IS STABILITY FOR REGIONAL DISPARITIES OF UNEMPLOYMENT RATES TRULY MYSTERIOUS? AN ANALYSIS FROM STATISTICAL APPROACH

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Abstract

The paper analyzes the peculiar phenomenon of regional disparities brought by the changes in the geographical distribution of US unemployment rates. Specifically, we investigate the characteristics concerning the gap of that regional distribution especially focusing upon the statistical analysis by mainly an exploratory way. *Reduction in disparities* or *Expansion in disparities* usually involves reducing or increasing the overall level of distribution, and the so-called *relative disparity* between all states of the U.S. shows an extremely stable transition of distribution within a certain range. This is a mysterious phenomenon that is also shown in any other country in the world. One of the reasons that the regional distribution of unemployment rates becomes stable is derived from the robustness of that geographical distribution; this is one of the reasons that the unemployment rate does not fluctuate significantly. Even if that robustness deteriorates for some reason, then the unemployment rate updates the values of minimum and maximum, or only just the range of variation expands; the relative disparities between regions tend to be offset by increases or decreases in the same direction as a result. Since that range is usually very limited, the gap frequently fluctuates up and down within a confined extent and it does not necessarily converge or diverge to a specific point; it would constantly change within the allowable fluctuation range depending on the socio-economic situation.

Keywords: unemployment rate, regional disparity, convergence, equilibrium, stability
JEL classification: C13, C15, J69, R12, R19

1. Introduction

The regional disparities concerning the issues of unemployment rates have been one of the central topics in regional economics and the related fields. When the level of national unemployment rate rises, generally the one of unemployment rate in each region also rises, and the regional distribution levels up overall (see Figure 1): Thus, corresponding disparity also enlarges by its increase. The distribution of relative disparities between regions is very stable, and the relative degree hardly changes over time (see Figure 2).

Figure 1. Unemployment rate and their SD based on raw data

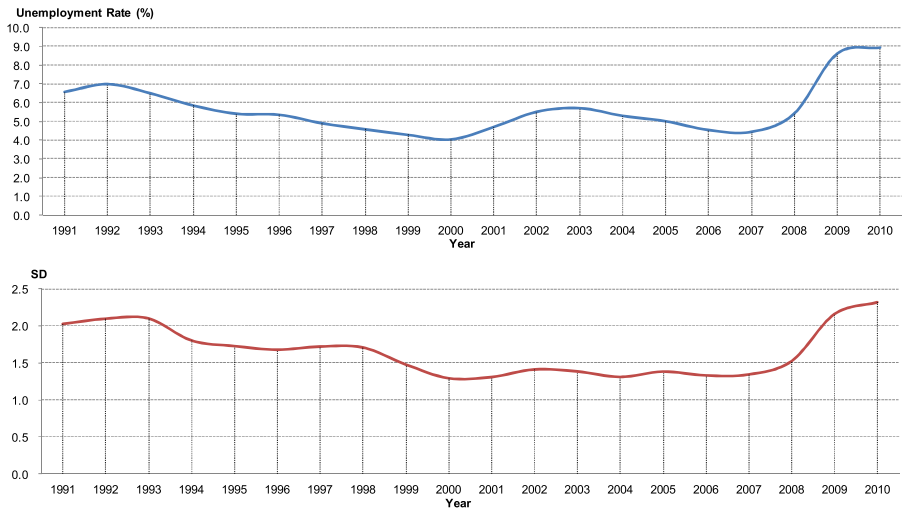
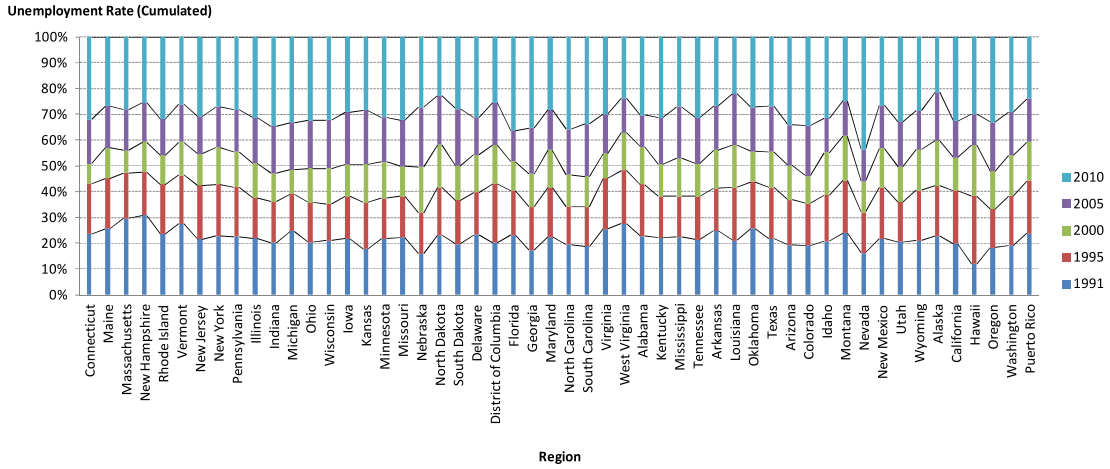


Figure 2. Regional distribution based on raw data



The detailed effects of the geographic distribution observed over a long period have been enigmatic and its causality is still veiled in mystery; however, this topic can be effectively approached from the matter of convergence in the regional distribution. Here we concisely review the previous literature for the regional distribution of unemployment rates, which particularly focuses on the nature of convergence in such a distribution. We introduce the selected list of highly suggestive viewpoints obtained from the existing studies by item as follows.

1.1. Relevant previous research

1.1.1. Opinions indicating conditional convergence

・ Regional unemployment rates generally have strong sustainability; it shows a slow convergence, a conditional convergence, or a convergence to a stable equilibrium distribution (Bayer 2007, for example).

・ The regional disparity of unemployment rates shows a peculiar phenomenon and has a certain fixed pattern; it leads to a region-specific convergence and finally reaches a stable distribution. This suggests the formation of a steady unemployment distribution, which is symbolized by some kind of equilibrium (Kunz 2009, for example).

・ Generally, any regional discrepancy of unemployment rates decreases after a certain period. The process of convergence is guided by factors that bring about an equilibrium status in the local labor market: Therefore, it suggests that the degree of disparities decreases as a result (Rios 2014, for example).

1.1.2. Opinions indicating non-convergence or intermediate states

・ The fluctuation of regional unemployment rates is generally stable and does not normally converge or diverge (Tyrowicz and Wojcik 2010, for example).

・ The conditions of regional unemployment differ depending on the degree of unemployment rates. For example, low, medium, and high unemployment areas have regional differences in sustainability and stability. Therefore, they do not seem to converge uniformly. This suggests that the disparity is led to unstable or expanding tendencies (Tyrowicz and Wojcik 2007, for example).

1.1.3. Other related viewpoints

・ Regional disparities widen when the national unemployment rate rises; the resulting disparities are remarkably persistent (Filiztekin 2009, for example).

・ The socioeconomic shock affects the transition of the unemployment rate, and it will take some time to return to a stable or equilibrium state (Kiral and Mavruk 2017, for example).

・ Shock has a major impact on the region at the outset, and then adversely affects the local labor market if a rapid recovery cannot be expected (D'Apice 2014, for example).

・ The process of adjusting regional unemployment, which is delayed in response to a shock, is not always effective against the persistent unemployment gap (Kunz 2009, for example).

・ The spatial distribution of the unemployment rate is deeply involved in the formation and widening of disparities. Region-specific shocks not only affect the labor market but also spread to neighboring areas as a spillover effect. The unemployment gap is a temporary imbalance phenomenon that is offset by an increase in the inflow of population due to migration and economic integration. Also, the spatial outflow structure and the spatiotemporal transmission process are considered to play an important role in reducing the unemployment gap (Rios 2014, for example).

1.2. Theoretical background and motive

Generally, the *equilibrium theory* and the *disequilibrium theory* are often used as the rationale for dealing with the distribution behavior of the regional unemployment rate. Most of the existing literature for regional disparities is based on the hypothesis of stable equilibria of labor markets (Cracolici and Nijkamp 2007). They argue about whether the values of regional unemployment data ultimately converge to a certain equilibrium point or not (Marston 1985, and others).

Usually, the equilibrium theorists have a theoretical scenario: After big shocks of business fluctuations, the substantial effects by them would remain for a considerably long period and spread widely throughout regions (Blackley 1989; Veder and Gallaway 1996; Aragon et al. 2003, and others). This remaining ripple effect is a cause of the areal persistence of unemployment rates, and it induces a specific rate for unemployment sometimes called the natural ratio of unemployment which would be a targeting equilibrium point.

On the other hand, based on the fact that the differentials of unemployment rates tend to be lost during a certain period, the disequilibrium approach generally assumes a relatively short time. In that sense, this theory is built on the thought that the level of the unemployment rate is always moving, and they never spontaneously converge on a specific rate.

There are several reasons why disequilibrium phenomena occur. As an example, the speed of adjustment for relieving the fluctuation of the unemployment rate plays a key role. Any failure or collapse of this adjustment process would cause a serious problem such as high unemployment rates and/or low economic growth in many areas.

As an alternative idea that could encompass these discussions, the existence of *multiple equilibrium* points was suggested by Fujita, Krugman, and Venables (1999); it claims that such equilibria or disequilibria are tentative or local ones, not global ones, and then the idea seems to become quite a natural compromise proposal of the set of arguments: Incidentally, that idea theoretically supports a part of conclusions of the paper. Although a great deal of theoretical and empirical work has been done so far, we would prove this problem from a different perspective as described below.

2. Data and notes

The data and supplementary matters are as follows: All analyses, definitions, and calculations used are based on published labor unemployment statistics and the US Census of 1991-2010 (see References for details). All tables and figures in the paper are made through these analyses. Some statistical outputs mainly depend on the bootstrap method in addition to the fundamental statistics derived from the data. Finally, some frequently used abbreviations and the notation for symbols are listed up for convenience' sake:

SD (Standard Deviation), σ(Standard Deviation), SV (Standardized Variable), Mean (Arithmetic Mean).

Note: In the paper, the *average* is used in an even more broad sense, and the *mean* stands for just an arithmetic mean by definition.

3. Results

3.1. SD by bootstrap estimates

As the following, we see the result of SD estimation by the bootstrap method with random sampling based on the raw unemployment data from 1991 to 2010; we compare the values of the obtained estimates to the ones of the raw data to evaluate the possibility of fluctuation range (see Table 1 and Figure 3). Specifically, all 52 data are extracted at once to determine the SD estimates, and the operation is repeated up to 1,000,000 times in total.

From the results in Table 1, the bootstrap estimate of SD for the unemployment rates in the entire period from 1991 to 2010 is 0.0241. Note that here we focus only on the data and its distribution and spatiotemporal relationships between the regions are completely excluded in the results by the bootstrap process. Since the distribution of the bootstrap estimates can be assumed to be the symmetric normal distribution this time, the range of the Mean ± 3σbecomes 0.0139 to 0.0343; it means approximately 99.7% of all data is distributed in that range.

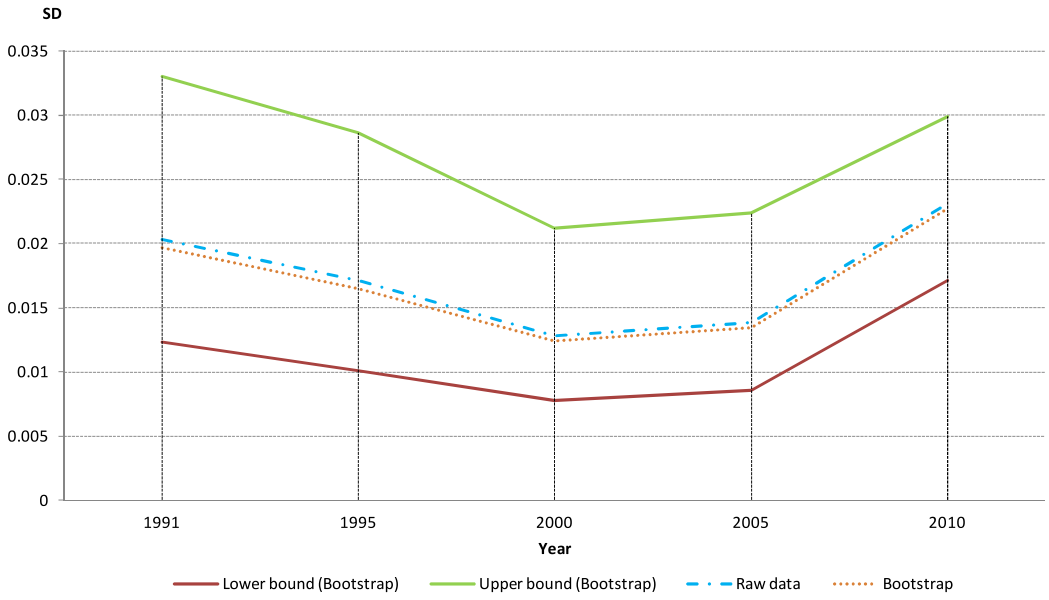
For reference, this time we have run a total of six bootstrap methods (random sampling with permutation, chi-square distribution, normal, fundamental percentile, and BCa) with 95% confidence intervals. As a result, the minimum of the lower bound is 0.0079 obtained by the Normal method, and the maximum of the upper bound is 0.0330 done by the BCa method. Therefore, the allowable range of the lower bound and the upper bound (maximum possible range) is considered to be approximately 0.008 to 0.033 for the Bootstrap method (see Figure 3). Comparing with the above range, it shows that the lower bound might be possible to stretch a little bit downward though the upper bound has almost no potential to increase.

By the way, should the values for the obtained ranges be evaluated as significantly large as a result? Also, what would be the possible range of the regional distribution of unemployment rates? For answering these questions, we further discuss a simulated distribution while maintaining the spatial and temporal relationships of each region in Section 3.3.

Table 1. SD by raw data and bootstrap method

Year	1991	1995	2000	2005	2010	1991-2010
SD (Raw data)	0.0203	0.0171	0.0128	0.0138	0.0231	0.0244
SD (Bootstrap)	0.0196	0.0165	0.0124	0.0134	0.0227	0.0241

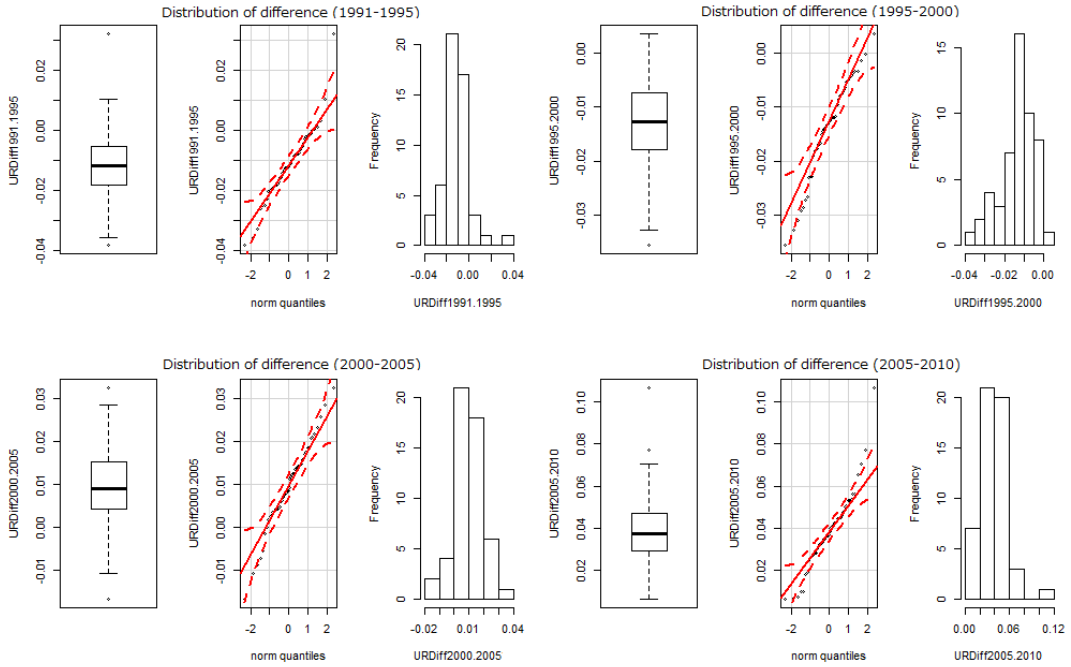
Figure 3. Upper and lower bounds for SD



3.2. Distribution of the simple differences in unemployment rates

We here show some supplemental results to use the technique of standardized variables in Section 3.3. Figure 4 shows the distribution of the simple difference in the unemployment rates for the periods of 1991-1995, 1995-2000, 2000-2005, and 2005-2010. From the left, the graphs of box-and-whisker plots, Q-Q plots, and histograms for 1991-1995, 1995-2000, 2000-2005, and 2005-2010 are displayed. From the results, it shows that the distributions are close to normal ones as a whole although the distributions are skewed by some outliers in each period. Therefore, there would be no problem even if it is assumed that the distribution of the simple difference for unemployment rates in each period is the normal distribution.

Figure 4. Distribution of the simple difference between regions



3.3. Simulated distribution by the standardized variables

Based on the geographic distribution of unemployment rates in 1991 as a baseline, we show how the geographic distribution of unemployment changes in some patterns by simulation. Note that here we simulate the distribution of each area maintaining time-series trends and geographic structure.

Specifically, we examine the simulations in the reduction and expansion directions to determine the lower and upper possible bounds of the distribution. At first, expand the difference between regions equally by adding the scaled SV to the Mean of the simple difference in the unemployment rates for each period of 1991-1995, 1995-2000, 2000-2005, and 2005-2010; we simulate a total of 9 transition patterns for the geographical distribution by sequentially adding the Mean and the scaled SV of the simple difference for each period to the unemployment rate of 1991. We show the possible lower and upper bounds from these patterns. Let's examine the validity and feasibility of the fluctuation range in a series of simulations below (see Figure 5 and Figure 6).

Firstly, we show the lower bound for the reduction direction; this is not so difficult to judge. The SD value of 0.0171 by the Mean + SV / 150 seems to be reasonable for the lower bound since the SD value of any other cases is larger than that level.

Secondary, we evaluate some cases with the large fluctuation range; the Mean + SV / 10 and the Mean + SV / 20 have a couple of regions that indicate the negative values for unemployment rates. These two cases are clearly out of common sense. For the case of the

Mean + SV / 30, the minimum unemployment rate in all US states becomes 0.1%, and thus this is also nonsense. Therefore, only the case where the expansion width is smaller than the Mean + SV / 30 should be considered in the list of simulations; for example, the SD value for the Mean + SV / 40 is 0.0311 which is almost consistent with the upper bound of the results in Section 3.1. And that is considered a practically reasonable level as the upper bound of the SD that can be realistically taken.

Next, evaluate the contribution of the spatiotemporal structure to the potential impact on the lower and upper bounds. According to the results of Section 3.1, about 99.7% of SD estimates of unemployment rates in the U.S. for the observed period would fall in the range of 0.0139 to 0.0343 if the spatial and temporal relationships are not taken into account. If the spatiotemporal relationships are taken into consideration, the regional disparity is likely to be approximately in the range of about 0.0171 to 0.0311 based on the simulation in Section 3.3. Thus, the lower bound has approximately the potential of 23% [(0.0171-0.0139) /0.0139*100] toward the expansion direction. Also, the upper bound has approximately the potential of 9.3% [(0.0311-0.0343) /0.0343*100] toward the reduction direction. Thus, the spatiotemporal relationships appear to reduce the range of regional disparities in this case.

By the way, the results obtained with the two methods are very similar to each other for both upper and lower bounds although the two results above have been created from completely different computational processes. What does this mean? Is it a coincidence? Otherwise, is there any causal relationship? One reasonable answer is the following: As far as the regional disparities in unemployment rates are assessed using the technique of standard deviations, this is only an extremely limited movement within a certain range as described above. In other words, since the disparity phenomenon for unemployment rates is virtually a *relative disparity phenomenon* between regions, it is inevitable that the degree of variance is statistically limited for the regional unemployment rate. It would be reasonable to recognize that the disparity cannot be extremely large.

Figure 5. Regional distribution simulated by SV

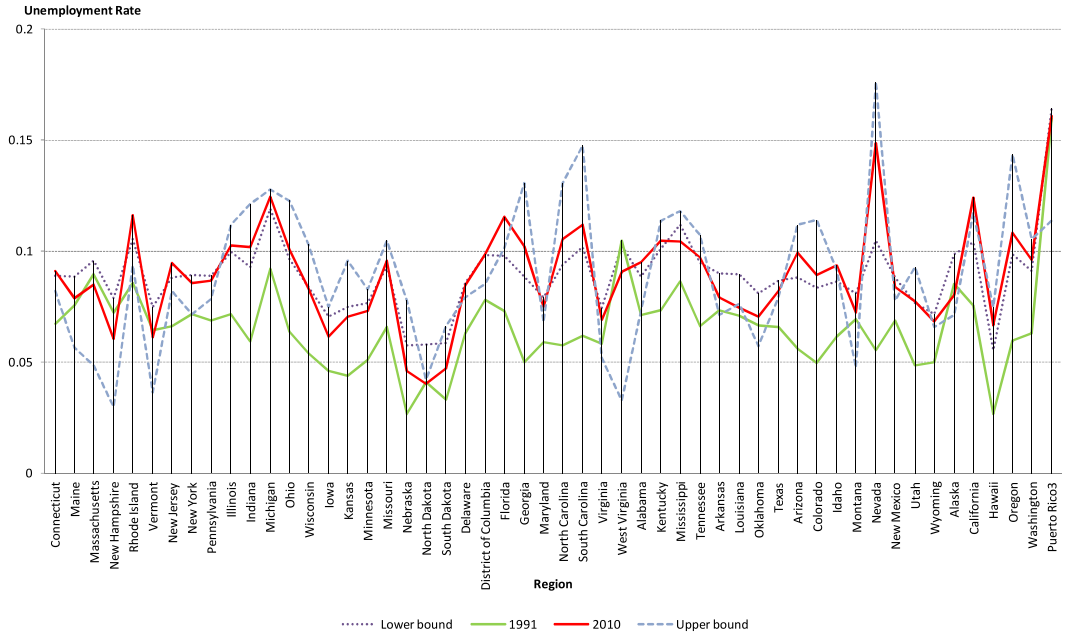


Figure 6. SD simulated by SV (left)

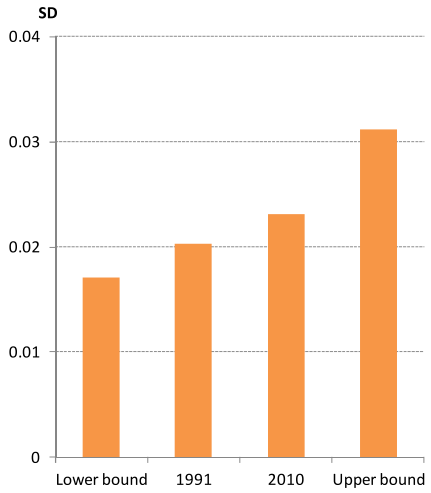
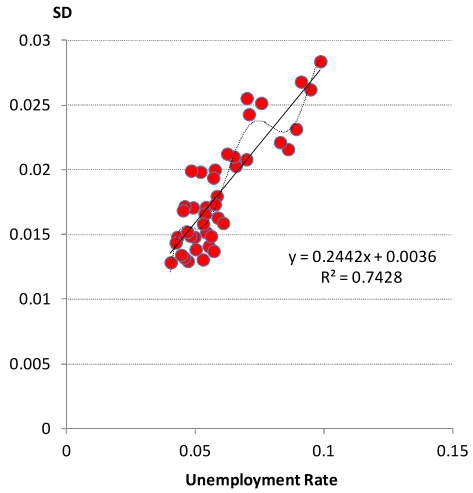


Figure 7. Regression model for SD (right)



At last, we additionally show a couple of results as the supplementary information to lead the conclusion.

As stated above, 0.0311 is considered to be the possible upper bound of SD value for regional unemployment rates (see Figure 5 and Figure 6). Next, a regression analysis is performed based on the data from 1991 to 2010 (see Figure 7): We get X (the national average unemployment rate) = 0.1126 by substituting Y (SD of the unemployment rate) = 0.0311 into the equation of Y = 0.0036 + 0.2442X if the extrapolation in regression analysis is allowed. If the upper bound of the SD is 0.0311, the corresponding national average unemployment rate becomes around 11.3%. Conversely, if we assume that the upper bound of the national average unemployment rate is at this level, then the corresponding possible SD would be limited to the above level.

4. Concluding remarks

As a conclusion obtained from the series of results, the range of reasonable SD value that can be taken for evaluating the regional disparity of unemployment rates is extremely limited and the value fluctuates within such a limited range; this range can be finally estimated at around 0.010 to 0.035 for the observed period of 1991 to 2010 in the U.S.

Although the spatiotemporal structure influences the expansion or contraction direction in regional unemployment rates, the disparity movement would be thus limited in a certain range. One of the reasons is that the *relative differences* between regions tend to fluctuate in almost the same direction at the same time in each region, which necessarily limits the relative differences between regions to a certain range. On the other hand, it might appear to converge locally to what seems to be an equilibrium point for a short period, but even that equilibrium point is just a temporary process as indicated by Fujita, Krugman, et al. (1999).

From the results of a series of statistical analyses, we can draw the following conclusions: Probably the variability of the regional distribution would remain virtually limited within a certain degree unless there is a radical restructuring of the spatiotemporal structure for regional unemployment rates. Moreover, it is almost impossible to deviate from that range in the usual case. This is one piece of evidence demonstrating that the regional distribution of unemployment rates remains extremely stable. Future research is expected to obtain a further determinate conclusion by the related discussions.

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