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THE INS AND OUTS OF UNEMPLOYMENT IN POLISH VOIVODESHIPS

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Abstract: This paper measures and compares the job-finding and separation transition rates of Polish voivodeships from 2005:Q1 to 2014:Q2. It uses readily accessible data of Local Data Bank in Poland: registered unemployment person by duration of unemployment and registered unemployment rate. The method of measurement stems from influential paper by Shimer on "Reassesing the Ins and Outs of Unemployment". The main sources of variability between the rates are investigated in terms of functional principal components.

Keywords: unemployment rate, Poisson process, smoothing, functional principal component data analysis

INTRODUCTION

Unemployment rate in Poland varied substantially across time but not across voivodeships over the last ten years. This phenomenon may occur as a result of variation in the rate at which workers flow the unemployment pool, variation in the rate at which workers exit the unemployment pool, or a combination of the two. It is largely these flows that drive the overall unemployment rate which is the main indicator of the health of the labour market. These flows generally follow a pattern in a typical business cycle. As the economy enters a downturn, separations start rising and job-finding rates start falling. These movements cause the overall unemployment rate to rise. The diagnosis of the labour markets should take into account the rates of reallocation of labour force. Reduced rates of worker turnover are usually associated with the more regulated labour markets. The reduced turnover may contribute to higher unemployment. Lower turnover could reflect the fact that searching for jobs and workers has gotten costlier or harder, resulting in poorer worker-job matches, and therefore lower productivity. Low rates would indicate that firms and workers are settling for matches that are substantially suboptimal. What is optimal, of course, depends on the quality of the match and on the costs of searching.

To learn more about these flows in Polish voivodeships, I track the job-separation and job-finding rates. I show that the split job-finding to job-separation rate is closely related to the unofficial distinction to Poland A and B. Although the distinction is oversimplified, it is widely acknowledged and discussed in Poland. It refers to the historical, political, and cultural distinction between west and east areas of Poland, with the west (Poland A) being significantly more economically developed. Historically it can be traced to the period of the partitions of Poland: the Prussian partition (Poland A), compared to the Austrian and Russian partitions (Poland B). Poland B encloses for example Podlaskie, Mazowieckie, Lubuskie, Łódzkie, Małopolskie and Podkarpackie voivodeships. I show that these voivodeships display the lowest rates of reallocation of labour force. In contrast I show that the west voivodeships have the highest rate of worker turnover.

METHODOLOGY

I relate to the method developed by Shimer (2012). The model relates to continuous time environment in which data are available at discrete dates. For every $t \in [0, T]$ the interval $[t, t+1)$ will be referred to as 'period t'. It is assumed that all unemployed workers find a job according to Poisson process with arrival rate $f_t = -\log(1 - F_t)$ and all employed workers lose their job according to Poisson process with arrival rate $s_t = -\log(1 - S_t)$, where $F_t \in [0,1]$ is the job finding probability and $S_t \in [0,1]$ is the separation probability during period t. Two critical assumptions in the model should be underlined: (i) movements in and out of the labour force are ignored, (ii) arrival rates s_t and f_t are constant during period t. For evidence that the assumptions are good approximation of reality see Shimer (2012) and Elsby et al. (2013).

Let $\tau \in [0,1]$ and let $e_{t+\tau}$ denote the number of employed workers at time $t + \tau$, $u_{t+\tau}$ the number of unemployed workers at time $t + \tau$, and $u_t^s(\tau)$ workers who are employed at some time $t' \in [t, t + \tau]$. For $t \in \{0,1, \ldots\}$ and $\tau \in [0,1)$, unemployment and short unemployment evolve according to

$$\begin{aligned} \frac{d}{d\tau} u_{t+\tau} &= e_{t+\tau} - u_{t+\tau} f_t \\ \frac{d}{d\tau} u_t^s(\tau) &= e_{t+\tau} s_t - u_t^s(\tau) f_t \end{aligned} \quad (1)$$

Note that $u_t^s(0) = 0$ and, under assumption (i), $e_{t+\tau} + u_{t+\tau} = l_t$ holds for every $\tau \in [0,1)$, where l_t denotes labour force in period t. Thus equations (1) have the following solutions in discrete time t:

$$\begin{aligned} \exp\{-f_t\} &= \frac{u_{t+1} - u_t^s(1)}{u_t} \\ u_{t+1} &= \frac{(1-\exp\{-f_t - s_t\})s_t}{f_t + s_t} l_t + \exp\{-f_t - s_t\} u_t \end{aligned} \tag{2}$$

We can estimate f_t and s_t for $t \in \{0,1,\dots\}$ as we know u_t and $u_t^s(1)$ from available data. The second equation in (2) implies that if $u_{t+1} = u_t$ then the unemployment rate $\tilde{u}_t := \frac{u_t}{l_t} = \frac{s_t}{s_t+f_t}$ ($\frac{s_t}{s_t+f_t}$ will be denoted as $\tilde{u}_t^\star$ and be called the flow steady-state unemployment rate). The equation can be reformulated into the form

$$\tilde{u}_{t+1} = \frac{l_t}{l_{t+1}}(\lambda_t \tilde{u}_t^\star + (1-\lambda_t)\,\tilde{u}_t)\text{ , where } \lambda_t = 1 - \exp(-f_t - s_t) \tag{3}$$

In practice $\frac{l_t}{l_{t+1}} \simeq 1$ and $\lambda_t \simeq 0$ so $\tilde{u}_{t+1} \simeq \tilde{u}_t^\star$. In particular, log differentiation of $\tilde{u}_{t+1} \simeq \tilde{u}_t^\star$ yields

$$\frac{d\log \tilde{u}_{t+1}}{d\log(t)} \simeq (1-\tilde{u}_t)\left[\frac{d\log(s_t)}{d\log(t)} - \frac{d\log(f_t)}{d\log(t)}\right]. \tag{4}$$

The approximation provides a decomposition in which the contributions of the inflow and outflow rates are separable and may be compared on an equal footing with respect to their impact on the unemployment rate. To obtain a transparent view of the relative contributions of the inflow and outflow rates it is advisable to plot charts (see Elsby et al. (2013)):

$$\begin{aligned} &\{(t, \log(s_t)) : t \in \{0,1,\dots\}\}, \\ &\{(t, \log(f_t)) : t \in \{0,1,\dots\}\}. \end{aligned} \tag{5}$$

In this paper I plot the charts for each voivodeship. Next I smooth the obtained series and apply functional component analysis[1] to the smoothed data. The goal is to recover the dominant modes of variation of the smoothed series. For example I reveal that the main source of variability between the inflow rates and between the outflow rates does not change in time and relates to Poland A and B.

Functional principal component analysis for functions $y_i(t),\ i = 1,\dots,N$, is designed to find weight functions $\xi_i,\dots,\xi_M$, where each function $\xi_m, m \in \{1,\dots,M\}$, maximizes

[1] For a theory of functional principal analysis the book by Ramsay and Silverman (2005) is recommended

$$\frac{1}{N}\sum_i\left(\int_0^T \xi_m(s)y_i(s)ds\right)^2$$

subject to

$$\int_0^T \xi_k^2(s\,)ds = 1 \text{ and } \int_0^T \xi_m(s)\xi_k(s)ds = 0, \quad (\forall\, k < m).$$

The vector $f_m = (f_{1m}, \dots, f_{Nm})$ where $f_{im} = \int_0^T \xi_m(s)y_i(s)ds$ is called the m -th principal component. The percentage of variability of the first m components is expressed as

$$V_m = \frac{\sum_{i=1}^N \sum_{l=1}^m f_{jl}^2}{\sum_{i=1}^N \sum_{l=1}^M f_{jl}^2}\,. \tag{6}$$

The method found to be helpful in interpreting the components is to examine plots of the overall mean function $\hat{\mu}(t) = \frac{1}{N}\sum_i y_i(t)$ and the functions obtained by adding and subtracting a suitable component functions:

$$\hat{\mu} \pm C_k\xi_k,\ k \le m, \tag{7}$$

where $C_k^2 = \frac{1}{N}\sum_i f_{ik}^2$. The plots of the components along with the principal components scores plots

$$\{(f_{ik_1}, f_{ik_2}) : i = 1, \dots, N\,\}, \tag{8}$$

$k_1 < k_2 \le m$, give good insight into the differences between objects $y_i, i = 1, \dots, N$.

In this paper y_i represents smoothed $\log(f_t)$ or $\log(s_t)$ for the i-th voivodeship, $N = 16$ is the number of voivodeships and the interval $[0, T]$ is the range time of observations ($t \in [0, T]$, the interval corresponds to time from 2005:Q1 to 2014:Q2).

ANALYSIS

I use readily accessible data of Local Data Bank in Poland: quarterly registered unemployment by duration of unemployment, quarterly registered unemployment rate and gross domestic product GDP. The data covers the period since 2005 to the second quarter of 2014. Figure 1 shows the time series for the job finding rate f_t, separation rate s_t constructed according to equations (2) and unemployment rate, all of in logarithmic scale. Both rates exhibits seasonal variability of length 4. At each first quarter the rates are relatively high and at each fourth quarter are relatively low. The rates of worker turnover are thus the highest in each second quarter and the lowest at each fourth quarter. It corresponds to the gross domestic product, that is the highest turnover corresponds to the lowest GDP. The high turnover precedes the growth of GDP in next three quarters.

The curves in Figure 1 are almost parallel to each other. It means that we can expect the differences between the voivodeships hold over time. I seasonally adjust the time series, $\log(f_t)$ and $\log(s_t)$, by smoothing and apply functional principal analysis.

The first two components of $\log(f_t)$ explain 95% of variability ($V_1 = 0.90, V_2 = 0.05$; calculated according to the formula (6)). The first and the second component are plotted in Figure 3 and in Figure 4 accordingly. We can note from Figure 3 that the job-finding rate vary between the majority of voivodeships in the same pattern over the whole observational period. The difference between voivodeships is constant since 2008. The order of voivodeships with respect to the level job-finding rate holds from 2005. However, there are some of 5% of voivodeships which changed their ranking in 2009 (for example Świętokrzyskie and Podlaskie). The change is represented by the second functional component (see Figure 4}): the curves $\hat{\mu} \pm C_2\xi_2$ crossed in 2009. It can be noted from functional principal scores plot (Figure 5}) that the curve $\hat{\mu} + C_2\xi_2$ represents Podlaskie voivodeship and the curve $\hat{\mu} - C_2\xi_2$ Świetokrzyskie voivodeship.

The first two components of $\log(s_t)$ explain 99% of variability ($V_1 = 0.98, V_2 = 0.01$). The first and the second component are plotted in Figure 6 and in Figure 7 accordingly. The first component imply the long-term upward and downward movement of job-separation rates go simultaneously across voivodeships. The 1% of variability (see Figure 4 and compare with Figure 8) relates to the period before the end of 2007 when the job-separation rate of Podkarpackie became lower than the job-separation rate of Dolnośląskie voivodeship.

The majority (over 95%) of diversity of both flows are included in first components. Figure 9 depicts these components. The range of the component for $\log(f_t)$$ is half the range of the component for $\log(s_t)$, what can be compared with Figure 1. Thus we can expect that the separation rate causes the gross of diversity in unemployment rate across voivodeships. Plotting the components in the same plot gives us possibility to find voivodeships with low and high dynamics of reallocation of labour force. The first group of the low dynamics consists of Mazowieckie, Lubelskie, Podlaskie, Małopolskie and Łódzkie voivodeships. The group of the high dynamics consists of Lubuskie, Zachodniopomorskie, Opolskie and Dolnośląskkie voivodeships.

SUMMARY

This paper measures and compares the job-finding and separation transition rates of Polish voivodeships from 2005:Q1 to 2014:Q2. It uses readily accessible data of Local Data Bank in Poland: registered unemployment person by duration of unemployment and registered unemployment rate. The following conclusions are drawn:

1. The job-finding rate vary between the majority of voivodeships in the same pattern over the whole observational period. The difference between voivodeships is constant since 2008. The order of voivodeships with respect to the level job-finding rate holds from 2005. However, there are some of 5 \% of voivodeships which changed their ranking in 2009 (for example Świętokrzyskie and Podlaskie).
2. The long-term upward and downward movement of job-separation rates go in majority simultaneously across voivodeships. Only the job-separation rate of Podkarpackie became significantly lower then the job-separation rate of Dolnośląskie voivodeship. The separation rate causes the gross of diversity in unemployment rate across voivodeships.
3. The split job-finding to job-separation rate is closely related to the unofficial distinction to Poland A and B. We can separate two groups with respect to the dynamics of reallocation of labour force. The first group of the low dynamics consists of Mazowieckie, Lubelskie, Podlaskie, Małopolskie and Łódzkie voivodeships (Poland A). The group of the high dynamics consists of Lubuskie, Zachodniopomorskie, Opolskie and Dolnośląskkie voivodeships (Poland B).

The difference between voivodeships with respect to unemployment rate is strongly influenced by the inflow to unemployment. However, the outflow of unemployment has to be taken into account. What is most important nothing heralds changes in the flows across Poland A and B. Note that Poland A characterise of low job-finding rate and low separation rate. It is typical to so called sclerotic labour markets, where the unemployment rise more in a downturn and stay persistently high. Thus we should expect that unemployment differentiate Poland A from Poland B in a downturn. But it is not the case of Polish voivodeships. The remark is of paramount importance. The research of Polish labour market, relating to differences with respect to sex, age, social groups and similar, should take into account the type of part of Poland (A and B) as strongly influencing factor.

REFERENCES

Besse P.; Ramsay J.O. (1986) Principal components analysis of sampled functions. Psychometrika, 51, 285-311.

Elsby M.W., Hobijn B., .Sahin A. (2013) Unemployment Dynamics in the OECD, Review of Economics and Statistics (2013), MIT Press, vol. 95(2), pages 530-548.

Ramsay J.O., Silverman B. W. (2005), Functional Data Analysis. Second Edition, Springer. NY.

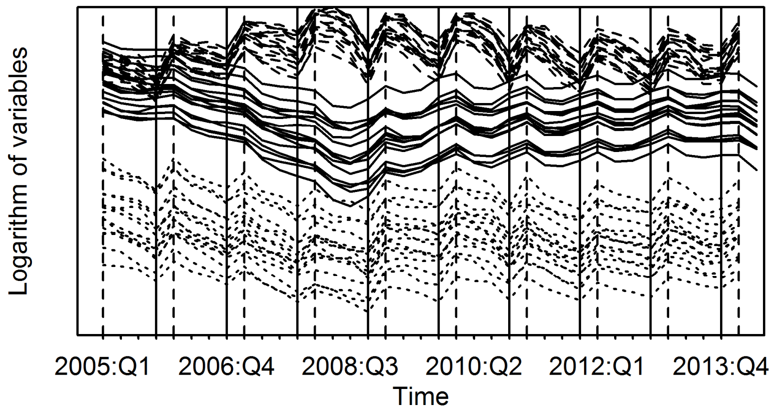
Shimer R. (2012) Reassesing the Ins and Outs of Unemployment Review of Economic Dynamics, Elsevier for the Society for Economic Dynamics, vol. 15(2), 127-148.

FIGURES

In some Figures the following abbreviations are used:

DOLNOŚLĄSKIE *DOLN*	KUJAWSKO-POMORSKIE *KUJA*
LUBELSKIE *LUBE*	LUBUSKIE *LUBU*
ŁÓDZKIE *ŁÓDZ*	MAŁOPOLSKIE *MAŁO*
MAZOWIECKIE *MAZO*	OPOLSKIE *OPOL*
PODKARPACKIE *PODK*	PODLASKIE *PODL*
POMORSKIE *POMO*	*ŚLĄSKIE* *ŚLĄS*
WIELKOPOLSKIE *WIEL*	ZACHODNIOPOMORSKIE *ZACH*
ŚWIĘTOKRZYSKIE *ŚWIĘ*	WARMIŃSKO-MAZURSKIE *WARM*

Figure 1. Dashed lines: job-finding rates in voivodeships; dotted lines -- separation rates; solid lines -- unemployment rates in voivodeships. Solid vertical lines -- fourth quarters. Dashed vertical lines -- first quarters.



Source: own preparation

Figure 2. Gross Domestic Product. Vertical solid lines -- fourth quarters. Vertical dashed lines -- first quarters.

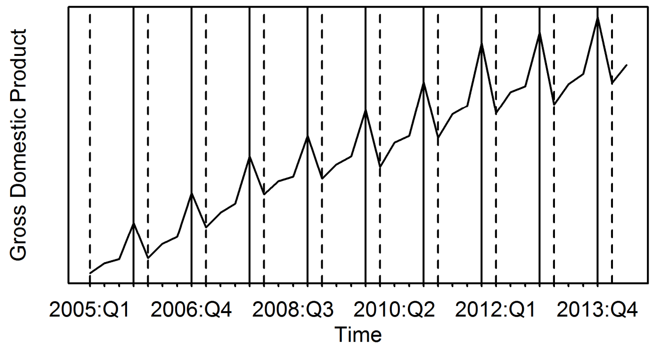


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Figure 3. First component function of $\log(f_t)$.

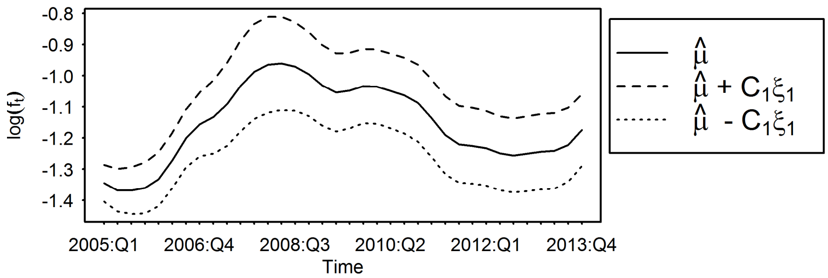

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Figure 4. Second component function of $\log(f_t)$.

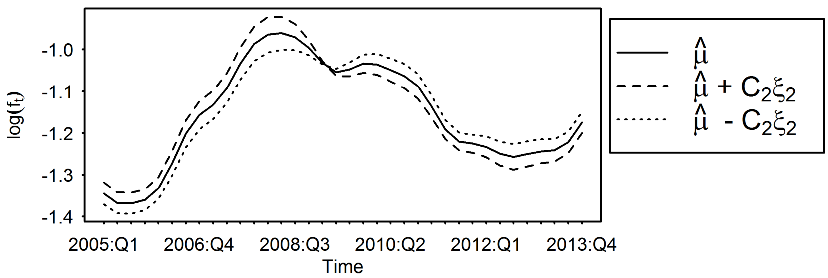

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Figure 5. Principal components plot of $\log(f_t)$.

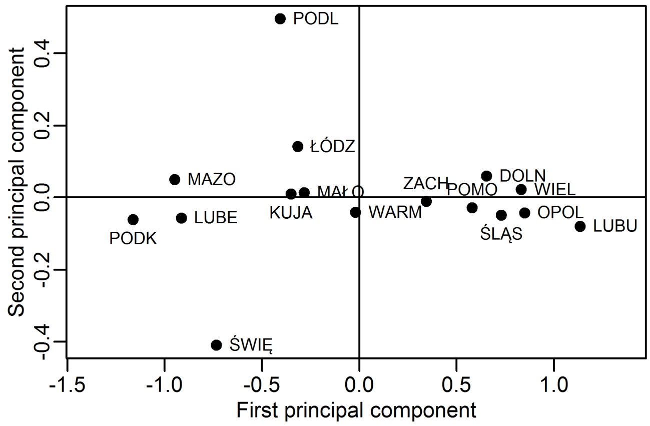

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Figure 6. First component function of $\log(s_t)$.

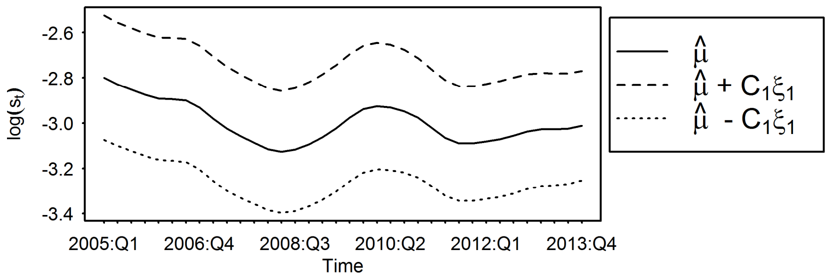

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Figure 7. Second component function of $\log(s_t)$.

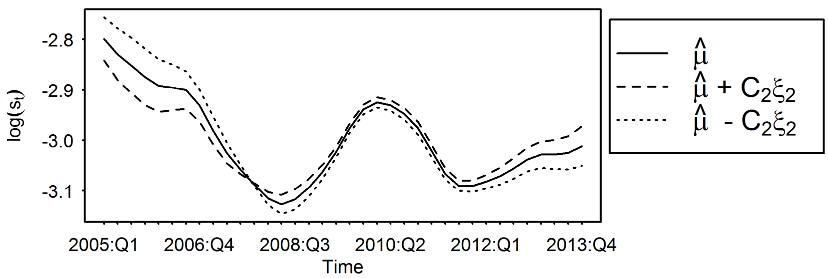

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Figure 8. Principal components plot of $\log(s_t)$.

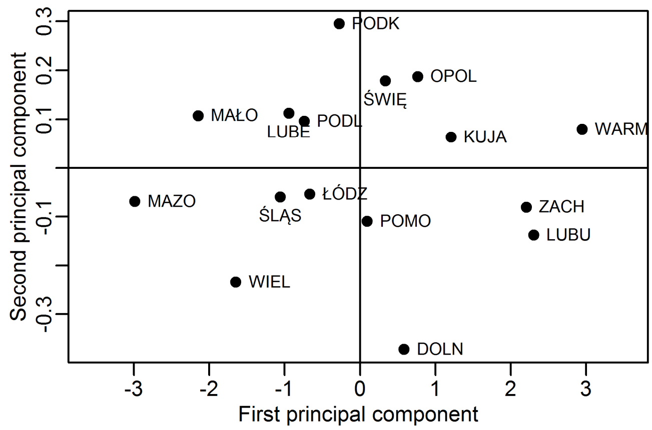

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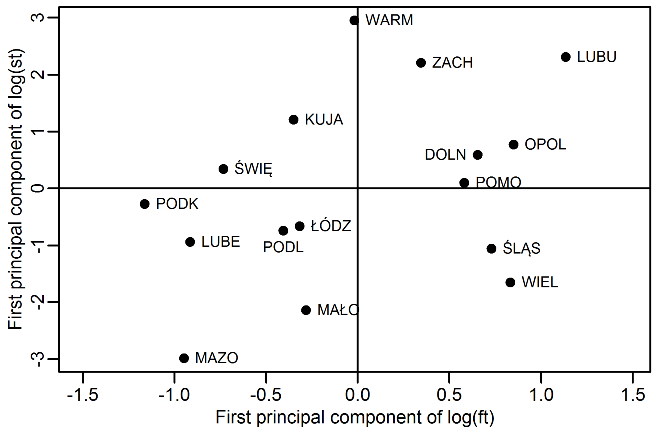
Figure 9. Plot of first principal components.



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