low quality.

The study also found a significant negative effect of world oil price (WOILP) and the Indonesian exchange rate (ER) on the IDCOP at the 1% level, respectively. Almost 90% of cocoa production in Indonesia is marketed in the domestic market (Dewanta, 2019). Thus, the changes in the world oil price took a more prolonged effect on the Indonesia local market. An increase in world oil price caused a rise in the cost of production of processed cocoa such as cocoa liquor, powder and cocoa butter which lead to lower demand of the processed cocoa products in the Indonesian cocoa trading partners. Since Indonesia mainly exported the raw cocoa to Malaysia and Singapore that used as complementary inputs for their processed cocoa products (Dewanta, 2019), thus their demand for Indonesian cocoa would decline in the long-run. Lower demand for Indonesia cocoa has led to the price of Indonesian cocoa would also fall. The finding of negative effect exchange rate on Indonesian cocoa is in line with many previous studies (Olaiya, 2016; Verter, 2016). As the IDR appreciates, it has caused the domestic cocoa price in Indonesia to become more expensive and less competitive in the world cocoa market. Consequently, the demand for the price would decline, and their price would fall in the long-run.

On the other hand, the IDCOP has an insignificant effect in the WOILP, while IDCOP negatively affected ER. Only about 10% production of Indonesian cocoa beans has been mainly exported to the Asian market (92.46%), mostly to Malaysia (57.26%) and Singapore (31.88%). Meanwhile, the cocoa exports of Indonesia to other countries have been too small, namely to North America (4.95%) and Europe (2.54%) (International Trade Centre - IRC, 2001-2020). Overall, the Indonesian cocoa export value only amounted to USD112 Million in 2017. A small portion of Indonesian cocoa contribution to the world cocoa market is believed to have an insignificant effect on the world oil price. Finally, implementation of a cocoa bean export tax in the country through the Minister of Finance Regulation No. 67/PMK.011/2010, further caused lower export values of Indonesian cocoa beans to the world market (Permani, 2011).

A relatively higher domestic cocoa price caused Indonesian cocoa becomes less competitive worldwide in the short-run. Thus, to make it more attractive and competitive to the cocoa market, the exchange rate policy is implemented by depreciating Indonesian exchange which caused IDR to decline in the long-run. This could be the main reason for the adverse effect of IDCOP on the exchange rate in Indonesia.

Our study also documented a positive effect of world cocoa price on the exchange rate and vice versa. As the IDR appreciates, it has caused the domestic cocoa price in Indonesia to become more expensive and less competitive in the world cocoa market. To anticipate a lower demand for the Indonesian cocoa beans in the long-run due to its exorbitant prices, the price of the Indonesian cocoa beans would be lower and adjusted to the world cocoa market. Our finding is similar to Alori and Kutu (2019), who revealed that the shocks to the exchange rate affected the volatility of the value of cocoa exports in Nigeria positively. Thus, to enhance the cocoa exports, the government should stabilize the exchange rate through the managed exchange rate policy.

Finally, the WOILP positively affected both WCOP and ER, while WCOP and ER have a non-causal effect on WOILP. It has been well-documented that oil is the main caused on supply-side inflation. An increase in oil price contributes to the rise in the prices of many other products, including cocoa processed commodities. Additionally, real oil prices have been documented as the dominant source of real exchange rate movements. There has been a link between real oil prices and real exchange rates (Chen & Chen, 2007). Ghosh (2011) found positive oil price shocks on exchange rate volatility, and their effects were permanent on exchange rate volatility.

Overall, the nature of long-run relationships between IDCOP and other variables were similar across the sub-samples; the only differences are in term of the sizes. During the 2008 global financial crisis and the 2011 European financial crisis, the effects of exchange rate were more prominent due to higher exchange rate volatility during economic crises periods. For all sub-samples, the study found the bidirectional long-run effects between IDCOP and WCOP, IDCOP and ER, and WCOP and ER, while the unidirectional long-run effect is seen from the WOILP to IDCOP, WOILP to WCOP, and WOILP to ER. These findings show the critical role of world oil price in determining the worldwide economy. An increase in world oil price has led the world cocoa beans price to increase, the IDR to appreciate, and the IDCOP to decline.

The existence of a long-run relationship between IDCOP and WOC indicates the integration of the Indonesian and world cocoa market horizontally (Arnade et al., 2017). Due to weak competitiveness after being subjected to cocoa export duties, low quality of cocoa beans, and non-fermented cocoa exports lead to asymmetrical relationships between domestic cocoa in Indonesia and world cocoa market (Witjaksono and Asmin, 2016; Hasibuan and Sayekti, 2018). A sense of awareness to establish cooperation through regional trade agreements has reduced competition in the agricultural commodity market (Jambor et al., 2020). In general, our findings also show the sensitivity of IDR against USD exchange rate to net exports, the country's economic policies and market turmoil. The relationship between fiscal and monetary policy interactions can explain the implications of exchange rate conditions.

Finally, according to Volkov and Yuhn (2016) and Nakatani, 2018), an increase in inflation can damage the real exchange rate. WTI crude oil failed to reach equilibrium in short- to long-term. Haugom et al. (2016) stated that to make predictions about oil prices, it has a risk challenge. WTI oil prices fluctuated when the economy experienced a crisis in 2008 and 2011, the peak of which occurred in 2015. According to Evgenidis (2018), geo-political tensions, particularly in the Middle Eastern countries have caused high volatility in world oil prices and have an impact on macroeconomic fluctuations. The relationship of agricultural commodity prices is non-neutral with the world price of oil (Fowowe, 2016).

3.5. Multivariate dynamic causal relationships among prices of Indonesian cocoa, world cocoa, world oil, and exchange rate

Table 5 provides the findings of short- and long-run relationships and multivariate dynamic causal relationship among Indonesian cocoa price (IDCOP), world cocoa price (WCOP), world oil price (WOILP), and exchange rate (ER) across three sub-sample periods.

As illustrated in Table 5, the study found a long-run equilibrium between Indonesian cocoa price (IDCOP) and the variables of world cocoa price (WCOP), world oil price (WOILP), and exchange rate (ER). This is indicated by negative and significant Error Correction Terms (ECT) for all sub-samples. This means that a short-run disequilibrium in the Indonesia domestic cocoa price would be adjusted to a long-run equilibrium with the speed of adjustments of 0.931 during the 2003-2018 (full sample), -0.773 during the 2003-2010 period (the 2008 global financial crisis sub-sample), and -0.919 during the 2011-2018 period (the 2011 European debt crisis sub-sample). During the 2008 global financial crisis period, the speed of adjustment is slower as compared to the 2011 European debt crisis period, and the full sample period. It took a week for a short-run disequilibrium in the domestic cocoa price to be cleared and restored back to a long-run equilibrium during the 2008 global financial crisis.

Meanwhile, during the 2011 European debt crisis period and full sample period (2003-2018), to restore back the Indonesian cocoa market from the short-run disequilibrium to long-run equilibrium, it took 3 days and days, respectively. This further shows that the 2008 global financial crisis hit hardest the world economy, including the cocoa market. Thus, it took a more extended period for the cocoa market to restore back to its long-run equilibrium.

Table 5. Multivariate Dynamic causal relationships

Variable	IDCOP	WCOP	ER	WOILP	ECT
Full-sample: 2003-2018					
IDCOP	-	87.934*** (0.000)	58.622*** (0.000)	1.980 (0.371)	-0.931 [-11.270]***
WCOP	18.757*** (0.000)	-	9.562*** (0.008)	2.172 (0.337)	-0.474 [-5.331]***
ER	3.625 (0.163)	7.816** (0.020)	-	4.193 (0.123)	-0.089 [-1.582]
WOILP	1.800 (0.406)	2.359 (0.307)	4.833* (0.089)	-	0.003 [1.225]
Sub-sample 1: The 2008 global financial crisis (2003-2010)					
IDCOP	-	63.396*** (0.000)	33.011*** (0.000)	1.568 (0.456)	-0.773 [-8.960]***
WCOP	8.995*** (0.011)	-	1.961 (0.375)	0.244 (0.885)	-0.324 [-2.626]**
ER	2.330 (0.312)	12.769*** (0.002)	-	2.289 (0.318)	-0.145 [-1.832]*
WOILP	3.713 (0.156)	5.944** (0.051)	5.631* (0.060)	-	0.004 [1.695]
Sub-sample 2: The 2011 European debt crisis (2011-2018)					
IDCOP	-	29.049*** (0.000)	16.219*** (0.003)	0.053 (0.974)	-0.901 [-11.081]***
WCOP	13.314*** (0.001)	-	12.956*** (0.002)	3.819 (0.148)	-0.656 [-5.065]***
ER	0.226 (0.893)	0.260 (0.8780)	-	2.325 (0.313)	0.022 [0.363]
WOILP	1.573 (0.4552)	1.216 (0.5444)	1.384 (0.501)	-	-0.006 [-1.099]

Note: ***, **, and * show significance at the level 1%, 5%, and 10%, respectively. Figures in (.) and [.] show probability value and t-statistics.

The impact of the 2008 global financial crisis has caused shocks to the global cocoa market (Bahmani-oskooee and Aftab, 2018; Dias et al., 2019). This effect was evident in an increased level of fragility of the Indonesian cocoa market marked. Thus, when the economy faces a financial crisis, a hedging policy is a suitable strategy to manage the cocoa price sensitivity to the exchange rate fluctuations (El-Khatib and Hatemi, 2018). Besides, Indonesian cocoa beans traded in the global cocoa market were generally of low quality and non-fermented (Witjaksono and Asmin, 2016). This made the Indonesian cocoa beans used as supplementary raw material for the premium quality of Ghana cocoa beans (Quarmine et al., 2012) in the cocoa industry activities in Malaysia (Dewanta, 2019). Indonesian cocoa market has also faced an increasingly widespread of the 2011 European debt crisis.

In terms of short-run relationship and multivariate Granger causal relationship, the study recorded a bidirectional Granger causality between Indonesian cocoa price (IDCOP) and world cocoa price (WCOP) for all sub-samples. The Granger causal effects of WCOP on IDCOP were higher than the effects of IDCOP on WCOP for all sub-samples period. Although Indonesia is the third-largest cocoa producing country in the world, but more than 85% of its production is marketed in the domestic market. In comparison, only less than 15% of its production is exported to the world market (Dewanta, 2019). Countries in the African region dominate the determination of world cocoa bean prices (Wessel and Quist-wessel, 2015). This is believed to be the main reason for the more considerable influence of the world

cocoa market in the Indonesian domestic cocoa market. In other words, the world cocoa market dominated the changes in the Indonesian cocoa market. This finding shows that any pricing policy designed by the Indonesian government to regulate the domestic cocoa market should be strictly referred to the world cocoa market movements. Thus, pricing policy harmonization between the world cocoa suppliers, mainly through the ICCO, should be enhanced.

As the third-largest producer of cocoa beans in the world, Indonesia could ideally play a more significant role in determining the world cocoa market (Hoang and Meyers, 2015). But in fact, the behaviour of Indonesian cocoa prices follows the world price, because 70% of the world cocoa market share is controlled by countries in the West African region (Wessel and Quist-Wessel, 2015). Countries in the African region have a more exceptional competitive ability in the world cocoa market. Although the smallholder farmers have produced both cocoa farming in Africa and Indonesia (Wessel and Quist-Wessel, 2015; Hoffmann et al., 2020), but Indonesia has a minor role in the global cocoa market.

Table 5 also shows that there was a unidirectional relationship running from the ER to the IDCOP for all sub-samples. This indicates that the exchange rate volatility Granger caused changes in the price of cocoa beans in Indonesia. An appreciation (depreciation) of IDR caused the domestic cocoa product to become more expensive (cheaper) as compared to the cocoa prices in the world market. Similarly, the changes in the exchange rate have also a unidirectional Granger caused world oil price during the 2008 global financial crisis and the full sample period. However, during the 2010 European crisis period, the exchange rate has no causal relationship with the world oil price.

The exchange rate (ER) shows the asymmetrical effect in realizing the IDCOP balance in short- to long-run equilibrium. This is in line with the study by Volkov and Yuhn (2016), which documented that exchange rates have asymmetrical behaviour. Over the 2010-2018 period, IDR experienced a higher depreciation against USD. The financial crisis has triggered exchange rate fluctuations (Nedeljkovic and Urosevic, 2012). Commodity price movements have a higher level of significance after 2008 (Zhang et al., 2019). However, profits from trading activities cannot always be achieved when export duties imposed and faced high exchange rate risks. The Indonesian government has imposed a tax on Indonesian cocoa bean exports since April 2010. The implementation of the export tax policy hurts the competitiveness of cocoa beans (Hasibuan and Sayekti, 2018).

Furthermore, the study found that the WCOP and ER are found to have a bidirectional causal relationship during the full sample period. However, Effect of WCOP on ER is smaller as compared to the effect of ER on WCOP, indicating the more significant role of managing exchange rate in stabilizing the world cocoa market. During the 2008 global financial crisis, a unidirectional causality running WCOP to ER is found. On the other hand, during the 2011 European debt crisis, a unidirectional causality running from ER to WCOP is documented. Higher volatility of the exchange rate in the Eurozone during the debt crisis in 2011 adversely affected the world cocoa market. The movement of the exchange rate of IDR against USD was relatively stable over the 2003 to 2010 period, but experienced a substantial depreciation from over the period from 2011 to 2018, as was the case with world oil prices. In general, the exchange rate volatility has been very sensitive to net exports, the country's economic policies and market turmoil. The relationship between fiscal and monetary policy interactions can explain the implications of exchange rate conditions. Volkov and Yuhn (2016) and Nakatani (2018), an increase in inflation can damage the real exchange rate and consequently world oil price. Thus, predicting oil prices movement has a risk challenge as it caused by many other variables (Haugom et al., 2016).

Finally, the WOILP is found to be independent during all sub-sample periods, indicating non-unidirectional Granger causal effect running from WOILP to other variables. This evidence is also supported by the insignificance of all estimated coefficients of ECTs in the equation system. The price of WTI oil (WOILP) was insignificant in realizing the balance of IDCOP as a raw material product for the agricultural sector in all three sub-samples. Fluctuations in oil prices have an insignificant effect on the prices of cocoa beans in the domestic market. During the 2008 global financial crisis and 2011 European debt crisis, the price of WTI oil reached a maximum value of USD133.93 and USD110.04 per barrel; however, its volatility could be a source of fluctuations in economic variables (Dahl et al.,

2019) but in the Indonesian and global cocoa market. However, Ramli et al. (2019) found that the prices of rubber in Indonesia, Thailand, Malaysia and crude oil were symmetrical. Thus, it shows that the transmission of prices between commodities in international markets has been different, depending on their nature and use value (Arnade et al., 2017).

Overall, our findings show the integration between Indonesian and world cocoa markets during the study period, including the 2008 global financial crisis and the 2011 European debt crisis periods. A short-run disequilibrium in the Indonesian cocoa market due to shocks in other macroeconomic variables has been adjusted from time to time to its long-run equilibrium (Nazlioglu, 2014; Ahrens et al., 2017). The level of integration in cocoa commodity markets has been influenced by global factors (Yin and Han, 2015). However, their nature of dynamic causal relationships has been shaped by the nature, intensity, and consequences of economic crisis. Macroeconomic harmonization policy should be designed by cocoa-producing countries under the purview of ICCO to minimize the global economic shocks. Finally, the hedging policy is a better strategy to be implemented by the Indonesian government and other cocoa-producing countries to mitigate the exchange rate risk.

4. Conclusion

This study examined and analyzed the short- and long-run dynamic relationships between the prices of Indonesian cocoa beans and the world cocoa market during the 2003-2018 period, comprising the periods of 2008 global financial crisis and 2011 European debt crisis. Based on cointegration analysis, the study documented a long-run equilibrium between the Indonesian and the world cocoa market. Based on the VECM approach, the study found disequilibrium in the Indonesian cocoa markets due to shocks in the world cocoa market, exchange rate, and world oil prices were corrected in realizing long-run equilibrium conditions. The exchange rate affected Indonesian cocoa prices, while, fluctuations in world oil prices was independent to the cocoa markets, domestically and globally.

Efforts to explain the relationship and influence of global factors on the price of a commodity are the leading indicators that need to be managed to gain trade benefits (Ceballos et al., 2017). The relatively low price of Indonesian cocoa beans in the international market is a challenge and at the same time an opportunity if it can prepare fermented cocoa beans. Indonesian cocoa market has the potential to have horizontal integration with the global cocoa market. The prices of Indonesian and world cocoa beans influence each other in the short-term and long-term equilibrium relationships. Most of the Indonesian cocoa beans traded on the international market have been of low quality and generally non-fermented. The low quality of cocoa has an impact on weak market competition. Improving the quality of cocoa supplier enhance the market power of cocoa producers to determine the price of cocoa beans (Figueroa-Hernández et al., 2019).

The corrective ability of Indonesian and world cocoa beans prices to make adjustments towards different economic shocks was difference across the crisis periods. The speed of adjusting the price of Indonesian cocoa beans has been relatively slower compared to world prices. The Indonesian cocoa market tends to follow the direction of changes in world markets with a pattern of asymmetrical relations. The integration of international and domestic markets is symmetrical (Arnade et al., 2017). On the other hand, Andrade and Zachariadis (2016) stated that asymmetrical relationships occur between markets that have vertical integration. The exchange rate has a significant effect on Indonesian and world cocoa prices. The economic crisis contains uncertainty, making oil prices play a unique role in more considerable variations in agricultural commodity prices (Wang et al., 2014; Degiannakis and Filis, 2018).

The government and stakeholders need to encourage the success of Indonesian cocoa farming through agricultural and trade policies by taking into account the profitability of farmers. The government needs to increase international trade cooperation with export destination countries based on improving the quality standards of cocoa production to grasp full advantage of export opportunities at the time of exchange rate depreciation. The intensifying land for cocoa could promote Indonesian cocoa farming business to the world market.

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Announcements, Conferences, News

SPACE International Conference 2021 on "Sustainable Architecture, Planning and Urban Design"

16 – 17 April 2021 | fully remote

Conference Overview[1]

The **Studies of Planning and Architecture Consulting & Education** (SPACE), which is an Independent Academic Platform Company, announces the 4th SPACE International Conference on "**Sustainable Architecture Planning and Urban Design**" aiming to discuss sustainability from different perspectives and research areas. The Conference will provide platform to recent advances and research results in the fields of architecture, planning, urban design, and all related areas, such as engineering, education, interior architecture, technology, business, politics, social sciences, and so forth. The scientific committee of the conference consists of the 21 members of the SPACE International Advisory Board, which are academics from various universities worldwide.

The conference has a broad range of topics which are listed (but are not limited to) below:

Sustainable architecture, Ecological footprints and eco-spaces, Planning and built environment, Climate change, Energy efficiency, Sustainability in education and training, Sustainable tourism and regional development, Sustainable materials and building technology, Sustainable urbanism, Transportation, Biological diversity, Case studies, Sustainable solutions in emerging countries, Wastewater, Cultural heritage and sustainability, Social sciences and sustainability, Gender and sustainability, The politics of sustainability, Sustainable policies and governance, Sustainability and community participation, Economics and management, Green infrastructure development, Sustainable landscape planning and design, Sustainability and the city, Quality of life and sustainability, and Health issues and sustainability.

Within the context of awareness about COVID-19 pandemic in the United Kingdom (where the SPACE office headquarters is located) and worldwide, the 4th SPACE International Conference on "Sustainable Architecture Planning and Urban Design" **will be held exclusively online**, through the Zoom Webinar platform. Before the conference, each presenter will get an invitation-email to connect with Zoom, as a panelist.

All accepted abstracts and full papers will be published in the conference e-proceedings equipped with ISBN. The Conference E-Proceedings' paperback version will be also published and can be available to buy. Selected papers will be accepted through a double-blind reviewed process and will be published electronically with ISSN in the oncoming SPACE International Journal on Space Studies in Architecture and Urban Design. Both the proceedings and the journal will submitted to be indexed in the Thomson Reuters, SCOPUS, The Avery Index, Google scholar, and CiteULike databases. Submission will be available with the use of full paper template. The conference deadlines are 29 June 2020 for Abstract Submission, 7 December 2020 for Notification of Acceptance, 14 December 2020 for Early-Bird Registration, 29 January 2021 for Full-Paper Submission, 15 March 2021 for Late Registration, and 22 March 2021 for Presentation Submission.

More details on this conference, as well as information about the Submission Guidelines, the Important Dates, the Program, the Keynote Speakers, the Venue & Accommodation, the Registration, and more can be found at the SPACE Conference's official webpage https://spacestudies.co.uk/conference/space-international-conference-2021-on-sustainable-architecture-planning-and-urban-design/.

1 Conference overview edited by Dimitrios Tsiotas, RSIJ

India Spatial Statistics 2021: Climate and the Environment
20 – 23 July 2021 | University of Colorado Boulder, USA

Conference Overview[2]

The **Elsevier** Information and Analytics Company and the **Spatial Statistics Society** have announced the **6th Spatial Statistics** conference to be held at the University of Colorado, Boulder, USA, from 20 – 23 July 2021, under the theme **Climate and the Environment**. Within the context of conceptualizing the dynamic and continuously evolving (at many spatiotemporal scales) nature of the environment and its interaction with the sphere of socioeconomic activity, the conference aspires to provide a forum to debate and discuss how spatially referenced data can be used to advance the understanding and provide support for decision making, in the domain of Earth system dynamics. The major focus of the conference will be on the climate change dynamics and their causes, effects, and future. The conference will conceptualize Earth as a *unified system* described by interconnection between physical and biological spheres and human activities.

The conference accepts oral and poster abstracts on the topics listed (but are not limited to) below:

Methods

- Space-time statistics, e.g. geostatistics, point patterns, estimation methods, large dimensions
- Spatial deep learning
- Inverse modeling
- Modeling of extremes
- Stochastic geometry, tesselation, point processes, random sets
- Causal statistical modeling
- Trajectory/movement modeling

Applications

- Climate system modeling and observations
- Health e.g. epidemiology, geohealth and global health
- Spatially-Explicit Ecological Models
- Plant and animal epidemiology
- Quantifying the spatial extent of hazards and risk
- Crime and poverty mapping
- Space/time econometrics
- Interface of Neural Computing and Spatial/Spatio-Temporal Statistics
- Inferring Movement and Behavior from Telemetry

Abstracts should be submitted using the online abstract submission system until 15 January 2021 and the registration deadline is until 30 April 2021. There is also an early bird registration option available until 30 April 2021.

The conference will be in line with the protocols set by the World Health Organization, national and local health authorities, and Elsevier's COVID-19 Resource Centre and declares adaptability to the dynamic environment due to the uncertainty of the pandemic. Within this context the organizers assure a refunding of registration fees, with no penalty, for cancelations due to the uncertainty of the outbreak.

More details on this conference, as well as information about the Program, the Committee, the submission guidelines, the COVID-19 protocols, the Exhibitors & sponsors, the Location, and more can be found at the official webpage

https://www.elsevier.com/events/conferences/spatial-statistics.

2 Conference overview edited by Dimitrios Tsiotas, RSIJ

Academic Profiles

Dr. **César Ducruet,** Ph.D., is a Research Director of Geography at the French National Centre for Scientific Research (CNRS) in Paris, France, since 2009. After graduating his PhD at Le Havre University in 2004, he had been post-doctoral researcher at the Korea Research Institute for Human Settlements (KRIHS) and at the Erasmus University (Rotterdam).

He has been invited to teach at various universities abroad (Inha, Catania, Erasmus, Antwerp, HK PolyU, Shanghai ECNU) or in France (Paris Sorbonne I and IV) and business schools in France, while he frequently works as an expert for local, national, and international organizations (World Bank, OECD).

His scientific research focuses on the following topics: a) economic, urban, and transport geography, b) territorial planning, c) ports and maritime transport, d) network analysis, e) regional science, f) Europe-Asia comparisons. In particular, he has been principal investigator of the European Research Council Starting Grant project "World Seastems" between 2013 and 2019 on the evolution of global maritime networks and port cities since the late 19th century, giving rise to numerous publications on the matter

(see https://cordis.europa.eu/project/id/313847/results, scroll down & click on "Publications via OpenAire").

Furthermore, he is associate member of the porteconomics.eu research network and reviews numerous articles from international journals. He is also editorial board member of Journal of Transport Geography.

His research has been published in high impact journals and is widely accepted by the scientific community. His most recent publications include, but are not limited to, the following:

• Ducruet C. (2020) The geography of maritime networks: a critical review, Journal of Transport Geography, 88: 102824, Special issue "Integrating short and long distance perspectives on freight transportation" (https://hal.archives-ouvertes.fr/halshs-02922543).

• Ducruet C., Wang L. (2018) China's global shipping connectivity: internal and external dynamics in the contemporary era (1890–2016), Chinese Geographical Science, 28(2): 202-216, Special issue "The global inter-city relations of Chinese cities" (https://halshs.archives-ouvertes.fr/halshs-01832319/).

• Ducruet C., Itoh H. (2016) Regions and material flows: Investigating the regional branching and industry relatedness of port traffic in a global perspective, Journal of Economic Geography, 16(4): 805-830 (https://halshs.archives-ouvertes.fr/halshs-01145663).

• Arvis J.F., Vesin V., Carruthers R., Ducruet C., De Langen P.W. (2019) Maritime Networks, Port Efficiency, and Hinterland Connectivity in the Mediterranean, World Bank Group, International Development in Focus, 139 p.

(https://openknowledge.worldbank.org/handle/10986/30585)

• Ducruet C. (Ed.) (2017) Advances in Shipping Data Analysis and Modeling. Tracking and Mapping Maritime Flows in the Age of Big Data, Routledge Studies in Transport Analysis, London & New York: Routledge.

Academic Profile by:
Dimitriost TSIOTAS, Ph.D., RSI J

Prof. **Michail Fragkias**, Ph.D., is an applied economist and interdisciplinary social scientist working broadly on issues of urbanization, land use, and the environment. He is an Associate Professor in the Department of Economics at Boise State University's College of Business and Economics (COBE).

He is the recipient of the COBE Distiguished Research Professor Award and University Foundation Scholar Award for Research. He researches issues of urban and regional development, land-use change, urban spatial structure dynamics, and sustainability.

He is the author and co-author of more than 30 journal articles and book chapters, as well as 2 edited books. His research has been featured in journals such as: PNAS, Science of the Total Environment, Annual Reviews of Environment and Resources, Current Opinion in Environmental Sustainability, Global Environmental Change, Urban Climate, PLoS ONE, Environment and Planning B, among others.

He has been recognized as a highly influential researcher (demonstrated by the production of multiple highly-cited papers that rank in the top 1% by citations for field and year in Web of Science.)

He has served as a lead author in large scientific assessment reports including the UN-CBD Cities and Biodiversity Outlook and the 3rd National Climate Assessment of the US Global Change Research Program. He was also a Contributing Author for the 5th Assessment Report of the IPCC.

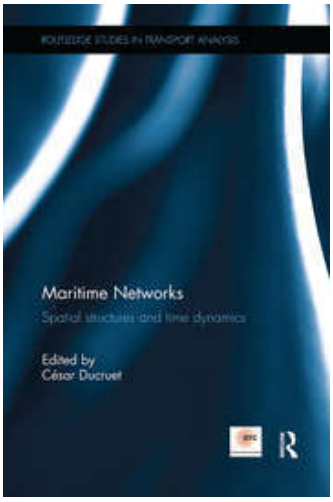
Between November of 2006 and August of 2012, he served as the executive officer of the Urbanization and Global Environmental Change (UGEC) – an IHDP Core Project, hosted by the Global Institute of Sustainability, Arizona State University.

From September 2003 to September 2006, he was a Postdoctoral scholar at the Center for Environmental Science and Policy (CESP), then housed at the Freeman Spogli Institute for International Studies at Stanford University.

He holds a Ph.D. in Economics from Clark University.

Academic Profile by:
Dimitriost TSIOTAS, Ph.D., RSI J

Book Reviews



MARITIME NETWORKS, SPATIAL STRUCTURES AND TIME DYNAMICS

Edited by Cesar Ducruet
published by Routledge
ISBN 9781138599307

The book "Maritime Networks, Spatial structures and time dynamics" is a collective volume edited by Dr. Cesar Ducruet, who is a distinguished researcher in the field of maritime transport. Maritime transport is one of the most ancient supports to human interactions across history and it still supports more than 90% of world trade volumes today. The evolving connectivity of maritime networks is of crucial importance to port, transport, and economic development and planning. The way that ports, terminals, but also cities, regions, and countries, are interconnected through maritime flows is not known in a comprehensive context and is difficult to represent, model, and measure, even for the transportation actors themselves. Within this framework, there is a strong and urgent need for a review of the relevant theories, concepts, methods, and sources that can be employed for the study and the analysis of maritime networks.

The book is composed by contributions from reputable scholars from all over the world and it investigates the analysis of maritime flows and networks from interdisciplinary angles, which range between archaeology, history, geography, regional science, and economics to mathematics, physics, and computer sciences. Built on a vast array of methods, such as Geographical Information Systems (GIS), spatial analysis, complex networks, modeling, and simulation, it addresses several crucial issues related with port hierarchy, such as route density, modal interdependency, network robustness and vulnerability, traffic concentration and seasonality, technological change, and urban/regional economic development.

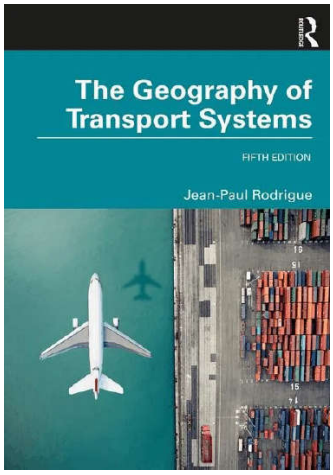
The book examines new approaches about how socio-economic trends are reflected (but also influenced) by maritime flows and networks, and about the way this knowledge can support and enhance decision-making in relation to the development of ports, supply chains, and transport networks in general. In terms of structure, it includes 20 chapters that are separated into four sections; the first includes chapters 1:4 and is an introduction to maritime network analysis, the second one includes chapters 5:9 and covers topics of modeling past maritime networks, the third includes chapters 10:14 and deals with the topology and spatial distribution of maritime networks, and the fourth includes chapters 15:20 and deals with maritime networks and regional development.

Although the book can be considered as including an integrated approach in the study of maritime networks, the Editor already elaborates new avenues of further research, to be available in future editions, on topics concerning the comparability of network structures and dynamics between different historical periods, the deeper exploration of intermodal networks involving shipping (e.g. short sea/Ro-Ro and road, container/rail), a more detailed research about technological diffusion through shipping networks (from sail to steam, steam to oil, containerization), and the impact of the COVID-19 pandemic on global network structure and port systems.

The book "Maritime Networks, Spatial structures and time dynamics", Edited by Cesar Ducruet, is an ideal companion to those interested in network analysis of transportation and economic systems, in general, as well as in the effective ways to analyze large datasets to answer complex issues in transportation and socio-economic development. A limited free version of the book is also available in a Google-books form (at the URL: https://books.google.gr/ books?id= 0u2oCgAAQBAJ&printsec= frontcover&hl=el&source= gbs_ge_summary_r&cad= 0#v= onepage&q&f= false, to be used without intermediate spaces).

Overall, the book promotes the interdisciplinary way of thinking in maritime research and within this context it can be considered as a reference work for regional scientists, geographers, economists, engineers, and other scholars activating in maritime research.

Book Review by Dimitrios TSIOTAS, Ph.D., RSI J



THE GEOGRAPHY OF TRANSPORT SYSTEMS
Fifth Edition
by Jean-Paul Rodrigue
published by Routledge
ISBN 9780367364632

The Geography of Transport Systems, by Dr. Jean-Paul Rodrigue, Professor of Geography at Hofstra University, who is distinguished in research on transportation and economics, is a textbook aiming at understanding how mobility is linked with the geography of transportation.

In general, mobility of passengers, freight, and information is the result of the derived demand emerging in space and is fundamental to economic and social activities, such as commuting, manufacturing, distributing of goods, or supplying energy. Provided that each movement has a purpose, an origin, a potential set of intermediate locations, and a destination, the transportation systems emerging in geographical space can be considered as the result of human causality. Within this context, mobility is supported and driven by transport systems which are composed by infrastructures, modes, and terminals and they enable individuals, institutions, corporations, regions, and nations to interact and develop economic, social, cultural, or political activities.

To the extent that transport geography can be considered as a sub-discipline dealing with human-based mobility and its spatial organization, the "Geography of Transport Systems" is a textbook that accosts to an undergraduate audience and offers a comprehensive and accessible introduction to the field, including a broad overview of concepts, methods, and areas of application. This book refers to a multidisciplinary audience, from transport engineers, geographers, economists, regional scientists, management scientists, to even physicists, statisticians, and information scientists, and is provided to practitioners, policymakers, educators, researchers, students, and individual learners and includes a wide variety of media elements such as maps, figures, and Power-Point presentations.

A major added-value of this textbook is that is freely available online, at the URL https://transportgeography.org, suggesting a bright example of knowledge being available beyond limits. However, printed and electronic version is also available for this well-written textbook by Routledge. Future editions of this textbook can integrate by including exercises to facilitate undergraduate teaching. Also, the figures' illustration is very insightful and descriptive, making comprehension easier.

The textbook is divided into twelve chapters. The first ten (1.Transportation and Geography, 2.Transportation and Spatial Structure, 3.Transportation, Economy and Society, 4.Transport, Energy and Environment, 5.Transportation Modes, 6.Transportation Terminals, 7.Trade, Logistics and Freight Distribution, 8.Urban Transportation, 9.Transport Planning and Policy, and 10.Challenges for Transport Geography) cover a specific conceptual dimension of transport geography, such as networks, modes, terminals, and urban transportation, as well as emerging issues such as globalization, supply chain management, information technologies, energy, and the environment. Provided that transportation is a field of application, the use of methodologies is particularly relevant to assist transport-operators to allocate their resources (e.g. investments, infrastructure, and vehicles) or to influence public policy. Appendix A (Methods in Transport Geography) focuses on qualitative and quantitative methodologies linked with transport geography, such as accessibility, spatial interactions, and graph theory. Finally, Appendix B (Applications and Case Studies) includes case studies of investigation and application to real-world issues, where transportation is a very active field.

Overall, "The Geography of Transport Systems", by Prof. Jean-Paul Rodrigue, can be considered as a reference textbook that excellently illustrates the conceptual framework of transport geography, as it expressed by human-based mobility and its spatial organization.

Book Review by Dimitrios TSIOTAS, Ph.D., RSI J

GUIDELINES

for the Writers & a format model for the articles submitted to be reviewed & published in the journal

Regional Science Inquiry Journal

(EconLit, Scopus, RSA I) – www.rsijournal.eu

Guidelines for the Writers & a format model for the articles submitted to be reviewed & published in the journal

The Title of the paper must be centered, and the font must be Times New Roman, size 12, in Uppercase, in Bold

For the writers' personal information use the Times New Roman font, size 11, in bold, and centered. Use lowercase for the first name and uppercase for the last name. The line below the name includes the professional title and workplace; use the Times New Roman font, size 10, centered. In the third line write only the contact e-mail address in Times New Roman 10, centered.

Name LAST NAME
Professional Title, Workplace
E-mail Address

Name LAST NAME
Professional Title, Workplace
E-mail Address

Abstract

The abstract consists of a single paragraph, no longer than 250 words. The font must be Times New Roman, size 11. The text must be justified. The title "Abstract" must be aligned left, in Times New Roman, size 11, in bold. A space of one line must be left between the title and the text of the abstract. The abstract must contain sufficient information, be factual, and include the basic data of the paper.

Keywords: Use 3 to 5 keywords, separated by commas

JEL classification: We kindly request that you classify your paper according to the JEL system, which is used to classify articles, dissertations, books, book reviews, and a variety of other applications. The use of the JEL classification is necessary so that your paper be properly indexed in databases such as EconLit. Select the codes that represent your article and separate them by commas. You can find information on the JEL system here: https://www.aeaweb.org/jel/guide/jel.php

1. Introduction

All articles must begin with an introduction, a section which demarcates the theoretical background and the goals of the paper.

The present document provides the necessary information and formatting guidelines for you to write your article. We recommend that you copy this file to your computer and insert your own text in it, keeping the format that has already been set. All the different parts of the article (title, main text, headers, titles, etc.) have already been set, as in the present document-model. The main text must be written in regular Times New Roman font, size 11, justified, with a 0.5 cm indent for the first line of each paragraph.

We recommend that you save this document to your computer as a Word document model. Therefore, it will be easy for you to have your article in the correct format and ready to be submitted. **The only form in which the file will be accepted is MS Word 2003**. If you have a later version of Microsoft Office / Word, you can edit it as follows:

- Once you have finished formatting your text, create a pdf file, and then save your file as a Word "97-2003" (.doc) file.

- Compare the two files – the pdf one and the Word "97-2003" (.doc) one.
- If you do not note any significant differences between the two, then – and only then – you can submit your article to us, **sending both the pdf and the Word "97-2003" (.doc) files** to our e-mail address.

If you use a word processor other than Microsoft Word, we recommend that you follow the same procedure as above, creating a pdf file and using the appropriate add-on in order to save your document in MS Word "97-2003" (.doc) form. Once you compare the two files (and find no significant differences), send us both.

2. General Guidelines on Paper Formatting

2.1. Body

The body of the text consists of different sections which describe the content of the article (for example: Method, Findings, Analysis, Discussion, etc.). You can use up to three levels of sections – sub-sections. For the Body of the text, use the default format style in Word, selecting the Times New Roman font, size 11, justified, with a 0.5 cm indent for the first line of each paragraph (this is further detailed in the section "Paragraphs").

2.2. References

The references included in the paper must be cited at the end of the text. All references used in the body of the paper must be listed alphabetically (this is further detailed in the section "References").

2.3. Appendices

The section "Appendices" follows the section "References".

3. Page formatting

3.1. Page size

The page size must be A4 (21 x 29,7 cm), and its orientation must be "portrait". This stands for all the pages of the paper. "Landscape" orientation is inadmissible.

3.2. Margins

Top margin: 2,54cm
Bottom margin: 1,5cm
Left and right margins: 3,17cm
Gutter margin: 0cm

3.3. Headers and Footers

Go to "Format" → "Page", and select a 1,25cm margin for the header and a 1,25cm margin for the footer. Do not write inside the headers and footers, and do not insert page numbers.

3.4. Footnotes

The use of footnotes or endnotes is expressly prohibited. In case further explanation is deemed necessary, you must integrate it in the body of the paper.

3.5. Abbreviations and Acronyms

Abbreviations and acronyms must be defined in the abstract, as well as the first time each one is used in the body of the text.

3.6. Section headers

We recommend that you use up to three sections – sub-sections. Select a simple numbering for the sections – sub-sections according to the present model.

3.7. First level header format

For the headers of the main sections use the Times New Roman font, size 11, in bold and underlined, and leave a size 12 spacing before the paragraph and a size 6 spacing after the paragraph. The header must be aligned left. Use a capital letter only for the first letter of the header.

3.8. Second level header format

For second level headers, follow this model. Use the Times New Roman font, size 11, in bold, and leave a size 12 spacing before the paragraph and a size 3 spacing after the paragraph. Select a 0.5 cm indent. The header must be aligned left. Use a capital letter only for the first letter of the header.

3.8.1. Third level header

For third level headers, follow this model. Use the Times New Roman font, size 11, in bold and italics, and leave a size 6 spacing before the paragraph and a size 0 spacing after the paragraph. The header must be aligned left, with a left indent of 1 cm. Use a capital letter only for the first letter of the header.

4. Paragraphs

In every paragraph, use the Times New Roman font, size 11, with single line spacing. We recommend you modify the default (normal) format style in Word and use that in your text. For all paragraphs, the spacings before and after the paragraph must be size 0, and the line spacing single. Use a 0,5cm indent only for the first line of each paragraph. Leave no spacings nor lines between paragraphs.

4.1. Lists

In case you need to present data in the form of a list, use the following format:

- Bullet indent: 1,14cm
- Text:
    - Following tab at: 1,5 cm
    - Indent at: 1,5cm

Use the same format (the above values) if you use numbering for your list.

1. Example of numbered list 1
2. Example of numbered list 1

5. Figures, images, and tables

5.1. Figures and images

Insert your figures and images directly after the part where they are mentioned in the body of text. They must be centered, numbered, and have a short descriptive title.

Figures put together "as they are", using Office tools, are absolutely inadmissible. The figures used must have been exclusively inserted as images in Word, in gif, jpg, or png form (with an analysis of at least 200dpi), and in line with the text. The width of an image must not exceed 14,5cm so that it does not exceed the margins set above.

The images, figures, and tables must be inserted "as they are" in the text, in line with it. **Figures and images which have been inserted in a text box are absolutely inadmissible.**

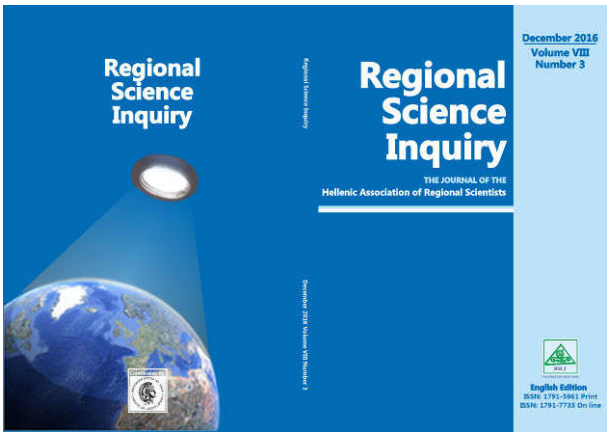
5.1.1. Reference inside the text

Avoid phrases such as “the table above” or the “figure below” when citing figures and images. Use instead “in Table 1”, “in Figure 2”, etc.

5.1.2. Examples

A model of how to format figures/images follows. For the title, use the Times New Roman font, size 10, in bold. Write the title above the figure, and set a size 6 spacing before the title and a size 0 spacing after it. The line spacing of the title must be 1.5 line. Both the image and its title must be centered.

Image 1: Title



Source: cite the source

Directly below the figure you must cite the source from which you took the image, or any note regarding the figure, written in Times New Roman, size 10. Write it below the figure, leaving a size 0 spacing before and after it, use a line spacing of 1.5 line, and make it centered.

5.2. Tables

For the title, use the Times New Roman font, size 10, in bold. Write the title above the table, and set a size 6 spacing before the title and a size 0 spacing after it. The line spacing of the title must be 1.5 line. Both the table and its title must be centered. The width of the table must not exceed 14,5cm so that it does not exceed the page margins set.

Table 1. Example of how a table must be formatted

Age	Frequency	Percentage %
Under 40	44	32.1
40 - 49	68	49.6
Over 50	25	18.2
Total	**137**	**100.0**

Source: cite the source

If the table needs to continue on the next page, select in the “Table properties” that the first line be repeated as a header in every page, as in the above example of Table 1. **Tables (or figures or images) which are included in pages with a “Landscape” orientation are absolutely inadmissible.**

Every table must have horizontal lines 1 pt. wide at the top and bottom, as shown in the example. The use of vertical lines and color fill at the background of the cells is strictly prohibited.

Directly below the table you must cite the source or any note regarding the table, written in Times New Roman, size 10. Write it below the table, leaving a size 0 spacing before and a size 6 spacing after it, and make it centered.

6. Mathematical formulas

There is a variety of tools in order to insert and process mathematical formulas, such as the “Mathematics”, found in the most recent editions of Word, “Math Type”, “Fast Math Formula

Editor", "MathCast Equation Editor", "Math Editor". Since it is impossible for us to provide you with compatibility with all these tools in all their editions, **we can only admit your paper if it contains mathematical formulas solely in the form of images.**

Keep a continuous numbering for the mathematical formulas and center them in the page, as shown in the following example:

$$y = ax^2 + bx + c \tag{1}$$

The same stands for formulas or particular mathematical symbols you may have integrated in your text. For instance, if you want to use the term ax^2 in your text, you must insert it as an imaged, in line with the text. The images containing the mathematical formulas must be legible (at least 300dpi).

In the exceptional case of a text which may contain a great number of mathematical formulas, the writer may send it to us in TeX form if they so wish.

7. References

We recommend that you use the Chicago Manual of Style Author-Date system, as it is recommended by the AEA (American Economic Association) for the journals included in the EconLit database, and it is the dominant style of bibliography in the field of Economics. For more information you can go to the following links:

- https://www.aeaweb.org/journals/policies/sample-references
- http://www.chicagomanualofstyle.org/tools_citationguide.html
- http://libguides.williams.edu/citing/chicago-author-date#s-lg-box-12037253

7.1. Online references (internet citations)

Check your links again before sending your file, to confirm that they are active.

Avoid long internet links. Where possible, also cite the title of the website operator-owner. Return the font color to black, and remove the hyperlink. Links such as the following are impractical and distasteful, therefore should be avoided.

Example of an inadmissible hyperlink

https://el.wikipedia.org/wiki/%CE%9F%CE%B9%CE%BA%CE%BF%CE%BD%CE%BF%CE%BC%CE%B9%CE%BA%CE%AC

7.2. References Formatting

For your list of references, use the Times New Roman font, size 10, with single line spacing. The paragraph format must include a size 0 spacing before the paragraph and a size 0 spacing after it, aligned left. Use a 0,5 cm indent only for the first line of each paragraph. Leave no spacings or lines between paragraphs.

7.3. Example of how References must be formatted

Bureau of Labor Statistics. 2000–2010. "Current Employment Statistics: Colorado, Total Nonfarm, Seasonally adjusted - SMS08000000000000001." United States Department of Labor. http://data.bls.gov/cgi- bin/surveymost?sm+08 (accessed February 9, 2011).

Leiss, Amelia. 1999. "Arms Transfers to Developing Countries, 1945–1968." Inter-University Consortium for Political and Social Research, Ann Arbor, MI. ICPSR05404-v1. doi:10.3886/ICPSR05404 (accessed February 8, 2011).

Romer, Christina D., and David H. Romer. 2010. "The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks: Dataset." American Economic Review. http://www.aeaweb.org/articles.php?doi=10.1257/aer.100.3.763 (accessed August 22, 2012).

Ausubel, Lawrence M. 1997. "An Efficient Ascending-Bid Auction for Multiple Objects." University of Maryland Faculty Working Paper 97–06.

Heidhues, Paul, and Botond Kőszegi. 2005. "The Impact of Consumer Loss Aversion on Pricing." Centre for Economic Policy Research Discussion Paper 4849.

Zitzewitz, Eric. 2006. "How Widespread Was Late Trading in Mutual Funds?" http://facultygsb.stanford.edu/zitzewitz.