Spatial differentiation of seasonal unemployment in the USA

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Abstract: The paper presents an analysis of spatial differentiation of seasonal unemployment in the USA. Harmonic analysis was used in the research. An attempt was made to present regional differences in the seasonality of unemployment as an effect of different amplitude and frequency. In this study, seasonality analysis was carried out on the example of the United States, one country, but with a varied climate structure. Limiting research to one economy allows a better understanding of the importance of non-economic factors. And as it turns out, these are crucial in the scale and distribution of seasonal fluctuations. Differences among states arise from a different share of waves of an annual and semiannual frequency, and from a date of maximal unemployment in a wave of an annual frequency. Northern states are characterised by the prevalence of a wave, of annual frequency, with its maximum in the winter period. In the southern states, the unemployment maximum is a wave of annual frequency occurring in the summer period, in which the further south, the bigger the share of this wave in total seasonal variability. In the majority of states between the northern and southern ones, seasonality of unemployment has the character of a cycle of semiannual frequency with seasonal maximum in both winter and summer periods. The value of seasonal fluctuations is clearly related to the distribution of seasonal fluctuations. Smaller seasonal fluctuations characterise those states where the maximum for the annual harmonic occurs in the summer period. The superposition of waves of different frequency results in specific seasonal fluctuations in unemployment in particular states.

Keywords: unemployment, seasonality, spatial differentiation

JEL: J64

Introduction

Seasonality is a phenomenon describing the functioning of entire economies and the majority of particular markets. In most countries, labour markets are subject to seasonal fluctuations. This is indicated by the number of people who are in work or are unemployed, and the number of vacancies – a number that changes over the year. Seasonality also concerns changes in markets with regard to time, but can describe market differences in space as well. Due to diverse climatic, economic and institutional conditions, particular domestic and regional labour markets may differ by a value of seasonal fluctuations [Krane, Wascher, 1999, 523-553; Rembeza, Przekota, 2014, 391-399]. The distribution of fluctuations within a year can be unequal. Seasonality is defined as a fairly regular change in a given value which is ongoing within a year. This definition does not state that seasonal fluctuations are described by one cycle in a year, or more. Therefore, such situations where some labour markets are characterised by one seasonal cycle, instead of two, are possible. Particular markets may differ also in terms of seasonal maxima and minima of particular values, e.g. number of people unemployed. Seasonal fluctuations may also show medium- and long-term changes over time, so seasonality may constitute a non-stationary variable [Canova, Hansen, 1995, 237-252]. Therefore, seasonality analysis cannot be brought to a simple determination of a value of seasonal fluctuations, while the specificity of the functioning of labour markets in a short period should consider various aspects of seasonality.

The literature on macroeconomics mainly concerns a discussion on the significance of seasonal fluctuations for the efficiency of an economy. This discussion is multithreaded, concerns interpretations and determinants of seasonal fluctuations. Similarities and differences between the causative factors of seasonal and cyclical fluctuations are discussed. There are two approaches to this problem. The first approach treats seasonal fluctuations as the "pollution" of economic time series [Sims, 1974]. They are caused by different factors affecting cyclical fluctuations and economic growth. The conclusion is that the analysis of seasonal changes adds nothing to understanding the changes in the economy that go beyond the annual horizon. Therefore, the right procedure is to remove seasonal ingredients from the time series. Such an approach may be justified when an assessment of changes in the economic situation is carried out, e.g. comparing one quarter to the previous quarter. In this case, seasonal fluctuations may interfere with the assessment of the dynamics. The second approach to the problem of seasonal fluctuations indicates the occurrence of similarities between seasonal and cyclical fluctuations. It is justified that the mechanisms shaping both types of fluctuations are partly shared, so the model describing economic fluctuations should take into account both cyclical and seasonal fluctuations [Beaulieu, 1992]. According to this position, the removal of seasonal fluctuations from economic time series is not necessary, and their analysis allows a better understanding of the shaping of changes in the economy which are also of a cyclical nature.

An important problem of seasonal fluctuations is their impact on the economic optimum and the economic policy of a state. In this context, it should be noted that if seasonal fluctuations associated with short-term fluctuations in demand and supply are treated as a manifestation of striving for the optimum, then economic policy should not be aimed at levelling out seasonal fluctuations. Some economists recognise that every kind of cyclical and seasonal fluctuation negatively affects the level of social well-being. They postulate such a setting of the economic policy of a state whose aim is to eliminate all kinds of fluctuations. This position was initiated by Kuznets' research.

An important part of research into the significance of seasonal fluctuations in the economy is their relationship with the labour market [Olivei, Tenreyro, 2007; Popp, 2011]. Olivei and Tenreyro stated that seasonal fluctuations in the labour market are a source of seasonal fluctuations in product, which largely depends on monetary policy [Olivei, Tenreyro 2007]. According to the conducted research, entrepreneurs react differently to monetary shocks at the end of the year and at the beginning of the year. A monetary shock at the end of the year is the cause of wage changes, while a monetary shock at the beginning of the year becomes a reason for changes in production. In this model, it is noted that wage rigidity depends on the period during the calendar year. At the end of the year, wages are more flexible and stiffen after the beginning of the year. In turn, the model proposed by Poppa leads to the conclusion that relatively small fluctuations in the stiffening of the economy in real expression may not only generate significant seasonal cycles, but also have an impact on cyclical fluctuations [Popp 2011].

Seasonality in the labour market has been the subject of numerous empirical studies. Their results show significant differences between individual national labour markets in the size and distribution of seasonal fluctuations [Engle, Hylleberg 1996]. Seasonality in the labour market changes, even over a single decade the volume of seasonal fluctuations may change. The impact on seasonal fluctuations is mainly caused by changes of a structural nature, and in this context one can speak about the significance of the economic policy of the state for seasonal fluctuations [Krane, Wascher 1999].

This paper presents an analysis of seasonal fluctuations of the number of people unemployed in particular states in the USA. The subject of interest was not only the size of the fluctuations, but also the number of seasonal cycles and their distribution within a year. We attempted to determine whether potential differences among states are subject to spatial regularity and whether there is any noticeable relation between the distribution of the fluctuations and their value. The analyses presented in the paper use the method of harmonic analysis. Thus, while referring to the assumptions of this method, seasonal fluctuations were treated as an effect of the superposition of waves of various frequency and amplitude. The paper uses the 1976-2014 data for the monthly number of people unemployed in particular states, published by the U.S. Bureau of Labor Statistics.

Method of analysis

Modelling of natural phenomena consists in the identification of components of the observed time series, i.e. a systematic component (trend), periodical component (long-term – cyclical development or short-term – seasonality), and a random component (noise). As observation of the unemployment-related data shows, it is possible to identify all these components, and in the case of the periodical component – both cyclical and seasonal changes. Harmonic analysis is a tool that enables us to describe such a time series in a clear way [Kammler, 2000]. A basic advantage of this tool is the detection of cyclical and seasonal changes, as well as the lack of special assumptions concerning its applicability. Its disadvantage is constituted by the fact that in a theoretical model a regular periodicity is assumed, which is often disturbed in natural phenomena.

The harmonic analysis is applied to study the phenomenon of periodicity in a time series [Box, Jenkins, Reinsel, 1994]. A time series is distributed into a sum of harmonics, i.e. the sinusoidal and cosinusoidal functions of a given period [Wei, 2005; Thornley, France, 2007]:

$$(1) \quad y_t = \alpha_0 + \sum_{i=1}^{n/2} [\alpha_i sin(\omega i t) + \beta_i cos(\omega i t)]$$

where:

i – number of the harmonic,

$\omega = \frac{2\pi}{n}$ – frequency related to the period n,

α_0, α_i, β_i – parameters.

The first harmonic (i=1) has a period equal to the length of an entire series, so with its help the cyclicity (periodicity) of length n can be tested; the second harmonic (i=2) has a period equal to a half of this series, so it enables us to test the cyclicity (periodicity) of length n/2; the third harmonic (i=3) – one third of the series length, enables us to test the cyclicity (periodicity) of length n/3; etc. The last harmonic of a number i=n/2 has a period equal to 2/n and enables us to test the cyclicity (periodicity) of length equal to 2. In general, it is about mapping n values of a time series per values of sinusoidal functions onto the section [0; 2π].

Assessments of the parameters of the above model are determined using the least squares method. They may be established from the following formulas:

$$(2) \quad a_0 = \frac{1}{n} \sum_{t=1}^{n} y_t \, ;$$

(3) $$a_i = \frac{2}{n}\sum_{t=1}^{n} y_t sin(\omega i t)\,, fori = 1, \dots, \frac{n}{2} - 1;$$

(4) $$b_i = \frac{2}{n}\sum_{t=1}^{n} y_t cos(\omega i t), fori = 1, \dots, \frac{n}{2} - 1.$$

Harmonic analysis concerns the study of a phenomenon formed around an average level represented by the parameter a_0. In the event of a trend's occurrence, it should be previously blocked, so the following model should be applied:

(5) $$y_t = f(t) + \sum_{i=1}^{n/2} [\alpha_i sin(\omega i t) + \beta_i cos(\omega i t)]$$

where: $f(t)$ – trend function.

In the paper the trend was eliminated with use of the Hodrick-Prescott filter [Hodrick, Prescott, Postwar, 1997, 1-16].

An individual cyclical component may be presented with the use of the following formula [Fichtenholz, 1969]:

(6) $$a_i sin(\omega i t) + b_i cos(\omega i t) = A_i sin(\omega i t + \varphi_i)$$

which enables us to define the amplitude A_i and the phase shift φ_i for every harmonic component:

(7) $$A_i = \sqrt{a_i^2 + b_i^2},$$

and their phase shift:

(8) $$t_i = \frac{arctg\left(\frac{a_i}{b_i}\right)}{\frac{2\pi}{n} i}.$$

The phase shift enables us to locate on the timeline the points in which the phenomenon has extreme values, while the amplitude value allows for the definition of values of this extremum.

The harmonics are not correlated with each other, so each of them explains a different part of variance of the variable Y. The share of particular harmonics in the explanation of variance of the variable Y of a tested variable is determined from the following formula:

(9) $$\frac{a_i^2 + b_i^2}{2s^2}, fori = 1, \dots, \frac{n}{2} - 1;$$

where: s^2 – assessment of variance of the tested variable Y.

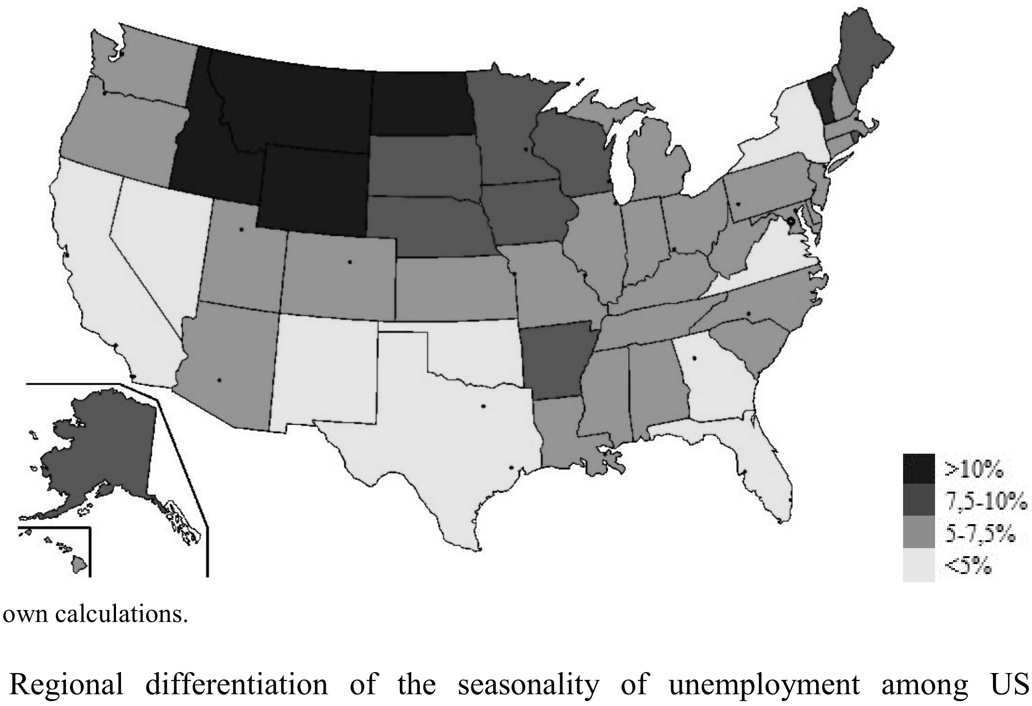
Subsequent stages of data analysis included:

1. Distinguishing the seasonal component from the data concerning the number of people unemployed. This made using the TRAMO/SEATS procedure.
2. For the seasonal component, two harmonics were distinguished: annual and semiannual. The length of the tested time series comes to 468, i.e. 39 years (1976-2014), 12 months each. Therefore, the annual harmonic has number 39 and semiannual – 78.
3. For the distinguished harmonics amplitudes, phase shifts and share of each harmonic in variance of the seasonal component were defined.

Spatial differentiation of the seasonality of unemployment

The first part of the paper describes the differences among states in the seasonality of unemployment illustrated with selected examples. Figure 1 presents the division of states by a year average value of seasonal fluctuations. The presented data show significant regional differentiation of the seasonality of unemployment in the United States.

Fig. 1. Average value of seasonal fluctuations

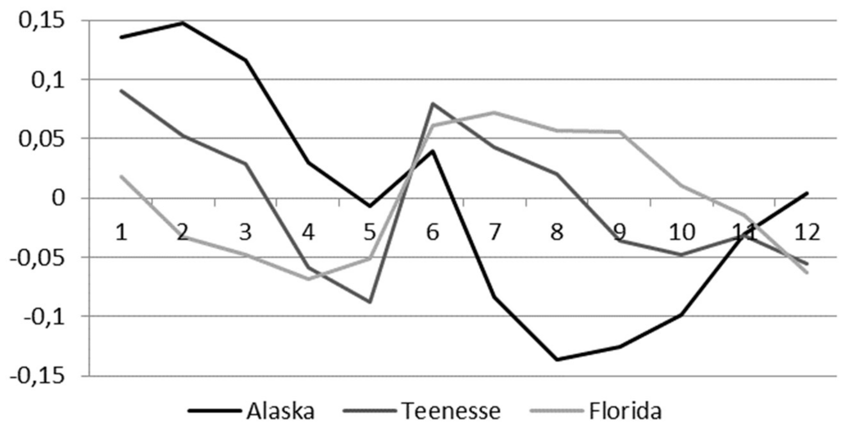


Source: own calculations.

Regional differentiation of the seasonality of unemployment among US states is similarly high among particular states of the European Union. In extreme cases, differences among states were more than three times. In general, it may be said that the seasonality of unemployment decreases together with movement towards the southern states. This suggests an explicit relation between climatic conditions and the value of seasonal fluctuations. The northwestern states show the largest fluctuations, especially North Dakota (13.5%) and Idaho (11.9%). The states with the lowest seasonality have smaller spatial concentration. This mainly concerns the southern states, including California (4.0%), Nevada (4.5%) and Texas (4.6%). However, neighbouring states with very different seasonality can also be indicated, e.g. Vermont (10.4%) and New York (4.4%).

The second indication of the differentiation of the seasonality of unemployment is its various distribution within a year. This phenomenon is also explained by the regional differentiation of climatic and economic factors [Guillemette, L'Italien, Grey, 2000]. Figure 2 presents average deviations of the number of people unemployed in particular months based on the example of three states.

Fig. 2. Seasonal fluctuations in the number of people unemployed



Source: own calculations.

The presented data indicate two aspects of regional differences that may be subject to more detailed analysis. Firstly, the dates of seasonal maxima and minima of unemployment can fall in different months. Alaska and Florida, in the presented example, are extreme oppositions. In the first state, the unemployment maximum is in February, while its minimum is August. In the second state, the maximum occurs in July and minimum in December. Therefore, we observe here an inversion of the course of seasonal fluctuations in unemployment in Florida against Alaska. In both states, one annual cycle of seasonal fluctuations can be observed. However, in Tennessee the situation is different, as two dates of seasonal increases and decreases in unemployment occur. Increases occurred in winter and summer months, while decreases in spring and fall months. Thus, a question may be asked whether the change in the distribution of seasonal fluctuations demonstrates spatial regularity, and how the inversion of a cycle of seasonal fluctuations as illustrated by Alaska and Florida can be described. As these states are located at opposite extremes, it may be assumed that between them are states with an intermediate distribution of seasonal fluctuations. The data presented in Fig. 1 indicate, though, that this transformation in the distribution of seasonal fluctuations does not consist in a simple suppression of an annual wave with a winter peak and its inversion into a wave with a summer peak. Then, the smallest seasonal fluctuations should characterise states located between those positioned in the extreme north and south of the country. Whereas in fact, the smallest seasonal fluctuations in unemployment concern the southern states.

Seasonality of unemployment – results of the harmonic analysis

The data presented in the previous section indicate the large regional differentiation of seasonal fluctuations in the USA. This section presents the results of the harmonic analysis of changes in unemployment in particular states. Harmonic analysis can be used to study the phenomenon of cyclicity in time series. It consists in the treatment of a time series as a sum of harmonics constituting the sinusoidal and cosinusoidal functions of a given period. A basic advantage of this tool is the detection of cyclical and seasonal changes, as well as the lack of special assumptions concerning the capacity of its application. A disadvantage of it is constituted by the fact that in a theoretical model a regular periodicity is assumed, which is often disturbed in practice.

The analysis presented in this section applied a model in which data on the number of people unemployed were cleaned of a trend. Data for 39 years were used, which means 234 harmonics in total. The subject of interest constituted two harmonics related to seasonal fluctuations: the harmonic of an annual period and harmonic of a semiannual period.

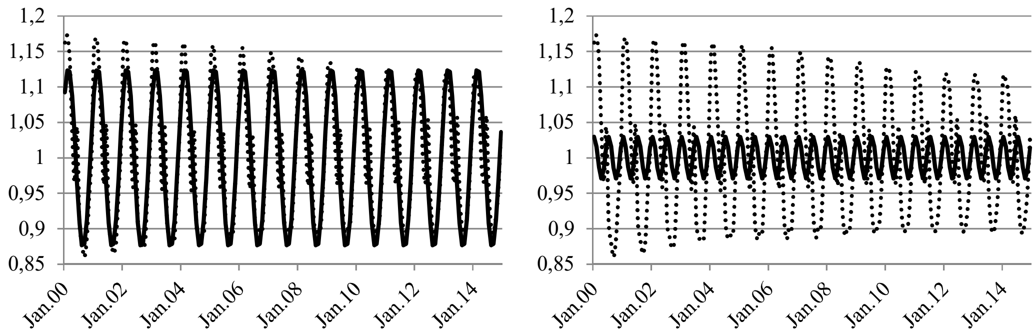
Figure 3 presents the way these harmonics are formed against total seasonal fluctuations illustrated with the example of two states: Alaska and Tennessee. The presented results show that seasonal fluctuations in Alaska are better described by the harmonic with an annual period, while in Tennessee – the harmonic with a semiannual period. This means that seasonal fluctuations in Alaska are dominated by one annual cycle, and in Tennessee – by two semiannual cycles.

Fig. 3. Seasonal fluctuations in the number of people unemployed (dotted line) and particular harmonics (unbroken line) for Alaska and Tennessee (example of behaviour)

Alaska

annual harmonic

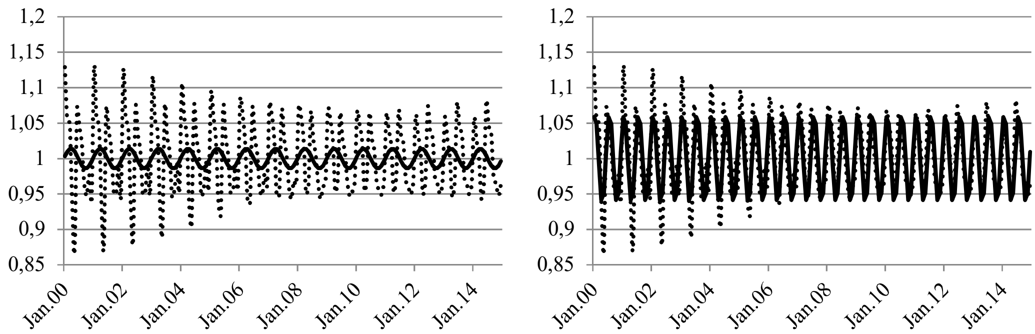
semiannual harmonic



Tennessee

annual harmonic

semiannual harmonic



Source: own calculations.

Table 1 presents detailed characteristics of the analysed harmonics in particular states. The summarised data concern the following values:

- amplitude describing values of extremes on a percentage basis (A);
- phase shift that enables to locate on a timeline the points (months) in which the number of people unemployed has maximal values (t_{max}). In the table 1 means January and 12 – December;
- share of harmonic in total variability of a seasonal component of the number of people unemployed (w).

While interpreting the results, attention should be paid to the fact that harmonics are not correlated with each other, so each of them explains a different part of variability of seasonal unemployment.

Tab. 1. Selected characteristics of the annual and semiannual harmonics in particular states

State	Average deviation	Annual harmonic			Semiannual harmonic			
		A	t_{max}	w	A	$t_{max\ (I)}$	$t_{max\ (II)}$	w
USA	0,0484	0,0296	3,3	15,6%	0,0564	1,4	7,4	56,9%
Alabama	0,0620	0,0298	7,8	8,4%	0,0774	1,4	7,4	56,6%
Alaska	0,0839	0,1269	2,4	83,3%	0,0296	1,0	7,0	4,5%
Arizona	0,0546	0,0531	7,9	37,0%	0,0524	1,6	7,6	35,9%
Arkansas	0,0765	0,0715	3,5	32,6%	0,0930	1,2	7,2	55,4%
California	0,0399	0,0215	2,8	11,0%	0,0495	1,5	7,5	58,3%
Colorado	0,0590	0,0524	2,7	29,9%	0,0539	1,4	7,4	31,6%
Connecticut	0,0626	0,0507	4,4	24,0%	0,0719	1,3	7,3	48,2%
Delaware	0,0718	0,0410	4,0	12,6%	0,0899	1,7	7,7	60,6%
District Columbia	0,0441	0,0278	7,0	12,0%	0,0546	1,1	7,1	46,3%
Florida	0,0465	0,0547	8,1	53,4%	0,0344	1,4	7,4	21,1%
Georgia	0,0449	0,0328	6,9	17,6%	0,0526	1,3	7,3	45,2%
Hawaii	0,0573	0,0745	7,1	48,9%	0,0228	0,8	6,8	4,6%
Idaho	0,1185	0,1697	2,1	72,6%	0,0846	1,8	7,8	18,0%
Illinois	0,0509	0,0406	3,4	25,2%	0,0579	1,3	7,3	51,1%
Indiana	0,0522	0,0635	2,7	48,3%	0,0521	1,5	7,5	32,5%
Iowa	0,0966	0,1345	2,0	66,1%	0,0742	1,6	7,6	20,1%
Kansas	0,0574	0,0229	4,9	5,7%	0,0643	1,4	7,4	45,1%
Kentucky	0,0625	0,0655	3,0	40,5%	0,0636	1,3	7,3	38,2%
Luisiana	0,0744	0,0596	7,4	22,5%	0,0810	0,9	6,9	41,6%
Maine	0,0909	0,1417	2,3	81,9%	0,0377	1,6	7,6	5,8%
Maryland	0,0462	0,0176	3,1	5,4%	0,0517	1,3	7,3	46,6%
Massachusetts	0,0627	0,0444	3,3	18,8%	0,0766	1,6	7,6	55,8%
Michigan	0,0682	0,0521	3,7	23,3%	0,0746	1,3	7,3	47,8%
Minnesota	0,0944	0,1103	2,6	50,1%	0,0819	1,6	7,6	27,6%
Missisipi	0,0594	0,0502	6,1	20,2%	0,0682	0,9	6,9	37,4%
Missouri	0,0652	0,0508	3,6	23,0%	0,0789	1,4	7,4	55,6%
Monatana	0,1001	0,1508	2,1	75,1%	0,0566	1,4	7,4	10,6%
Nebraska	0,0870	0,0739	3,2	28,5%	0,0913	1,2	7,2	43,4%
Nevada	0,0449	0,0247	2,2	9,0%	0,0581	1,3	7,3	50,0%
New Hampshire	0,0651	0,0760	2,7	43,8%	0,0690	1,7	7,7	36,1%
New Jersey	0,0549	0,0398	3,8	21,3%	0,0620	1,4	7,4	51,6%
New Mexico	0,0492	0,0470	6,0	26,5%	0,0529	1,0	7,0	33,7%
New York	0,0439	0,0372	2,2	26,0%	0,0524	1,6	7,6	51,5%
North Carolina	0,0526	0,0329	3,4	13,5%	0,0618	1,1	7,1	47,7%

State	Average deviation	Annual harmonic			Semiannual harmonic			
		A	t_{max}	w	A	$t_{max (I)}$	$t_{max (II)}$	w
North Dakota	0,1351	0,1745	3,0	61,0%	0,1086	1,3	7,3	23,6%
Ohio	0,0561	0,0506	2,5	29,7%	0,0615	1,5	7,5	43,9%
Oklahoma	0,0494	0,0325	2,2	14,1%	0,0496	1,1	7,1	32,9%
Oregon	0,0675	0,0894	2,6	58,9%	0,0588	1,7	7,7	25,4%
Pennsylvania	0,0602	0,0479	3,2	25,3%	0,0611	1,5	7,5	41,2%
Puerto Rico	0,0284	0,0252	6,9	26,5%	0,0236	1,8	7,8	23,2%
Rhode Island	0,0801	0,0789	2,1	31,2%	0,0878	1,7	7,7	38,6%
South Carolina	0,0509	0,0145	8,0	3,0%	0,0612	1,3	7,3	53,5%
South Dakota	0,0870	0,1236	2,5	64,1%	0,0700	1,5	7,5	20,6%
Tennesee	0,0526	0,0139	3,6	2,7%	0,0629	1,4	7,4	56,4%
Texas	0,0461	0,0296	6,3	14,1%	0,0547	1,2	7,2	47,9%
Utah	0,0651	0,0385	4,1	14,1%	0,0696	1,6	7,6	46,1%
Vermont	0,1037	0,1456	2,5	71,3%	0,0476	1,8	7,8	7,6%
Virginia	0,0474	0,0221	4,0	8,0%	0,0599	1,4	7,4	58,4%
Washington	0,0646	0,0932	2,1	63,8%	0,0559	1,4	7,4	22,9%
West Virginia	0,0675	0,0867	2,9	54,1%	0,0554	1,5	7,5	22,1%
Wisconsin	0,0953	0,1242	3,2	62,1%	0,0735	1,7	7,7	21,8%
Wyoming	0,1054	0,1643	2,1	81,5%	0,0479	1,3	7,3	6,9%

Source: own calculations.

The results obtained indicate large differences among particular states in reference to all analysed values, including the share of particular harmonics in the seasonal variability of the number of people unemployed and months when a given harmonic has maximal values. In some states an annual harmonic prevails in the seasonal variability, while in the other states – a semiannual one. The first group mainly includes the more northerly (e.g. Alaska, Idaho, Iowa, Montana) and southerly states (e.g. Florida, Hawaii). It means that in these states there is a clear single cycle of seasonal fluctuations in unemployment. The second group includes the states decidedly dominated by a semiannual harmonic. They mainly include the central states of the USA (Alabama, Arkansas, California, Missouri, Nevada, South Carolina, and Tennessee). In this group, two semiannual cycles are clearly visible. However, in a great number of states both annual and semiannual harmonics had a significant share in the formation of seasonal variability. In the case of these states, seasonal changes in unemployment are, thus, the superposition of two waves and have a less regular course, depending, say, on the prevalence of the annual or semiannual harmonic.

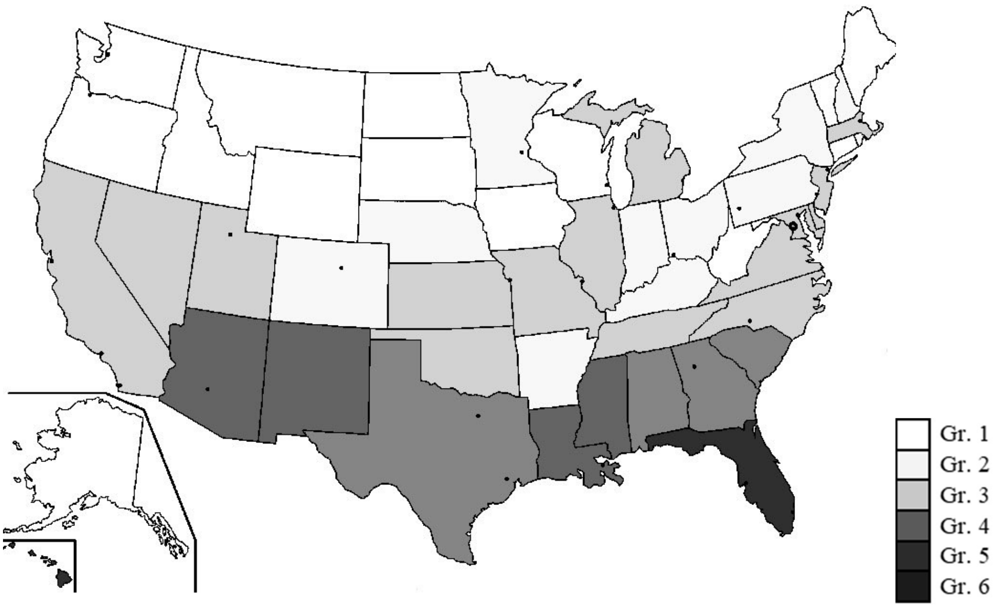
The second characteristic of the harmonic analysis was constituted by the phase shift, determining the months when a given harmonic had its maximal values. The results obtained indicate that in the event of a semiannual harmonic the differences among states were insignificant. It peaked in January and July. An annual harmonic created large differences among the states concerned. In some states, mainly the northern ones, the maximum occurred in the winter months (usually February or March), whereas in the southern ones, the maxima occurred in summer months (usually July).

To sum up, it may be said that particular states differ with regard to two criteria: the share of particular harmonics in the seasonal variability of the number of people unemployed, and the month when the number of people unemployed attains its maximum in the annual harmonic. Taking into account those two criteria, the following division of states into six groups was proposed:

- group 1: peak of unemployment of the annual harmonic in the winter-spring period (XII-V), the annual harmonic prevails (share of the annual harmonic at least twice the size of the semiannual one);
- group 2: peak of unemployment of the annual harmonic in the winter-spring period (XII-V), share of the annual harmonic does not differ significantly from the share of the semiannual harmonic (share of the annual one not larger than twice the size, and not smaller than half of the share of the semiannual one);
- group 3: peak of unemployment of the annual harmonic in the winter-spring period (XII-V), the semiannual harmonic prevails (share of the semiannual one at least twice the size of the annual one);
- group 4: peak of unemployment of the annual harmonic in the summer-fall period (VI-XI), the semiannual harmonic prevails (share of the semiannual one at least twice the size of the annual one);
- group 5: peak of unemployment of the annual harmonic in the summer-fall period (VI-XI), share of the annual harmonic does not differ significantly from the share of the semiannual harmonic (share of the annual one not larger than twice the size, and not smaller than half of the share of the semiannual one);
- group 6: peak of unemployment of the annual harmonic in the summer-fall period (VI-XI), the annual harmonic prevails (share of the annual one at least twice the size of the semiannual one).

Figure 4 presents the results of the division of states into particular groups. Their parallel arrangement is clearly noticeable. The northern states belong mostly to group 1, so they are characterised by the prevalence of the annual harmonic, attaining a maximum in the winter months. A common feature of the southern states is the maximum of the annual harmonic in the summer months. Among them, Florida and Hawaii are described by the prevalence of an annual harmonic just like the northern states. States between these regions are characterised by the more complicated course of seasonal fluctuations. Some states are dominated by a semiannual harmonic, with two peaks of unemployment within a year (group 3), in some the seasonal fluctuations in unemployment are described by the superposition of annual and semiannual harmonics.

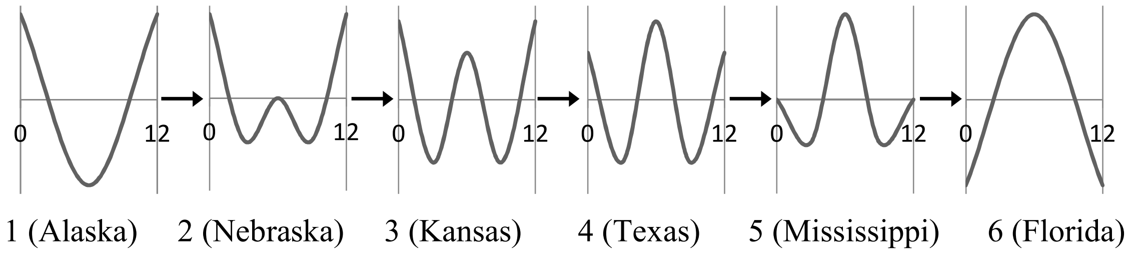
Fig. 4. Division of states with regard to the character of seasonal fluctuations



Source: own calculations.

Referring to the harmonic analysis results, the inversion of seasonal fluctuations in unemployment observed among the extreme northern (e.g. Alaska, Idaho, Wyoming) and southern states (Florida, Hawaii) may be described as an effect of the inversion of the annual harmonic, and the change in the share of annual and semiannual harmonics in the variability of seasonal unemployment. Figure 5 presents the model transformation from one extreme distribution to the other one. To put it simply, it was assumed that an amplitude of fluctuations with the annual harmonic of a winter and summer peak was the same. In fact these amplitudes can be different. When going from north to south, in the beginning the share of the annual harmonic with a winter maximum decreases and the share of the semiannual harmonic increases (2 and 3). Another stage of transformation is constituted by the dwindling of the annual harmonic for the benefit of the semiannual one (4). The next stage is a decreased share of the semiannual harmonic and an increased share of the annual harmonic with maximum in a summer period (5 and 6). The presented model of transformation from one wave to another may explain why the seasonal fluctuations in regions located between the two extremes are not the smallest.

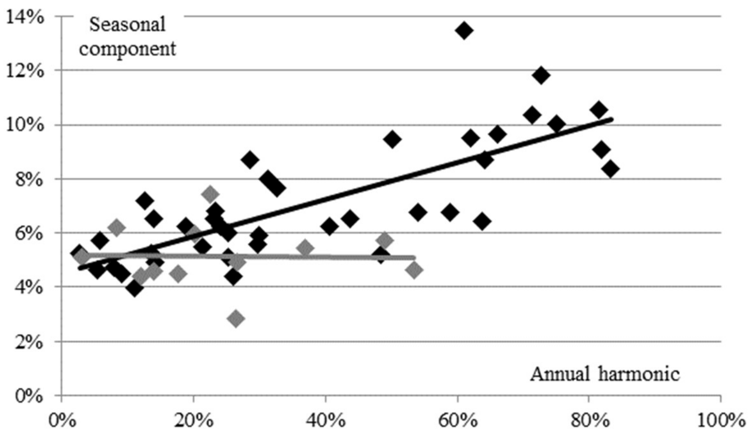
Fig. 5. Model of shift from an annual unemployment cycle with winter maximum to an annual cycle with summer maximum (in brackets, states with a set of seasonality features similar to the model)



Source: own calculations.

According to the statistical data, the largest seasonal fluctuations in unemployment concern the northern states, while the smallest ones – the southern. The harmonic analysis indicates significant differences among these states. This suggests a relation between the features of the characteristics obtained in the harmonic analysis and the value of the seasonal fluctuations in unemployment.

Fig. 6. Seasonal fluctuations in unemployment and share of annual harmonic in seasonal variability (black points – harmonic with winter maximum, grey points – harmonic with summer maximum)



Source: own calculations.

Figure 6 presents the dependence between the size of these fluctuations in particular states and the annual harmonic share in total seasonal variability, dividing states into two groups according to the date of unemployment maximum in the annual harmonic (maximum in winter or summer period). The data indicate that seasonality of unemployment in states where the annual harmonic peaks in the summer period are low, regardless of the harmonic's share in seasonal variability. In states where the annual harmonic attains a maximum in winter, the seasonal variability of unemployment increases with the increasing share of this harmonic in total seasonal variability.

Conclusions

This paper presents regional differences in the seasonality of unemployment as an effect of superposition of differing amplitude and frequency. Superposition of waves of a different frequency results in specific seasonal fluctuations in unemployment in particular states. Differences among states arise from the different share of waves of annual and semiannual frequency, and from the date of maximal unemployment in a wave of an annual frequency. Northern states are characterised by the prevalence of a wave of annual frequency with a maximum in winter. In southern states, the unemployment maximum in a wave with annual frequency occurs in the summer period, while the further south, the bigger the share of this wave in total seasonal variability. In the majority of states between the northern and southern ones, seasonality of unemployment has the character of a cycle of semiannual frequency with a seasonal maximum in the winter and summer periods.

The value of seasonal fluctuations is clearly related to the distribution of seasonal fluctuations. Smaller seasonal fluctuations are demonstrated by states where the maximum for the annual harmonic occurs in summer. In the case of the states where the maximum of the annual harmonic occurs in winter, the seasonal fluctuations in unemployment are the smaller, the smaller the share of this harmonic in total seasonal variability, and the larger the share of semiannual harmonic is.

This paper presents seasonal fluctuations in unemployment, limiting the presentation of results to two harmonics. In most states, they explained the vast majority of seasonal variability. In some states a significant part of the seasonal variability was not explained by those harmonics, though. It may be caused by the less regular course of seasonal fluctuations and/or changes in the seasonal distribution of seasonal fluctuations that might have had a character of a long-term trend or fluctuations in the area of cyclical development. Those aspects of changes in the seasonality of unemployment were not analysed in this paper.

Seasonality in the labour market is to a large extent a phenomenon specific to a given country. On the example of the United States, one can notice how climate conditions mean that the size and distribution of seasonal fluctuations over time may be spatially different. It is difficult to assume in advance that only seasonality is determined by non-economic factors, such as climatic conditions. Different economies may react differently to such, often similar climate conditions. Assuming that sensitivity to short-term disturbances indicates the lower efficiency of the economy, it can be hypothesised that weaker, less-efficient economies will be characterised by an average higher seasonality of production. However, the seasonality scale does not affect the growth dynamics.

In many empirical studies, seasonal variations occurring in different countries are compared. However, the differences between countries have in themselves uneconomical and structural factors. The important role of the structural factor is often indicated. Meanwhile, in this study, seasonality analysis was carried out on the example of the United States, one country, but with a varied climate structure. Limiting research to one economy allows a better understanding of the importance of the non-economic factor. And as it turns out, it is crucial in the scale and distribution of seasonal fluctuations.

Macroeconomic policy, which should serve to stabilise employment not only within the economic cycle, but also in the seasonal cycle, should take into account flows between the groups of the employed, the unemployed and economically inactive. Other reasons may be indications of short-term transition to and from the group of inactive people, than to and from the group of the unemployed. Attention should also paid to the relationship between the seasonality of employment and the seasonality of production. Studies carried out in this respect indicate that this relationship varies depending on the sector of the economy. Structural changes in the economy may contribute to limiting seasonal fluctuations and to better use of labour resources, and thus to more sustainable economic development.

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