SPATIAL ANALYSIS OF THE IMPACT OF MIGRATION ON REGIONAL GROWTH IN IRAN (2006-16)

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Abstract

One of the most important applications of economic growth models is for regional economic growth. In regional growth studies, it is necessary to consider spatial effects because of spatial dependence among the growth rates of regions. This research investigates the impact between net migration and its spatial lag on regional growth, based on the neoclassical (Solow) growth model. The used model in the study is the Dynamic Panel Data (DPD) which has been specified as a Spatial Durbin Model (SDM) and estimated by the spatial generalized method of moments (SGMM). The specified model has been tested for the 30 provinces of Iran in the period of 2006-16. The estimated results show that the time-lagged dependent variable had a positive and highly significant effect on income per capita. The impact of initial income per capita on growth is negative, and the convergence hypothesis is thus accepted. That is, poor provinces grow faster than the rich. The income per capita and growth are positively related to net migration rate. Expectedly, the new coming people to a province would increase income per capita and growth. The estimated coefficient of the spatial lag of the dependent variable is statistically significant and demonstrates spatial dependence in income as well as economic growth among the provinces of Iran. Every province's growth rate was positively impacted by the economic growth of its neighbors. However, net migration has no spatial effect on income per capita and growth. In other words, the regional economic growth has not been influenced by migration to neighboring provinces.

Keywords: Neoclassical growth model, convergence, migration, spatial Durbin model, spatial generalized method of moments.

JEL classification: O47, C23, R23

1. Introduction

The economic convergence hypothesis is an important result of the neoclassical economic growth model. According to neoclassical growth models, such as Solow (1956), Cass (1965), and Koopmans (1965), an economy's growth is inversely related to its initial level of income per capita. Therefore, small economies grow faster, termed β-convergence (Barro, 1991). Economists have acknowledged this important hypothesis since the 1990s, after the widespread studies of Barro and Sala-I-Martin (1992). The reason is that poor economies have high marginal products of capital, since their ratios of capital to labor are low. As a result, they tend to grow faster. In fact, the convergence hypothesis returns to the diminishing returns to capital in neoclassical growth models (Barro, 1991).

The convergence hypothesis has been tested in many studies for cross-country cases of and regions in a country as well. Usually, this hypothesis is more compatible with the cases of regions. It seems that in such cases, the growth rates have higher correlation with their initial level of income per capita than cross-country cases of. This study uses the neoclassical growth model for the case of the regions of Iran, with the emphasis of migration. Like other developing countries, there is a dichotomy between developing and less-developed regions of Iran. Some regions have a higher level of development with higher income per capita and people tend to immigrate to such regions (Rahmani, 2011).

Migration within a country has both positive and negative impacts. On one hand, migration and redistribution of population within a country is one of the most fundamental instruments that policymakers rely on to control population density, and to direct population displacements to economic poles (Mirza-Mostafa and Ghasemi, 2013). On the other hand, displacements — especially from rural to urban areas—have created a wide variety of socio-economic problems for less-developed and developing countries. Regional imbalances accelerate and reinforce regional migration and cause reduction in the national growth rate. As a result of regional migration, origin regions will be faced with the reduction of labor (especially experts) and loss of various types of capital which will eventually lead to production decline. On the other hand, although (physical and human) capital would rise in destination regions, population density will increase and many social and economic problems would emerge.

The neoclassical economic growth models are of the most widely used in investigating the impact of migration on economic growth rates at regional levels. There are two opposing points of view about the results. From the negative view, migration will lead to a reduction in human capital in the origin regions and the accumulation of human capital in destinations, and therefore the growth of origin regions will decrease. In contrast, some economists emphasize the positive effect of migration in destination regions (Anjomani, 2012).

The objective of this study is to estimate the impact of regional migration on economic growth in the provinces of Iran for 2006-16. Accordingly, the paper is structured as follows: Section 2 reviews the literature, section 3 specifies the econometric model, and section 4 analyzes the obtained results. The paper ends with a conclusion and suggestions.

2. Literature review

2.1. The impact of regional migration on growth

Studies for diversified cases including Anjomani (2012) for the USA, Rahmani and Hassanzadeh (2011) for Iran, Di Maria and Stryszowski (2009) for some other countries in a panel data model, Groizard and Llull (2007) for a panel of 92 developing and developed countries, Moody (2006) for Australia, Shoiji (2001) for Japan, Persson (1994) for Sweden, and so on, demonstrate that regional migration plays a crucial role in regional growth and development. Therefore, countries try to control the displacement of people among regions. Regional migration is a process through which population growth rate and the growth rate of labor supply change. Thus, regional migration would affect regional economic growth. Regional migrations are generally characterized by a flow of human resources from villages or towns with fewer facilities (the origin regions) to big cities and metropolitan areas with more facilities and higher educational attainment (Sabagh Kermani, 2001: 124). Migration flows are from villages to cities, from towns and small cities to capital cities of provinces, and from capital cities of provinces to nearby metropolitans in other provinces. People prefer to immigrate to rich provinces in which there are more facilities for life and more job opportunities.

The impact of migration on regional growth and development is one of the most important problems of developing and less-developed countries (LDCs). In fact, it is a truly uncontrollable and ungovernable phenomenon in many cases. Consequently, it negatively influences macroeconomic variables including economic growth and development. Indeed, regional imbalances strengthen and accelerate regional migration, and this is one of the most disturbing obstacles to the growth of such economies at the national level. In addition, this phenomenon can impact other macroeconomic variables in a disorderly manner.

These consequences can be considered from the perspective of both the origin and destination regions. With the emergence of displacement flows from an origin region, that area will be faced with the reduction and even loss of various types of capital—especially human and physical capital stock—which will eventually lead to a reduction in production. In contrast, this phenomenon in destination regions leads to congestion, pollution, administrative complications, etc. The final consequence is higher living costs and higher production costs as well. Eventually, the economic growth will decrease in both origin and destination regions (Zangeneh, 2007). On the other hand, migration would increase production and economic growth in destination regions through enhancing physical and human capital stocks. In other words, the impact of migration on regional economic growth is ambiguous.

Regional migration is one of the most important factors that socioeconomic policy makers pay attention to when planning for regional development using population control tools and directing population displacement according to regional facilities. The objective is to reduce the costs of displacement for both regions. Local governors try to turn threats into opportunities and weaknesses into strengths through local development planning. A rise in human capital is an inevitable result for destination regions. Since, theoretically and empirically, human capital is one of the main determinants of economic growth and development, destination regions reap this benefit. In addition to the growth of human capital and economic growth, other positive impacts include increasing positive externalities and higher productivity. These factors lead to higher economic growth in turn.

In recent decades, along with the expansion of endogenous growth theories, various views have been raised on how regional migration influences economic growth through human capital. In endogenous economic growth models, including Romer (1990) human capital have a fundamental role, since it generates the new products and ideas that underlies technological progress (Barro, 1991). A region with more human capital would absorb new ideas and products and catch to the newer technology up, and would thus grow faster (Nelson and Phelps, 1966).

2.2. The theoretical framework

Economists classify regional growth theories in different ways. According to one source, there are four groups (Sabagh-Kermani, 2001) The theory of cumulative causation was proposed by Myrdal (1956) and expanded by Kaldor (1957). According to this theory, the regional growth of production per labor is determined by the extended use of economies of scale as well as localized agglomeration (specialization) in production (Sabagh-Kermani, 2001: 238). 2) The growth poles theory is a regional and industrial planning model proposed by Perroux (1955). This theory is similar to the theory of cumulative causality but provides more details on the mechanism of unbalanced regional growth. Hirschman (1958) proposed polarization and trickle down effects as factors to add to this theory. 3) Wave growth models believe that regional growth has a wave pattern instead of a smooth and continuous trend. This model is similar to the growth poles theory. 4) Neoclassical growth model, known as the Solow model, is one the most applied models in empirical studies. In fact, this model has attracted a considerable attention in empirical regional studies. The Solow model is one of the most widely used models in investigating the impact of migration on economic growth at the regional levels. Since the specified model in our study is based on the neoclassical growth model, we will discuss this model in more detail.

The Solow growth model focuses on four main variables: output, capital, labor, and knowledge (effectiveness labor). This model is based on two central assumptions. First, in the considered production function, the returns to scale in capital and effective labor is constant. Second, other inputs than capital, labor and knowledge are unimportant (Romer, 2001). One of the most important obtained results, according to the model, is the conditional convergence hypothesis for regions. This model attempts to explain long-term economic growth using the relationship of capital accumulation, population or labor growth, and increasing productivity, which is generally known as technological progress. The core of this model is the neoclassical Cobb-Douglas production function which provides a link to microeconomic foundations. The production function is shown as follows:

$$Y_t = F(K(t), A(t).L(t)) \quad (1)$$

in which Y is output, K is capital stock, L is labor, and A is knowledge stock and multiplied by L. t shows time. Time does not enter the production function directly, but only through variables (inputs). In other words, output changes over time only if inputs change (Romer, 2001). For understanding equilibrium properties, it is divided by A.L:

$$F\left(\frac{K}{A.L}, 1\right) = \frac{1}{A.L}F(K, A.L) \quad (2)$$

(K / A.L) is the level of capital per unit of effective labor (worker) and is shown by *k*. Thus, $\left(\frac{F(K,AL)}{AL}\right) = \frac{Y}{AL}$ is output per unit of effective worker (demonstrated by y).

Finally, we will have:

$$y = f(k) \tag{3}$$

That is, output per unit of effective labor as a function of capital per unit of effective labor. Considering the production function in the Cobb-Douglas form, we have:

$$f(k) = f\left(\frac{K}{A.L}, 1\right) = \left(\frac{K}{A.L}\right)^{\alpha} = k^{\alpha} \tag{4}$$

$$f'(k) = \alpha\, k^{\alpha-1} > 0$$
$$f''(k) = -(1-\alpha)\, \alpha\, k^{\alpha-2} < 0$$

In addition: $\Longrightarrow$

$$\dot{L}(t) = nL(t)$$

$$\begin{cases} \dfrac{\dot{L}(t)}{L(t)} = n \text{ or } \dot{L}(t) = n.L(t) \\ \dfrac{\dot{A}(t)}{A(t)} = g \text{ or } \dot{A}(t) = g.A(t) \end{cases} \tag{5}$$

in which *n* and *g* are exogenous parameters and show the growth rate of the labor force (population) and the rate of technological growth, respectively. However, since we assume that saving is equal to investment and changes in capital stock are equal to investment minus depreciation, changes in capital stock are determined through the following equation:

$$\dot{K}(t) = sY(t) - \sigma K(t) \tag{6}$$

where *s* is the saving rate and *σ* is the depreciation rate of capital stock.

It is assumed that *n* and *σ*, *g* are relatively small and their sum is positive (Romer, 2001). The model is set in continuous time. It implies that the model variables are defined at every point in time. According to the equation (6), the growth of capital stock per unit of effective labor is:

$$\dot{k}(t) = \frac{\dot{K}(t)}{A(t).L(t)} - \frac{K(t)}{[A(t).L(t)]}\left[A(t)\dot{L}(t) + L(t)\dot{A}(t)\right] \tag{7}$$

$$= \frac{\dot{K}(t)}{A(t).L(t)} - \frac{K(t)}{[A(t).L(t)]}\frac{\dot{L}(t)}{L(t)} - \frac{K(t)}{[A(t).L(t)]}\frac{\dot{A}(t)}{L(t)}$$

$$= \frac{sY(t) - \sigma.K(t)}{A(t).L(t)} - k(t).n - k(t).g$$

$$= s\frac{Y_t - \sigma K(t)}{A(t).L(t)} - \sigma.k(t) - n.k(t) - g.k(t), \quad f(k) = \frac{Y}{AL}$$

Therefore,

$$\dot{k}_t = s.f(k(t)) - (n + g + \sigma)k(t) \tag{8}$$

Equation (8) is the key equation of Solow model (Romer, 2001). The term of $s.f(k(t))$ is the actual investment per unit of effective worker and $(n + g + \sigma)$ is the amount of investment required to keep *k* at its existing level, termed break-even investment. *k* grows at a rate of n + g:

$$\frac{\dot{k}}{k} = n + g \tag{9}$$

Since the quantity of effective labor is growing at rate *n*+*g*, the capital stock must grow at rate *n*+*g* to keep *k* steady. Assuming constant returns to scale, *Y* grows at the same rate *(n + g)*. In equilibrium, the growth rate output per capita depends on technological progress (Taghavi, 2004). According to equation (8), the growth path of output per unit of effective worker is extracted.

In the Solow model, long-run growth of output per worker depends on technological progress, while short-run growth can result from either technological progress or capital accumulation (Romer, 2001). One of the most important results of the endogenous neoclassical growth model is the convergence hypothesis which has attracted a considerable attention in regional empirical studies. According to the hypothesis, areas with lower initial capital per worker grow faster and thus tend to converge towards regions with higher capital to worker ratios.

There are two concepts for convergence. First, the absolute convergence hypothesis says that poor economies tend to grow faster than rich economies, regardless of their characteristics. Second, the conditional convergence hypothesis proposes that economies tend to converge to their balanced growth paths, and hence their growth rates depend on their current position relative to balanced growth paths. The larger the distance, the faster the economy grows. In other words, poor regions do not grow quickly if they do not have the necessary infrastructure.

3. Methodology

In this study, two different approaches are used for assessing the impact of independent variables on economic growth. First, the model will be estimated through the generalized method of moments (GMM) or a dynamic panel data (DPD) model (Arellano–Bond estimator). Unlike static panel data models, dynamic panel data models include lagged levels of the dependent variable as regressors. The second approach will use the GMM estimator in a spatial Durbin model. Here, the variables of regional migration and income per capita will be used as spatial Durbin variables.

The GMM estimator is a powerful tool that, unlike the Maximum likelihood (ML) method, does not require precise data on the distribution of error terms (Meshki, 2011). A dynamic panel data model includes the lagged levels of the dependent variable. Hence, the assumption of the lack of autocorrelation between the independent (explanatory) variables and the error terms are violated. In other words, including a lagged dependent variable as a regressor violates strict exogeneity assumption because the lagged dependent variable is necessarily correlated with the idiosyncratic error term. As a result, using ordinary least squares (OLS) estimators (for fixed and random effects panel data models) provides biased and inconsistent results (Baltaji, 2008; and Arellano & Bond, 1991). The generalized method of moments (GMM) estimator resolves the problem through utilizing the instrumental variables (IV) estimation. Regression variables, even lagged variables, are used as instrumental variables to eliminate the bias caused by the endogeneity of explanatory variables (Green, 2012).

The first-order differential generalized method of moments (GMM) was first proposed by Arellano and Bond (1991). In the Arellano–Bond method, the first differences of the regression equation are taken to eliminate the fixed effects. In other words, the intercepts are eliminated in this method (Yavari & Ashrafzadeh, 2005). Arellano and Bover (1995), and Blundell and Bond (1998) proposed some changes to the first order equation of GMM and suggested the orthogonal deviations estimator. The difference between these two methods is the manner in which individual effects are included in the model. The advantages of the second method are to increase the accuracy and reduce the bias of limitations of sample size (Baltaji, 2008).

This study utilizes the Arellano-Bover /Blundell-Bond Dynamic Panel data two step estimator. The model is shown as follow (Arellano, 2003):

$$y_{it} = \sum_{j=1}^{p} \alpha_j y_{i,t-j} + x_{it}\beta_1 + w_{it}\beta_2 + v_i + \varepsilon_{it} \tag{10}$$

where α_js are p parameters that should be estimated. x_{it} is a k_1-dimentional vector of completely exogenous variables. w_{it} is a k_2-dimentional vector of predetermined or exogenous variables. β_1 and $\beta 2$ are respectively k_1-dimentional and a k_2-dimentional vectors of parameters to be estimated. vi is the panel level effect (which may be correlated with the explanatory variables). εit is the independent and identically distributed (i.i.d) variable with the variance of σ_ε^2. The model assumes that vi and ε_{it} are independent for each cross-section i

during the whole time period *t*. w_{it} and x_{it} include the lagged independent variables and dummy variables. However, these two variables are equivalent in dynamic panel data models.

In the study, the dynamic panel data model is specified through spatial econometric techniques. In order to specify the spatial GMM model, it is considered a Spatial Dynamic Panel Model (SDPD), shown as follows:

$$y_{it} = \alpha + \tau y_{it-1} + \rho \sum_{j=1}^{n} W_{ij} y_{it} + \sum_{k=1}^{K} \beta_k X_{itk} + \sum_{k=1}^{K} \sum_{j=1}^{n} D_{ij} Z_{itk} \theta_k + a_i + \gamma_t + v_{it} \quad (11)$$

The error term has three components: the panel model error term v_{it}, the within-group error term γ_t, and the between-group error term a_i. W is the row-standardized spatial weight matrix. a_i shows the individual (cross-sectional) fixed or random effects. γ_t also shows the fixed and random effects of time. If $\tau = 0$, the model will be static, and if $\tau \neq 0$, then the model will be dynamic. In other words, the lagged dependent variable will also enter into the model, and the model will be the spatial dynamic panel data (SDPD) model or spatial generalized method of moments (SGMM) model (Yu, Jang & Lee, 2008).

4. The model and variables

In empirical specification of the slow growth model, the growth rate of income per capita is dependent variable and the time-lagged of income per capita is one of the independent variables. Since the growth rate is calculated through $ln(y_t)$ minus $ln(y_{t-1})$, we can bring $ln(y_{t-1})$ to the left-hand side of the equation and write the relation in terms of $ln(y_t)$. According the theoretical base, the Dynamic Panel data (DPD) Model is specified as follows:

$$\ln(GDP_{it}) = \alpha + \beta_1 \ln(GDP_{it-1}) + \beta_2 IM_{it} + \beta_3 I_{it} + \beta_4 FR_{it} + \beta_5 BU_{it} + \beta_6 HC_t + \beta_7 HC_{it}^2 + \mu_{it}$$
$$\mu_{it} = a_i + \gamma_t + v_{it} \quad (12)$$

The specified model (12) is estimated for provinces of Iran for 2006-16. Since the data are regional, there would be spatial dependence between them. In other words, each region would be influenced by its neighbors' conditions and its conditions as well. Therefore, the spatial specification of the model is considered in the form of the spatial Durbin model:

$$\ln(GDP_{it}) = \alpha + \beta_1 \ln(GDP_{it-1}) + \beta_2 IM_{it} + \beta_3 I_{it} + \beta_4 FR_{it} + \beta_5 BU_{it} + \beta_6 HC_t + \beta_7 HC_{it}^2 + \rho W \ln(GDP_{it-1}) + \gamma WIM_{it} + \mu_{it}$$
$$\mu_{it} = a_i + \gamma_t + v_{it} \quad (13)$$

The spatial lag of income per capita (dependent variable) has entered the model. In addition, the spatial Durbin variable is the spatial lag of regional migration. The definition of variables in the models are stated in Table (1).

Table (1). Variables and parameters of the specified models

Variable	Definition
y	income per capita
IM	Net migration rate (net entrance to each province from others)
I	The ratio of Investment to *GDP*
FR	Fertility rate
BU	The ratio of the government consumption expenditures to *GDP*
HC	Human capital
HC^2	The square of human capital
W.y	The multiplication of the spatial weight matrix and *y* per capita (for considering spatial autocorrelation)
W.IM	The multiplication of the spatial weight matrix and *IM* (Durbin variable)
α	Intercept
β	Coefficients of explanatory variables
ρ	The coefficient of spatial autocorrelation
γ	The coefficient of spatial Durbin

$\ln(y_{t-1})$ plays a crucial role in the Solow growth model and its coefficient is used for testing the convergence hypothesis. If the estimated coefficient is negative and significant, the convergence hypothesis would be accepted. It implies that poor economies growth faster than rich toward their balanced growth paths. As mentioned in the previous sections, the impact of migration on growth rate is ambiguous.

In endogenous growth models, such as Robelo (1990) and Barro (1990), per capita growth and the investment ratio tend to move together. For example, an exogenous improvement in productivity tends to raise both the growth and investment ratio (Barro, 1991, p.422). On the other hand, some studies like Barro and Becker (1989), Becker, Murphy and Tamura (1990), and Barro (1991), in which fertility is exogenous, per capita growth and fertility rate tend to move inversely. In fact, a higher human capital leads to higher growth and lower fertility.

The effect on fertility involves an increase in the value of parent's time and therefore a rising in the cost of raising children (Barro, 1991). In other words, more educated people are more productive in producing goods rather than more children (Barro, 1991, p.409). Barro (1989, 1990, and 1991) found that government consumption expenditures (as a relative variable to GDP) had negative effects of growth and investment. He argues that government consumption had no direct effect on private productivity, but lowered saving and growth through the distorting effects from taxation or government-expenditure programs (Barro, 1991, p. 430). Human capital is a key factor affecting economic growth and is highlighted in endogenous growth theories. Actually, human capital influence technological progress through generating new ideas and new products. Barro (1991, p.409) believes that countries with greater initial stock of human capital experience a more rapid rate of introduction of new goods and ideas and thereby tend to grow faster.

In this paper, we considered two proxies for human capital: the percentage of population with secondary education and the mean years of schooling. Since the second proxy, mean years of schooling does not show significant effects of growth, the results of the first proxy have just presented in the next section.

As mentioned before, the model was estimated for 30 provinces of the country for the period 2006-2016. In this study, Alborz province is considered as a part of Tehran province due to limited access to data. The data were extracted from the Statistical Yearbooks of Iran and the Central Bank Statistics of Iran.

5. Empirical results

The model specifies in two forms in relations (12) and (13). In fact, relation (13) is the spatial Durbin specification of the relation (12) with two spatial variables: spatial lag of the income per capita (the dependent variable) and the spatial lag of migration. As explained before, in the empirical specification of the Solow growth model, the growth rate of income

(GDP) per capita, which is measured as the difference of natural logarithm of income per capita and its first order lag (ln y – ln y¬¬-1), is a function of the starting income per capita variable (the first order lag of natural logarithm of income per capita (ln y¬-1)), and other variables which reflex the structure of each economy. Therefore, we can consider the natural logarithm of income per capita as the dependent variable. However, we have to reduce 1 from the estimated coefficient of for investigating the convergence hypothesis.

Table (3) shows the estimated results. Model I is the traditional model which is presented in the equation (12). The model has been estimated through GMM. The estimated $\chi 2$ of the Sargan test is 13.579 with the probability of 0.404, therefore it is higher than Chi-squared of the table. Thus, the null hypothesis is not rejected. As a result, instrumental variables are correctly selected and there is no meaningful correlation between the instrumental variables and error terms. The results of the Arellano-Bond test has been demonstrated in the table.

Table 2. Arellano-Bond test for zero autocorrelation in first-differenced errors

Order	z	Prob. > z
1	-2.061	0.039
2	-1.578	0.115

Source: Authors' calculations. * H0: no autocorrelation.

Results indicate that the z-value of the first-order autocorrelation test is -2.061 with the probability of the 0.039, which shows that the null hypothesis of the absence of first-order serial autocorrelation cannot be accepted. Therefore, the model is dynamic and the first-order time lagged of the dependent variable enters in the model as an independent variable. However, in order to confirm that there is no higher serial autocorrelation—which leads to overestimating the coefficients of the two-step Arellano-Bover /Blundell-Bond model—higher order autocorrelation tests were used. The Arellano-Bond test for second-order serial autocorrelation shows the probability of z-value is 0.115 and confirms that the model does not have higher order serial autocorrelation.

Table 3. Estimating the coefficients of specified models for 30 provinces of Iran, 2006-16.

Variables	Model I	Model II
$\ln y_{-1}$	0.752^{***}	0.866^{***}
	(94.05)	(55.61)
IM	0.223^{***}	0.047^{**}
	(8.52)	(2.14)
I	0.0023	0.0002
	(0.55)	(0.02)
FR	1.349^{**}	0. 010
	(2.13)	(0.03)
BU	-0.024^{***}	-0.011^{***}
	(-16.13)	(-5.97)
HC	-0.134^{***}	0.236^{***}
	(-0.98)	(2.80)
HC^2	-0.157^{***}	-0.137^{***}
	(-11.68)	(-3.93)
α	3.113^{***}	1.392^{***}
	(25.80)	(8.00)
ρ	-	0.021^{*}
		(1.68)
γ	-	0.032
		(1.02)
Sargan test	χ^2 (13.579)	-
	(prob.=0.404)	
$\mathbf{R^2}$		0.972
Moran's I statistic		2.628^{**}
		(prob.=0.009)

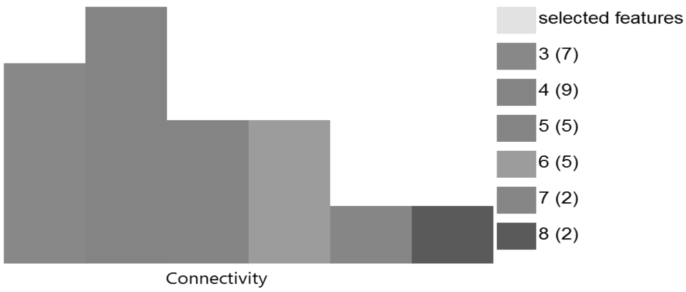
Source: Authors' calculations. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. z-statistics are in parentheses.

Estimating model I coefficients through Arellano-Bover/ Brundell-Bond by traditional econometric techniques demonstrates that the estimated coefficient of the lag of the dependent variable (ln y_{-1}) is 0.725 and highly significant. As mentioned before, for considering the impact of ln y_{-1} (the starting level of income per capita) on growth, we must compute 0.725-1 which is equal to -0.275. That is, the starting level of income per capita have a negative significant impact (with a coefficient of -0.275) on per capita growth which reflects the convergence hypothesis. It means that growth rates tend to be inversely related to the initial incomes per capita. In other words, poorer provinces with lower income per capita grow faster toward their balanced growth path. This result is consistent with the results of other studies on Iran's provinces such as Rahmani and Hassanzadeh (2011).

However, the estimated coefficients would be biased if there would be spatial dependence among observations, and the spatial specification of the model must be considered. The Moran's I test verifies the spatial dependence in incomes per capita. The estimated statistics is 2.627 and significant. Hence, there are positive spatial effects for the income per capita and growth of provinces in Iran. In other words, the income per capita and the growth rate of each province is related to the incomes per capita and growth rates of others. It is clear that more distance between provinces reduces the spatial effects. We enter spatial effects in the model through spatial weight matrix which is defined according to the first-order queen contiguity.

Figure (1) plots the neighbors histogram for provinces of Iran. The colors of columns are related to the numbers of neighbors in a spectrum of blue color with 3 neighbors to red color with 8 neighbors. For example, 7 provinces of Iran have 3 neighbors and 9 provinces have common borders with 4 other provinces, and so on. As the figure show, there is a strong spatial connectivity between provinces of Iran.

Figure 1. Neighbors histogram of the provinces of Iran.



Source: Research findings.

The last column of Table 2 shows estimated results for the spatial Durbin model in which two spatial variables were added: the spatial lag of the dependent variable, so that its estimated coefficient demonstrates spatial autocorrelation; and the spatial lag of regional migration which displays spatial effects of migration among provinces. As expected, the estimated coefficient of spatial lag of income per capita ($\hat{\rho}$) is positive and statistically significant which reflects positive spatial dependence among Iran’s provinces. That is, having borders with higher income provinces influences incomes per capita positively. In other words, having poor neighbors can be a negative factor for income per capita and economic growth. The estimated coefficient of the Durbin variable ($\hat{\gamma}$) is also positive but not significant. Hence, there is not significant spatial effects from regional migration.

The Moran's I test and significantly estimated coefficient of the spatial lag of the dependent variable demonstrate that the model has spatial form and the spatial effects must be considered in the model.

Results show that income per capita is strongly related to its time-lagged. The estimated coefficient in the spatial Durbin model is 0.866 and strongly significant. According the previous explanations, the initial level of income per capita would influence growth negatively with a coefficient of -0.134. Accordingly, higher initial income per capita decrease the growth rate of provinces. Thus, the convergence hypothesis is accepted for provinces of Iran. In other words, poor provinces tend to grow faster than the rich.

The estimated coefficient of the regional migration variable is 0.047 which is positive and statistically significant. Therefore, net migration has a positive effect on income and growth, and the entry of people from other provinces increases the incomes of destination provinces, and their growth rates rise. As expected, immigration to provinces increases the growth rate, since the physical and human capital would be increase as new people enter a region, and new opportunities would be created.

Although the estimated coefficient of investment is positive, it is not significant, which demonstrates that investment has had no significant effect on the income per capita and growth of the provinces of Iran. Also, the impact of fertility on income per capita and growth is positive and significant which is at odds with the predictions of Barro (1991). On the other hand, the share of government consumption expenditures in GDP has significantly negative effect on growth. This result is consistent with the Barro (1991) arguments. This means that provinces with higher government consumption expenditures are expected to have lower growth rates, which could be due to distorting effects from taxation or government-expenditure programs.

In the specified model, the square of human capital has been added. That is, instead of a linear form, the relationship between income per capita and human capital has been considered as a quadratic form. Thus, human capital and its square has been entered the model as explanatory variables. Both variables have statistically significant effects on income per capita and on growth as well. The estimated coefficient of human capital is significantly positive. As expected, income per capita is positively related to human capital and rising human capital increases growth. However, there is an inverse U-shape relationship between human capital and income per capita and growth. Accordingly, there is an optimal amount for human capital. After the optimum point, the income per capita would decline as human capital rises.

6. Conclusion

This research has considered the impact of regional migration on economic growth for the provinces of Iran in 2006-2011. The specified model is based on the Solow growth model. The specified model is a spatial dynamic panel data (SDPD) model. The obtained results show that both time lag and spatial lag of income per capita have statistically significant impacts on the income and growth of Iran's provinces. The starting income per capita has expectedly negative impact on per capita growth, which confirms the convergence hypothesis. That is, poor provinces grow faster toward their balanced growth paths. The positive estimated coefficient of the spatial lag of income shows positive regional effects. Accordingly, having rich neighbors increases income and economic growth. Also, being a destination province for migrants from other provinces positively influences income and economic growth, while there is no significant spatial effect from migration on income per capita and growth.

7. References

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