An analysis of federal income inequality in the United States, 1917–2018

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The study investigated the spatial patterns of fiscal incomes in the United States (US) between 1917 and 2018. The authors examined the spatial shifts in income and population center of gravity and analyzed the role of localities in changes in per capita income using shift-share analysis. The study also calculated the spatial dependence of income and population. The authors analyzed spatial differences using the Hoover index and tried to identify points in time at which economic recessions had a significant impact on spatial processes in the US. The most important result of our research is that, in terms of both spatial dependence and heterogeneity, the New Deal had the greatest impact on spatial processes in the US. No government intervention or market trend since then has had such an impact on spatial processes.

Introduction

Perceptible income differences in different territorial units constitute important characteristics of territorial differences. One very important theoretical model of the development of income differences is the Williamson hypothesis, which is theoretically based on the work of Kuznets (1955) regarding the relationship between social income inequalities and development (Gyuris 2011). Based on Williamson's (1965) calculations, he suggested that an inverted U-shaped relationship between territorial differences and development is likely, whereby the per capita income of regions becomes more unequal in the early stages of development and more equal in the later stages (Alonso 1980). Based on regional data from the US, Williamson concluded that there is a regular relationship in 16 of the 24 countries examined. Different opinions are linked to the diverse afterlife of the hypothesis. For example, Fan–Casetti (1994) argue that it is outdated and does not predict or explain recent increases in regional inequality. They argue that the regional dynamics literature on polarization, polarization reversal, and territorial restructuring offers a more powerful explanation for changes in regional income inequality. In agreement with the basic concept, several researchers have supplemented Williamson's curve. Amos (1988) examined United States (US) federal income data and supplemented the right side of the curve with a local minimum and then an upward segment (Gyuris 2011). Lee (2004) identified a similar trend based on data series from South Korea and Ezcurra–Rapún (2006) from Western European countries, with divergence occurring again at the level of high development and subsequent convergence.

The income spatial structure of the US has been examined by several studies in recent years. Without claiming to be exhaustive, we highlight the works of Sergio J. Rey (2001, 2018), whose studies greatly inspired our research. We consider the parallel examination of spatial dependence and heterogeneity between states in the US, using their different aggregations, to be crucial. According to Rey (2001, 2018), there is a strong positive relationship between measures of income inequality and the degree of spatial autocorrelation. This line of research was extended in Khan–Siddique (2021). We consider their most important finding to be that while income inequality is increasing in general, regional inequality – both between states and their groups and within them – has gradually decreased in the US. Khan–Siddique (2021) also observed a close relationship between spatial inequalities and spatial autocorrelation. Using data from 1955 to 2003, Daisaku Yamamoto (2008) conducted similar studies using data from different regional levels. Ezcurra–Pascual (2009) showed that during the sample period (1969–1999), a process of convergence of income inequality took place in the member states of the US, mainly due to the development of the states located at both ends of the distribution in 1969. At the beginning of the examined period, income dispersion approached the average over time. On the other hand, in federal states with the lowest level of inequality in 1969, the level of income dispersion increased the most during these three decades. Notably, in any case, when evaluating the implications of these findings, the calculations suggest that the convergence of income inequality observed between 1969 and 1999 will not continue indefinitely.

The spatial income differences of the past 40 years can be explained primarily by national factors, and the income differences reinforce previously existing territorial inequalities (Manduca 2019). Manduca (2019) showed that no significant changes occurred in the economic geography or spatial structure of the US during the study period. Thus, various possible disadvantages of regional development (such as divergence, macroeconomic policy challenges, and political dysfunction) have decreased. According to Petach (2021), US regional development policy at the beginning of the twentieth century was characterized by a centralized effort to redistribute economic activity from regions with limited capacity to regions with excess capacity. At the end of the twentieth century, the US gradually abandoned this policy in favor of a decentralized process of regional competition. At that time, state and local governments replaced the federal government, and regional income convergence decreased. According to Feldman et al. (2021), the increased general income in the US since 1980 has been accompanied by increased inequality, the reasons for which are analyzed in detail. In their article, Doran–Jordan (2009) show that between 1969 and 2009, income inequality increased in the US, considering the state and county levels together. They pointed out that that process was a consequence primarily of income inequality within the state, while inequality between states decreased. Garrett et al. (2007) provide strong evidence of a spatial correlation in state-level income growth.

In this study, we performed a spatial analysis of fiscal incomes[1] on the data series between 1917 and 2018. The data are from the World Inequality Database [1]. In addition to Puerto Rico, the database includes data from all states in the US (50 states and Washington DC[2]). In the case of Alaska, unfortunately, we do not have data for 1921–1937 or 1943–1954, which must be taken into account in the research. Although Alaska and Hawaii only became member states in 1959, we already had data for earlier years in our database, which we took into account. Unfortunately, our data did not provide an opportunity for examinations within states, so we analyzed income conditions according to the member states only.

We sought answers to the following questions: what characterizes the spatial distribution of income in the US? What are the most important spatial relationships and spatial patterns? Are some important relationships of spatiality observable? To what extent can Manduca's (2019) finding that income distribution is due mainly to national processes be justified? In the longer term, how did territorial differences among states develop, and what is the relationship between territorial heterogeneity and dependence?[3] What characteristic changes and shifts are perceptible? Are there defining periods that are related to typical political, economic, social changes and processes?

Spatial structure of fiscal income

On our topological map[4], we present the basic income processes of the examined period at a few key points in time, using all fiscal incomes. In 1917, New York, Pennsylvania, Illinois, Ohio, and Massachusetts topped the income rankings. In 1955, New York State continued to lead, but California moved up to second place, followed by Illinois, Pennsylvania and Ohio. By 1988, California took over from New York, followed by Texas, Illinois, and Florida. Finally, in 2018, after California, Texas moved into second place, followed by New York, Florida and Illinois. In terms of per

[1] Fiscal income is the sum of all income items shown on an income tax return before deductions. This amount includes labor income, capital income and mixed income. The concept of tax income varies according to national tax legislation, so for the sake of international comparison, it is advisable to use the concept of national income.

[2] For simplicity, Washington DC data are analyzed together with data from the 50 states.

[3] Spatial dependence means a function-like relationship between the values of the same variable measured at different locations.

[4] On these maps, the originally adjacent territorial units are also adjacent here, i.e., the original topology remains unchanged. The size of the territorial units and polygons is proportional to the socioeconomic volume to be represented.

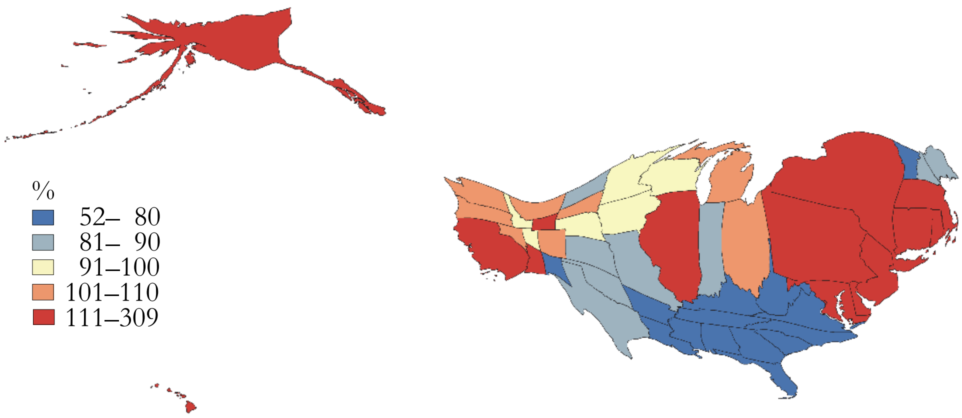
capita income, Alaska was in the most favorable position during the entire study period. By 2018, this situation changed, and the highest values were then seen in Connecticut, followed by Washington, Massachusetts, New Jersey and Wyoming.

The most important trend that can be observed in the change in fiscal incomes is that the dominant role of the northeastern states gradually decreased, and their role was increasingly taken over by California. In terms of specific incomes, the spatial pattern changed very little during the study period: the states along the two ocean coasts are the dominant states, together with Alaska. Additional states only periodically enter this elite club.

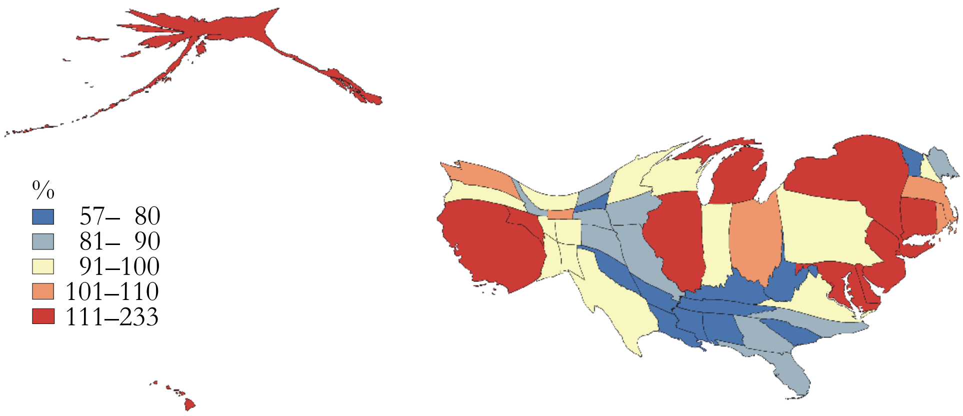
Figure 1

Development of fiscal income in the US

1917



1955



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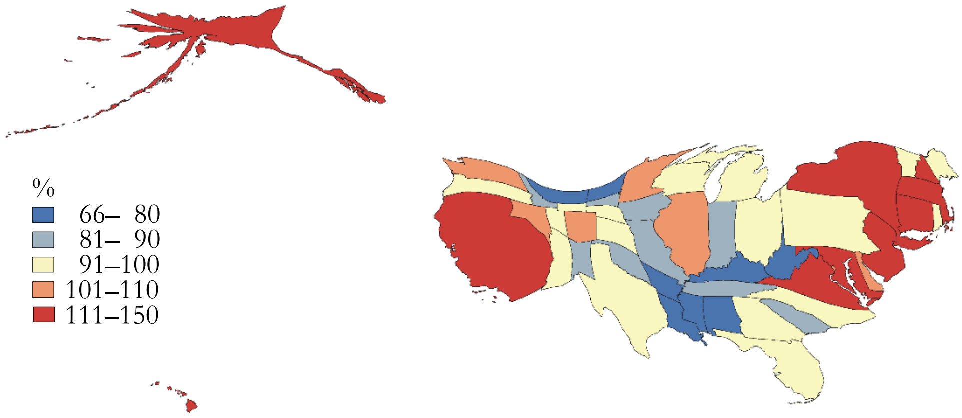
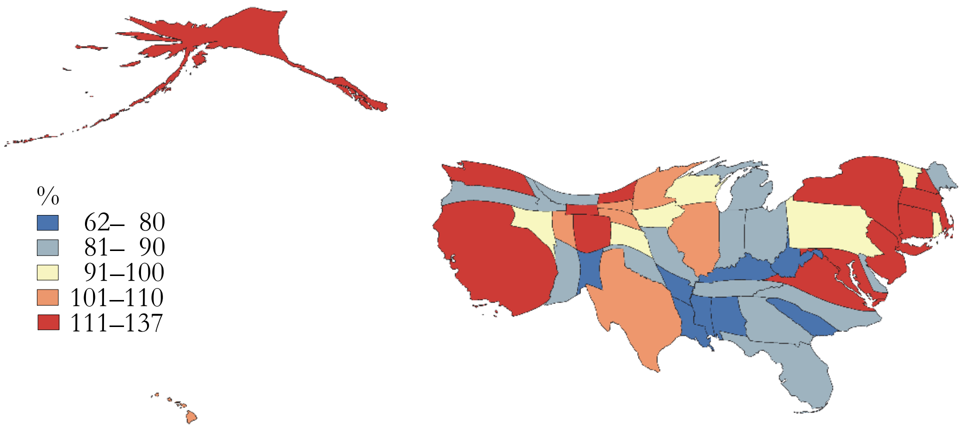
1988



2018



Note: The distortion in the polygons reflects the size of the fiscal income, and the coloring reflects the income per capita. The selection of years in the database was adapted to the availability of Alaska data due to gaps.

Source: The authors, based on the [1].

A northeast–southwest shift can already be seen on the map compilation. To explore this situation more thoroughly, we used the center of gravity method. The starting point of the method is the following idea: for coordinates of the center of gravity of a planar system consisting of n points, if the positions of the points are defined in space and a mass can be assigned to each point, then a weighted arithmetic mean of the coordinates of the points can be calculated (1):

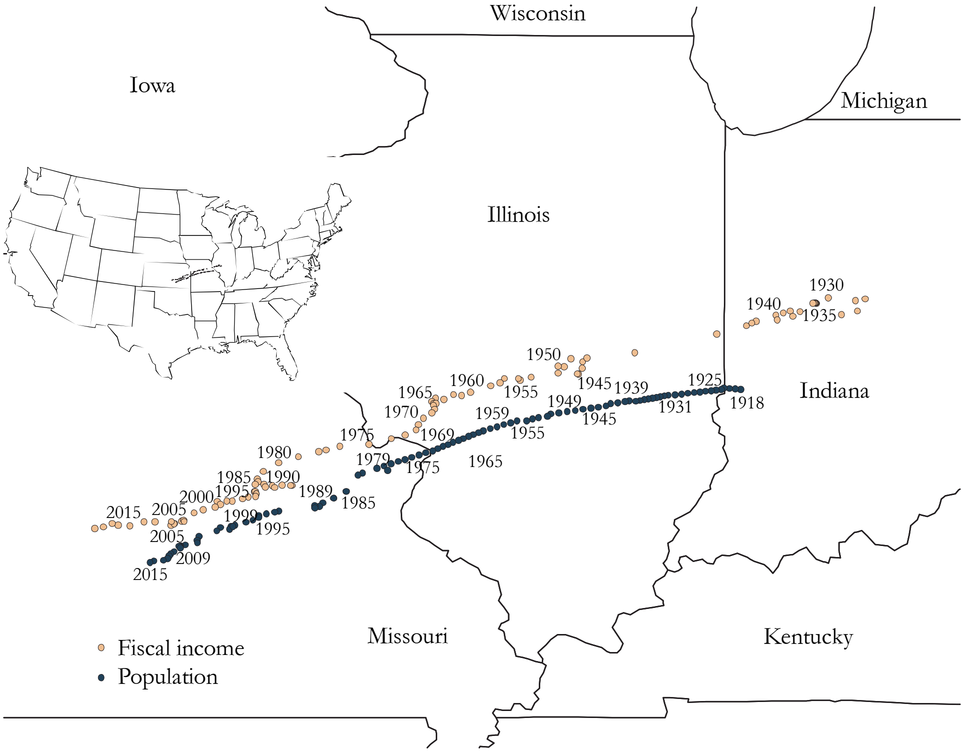
$$x = \frac{\sum_{i=1}^{n} x_i}{n}; y = \frac{\sum_{i=1}^{n} y_i}{n} \quad (1)$$

In this context, x and y denote the two coordinates of the center of gravity, x_i and y_i denote the coordinates of the base points, and f_i corresponds to the weights belonging to the base points.

We examined the population and income centers of gravity in the period under review. For both, we can see the centers of gravity in the states of Indiana, Illinois and Missouri. The northeast–southwest movement is clear in both cases; it is perhaps worth noting that while the movement of the population center of gravity is completely trend-like, a certain hecticness can be detected in the case of income.

Figure 2

Movement of income and population centers of gravity in the US, 1917–2018



Source: [1].

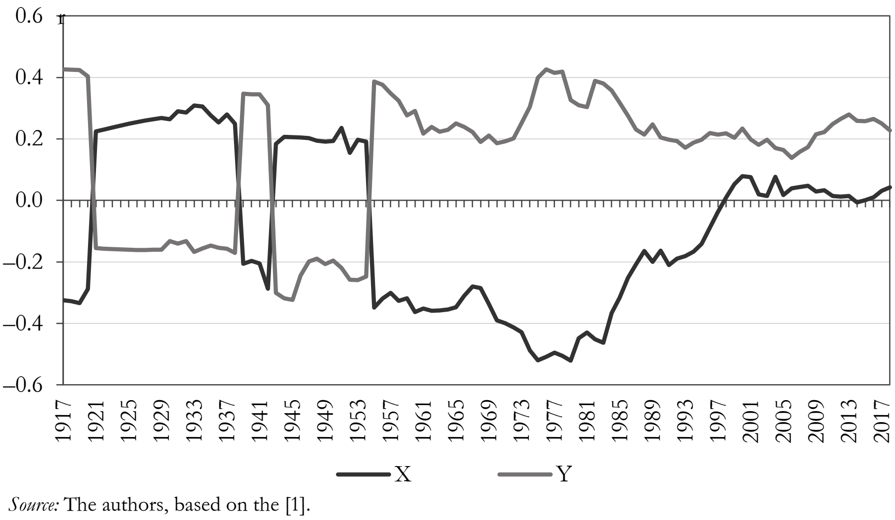
In the following, we examined the role of the most important directions of space in the temporal evolution of income, population and per capita population. In this study, we calculated the Pearson's correlation of the data with the geometric centers of the states and their x and y coordinates. We wondered whether the role of x, i.e., horizontal (E–W), or y, i.e., vertical (N–S) displacement is more decisive. For both income and population, the obtained correlation coefficients are relatively low (0.25–0.1). The trend in both cases, for both x and y coordinates, is decreasing, that is, the development of the two indicators can be explained less and less by the coordinates. Three periods do not fit into the negative trend. These three periods are 1920–1921, 1938–1944, and 1954–1955.

In the first period, we observe stronger verticality and less horizontality. This period was the era of economic recession after World War I, which was accompanied by a significant deflationary recession. Several people link the crisis to the Fed's erroneous interest rate policy, which had a significant impact on agricultural activity (Carlin–Mann 2018). In the second period, at the beginning of the period, contrary to the previous period, the strengthened horizontality was accompanied by weakened verticality, while at the end of the period, the opposite trends occurred. We draw attention to the fact that, based on our results, the change is not related primarily to the Great Depression between 1929 and 1939 but rather to the Second World War that followed.

Finally, in the third period, verticality weakened, while horizontality strengthened slightly. At that time (1953–1954), there was also a recession in the US. After the 1950–1953 Korean War, inflation increased, and considerable resources were injected into the national economy to address it. The crisis that followed was primarily monetary, which was first associated with an increase in interest rates. After the Fed intervened, interest rates fell, pushing the US into a demand-driven recession in output and employment. Gross domestic product (GDP) decreased due to government spending and investment (Meltzer 2009).

Figure 3

The relationship between per capita income and the coordinates of the states' center of gravity, 1917–2018 (r)



Source: The authors, based on the [1].

Regarding per capita income, the general downward trend is less apparent. The three periods indicated above also appear here. During the entire period, the role of the west–east relation, i.e., horizontality, is – in most cases – more significant than the north–south relation, i.e., verticality. In addition to the three periods indicated, the years 1975–1976 can be highlighted. Arguably, this change can best be seen as the consequence of the 1973 oil crisis. Since then, the role of horizontality has increased, while that of verticality has decreased.

The role of locality

In the next analysis, we examined to what extent the size of states' per capita income is justified by the change in per capita income over time and the independent local causes. For this purpose, we used the method of shift-share analysis. The method used differs in many respects from traditional shift-share analysis (see Lahr–Ferreira 2020), so it will be presented in detail in the following.

The method, which is essentially double standardization, requires data in at least two structural dimensions – territorial and sectoral. The sector designation can actually cover any disjunct distribution: economic sectors, age groups, settlement size groups (in this study, temporality means the sector dimension). The territorial dimension can also vary: for example, settlements, regions, countries, and specific spatial aggregates (in this case, the 50 federal states and Washington DC were included in this dimension).

This approach can also be used to examine the components of the growth of certain phenomena over time and the structure of the differentiation of specific data, such as income per capita. We now use the latter approach. We will describe the method using the example of differentiation of specific data. The starting points of the calculations are two matrices:

$$K = \begin{pmatrix} k_{11} & k_{12} & \dots & k_{1j} & k_{1m} \\ k_{21} & k_{22} & \dots & k_{2j} & k_{2m} \\ \dots & \dots & \dots & \dots & \dots \\ k_{i1} & k_{i2} & \dots & k_{ij} & k_{im} \\ k_{n1} & k_{n2} & \dots & k_{nj} & k_{nm} \end{pmatrix} \quad V = \begin{pmatrix} v_{11} & v_{12} & \dots & v_{1j} & v_{1m} \\ v_{21} & v_{22} & \dots & v_{2j} & v_{2m} \\ \dots & \dots & \dots & \dots & \dots \\ v_{i1} & v_{i2} & \dots & v_{ij} & v_{im} \\ v_{n1} & v_{n2} & \dots & v_{nj} & v_{nm} \end{pmatrix}$$

The following values can be calculated from the basic data (by adding the rows and columns to the matrices:

$$k_{i0} = \sum_{j=1}^{m} k_{ij} \text{ and } v_{i0} = \sum_{j=1}^{m} v_{ij}$$

for the income and population of the ith state,

$$k_{0j} = \sum_{j=1}^{m} k_{ij} \text{ and } v_{0j} = \sum_{j=1}^{m} v_{ij}$$

for the income and population of the jth year,

$$k_{oo} = \sum_i \sum_j k_{ij} \text{ and } v_{oo} = \sum_i \sum_j v_{ij}$$

for the total income and total population of the states during the entire period.

The first substantive step of the calculation is determining the matrix $M(m_{ij})$ of specific indices, which means dividing the elements of matrix V by the corresponding elements of matrix K.

$$M = \begin{pmatrix} m_{11} & m_{12} & \dots & m_{1j} & m_{1m} \\ m_{21} & m_{22} & \dots & m_{2j} & m_{2m} \\ \dots & \dots & \dots & \dots & \dots \\ m_{i1} & m_{i2} & \dots & m_{ij} & m_{im} \\ m_{n1} & m_{n2} & \dots & m_{nj} & m_{nm} \end{pmatrix}$$

Similarly, the overall growth index can be calculated by division – m_{oo} is the quotient of the sum of the elements of the two matrices, specific incomes by year – m_{io} is the quotient of the row sums of the matrices, and specific incomes by state – m_{0j} is the quotient of the column sums:

$$m_{00} = v_{00}/k_{00}$$
$$m_{i0} = v_{i0}/k_{i0}$$
$$m_{0j} = v_{0j}/k_{0j}$$

Using these equations, the specific income surplus or deficit (S_i) characteristic of the given period – created because of higher or lower specific income (development) than the national average – can be broken down into two factors, in our case, the so-called regional level, which includes the states (S_r) and the sector (S_a) effect, which in our study refers to the years.

$$(S_i) = (S_r) + (S_a)$$

where $S_i = v_{oj} - (m_{00} * k_{oj})$ that is, the specific income surplus/deficit = the total income for the entire period in each state – (the average per capita income of the states for the entire period * total population in the given state for the entire period).

$S_r = \sum_j (v_{ij} - m_{io} * k_{ij})$ that is, the income data in a certain year of the given state - (average, national per capita income of the corresponding year * population data in the given state in the corresponding year) $S_a = S_i - S_r$, that is, the difference between the two effects.

The regional factor (S_r) is usually positive if the income growth in a given state is faster than the national income growth in each year. On the other hand, the value of S_a will usually be positive if the years with dynamic, above-average income dynamics at the state level have a large weight, while years with slower growth have a small weight. In this sense, this factor indicates a favorable or unfavorable general trend in the given state.

In our study, we investigated what the change in states' per capita income depend primarily on in terms of general national processes, that is, on changes in the specific income over time or on independent local causes.

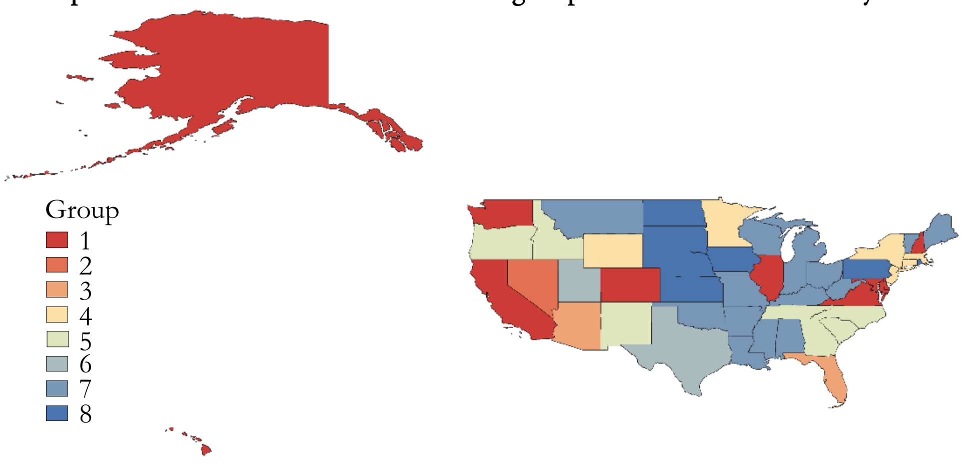
In the table (see Table A1 of the Appendix), states were given +100% where on average, the per capita income was higher than the national average over the entire period, while –100% is shown where it is lower. There are 22 states where the per capita income is higher than the national level and 29 where the per capita income is lower than the national level.

The next two columns examine its components. The temporality shows the general national trends, while the local component shows independent local causes. Additionally, in the formation of the income size per inhabitant in 39 states, the effect of the local component is only 12 for the time factor. In this respect, we did not find support for Manduca's (2019) statement.

Looking at the entire period (see Table A2 of the Appendix), California alone accounts for a third of the increase in specific income above the national average. The change in per capita income, which is smaller than the average, is characteristic mainly of Pennsylvania and Ohio. The positive role of the regional factor is also most significant in California, while its negative role is most significant in Florida. The positive role of the structural factor, i.e., temporality, is greatest in California, Florida and Texas, while its negative role is greatest in New York and Pennsylvania.

Figure 4

Spatial distribution of the theoretical groups of the shift-share analysis



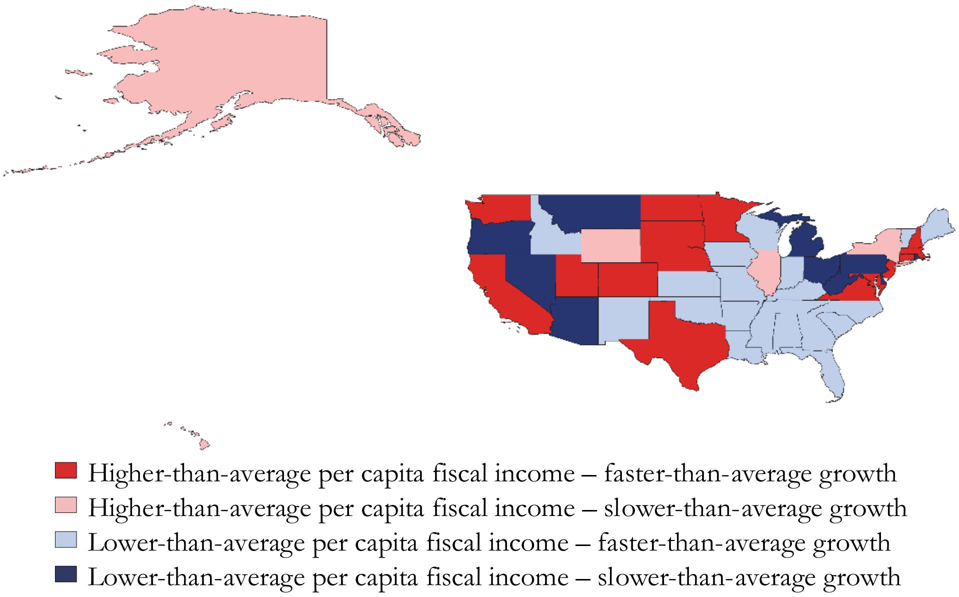
Source: The authors, based on the [1].

The individual states can be classified into 8 theoretical groups based on the results (see Table A3 of the Appendix). The classification is shown in Table A1 of the Appendix, while the result is shown in Figure 4. Based on the figure, we can highlight that the states belonging to the first two groups, i.e., states where both the national processes and the local component contributed positively to the development of per capita income higher than the national average are mainly in the western region of the country (Alaska, California, Washington, Colorado, and Nevada) than in the eastern part of the country, and fewer states can be classified here (New Hampshire, Virginia, Washington DC and Illinois).

This spatial picture changes if we categorize the growth rate from 1917 to 2018 and the relationship to the national average per capita income in 2018 (Figure 5 and Table 2 of the Appendix). We highlight the more favorable situation of North and South Dakota, Nebraska, Minnesota and Texas. The reason for this emphasis is that these states cannot be classified as states along the east and west coasts, which are generally considered dynamic, and their processes are also driven by other economic factors.

Figure 5

Spatial view of categories based on income growth between 1917 and 2018 and per capita income in 2018



Source: The authors, based on the [1].

Territorial differences

One of the most frequently used methods for examining regional differences is the Hoover index. On a scale from 0 to 100%, the Hoover index expresses how much one of the examined characteristics (in this case, fiscal income) would need to be reallocated between individual states for its distribution to be exactly the same as the that of the other examined characteristic (in this case, population) (Szakálné Kanó et al. 2017, Pénzes 2020, Szép et al. 2022). Formula:

$$h = \frac{\sum_{i=1}^{n} |x_i - f_i|}{2} \quad (2)$$

where x_i and f_i are two distribution ratios for which the following two equations hold:

$$\sum x_i = 100$$

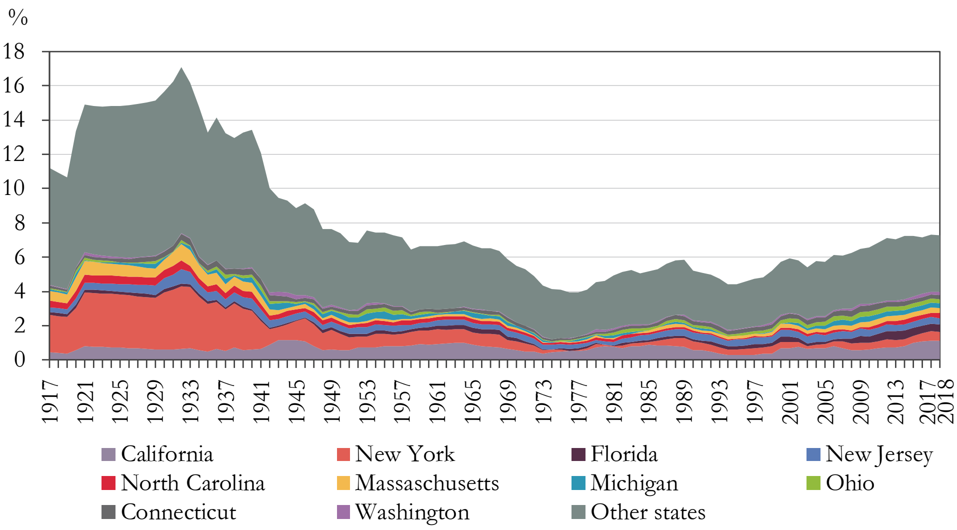
$$\sum f_i = 100$$

The theoretical minimum of the Hoover index is zero, the maximum is 100, and the unit is %. We can use the index to measure the relative difference between the territorial distribution of two quantitative characteristics. The index shows how many percentages of the quantity of one of the examined characteristics and socioeconomic phenomena must be regrouped among the territorial units for the territorial distribution to be the same as that of the other characteristic. In territorial research, the distribution of quantitative indicators with various socioeconomic content is most often compared with the territorial distribution of the population (Nemes Nagy 1998).

In the US, from 1917 to 1932, territorial differences were measured by the Hoover index, which then reached its peak of 17%. After that, we observe a continuous downward trajectory until 1977, when the convergence reached its peak, i.e., the lowest territorial difference (3.9%). Then, a continuous increase with minor fluctuations is observed. In 2018, we can see a territorial difference of 7.3%.

Figure 6

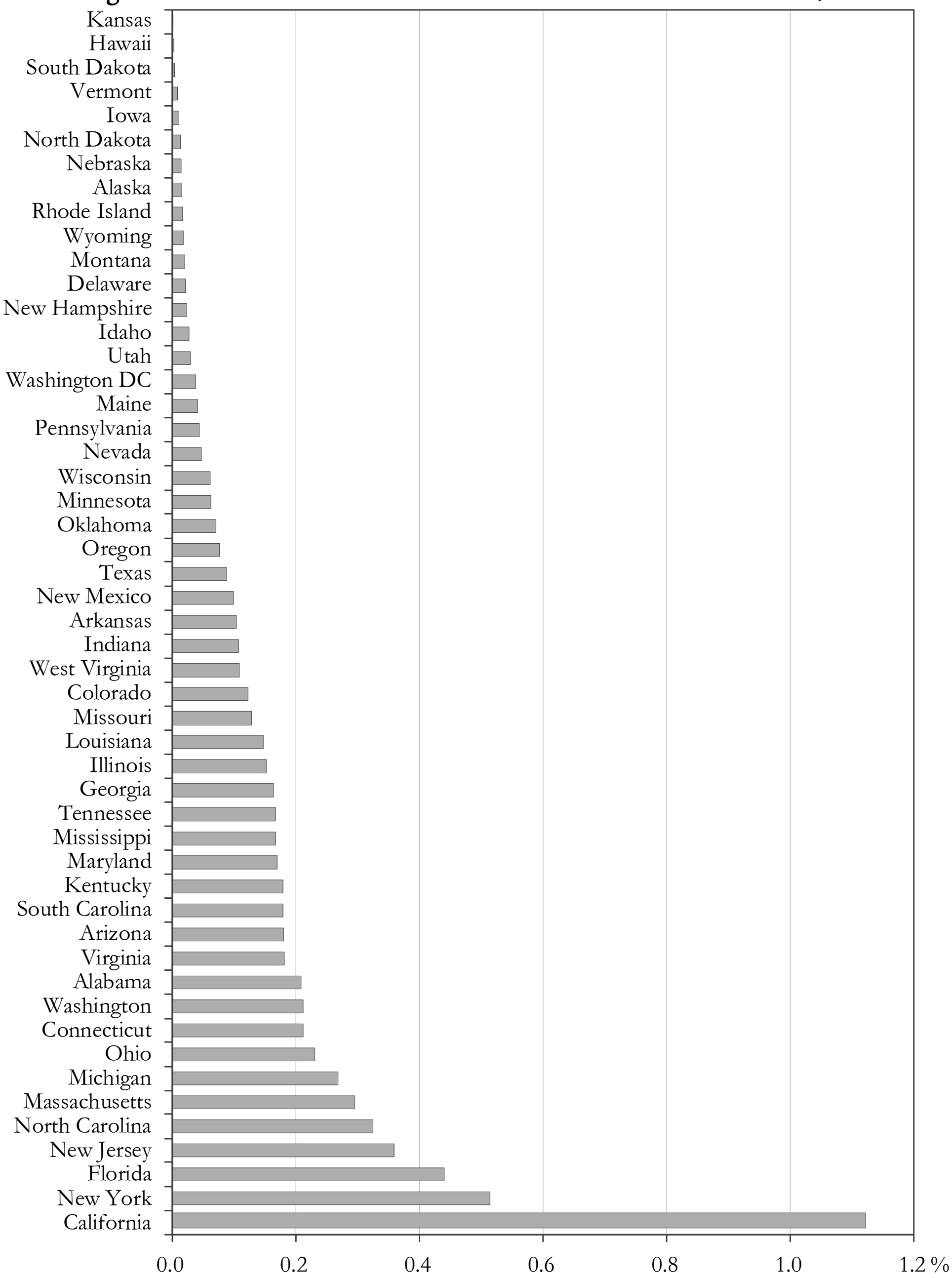
Evolution of the magnitude of territorial differences based on the Hoover index



Source: The authors, based on the [1].

Figure 7

Magnitude of territorial differences based on the Hoover index, 2018



Source: The authors, based on the [1].

Figure 6 shows which of the 10 states are most responsible for territorial differences. From 1917 to 1951, New York was of greatest importance in terms of territorial differences. It was then surpassed by California, which still holds this status today. However, these two states are comparable in that New York was responsible for a quarter of the territorial differences between 1917 and 1935. California has never achieved such an order of magnitude. Since 1952, California has accounted for approximately 7-15% of the national territorial disparity, and in 2018, it accounted for 15.4%.

Regarding the territorial differences in 2018, the differences between the 51 states stand out. The 40 states with the smallest territorial differences – based on the difference between the absolute share of population and fiscal income – are only responsible for 42% of the national territorial differences. California stands out by far among the states, with its share of regional disparities more than double that of New York in second place.

Heterogeneity vs. dependency

The general characteristics of territorial data are heterogeneity and dependence. In the following, we try to examine these two factors together. Our approach is similar in many respects to that of Sergio J Rey (2001), who performed similar calculations using both states and certain groupings of them. To examine c, we used the Theil T index (Brown 2004, Novotný 2007, Berisha–Meszaros 2018, Zagel–Breen 2019), whose formula is as follows (3):

$$T_T = \frac{1}{N}\sum_{i=1}^{N}\frac{x_i}{\mu} log\left(\frac{x_i}{\mu}\right) \quad (3)$$

where

$$\mu = \frac{1}{N}\sum_{i=1}^{N} x_i \quad (4)$$

Spatial heterogeneity refers to the instability and the lack of stationary characteristics of spatial phenomena. With Global Moran's I, we tried to quantify the degree of spatial dependence, that is, whether there is a function-like relationship between the values of the same variable measured in different places. In other words, we measured the closeness of the mutual spatial dependence of the data.

$$I = \frac{N}{\sum_{i=1}^{N}\sum_{j=1}^{N} Dij}\frac{\sum_{i=1}^{N}\sum_{j=1}^{N}(x_i-\bar{x})(x_j-\bar{x})D_{ij}}{\sum_{i=1}^{N}(x_i-\bar{x})^2} \quad (5)$$

where N is the number of territorial units, x_i and x_j are the values of the variable to be examined in each territorial unit, $\bar{x}$ is the arithmetic mean of the investigated indicator, and D_{ij} is the adjacency matrix. In the present case, the 4 nearest states were considered neighboring.

The indicator is interpreted according to the following ranges:
I > –1/N–1, positive spatial autocorrelation
I = –1/N–1, no spatial autocorrelation
I < –1/N–1, negative spatial autocorrelation.

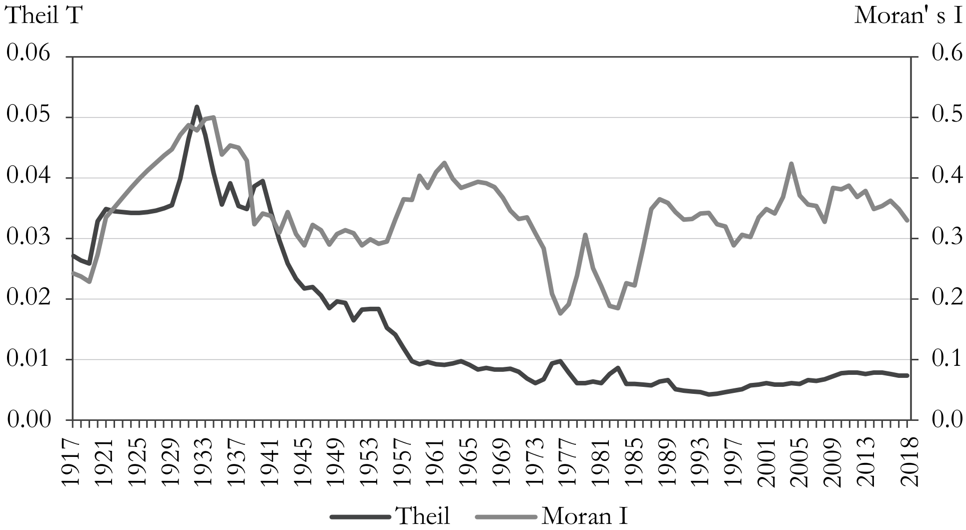
Moran's I can take a value between –1 and +1; the closer it is to –1, the stronger the negative autocorrelation is, and the closer it is to +1, the greater the positive autocorrelation is (0 shows the absence of autocorrelation) (Dusek 2004, Duran–Karahasan 2022, Thakur–Das 2022, Fitriani et al. 2022, Aritenang 2022, Riano et al. 2022). Determining the closeness of the autocorrelation is complicated by the fact that the minimum and maximum value of the indicator cannot be determined as clearly as for the correlation coefficient.

The reason for this fact is that the size of the indicator depends on the distribution of values, the number of territorial units and the territorial configuration recorded in the D_{ij} matrix. Moran's I has an expected value E[I] = –0.020. Comparing our results to this value, we obtain higher I values in the majority of the examined period, so a positive spatial autocorrelation is observed in terms of per capita income.

A weak positive relationship is observed between the two data series, r=0.42. Rey (2001) found a closer relationship, although he examined only 48 states. The maximum value of the territorial autocorrelation (I=0.5) was reached in 1935, which is believed to be the result of the effect of the New Deal, characterized by significant state interventions, which appeared spatially concentrated (Zarnowitz–Moore 1977).

Figure 8

Heterogeneity vs. dependence



Source: The authors, based on the [1].

The value reached its minimum (I=0.176 and 0.188) in 1976 and 1982, respectively. Here, we can observe that the favorable processes after the recession following the 1973 oil crisis were spatially balanced. The maximum value of the Theil T index, which measures territorial heterogeneity, can be seen in 1932 (up until the New Deal), and from then until 1994, there was a nearly continuous decrease. In 1994, the bond market crisis occurred, which was clearly interrupted by the reduction in spatial heterogeneity. Since then, we observe a small increase or stagnation (Figure 8).

The most important change in the spatial processes of the economy was brought about by the New Deal. Until then, spatial heterogeneity and dependence increased essentially simultaneously. In other words, the degree of spatial differences is still large and growing, but – primarily due to state intervention – the formation of specific spatial patterns is strengthening. The heterogeneity then gradually decreases and separates from the dependence. The degree of dependence – although it never reaches the New Deal period, fluctuates, reflecting the current economic processes.

Discussion

In our study, we used fiscal incomes, with the aim of using an indicator that would not primarily be used to analyze the performance of the economy or its spatial differences but rather the living conditions and standard of living. It follows that our investigation would yield different results over the same period if we were to use a different indicator, even GDP.

In examining the results of a recent global analysis (Kummu et al. 2018), the spatial picture and processes we present are less prominent. The indicated authors estimate GDP at a lower spatial level and do not address incomes. In addition, economic growth and the recession is reflected in the GDP differently than the prominent dates in the case of incomes. Therefore, the results of our analysis would have been slightly different if other indicators had been used. In subsequent research, we aim to investigate these differences.

Conclusion

In this research, we investigated the spatial processes of fiscal incomes between 1917 and 2018 in the US. We showed the change in the northeast–southwest direction, as a result of which the states of the Atlantic coast are increasingly relegated to the states on the west coast, especially to California. We pointed out that movement in the population center of gravity is completely trend-like, while a certain hecticness is visible in the case of income.

With regard to income and population, we also examined to what extent their magnitude can be explained by spatial location, which we modeled with coordinates.

We identified the dates, typically crises, with which the most important changes can be associated. Such dates in the case of income are 1921, 1938–1944, and 1954–1955, while in the case of specific income, they are 1972–1973. Importantly, certain other crisis periods, such as 1929, do not represent such a turning point in the spatial change in incomes, while its economic role is unquestionable.

We also examined the role of locality in shaping the size of per capita incomes. Contrary to Manduca (2019), we found that this role is more important than national change over time. With regard to territorial dependence and heterogeneity, we also found that the New Deal had the greatest impact on territorial processes in the US. Since then, no government intervention or market trend has affected spatial processes to such an extent.

Appendix

Table A1

Results of shift-share analysis, 2018

States[a)]	Total	Local ingredient	Tempo-rality	States	Total	Local ingredient	Tempo-rality
AK	100.0	71.9	28.1	MT	–100.0	–71.8	–28.2
AL	–100.0	–87.6	–12.4	NC	–100.0	–147.1	47.1
AR	–100.0	–81.0	–19.0	ND	–100.0	–32.7	–67.3
AZ	100.0	–302.8	402.8	NE	–100.0	–11.4	–88.6
CA	100.0	61.5	38.5	NH	100.0	81.7	18.3
CO	100.0	57.1	42.9	NJ	100.0	105.8	–5.8
CT	100.0	104.5	–4.5	NM	–100.0	–158.9	58.9
DC	100.0	157.9	–57.9	NV	100.0	11.1	88.9
DE	100.0	64.7	35.3	NY	100.0	216.1	–116.1
FL	100.0	–198.1	298.1	OH	–100.0	–50.8	–49.2
GA	–100.0	–181.8	81.8	OK	–100.0	–69.6	–30.4
HI	100.0	69.1	30.9	OR	–100.0	–169.5	69.5
IA	–100.0	–39.0	–61.0	PA	–100.0	–27.2	–72.8
ID	–100.0	–127.2	27.2	RI	–100.0	–26.7	–73.3
IL	100.0	328.6	–228.6	SC	–100.0	–113.6	13.6
IN	–100.0	–64.2	–35.8	SD	–100.0	–43.4	–56.6
KS	–100.0	–28.2	–71.8	TN	–100.0	–100.5	0.5
KY	–100.0	–80.8	–19.2	TX	100.0	–6.5	106.5
LA	–100.0	–91.3	–8.7	UT	100.0	–13.9	113.9
MA	100.0	158.4	–58.4	VA	100.0	76.3	23.7
MD	100.0	83.0	17.0	VT	–100.0	–73.0	–27.0
ME	–100.0	–73.5	–26.5	WA	100.0	64.1	35.9
MI	–100.0	–62.5	–37.5	WI	–100.0	–52.1	–47.9
MN	100.0	370.9	–270.9	WV	–100.0	–73.0	–27.0
MO	–100.0	–59.5	–40.5	WY	100.0	121.0	–21.0
MS	–100.0	–81.7	–18.3				

a) The full name of the states see in the Table 2.

Table A2

Results of shift-share analysis, 1917/2018

States	Total		Local ingredient		Temporality	
	+	–	+	–	+	–
Alaska (AK)	1.4	0.0	1.2	0.0	0.9	0.0
Alabama (AL)	0.0	6.6	0.0	6.9	0.0	1.7
Arkansas (AR)	0.0	5.2	0.0	5.0	0.0	2.1
Arizona (AZ)	0.9	0.0	0.0	3.1	7.3	0.0
California (CA)	33.9	0.0	24.6	0.0	27.7	0.0
Colorado (CO)	3.5	0.0	2.4	0.0	3.2	0.0
Connecticut (CT)	6.5	0.0	8.1	0.0	0.0	0.6
Washington DC (DC)	0.8	0.0	1.5	0.0	0.0	1.0
Delaware (DE)	0.5	0.0	0.4	0.0	0.4	0.0
Florida (FL)	3.5	0.0	0.0	8.2	22.1	0.0
Georgia (GA)	0.0	2.2	0.0	4.8	3.9	0.0
Hawaii (HI)	1.3	0.0	1.0	0.0	0.8	0.0
Iowa (IA)	0.0	3.8	0.0	1.7	0.0	4.9
Idaho (ID)	0.0	0.5	0.0	0.7	0.3	0.0
Illinois (IL)	1.9	0.0	7.4	0.0	0.0	9.3
Indiana (IN)	0.0	4.6	0.0	3.5	0.0	3.5
Kansas (KS)	0.0	1.9	0.0	0.6	0.0	3.0
Kentucky (KY)	0.0	6.6	0.0	6.3	0.0	2.7
Louisiana (LA)	0.0	4.5	0.0	4.8	0.0	0.8
Massachusetts (MA)	3.6	0.0	6.7	0.0	0.0	4.4
Maryland (MD)	6.7	0.0	6.6	0.0	2.4	0.0
Maine (ME)	0.0	1.5	0.0	1.3	0.0	0.9
Michigan (MI)	0.0	3.7	0.0	2.7	0.0	2.9
Minnesota (MN)	0.3	0.0	1.2	0.0	0.0	1.5
Missouri (MO)	0.0	6.0	0.0	4.2	0.0	5.1
Mississippi (MS)	0.0	6.2	0.0	6.0	0.0	2.4
Montana (MT)	0.0	1.1	0.0	0.9	0.0	0.6
North Carolina (NC)	0.0	3.4	0.0	6.0	3.4	0.0
North Dakota (ND)	0.0	0.7	0.0	0.3	0.0	1.0
Nebraska (NE)	0.0	1.2	0.0	0.2	0.0	2.2
New Hampshire (NH)	0.6	0.0	0.6	0.0	0.2	0.0
New Jersey (NJ)	10.0	0.0	12.5	0.0	0.0	1.2
New Mexico (NM)	0.0	1.0	0.0	1.9	1.3	0.0
Nevada (NV)	1.8	0.0	0.2	0.0	3.4	0.0
New York (NY)	6.7	0.0	17.2	0.0	0.0	16.6
Ohio (OH)	0.0	7.7	0.0	4.6	0.0	8.0
Oklahoma (OK)	0.0	4.0	0.0	3.3	0.0	2.6
Oregon (OR)	0.0	1.0	0.0	1.9	1.4	0.0
Pennsylvania (PA)	0.0	8.9	0.0	2.8	0.0	13.7
Rhode Island (RI)	0.0	0.5	0.0	0.2	0.0	0.8
South Caroline (SC)	0.0	3.7	0.0	4.9	1.1	0.0
South Dakota (SD)	0.0	0.9	0.0	0.5	0.0	1.1
Tennessee (TN)	0.0	5.3	0.0	6.3	0.1	0.0
Texas (TX)	5.7	0.0	0.0	0.4	13.0	0.0
Utah (UT)	0.6	0.0	0.0	0.1	1.5	0.0
Virginia (VA)	5.7	0.0	5.2	0.0	2.9	0.0
Vermont (VT)	0.0	0.5	0.0	0.4	0.0	0.3
Washington (WA)	3.7	0.0	2.8	0.0	2.8	0.0
Wisconsin (WI)	0.0	2.2	0.0	1.3	0.0	2.2
West Virginia (WV)	0.0	4.8	0.0	4.1	0.0	2.7
Wyoming (WY)	0.2	0.0	0.3	0.0	0.0	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table A3

8 theoretical groups created by shift-share analysis

Types according to state characteristics	S_i	S_r	S_a	The ratio of the magnitude of the factors	No.
	Sign				
Positive territorial and positive structural factor, **higher** than average per capita income	+	+	+	$S_r > S_a$	1.
				$S_r < S_a$	2.
Positive structural and negative territorial factor, **higher** than average per capita income	+	–	+	$\|S_r\| < \|S_a\|$	3.
Negative structural and positive territorial factor, **higher** than average per capita income	+	+	–	$\|S_r\| > \|S_a\|$	4.
Positive structural and negative territorial factor, **lower** than average per capita income	–	–	+	$\|S_r\| > \|S_a\|$	5.
Negative structural and positive territorial factor, **lower** than average per capita income	–	+	–	$\|S_r\| < \|S_a\|$	6.
Negative territorial and negative structural factor, **lower** than average per capita income	–	–	–	$S_r > S_a$	7.
				$S_r < S_a$	8.

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