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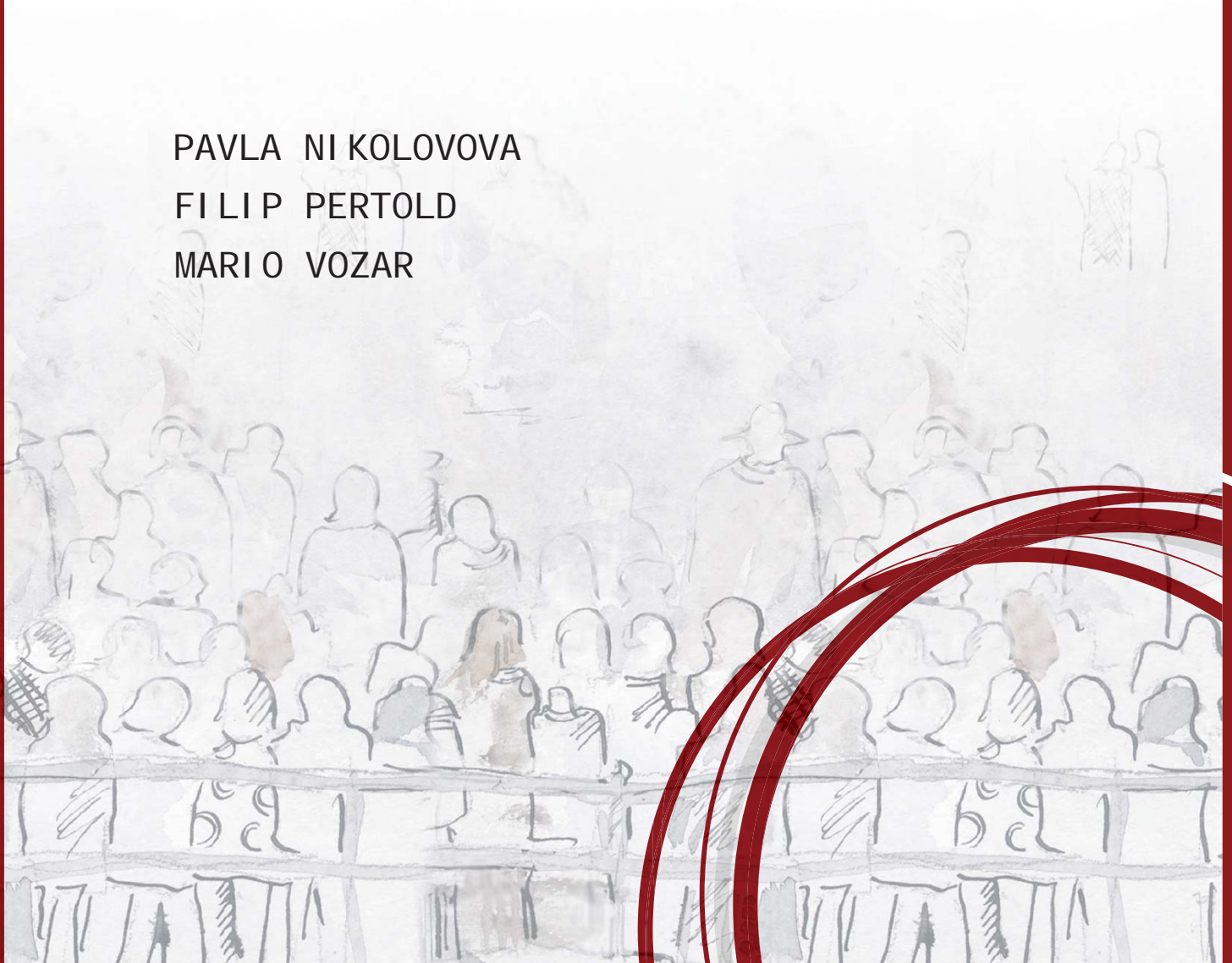MARIO VOZAR

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ABSTRACT

Self-employment and Small Workplaces in the Czech and Slovak Republics: Microeconometric Analysis of Labor Force Transitions*

In this paper we investigate the role of the business cycle for the transitions of Czech and Slovak workers to informal economy using Czech and Slovak Labor Force Survey data. We use two approximations for the participation in informal economy, self-employment and employment in small workplace (10 and fewer workers or 5 and fewer workers). Both statuses are potentially associated with the participation in an informal economy. Using the similar methodology as presented in Bosh and Maloney (2007), we show that recent recession caused substantial increase in transitions of workers from formal into both self-employment and employment. As compare to pre-recession time the flow into self- increased more than 4 times. The increase in transitions to small workplaces is less pronounced.

Keywords: informal economy, business cycle, labor force

JEL Classification: J21, H26

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1. Introduction

In this paper we investigate recent development on the Czech and Slovak labor markets. We particularly focus on the role of the business cycle for the transitions of Czech and Slovak workers to informal economy.

Using the methodology that is similar to the Bosh and Maloney (2007) we find that business cycle, especially recent economic crises, has strong impact on the probability to become employed in informal economy defined as being self-employed and our findings in terms of observed dynamics are similar to those in Bosh and Maloney (2007).

For the purpose of our analysis we use the Czech and Slovak Labor Force Survey data. Although these data contain detailed description of individual labor market activity, it does not allow for direct measure of participating in informal economy. Thus we have decided to use two approximations for the participation in informal economy, self-employment and employment in small workplace (10 and fewer workers or 5 and fewer workers). Both statuses are potentially associated with the participation in an informal economy. Self-employment turns out to be very sensitive on business cycle fluctuations, thus we suspect that it is a reasonable measure of the participation in informal economy, especially for male workers in labor market.

The workers in a smaller workplace with 5 and fewer workers seemed to be less sensitive and in 10 and fewer workers are least sensitive to business cycle. This finding corresponds with anecdotal evidence that smaller firms are more likely engaged in a shadow economy than those with more employees.

Our analysis is divided into two parts similarly as in Bosh and Maloney (2007). In the first part we focus on descriptive statistics and heterogeneity in the population of workers. We show, for example, how more educated versus less educated workforce behave in terms of transitions across formal employment, self-employment or employment in small workplaces, unemployment and out of labor force.

The second part of this paper analyses trends in the Czech and Slovak economies with special attention on the recent development related to financial and economic crises. We show that that the recent economic downturn dramatically increased probability of a transition into unemployment and into self-employment and employment in small workplaces, especially to the self-employment. In terms of observed dynamics the Czech and Slovak Republics behave fairly similarly.

This paper is organized as follow. In the next part, we summarize current literature on

informal economy in both countries. Third section describes methodology in detail. In the fourth part, we describe data and status that defines position of a worker on the labor market, including participation in informal economy. Section 5 describes results and we conclude in part 6.

2. Literature Review

Informal economy is widely studied problem in the current social and economic literature. However, not so much was written about the Czech and Slovak Republic.

The most recent paper describing general prevalence of undeclared work in the Czech economy is in Munich (2007). The author is describing general situation on the Czech labor market, where incentives to participate in informal economy were relatively high. This is due to the relatively high taxation of labor caused especially by social security and health insurance contributions. The personal income tax did not play the crucial role in tax burden according to Munich (2007).

He also mentions two types of undeclared work (UDW), which differ substantially in practice: illegal employment of foreigners and undeclared work of Czech citizens. The first type of UDW is mostly widespread among workers from Ukraine, mostly in construction. The later is widespread among self-employed and in construction and in services provided by SME with large proportion of unskilled labor.

Descriptive evidence about undeclared work is provided by Horkov and Kux (2003). They claim that highest incidence of UDW among workers with multiple jobs, entrepreneurs, registered unemployed, students and partially disabled. The sectors that are mostly affected are construction, agriculture, catering, retail, and textile. Hanousek and Palda (2004) show most up-to-date empirical assessment of informal economy in the Czech Republic. They run repeated surveys in 2000, 2002 and 2004 asking about past and current tax evasion behavior of respondents. Each cross-section provides evidence about transitions between tax evading and not-tax evading in 1995, 1999, 2000, 2002 and 2004. In our context evading taxes might be taken as a sign of participating in informal economy.

Their results suggest that relatively stable transition probabilities in time especially during economic boom in early years of 2000's. They also show that some demographic characteristics play important role in determining transition into informal economy. Unskilled men with primary and lower secondary education are much more likely to participate tax evasion. On the other hand, age does not play an important role in tax evasion.

One important conclusion that authors make is high difference between general involvement in informal economy in terms of buying goods or services and actual participation in terms of for example employment. About 55% of Czechs admitted buying a good from informal market, whereas about 4% admitted regular involvement in undeclared work. This difference could be due to general reluctance of participants to admit their undeclared work, probably general sense of high widespread of informal economy. It is also important to note that Hanousek and Palda found that occasional undeclared work is most widespread among workers with official employment contract, self-employed and unemployed. It is striking that more 50% of unemployed is involved in some form of undeclared work. The widespread of occasional undeclared work in population is measured as one fifth of respondents and it is assumed to be stable over time.

Finally, detail descriptive analysis focused on construction industry is provided by Kux and Kroupa (2006). They attempt to estimate extend of the shadow economy in construction using various methods and concluded that the shadow economy amounts to approximately 20% of gross value added.

The amount of literature concentrating on informal economy and especially on undeclared work is even scarcer in the Slovak Republic. European Employment Observatory Review: Spring 2007 summarizes situation across the EU member countries with respect to undeclared work and finds that Slovak Republic experienced small decline in the prevalence of undeclared work if compared with year 2004. The study further notes that the increase of minimum wage above labor productivity growth may result in an incentive for undeclared work, especially in small-firms with low wages. On the other hand, the Slovak Republic undertook major reform of its income tax system, for both corporate and individual taxes. Especially lower corporate taxes and higher individual deductible income policies have had positive impact on prevalence of undeclared work. However, the study warns that high and complicated social security costs continue to incentivize individuals and firms participating in informal sector.

Regional study "Undeclared work in Slovak society conditions" by Bednarik, Danihel and Sihelsky (2003) analyzes incidence and incentives for undeclared work. They found that among the self-employed and small firms the incidence of undeclared work is the most common, especially in construction and tourism. The authors identified workers of age between 25 and 35 year age with low qualification to be most likely engaged in undeclared work. As the main motives are mentioned costs saving effects, reluctance to change and move from informal to formal sector as well as high supply of workers willing to participate in informal sector.

Sklenar and Burger (2006) analyze the impact of Slovak tax reform on firm Ős tax evasion. The authors use the 2004 Slovak tax reform and the difference in differences approach with data from the Czech and Slovak firms to identify changes in the level of tax evasion caused by the reform. The authors find that the percentage of tax evading firms in both countries experienced over the time decrease, with bigger change in the case of Slovak Republic. Nevertheless, both countries are in general comparable to the measure of tax evading firms with approximately by 5% - 7% lower percentages in the case of Slovak Republic. As the main reason, the authors identify the difference in satisfaction with the tax systems in both countries. While in the Slovak Republic 55% of firms found the tax system simple or optimal, it is only 28% in the Czech Republic. To complement above stated statistics, Orviska, Caplanova, Medved and Hudson (2006) report that the shadow economy forms 18.8% and 17.9% of total income for the Slovak Republic and the Czech Republic respectively. Nikopour, Habibullah, Schneider and Law (2009) also examine the link between FDI and shadow economy. While theoretically, the effect of FDI on the economy is ambiguous, it is generally accepted that FDI stimulates economic growth and increases welfare which has a positive effect on suppression of shadow economy. However, the authors do not find support for the hypothesis that higher FDI causes lower shadow economy.

3. Methodology

Even though the quarterly data allow us to observe the transition between the states only in the discrete time points, it is realistic to assume that agents' decision are rather governed by the continuous than by discrete time Markov process. Therefore, to describe this continuous process derived from the discrete time Markov process, we closely follow approach Bosh and Maloney (2007) who relies on work of Geweke et al (1986) and Fougere and Kamionka (2005). To estimate the continuous transition matrix, we have to start by defining the discrete time Markov process described by transition matrix P, where

$$p_{ij}(t, t+n) = Prob\{X(t+n) = j | X(t) = i \quad for\ t, n = 0,1,2\dots,\}$$

The probability p_{ij} can be seen as the probability of moving from state i to state j over the time n. Given, that we observe N independent observations of the proces X_t, equally spaced over time, we use Maximum likelihood estimator of the matrix P. Following Fougere and Kamionka (2005),

$$\widehat{p_{ij}} = \left(\sum_{l=1}^{L} x_{j,k}(l)\right) / \left(\sum_{l=1}^{L} x_j(l-1)\right).$$

In other words, the total number of transitions from state j to state k divided by the total number of agents who were found previously in state j. As Bosh and Maloney (2007) state, with $n \to 0$ the overtime change of matrix P can be written as

$$\frac{dP(t)}{d(t)} = QP(t).$$

It can be easily shown, that the solution to this differential equation has the form

$$P(t) = e^{tQ},$$

where Q is so called intensity matrix with the following properties:

$$q_{ij} = \begin{cases} q_{ij} \in \mathbb{R}^+, j \neq i, i, j = 1, .., K \\ q_{ii} = -\sum_{j \neq i} q_{ij} < 0, i = 1, ..., K \end{cases}$$

To provide an intuition for the elements of the intensity matrix Q, q_{ij} can be seen as the instantaneous rates of transition from state i to state j. Bosh and Maloney (2007) note, that in practice matrix Q may not exists or be unique. However, in our analysis, in which we followed Fougere and Kamionka (2005) approach we did not encounter this problem and all presented intensity matrixes were found to be embeddable. Thus, to find intensity matrix Q we relied on spectral decomposition of estimated matrix $\hat{P}$

$$log(\hat{P}) = \hat{Q}T = A \times \begin{pmatrix} log_{k_1}(\lambda_1) & . & . & . & 0 \\ . & . & & & . \\ . & & . & & . \\ . & & & . & . \\ 0 & . & . & . & log_{k_K}(\lambda_K) \end{pmatrix} \times A^{-1},$$

where

$$log_{k_i}(\lambda_i) = log|\lambda_i| + (arg\lambda_i + 2k_i\pi); \ i, k_i \in \mathbb{Z}.$$

However, since all eigenvalues were real valued in our analysis the $log_{k_i}(\lambda_i)$ is reduced to $log(\lambda_i)$ and matrix $\hat{Q}$ is unique. In addition, the $T = 4$ to accound for the quarterly frequence of the available dataset. To express the mobility of the particular groups in population we compute the mobility index $M(Q) = -tr(Q)/K$, which can be seen as a benchmark for the labor market flexibility, which is an important indicator especially in the periods of recession, when mobility of the labor force is essential for surviving worsening labor market situation.

In their analysis, Bosh and Malony (2007) note, that intensities describe only the probability of a worker moving across sectors but do not account for specific underlying labor market

conditions which may influence magnitude of the observed probabilities. Therefore, the authors further decompose the matrix $\hat{Q}$

$$\hat{Q} = diag(\hat{Q}) \times R,$$

where elements $r_{ij} = -q_{ij}/q_{ii}$ for $i \neq j$. In other words, propensity matrix R accounts for the general rate of turnover in the sector i (all movements out of sector i). In addition, the described decomposition allows us to observe the duration average agent spends in each sector under the assumption of exponential distribution of $-q_{ii}$. From the properties of exponential distribution, we know that

$$E(d_i) = -q_{ii}^{-1}.$$

While propensity matrix R accounts for tendency of agents to move from sector i it does not account for the tendency of workers to move toward particular sector due to the availability of jobs in that sector or any other natural preference for a given labor market sector. Thus, to account for the destination specific effects, we construct transition matrix T as

$$t_{ij} = \frac{r_{ij}}{\frac{x_j - x_{jj}}{\sum_{k \neq i}(x_k - x_{kk})}}.$$

The expression $x_j - x_{jj}$ accounts for the measure of individuals that desided to move to sector j from any other sector and it is divided by the total number of jobs openings for individuals moving from sector i. Thus in other words, it is the proportion of job openings in sector j to jobs openings in the economy as seen by the individual moving from sector i.

The reduced form descriptive statistics $\hat{Q}, \hat{R}$ and $\hat{T}$ provide an overall picture of the labor market mobility. We further enhanced the results by using two sources of variation. First, we use worker characteristics such as gender, age and education to further identify labor market mobility specific for each group. Second, since we are interested on the effect of recession on formal and informal sector of the labor market in Czech and Slovak Republic we concentrate on the changes observable over time. To do so, we compute continuous transition matrices $\hat{Q}, \hat{R}$ and $\hat{T}$ for every quater to infer the effect of recession for the labor mobility between formal employment and self-employment and employment in small workplaces.

4. Data

For the purposes of our research we use Czech Labor Force Survey data from 1998–2009 containing detailed information about the labor market status of a representative

sample of 60,000 individuals and their households. On a rotating panel base, individuals and their households are surveyed during five consecutive quarters. Therefore, one fifth of the sample is replaced every quarter. We use all individuals that are observed at least 4 quarters in row and we did not include individuals that are younger than 15 and older than 65.

For the Slovak Republic we use similar data constructed in the same fashion. However, the number of observation is about 50% of the Czech data.

4.1 Sectoral definitions and limitations

We define two sectoral definitions of employment that should indicate whether a worker is in formal or informal employment. In fact, the data does not contain any direct measure of participation in informal economy. Thus, we use the following characteristics as an indirect measure of participating in shadow economy. The first one is employment in a small workplace (SW); we define such workplace in two different manners, either as such that contains 10 and fewer workers or such that contains less than 6 workers. The second approximation for participation in informal economy is self-employment (SE).

Both measures are definitely not the best approximation of shadow economy. Majority of individuals that are in both statuses do not most likely fully participate in shadow economy. As it is described in the literature review participating in informal is usually parallel with unemployment, self-employment and inactivity. Self-employment is often used by companies as a tool to reduce labor costs. We have to stress that this is not fully illegal procedure due to higher social security and health tax imposed on employees as opposed to self-employed workers. This is a common practice in construction sector and some service industries.

Furthermore, many changes in self employment and small workplaces over time might not be reflected in our data at all. Specifically, some industries (for example catering) often pay part of the wage unofficially. One can expect that during recession companies and workers are more likely in distress and thus reduce costs by tax evasion.

However, if we observe an individual that changes status into self-employment or smaller workplace, it is reasonable to assume that it might be driven at least partially by intention to participate in informal economy.

5. Results

Our analysis of the sector transitions in the Czech and Slovak Republics labor markets

can be divided into two parts. First, we report summary statistics for both countries and second, we analyze the effect of the recession on transitions from and to the proxied informal and formal sector. As we described in the previous section, we use three approaches are used to measure informal sector. The first one is employment in a small workplace (SW) that contains 10 and fewer workers (SW (10)) and 5 and fewer workers (SW (5)). The second approximation for participation in informal economy is self-employment (SE).

5.1 Descriptive statistics

Tables 1, 2 and 3 provide gender, age and education specific distribution of workers across sectors, unemployment and out of labor force. Both countries show qualitatively comparable results when the measure of male workers employed in firms with 10 and fewer employees is approximately 2 to 2.5 times smaller than measure of male workers employed in large (>11 employees) enterprises. For females, the ratio of these two sectors is smaller being 2 for Czech Republic and 1.5 for Slovak Republic. In other words, we can say that while both countries are comparable with respect to distribution of workers among sectors, unemployment and labor market inactivity (overall and also across age and education subgroups), Czech Republic can be characterized by bigger relative measure of firms with more than ten employees when compared to Slovak Republic. When looking at the second measure of informal economy in Czech Republic, it is clear that the measure of self-employed is significantly lower than the measure of other types of employment. More importantly, self-employment seems to be gender specific type of employment, when across all age and education categories, the share of self-employed males is as much bigger as the measure of self-employed females, an observation which was not present in the first proxy (number of employees).

Further, to provide inference about the labor market mobility between the formal employment, self-employment and employment in small workplaces, unemployment and out of labor force state, we computed continuous time transition matrices from the discrete time data as was described in methodology. In Tables 6, 7 and 8 we present estimated matrices $\hat{Q}$, which report instantaneous probability of moving form sector i to sector j. Further we present estimated propensity matrix $\hat{R}$, which accounts for the general rate of turnover in the sector i (all movements out of sector i). The tables are finished with the mean durations of stay in each sector, computed under the assumption that the duration is distributed exponentially. As we can see, the Slovak Republic has much higher duration of stay in self-employment and

unemployment. We do not have any convincing evidence that would explain it, but Slovak labor market was during majority of time span still in transition period. Real inflow of foreign direct investment started around EU enlargement (2004) when politics become also much more stable. Around year 2004 Slovaks did many reforms that basically reduce welfare benefits and made labor market flexible and together with high GDP growth, unemployment dropped dramatically. Before this drop, statistics showed huge gap between registered unemployment and unemployment according to the Labor Force Survey. The registered unemployment was much lower and indicated that many unemployed were in fact either discouraged to participate in any job center or they participated on shadow economy. Moreover, Slovak labor market is affected by low employment rate especial in some areas with high proportion of Roma. This all can cause big gap between the Czech and Slovak indicators. In any case, unemployment rate persists higher than in the Czech Republic during whole decade.

Tables 6, 7 and 8 are further complemented by the Figure 1, which graphically summarize movement between formal and proxied informal sectors as found in intensity matrix, propensity matrix as well as adjusted propensity matrix (matrix $\hat{T}$ accounting for the destination sector specific effects) for male gender for both approaches used in Czech Republic and one approach used in Slovak Republic. Clearly, qualitatively all three observations (CZ-SW, CZ-SE and SVK-SW[2]) are similar, when the instantaneous probability of moving from formal employment to self-employment or employment in small workplace significantly exceeds the probability of moving in opposite direction. This pattern remains clear in the propensity matrix adjusted for the rate of turnover in both the sectors. However, further adjustment for the specific effects of the sector, toward which agents are moving, at least partially erases the difference. The asymmetric pattern remains significant only for self-employed in the Czech Republic, which is different comparing to Latin America and might mean that the self-employment has different role there.

Figure 2 graphically depicts the expected duration in each sector computed separately for males and females. While in the Slovak Republic, the mean duration of stay in self employment or small workplace and formal employment is approximately the same for males and females, in the Czech Republic females spend on overage 4 years less in each sector. When comparing the mean duration in unemployment between the Czech Republic and the Slovak Republic, we observed that both Slovak males and females spend two times longer in unemployment than their Czech counterparts. We believe this finding reflects the country

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[2]In this figure, we use the measure SW as a small workplace that contains 10 and fewer workers.

differences in unemployment rate which was significantly higher in Slovak Republic especially during the transition period. Finally, we found that while Slovak males spend slightly shorter time out of labor force, this does not hold for females with approximately four years more in out of labor force state than Czech females.

The last aggregate statistic can be found in Table 10 which depicts the mobility index computed as $M(Q) = -tr(Q)/K$ across the genders, age, and education groups. In other words, mobility index computes the average probability of worker moving out of the sector the worker is currently in. Figure 3 graphically summarizes these results for all workers. It is clear, that both approaches used in the analysis of Czech Republic give consistent results with mobility indexes close to 0,3. For Slovak Republic the mobility index is almost half of the Czech one, what infers that an average worker is approximately half as inclined to move to between the sectors as Czech one.

To provide the first insight about the transitions among sectors of work we constructed the following age and education specific figures. We divided workers into three age groups with age 15-24, 25-39 and 40-64 and into low education (those without school leaving exam called "maturita") and high education (those with school leaving exam called "maturita" or higher education).

First, we constructed mean duration of stay in unemployment and in out of labor force state, which can be found in Figure 4. We found, that the unemployment duration in Slovak Republic is higher for each of these subgroups. The duration in out of labor force state is longer only for those in age category between 40 and 64 years old and for workers with low education. Figure 5 depicts mean duration of stay for self-employment and employment in small workplace against the mean duration of employment in the formal sector. It is clear that mean duration of staying in formal sector is longer in the Slovak Republic across all age and education subgroups. This fact reflects lower mobility of labor between sectors in the Slovak Republic found by mobility index. Similar story could be said for proxied informal sector if only first approach (workplaces with 10 or less employees serving as proxy for informal sector) would be taken into account. While till this point, results from both approaches to identifying informal economy in Czech Republic gave as expected fairly similar results, graph on the right of Figure 5 shows that mean duration of stay in self-employed employment is greater than mean duration of stay in small workplace.

In the following Figure 6, we report estimated propensities to move from unemployment to formal employment and self-employment or employment in small workplaces. As expected, approach 2 (self-employment as a proxy of informal sector) reports

small propensity to transit from unemployment to informal sector, which is related rather to characteristics of self-employment than to the characteristics of informal sector. With respect to the first approach, we found substitution effect for young workers and workers with high education, when in Slovak Republic the propensity to move from unemployment to self-employment or employment in small workplaces is higher than in Czech Republic and the propensity to move to formal sector is higher in Czech Republic than in Slovak Republic. On the contrary, for old workers and workers with low education we observed that propensities to move from unemployment to employment were higher for Slovak workers for both formal and proxied informal sector. Moreover, we found that in Slovak Republic the pattern is consistent between age groups. The propensity to move from unemployment towards either proxied informal or formal sector first increases with age and then decreases for the third age group. However, in Czech Republic, workers when young have tendency to rather go to bigger firms and then as age into the second age group (25 - 39) they have a tendency to rather go to small workplaces from unemployment.

Finally Figure 7 shows that with higher wage the propensity to move from out of labor force state to self-employment or employment in small workplaces is increasing with age in Czech Republic as well as in Slovak Republic. On the contrary, it does not hold for propensity to move from out of labor force state to formal sector, which is decreasing for workers of age 40-64 in Czech Republic. In Slovak Republic, the trend remains increasing. Interestingly, education does not seem to play a role in neither country when speaking about propensity to move to self-employment or employment in small workplaces from out of labor force state.

5.2 Time trends

This important section of the paper analyzes over the time changes in workers movement across the proxied informal sector, formal sector, unemployment and out of labor force state. To create foundation for these figures of interest we first present the overall development of macro indicators of Czech economy.

Figure 8 depicts how GDP and the share of formal sector with respect to overall employment developed over time. One can observe that during economic boom the fraction of workers in formal sector increases while recession push people to participate in self-employment or employment in small workplaces. This is especially obvious since 2003 when the Czech Republic was approaching access to EU and became standard European economy. One has to take into consideration that volatility of employment in formal economy

is relatively small. This is probably due to the rough measure of participating in informal economy – self employment. General trend is, however, in line with theory.

The Czech economy had two main recessions during the period 1998-2009. The first one was just finishing in 1998, the second one started in the end 2008. Both recessions are reflected in increase in unemployment rate by nearly 3 percentage points as can be seen on Figure 9. One can also observe lag in the changes in unemployment. This lag is approximately 2 quarters. The similar pattern is visible in Slovak Republic, especially during recent period world financial and economic crisis hit this region.

Figure 10 shows share of self-employed and small workplaces as share of the whole labor force (employed and unemployed). The size of self-employed is approximately 10 percent in the Czech Republic and currently the same in the Slovak Republic, which, however, has strong upward trend during last decade. Up to 2004, one can observe increase in the Czech self-employment, even the economy was in recovery. This could be due to the late transition of the economy that was converging institutionally to state of standard western economies. The same can said for the Slovak Republic, where the process of convergence is still ongoing. The small workplaces are more common in the Slovak Republic and again their share has upward trend during last decade. The reason is probably in relatively late structural changes in the Slovak economy. In the Czech Republic, one can observe that both measures of informal economy Ð self-employed and small workplaces Ð increase during recession and decrease in time of economic boom. Cyclical pattern in the Slovak Republic is less obvious due to the strong trend, but as analysis of flows, one can observe some cyclical pattern even there.

Figure 11 describes the transitions between formal employment and informal sector (informality is defined as self-employment). The figure can be divided into two disjoint parts. The first period till 2003 can be still characterized as late transition. Since 2003 the Czech Republic was already heading into EU and joining it in 2004. In the latter period transitions had standard pattern and transitions into self-employment dramatically increased during the economic downturn since end of 2008.

Transitions between formal sector and unemployment described by Figure 12 behave pretty much similarly in whole period and in line with economic theory. In the first part, the late transition recession caused high rates of transition probabilities between both sectors with natural opposite trends. In latter period, when Czech economy was more stable, transition rates generally decreased. The economic boom in 2004 – 2008 caused increase in outflow from unemployment into formal sector and decrease of inflow into formal employment. Economic crisis caused huge increase in inflow into unemployment. The latest development has some sign

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of improvement, but small number of observations makes the estimation less precise.

Previous figure is complemented by Figure 13 in which transitions into and from inactivity to formal employment follow more or less business cycle and are parallel. We observe higher probabilities of inflow into inactivity and into formal employment during recession. Higher probability to become inactive is easy to interpret. The increase in probability to become employed is already less intuitive and evidence from other countries (for example Mexico) suggests that during the economic boom the flow into inactivity should be smaller. One needs to be also aware of institutions that are not stable over time and can affect our results. For example statutory retirement has been prolonging over time, maternity leave benefits strongly affect participation of women. However, we believe that recent development was not affected by any major institutional change.

Important indicator in the periods of recession is the transition from employment into unemployment. Figure 14 compares transition from formal and from proxied informal sector into unemployment in Czech Republic. It is necessary to stress that unemployed by anecdotal evidence do participate very often in informal economy. Thus if a worker changes her status from self-employed to unemployed, it can mean an increase in her income due to the available income from shadow economy. Recent economic crisis naturally increased flow into unemployment from formal and informal economy as well. This increase was really dramatic – from levels near zero to more than 3 percent in the case of informal sector proxied by self employment.

Finally, we complete the presentation of results by Figure 15, which shows the flows into inactivity from formal employment and from self employment. We can observe relatively high volatility over time. Flow into inactivity from formal employment increased recently due to the economic crisis. On the other hand, transition probability from self employment to inactivity seems to have no link to economic growth.

The remaining figures (15-19) visualize the same time trends as presented above for the measure of informal economy given by small work place with 5 and fewer workers (SW (5)). They can be compared to those where a small work place is defined as having 10and fewer workers (SW (10)), and it can be concluded that the two are very similar, the only difference being that SW (5) seems to be slightly more sensitive to the business cycle and hence closer to the measure given by self employment.

6. Conclusion

In this analysis of labor market dynamics we estimate continuous time Markov processes from the discrete time labor market data from the Czech and Slovak Republics. Since the available data do not allow for direct observation of informal employment, we define two measures of informal employment, self employment and employment in small workplaces. In particular we use two measures of the small workplaces with the number of employees being 10 and less and 5 and less. Using the similar methodology as presented in Bosh and Maloney (2007), we show that recent recession caused huge increase in transitions of workers from formal into both self-employment and employment in small workplaces used as proxies for informal sector. As compare to pre-recession time the flow into proxied informal economy increased more than 4 times. This is visible specifically for transitions into self-employment. We also generally consider self-employment as the better measure of informal sector than the small workplaces, in which workers tend to behave similarly to the workers in large workplaces. The analysis we conducted is divided into two main segments. First, we provide descriptive statistics across genders, age groups and education level. In general, we found that workers tend to move from self-employment and employment in small workplaces to formal employment with no significant difference between male and female behavior. However, we found a difference between Czech and Slovak females: Slovaks have higher average duration in each sector of employment, unemployment and out of labor force state as compared to the Czech counterparts. The most important part of the analysis, directly related to the effect of recession on workers probability to move between formal and informal employment, was studied in the second part of the paper. We estimated intensity matrices for each quarter to observe over time changes between sectors transitions. We found that the effect of recession was significant not just on flows into self-employment and employment in small workplaces. There is also dramatic increase in the outflow of workers from formal employment into unemployment and out-of-labor force, while flows into formal employment remained stable or dropped. Important finding is also that the Czech and Slovak labor markets behave similar in terms of observed dynamics during recent crises. This finding contrasts with the fact that Slovak unemployment remains higher than the Czech unemployment during the studied period.

References

[1] Bednarik, R., Danihel, M and Sihelsky, J. (2003). *"Illegal Labor in the Slovak Society Conditions"*. Friedrich-Ebert-Stiftung. *http://library.fes.de/pdf-files/bueros/slowakei/04218.pdf*

[2] Bosch, M. and W. F. Maloney (2007). *"Comparative Analysis of Labor Market Dynamics Using Markov Processes: An Application to Informality."* IZA Discussion Paper 3038, World Bank Policy Research Working Paper 4429.

[3] European Employment Observatory Review: Spring 2007. European Commision, Directoreate-General for Employment, Social Affairs and Equal Opportunities.

[4] Fougre, D. and T. Kamionka (2005). *"Econometric of Individual Labor Market Trasitions."* IZA Discussion Paper 1850.

[5] Geweke J., R. Marshall and Gary A. Zarkin (1986a) . *"Mobility indices on continuous-time Markov chains."* Econometrica, Vol. 54 (6). pp 1407-1423

[6] Geweke J., R. Marshall and Gary A. Zarkin (1986b). *"Exact Inference for Continuous Time Markov Chain Models."* Review of Economic Studies 53(4). -pp 653-69

[7] Hanousek, J, and F.Palda. 2004. *"The Evolution of Tax Evasion in the Czech Republic: A Markov Chain Analysis."* CERGE-EI Discussion Paper 134/2004.

[8] Horkov, M., Kux, J. (2003). *"Country Study on Informal Economy in the CR."* Prague, Research Institute of Labour and Social Affairs. *http://www.vupsv.cz/INFORMAL_ECONOMY.pdf*

[9] Kux, J., Kroupa, A. (2006). *"Undeclared Labour in the Construction Industry."* CLR, European Institute for Construction Labour Research. Country Report – CR, RILSA. *http://www.rilsa.cz/an205.html*

[10] Munich, D. (2007). *"Undeclared Work in the Czech Republic: Thematic Article."* European Employment Observatory. *mimeo*

[11] Nikopour, H., Habibullah, S. M., Schneider, F. and Law, H. S. (2009). *"Foreign Direct Investment and Shadow Economy."* MPRA Paper No. 14485. *http://mpra.ub.uni-muenchen.de/14485/*

[12] Orvinska, M., Caplanova, A., Medved, J. and Hudson J. (2006). *"A cross-section apporach to measuring the shadow economy."* Journal of Policy Modeling, Vol. 208. pp. 713-724.

[13] Sklenar, P. and Burger, I. (2006). *"Impact of the Slovak Tax Reform on Firms' Tax Evasion: A Comparative Study of the Czech and Slovak Republic."* RRCV Paper No. 33. *http://www.cerge-ei.cz/pdf/gdn/RRCV_33_paper_01.pdf*

Table 1. Percentages of individuals across sectors and age and education groups: CZ-SW (10)

	All		15-24		25-39		40-64		Low education		High education	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
I	20	18	9	8	25	21	21	19	18	15	22	20
F	53	39	29	19	66	45	55	42	49	32	59	47
U	5	6	7	6	5	7	4	4	6	7	3	4
O	23	38	56	67	4	26	20	35	27	46	16	29
Total number of obs.	901768	958203	190203	179681	261386	274225	450179	504297	557721	518032	343955	440088

Note: I: Informal sector, F: Formal sector, U: Unemployment, O: Out of labor force

Table 2. Percentages of individuals across sectors and age and education groups: CZ-SE

	All		15-24		25-39		40-64		Low education		High education	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
I	10	4	3	1	13	5	11	5	10	3	11	5
F	63	53	36	27	78	62	66	57	59	45	71	62
U	4	5	6	5	4	7	4	4	6	7	3	4
O	22	38	55	66	4	26	19	34	26	46	16	29
Total number of obs.	754682	784104	152748	143664	221997	225130	379937	415310	465566	421824	289037	362225

Note: I: Informal sector, F: Formal sector, U: Unemployment, O: Out of labor force

Table 3. Percentages of individuals across sectors and age and education groups: SVK-SW (10)

	All		15-24		25-39		40-64		Low education		High education	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
I	21	19	8	9	29	28	22	19	17	14	26	24
F	39	29	17	13	52	42	42	29	33	20	47	38
U	13	11	16	12	14	15	10	9	16	13	8	9
O	28	41	58	66	5	15	26	43	34	54	19	29
Total number of obs.	275483	291800	65921	63090	77164	75698	132398	153012	155758	144719	119725	147081

Note: I: Informal sector, F: Formal sector, U: Unemployment, O: Out of labor force

Table 4. Percentages of individuals across sectors and age and education groups: SVK-SE

	All		15-24		25-39		40-64		Low education		High education	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
I	7	2	2	1	10	3	7	3	6	1	8	3
F	58	51	29	27	74	71	61	51	50	38	68	64
U	11	10	15	12	12	13	9	8	15	12	7	8
O	24	36	54	61	4	13	22	39	30	49	17	25
Total number of obs.	317984	329766	71336	68430	92908	89246	153740	172090	179043	160187	138941	169579

Note: I: Informal sector, F: Formal sector, U: Unemployment, O: Out of labor force

Table 5. Percentages of individuals in informal economy

Czech Republic	SW (10)	SE	Population	**Slovak Republic**	SW (10)	SE	Population
Males	51	71	49	*Males*	51	74	49
Females	49	29	51	*Females*	49	26	51
Married	68	72	59	*Married*	69	74	59
Single/divorced/widowed	32	28	41	*Single/divorced/widowed*	31	26	41
High education	48	47	42	*High education*	59	56	48
Low education	52	53	58	*Low education*	41	44	52

Note: SW (10): small workplaces with 10 and fewer employees used as a measure of informal sector, SE: self-employment used as a measure of informal sector

Table 6. Intensity matrix, Propensity matrix and Duration: CZ-SW (10)

	Males					Females			
	Intensity matrix								
	I	*F*	*U*	*O*		*I*	*F*	mn1c*U*	*O*
I	-0.088	0.030	0.038	0.020	*I*	-0.126	0.026	0.043	0.057
F	0.012	-0.076	0.040	0.024	*F*	0.010	-0.113	0.039	0.064
U	0.186	0.566	-0.881	0.129	*U*	0.204	0.400	-0.773	0.168
O	0.015	0.043	0.044	-0.102	*O*	0.019	0.041	0.042	-0.103

	Propensity matrix								
	I	*F*	*U*	*O*		*I*	*F*	mn1c*U*	*O*
I		0.343	0.427	0.231	*I*		0.206	0.343	0.450
F	0.162		0.519	0.319	*F*	0.091		0.342	0.567
U	0.212	0.643		0.146	*U*	0.264	0.518		0.218
O	0.145	0.422	0.432		*O*	0.188	0.400	0.412	

	Average duration (in years)							
	I	*F*	*U*	*O*	*I*	*F*	mn1c*U*	*O*
	11.321	13.114	1.135	9.759	7.921	8.868	1.294	9.736

Note: CZ-SW (10): Czech Republic, small workplaces with 10 and fewer employees used as a measure of informal sector
Intensity matrix: Each element of the matrix (except of diagonal, which has also technical meaning) is instantaneous rates of transition between state i and j
Propensity matrix: It also shows instantaneous rates of transition between sectors, but it accounts for total turnover in given sector

Table 7. Intensity matrix, Propensity matrix and Duration: CZ-SE

	Males					Females			

Intensity matrix

	I	F	U	O		I	F	U	O
I	-0.065	0.033	0.020	0.012	I	-0.091	0.036	0.022	0.033
F	0.006	-0.072	0.041	0.024	F	0.003	-0.107	0.041	0.063
U	0.065	0.707	-0.900	0.128	U	0.030	0.584	-0.782	0.168
O	0.005	0.055	0.044	-0.104	O	0.003	0.058	0.042	-0.104

Propensity matrix

	I	F	U	O		I	F	U	O
I		0.511	0.305	0.184	I		0.396	0.245	0.358
F	0.087		0.571	0.342	F	0.030		0.382	0.588
U	0.072	0.786		0.142	U	0.038	0.747		0.215
O	0.046	0.530	0.425		O	0.033	0.559	0.408	

Average duration (in years)

| I	F	U	O	I	F	U	O
15.438	13.966	1.111	9.574	11.000	9.342	1.279	9.632

Note: CZ-SE: Czech Republic, self-employment used as a measure of informal sector
Intensity matrix: Each element of the matrix (except of diagonal, which has also technical meaning) is instantaneous rates of transition between state i and j
Propensity matrix: It also shows instantaneous rates of transition between sectors, but it accounts for total turnover in given sector

Table 8. Intensity matrix, Propensity matrix and Duration: SVK-SW (10)

	Males					**Females**			

Intensity matrix

	I	*F*	*U*	*O*		*I*	*F*	*U*	*O*
I	-0.063	0.018	0.031	0.013	*I*	-0.068	0.014	0.031	0.023
F	0.007	-0.063	0.040	0.016	*F*	0.007	-0.059	0.033	0.020
U	0.092	0.219	-0.386	0.075	*U*	0.109	0.147	-0.329	0.074
O	0.012	0.024	0.071	-0.107	*O*	0.010	0.012	0.044	-0.065

Propensity matrix

	I	*F*	*U*	*O*		*I*	*F*	mn1c*U*	*O*
I		0.293	0.499	0.207	*I*		0.209	0.458	0.333
F	0.112		0.640	0.248	*F*	0.113		0.553	0.334
U	0.238	0.568		0.194	*U*	0.330	0.445		0.225
O	0.108	0.228	0.664		*O*	0.150	0.179	0.671	

Average duration (in years)

I	*F*	*U*	*O*		*I*	*F*	mn1c*U*	*O*
15.968	15.939	2.591	9.327		14.802	16.885	3.036	15.284

Note: SVK-SW (10): Slovak Republic, small workplaces with 10 and fewer employees used as a measure of informal sector
Intensity matrix: Each element of the matrix (except of diagonal, which has also technical meaning) is instantaneous rates of transition between state i and j
Propensity matrix: It also shows instantaneous rates of transition between sectors, but it accounts for total turnover in given sector

Table 9. Intensity matrix, Propensity matrix and Duration: SVK-SE

	Males					Females			

Intensity matrix

	I	F	U	O		I	F	U	O
I	-0.039	0.021	0.011	0.006	I	-0.051	0.027	0.013	0.010
F	0.005	-0.069	0.046	0.018	F	0.002	-0.061	0.036	0.023
U	0.020	0.359	-0.452	0.074	U	0.011	0.295	-0.380	0.073
O	0.002	0.043	0.071	-0.117	O	0.001	0.026	0.044	-0.071

Propensity matrix

	I	F	U	O		I	F	U	O
I		0.553	0.290	0.157	I		0.534	0.264	0.202
F	0.066		0.666	0.268	F	0.035		0.585	0.381
U	0.044	0.794		0.162	U	0.029	0.778		0.193
O	0.021	0.368	0.611		O	0.013	0.365	0.622	

Average duration (in years)

I	F	U	O		I	F	U	O
25.916	14.491	2.210	8.547		19.739	16.442	2.632	14.165

Note: SVK-SE: Slovak Republic, self-employment used as a measure of informal sector
Intensity matrix: Each element of the matrix (except of diagonal, which has also technical meaning) is instantaneous rates of transition between state i and j   Propensity matrix: It also shows instantaneous rates of transition between sectors, but it accounts for total turnover in given sector

Table 10. Mobility indexes across genders, age and education groups

	CZ-SW (10)	CZ-SE	SVK-SW (10)	SVK-SE
All	0.281	0.275	0.142	0.153
Males	0.287	0.285	0.155	0.169
Females	0.279	0.271	0.130	0.140
15-24	0.425	0.401	0.214	0.220
25-39	0.300	0.298	0.163	0.181
40-64	0.226	0.221	0.112	0.120
Low education	0.257	0.247	0.124	0.132
High education	0.353	0.352	0.188	0.203

Figure 1. Intensities, propensities and adjusted propensities between formal and proxied informal sector
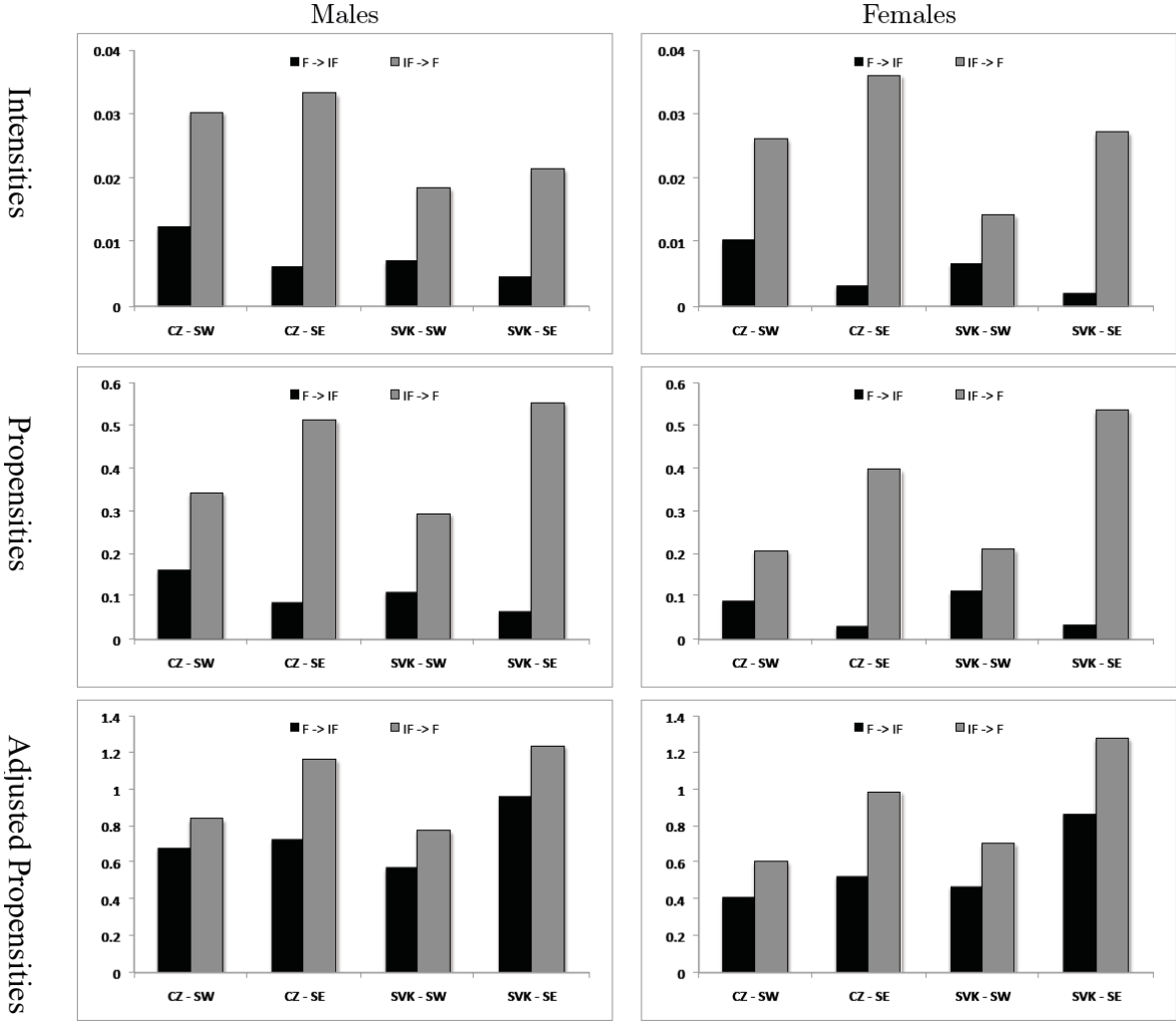
Note: F -> IF: Transition from formal employment into proxied informal employment, IF -> F: Transition from informal employment into formal employment

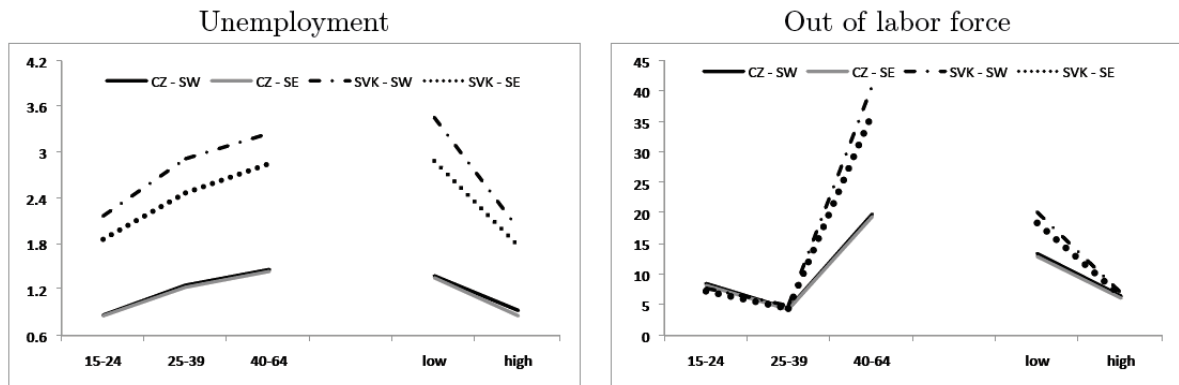**Figure 2. Average duration in each sector (in years)**
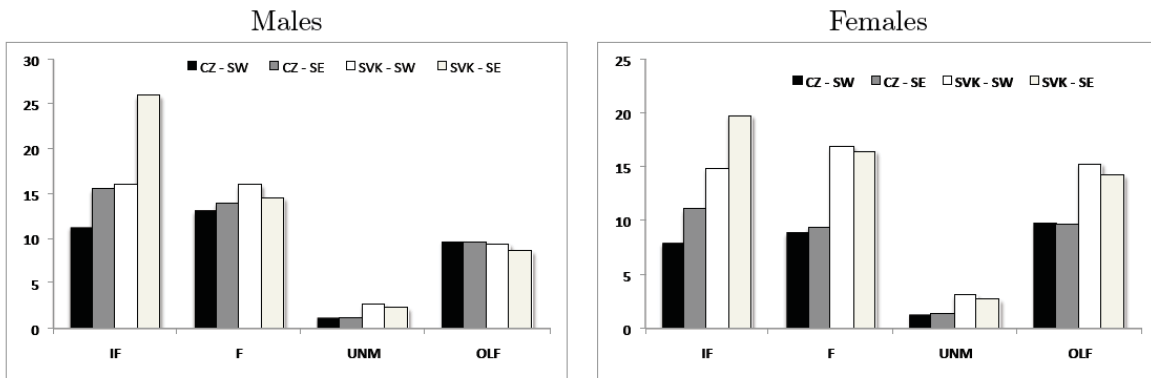
Note: F: Informal sector, F: Formal sector, UNM: Unemployment, OLF: Out of labor force
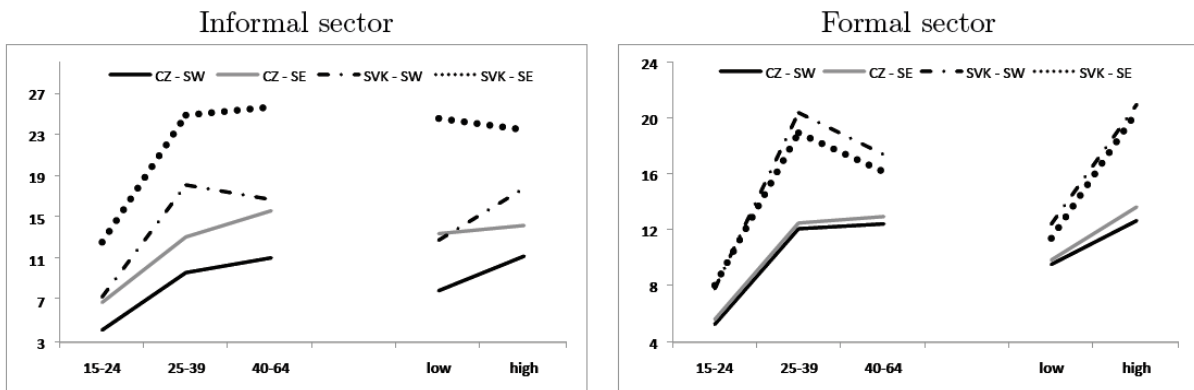
Figure 3. Mobility index
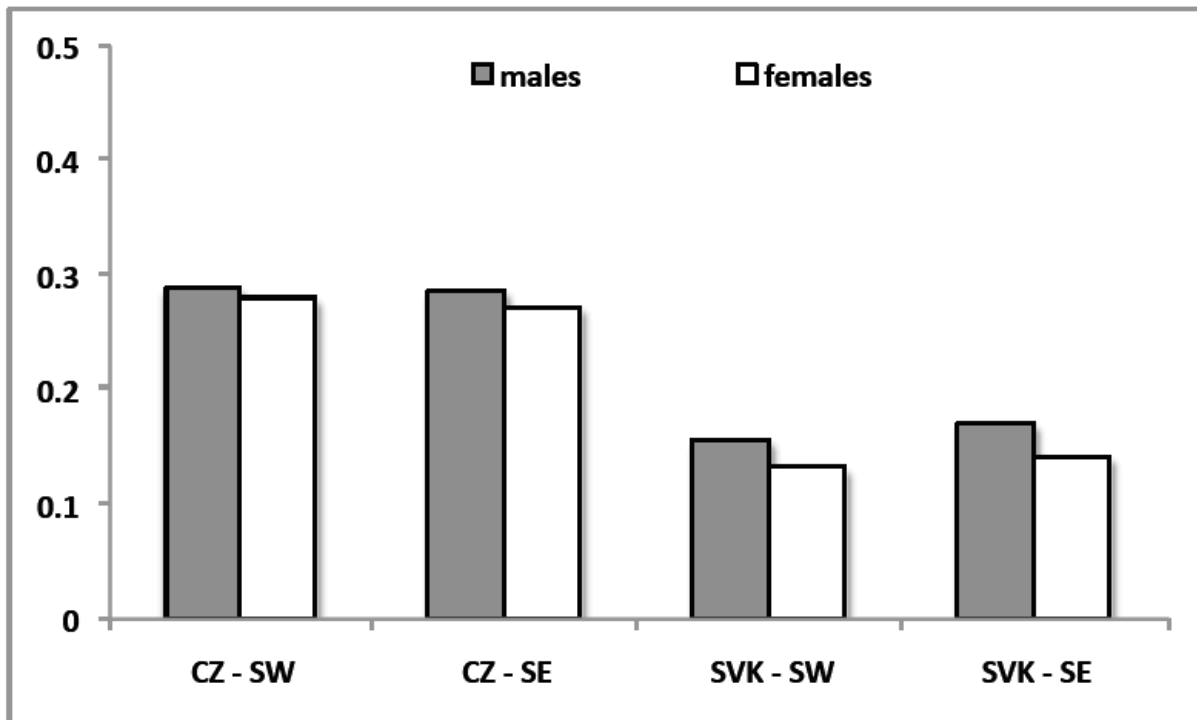
Figure 4. Mean duration in unemployment and out of labor force

Unemployment

Out of labor force

Note: Low education: those without school leaving exam called "maturita" , High education: those with school leaving exam called "maturita" or higher education

Figure 5. Mean duration in employment by sector

Informal sector

Formal sector

Figure 6. Propensities into employment from unemployment by sector

Informal sector

Formal sector

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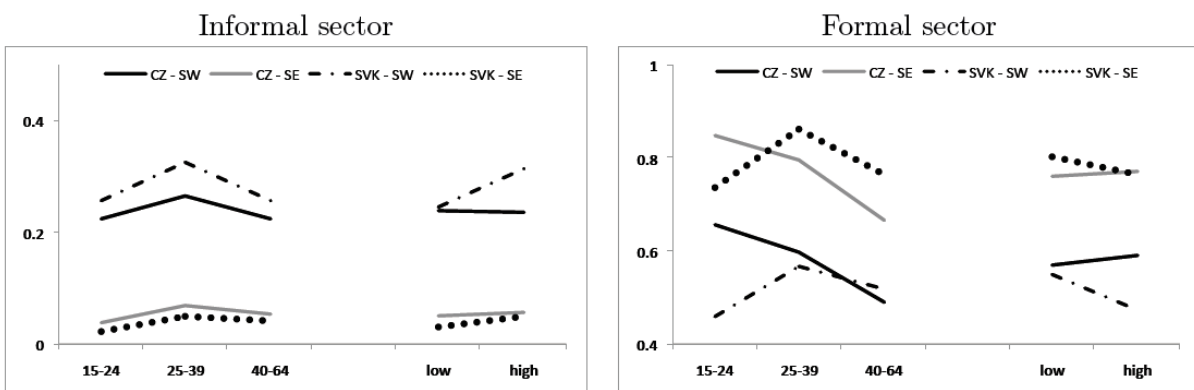
Figure 7. Propensities into employment from out of labor force by sector

Informal sector   Formal sector
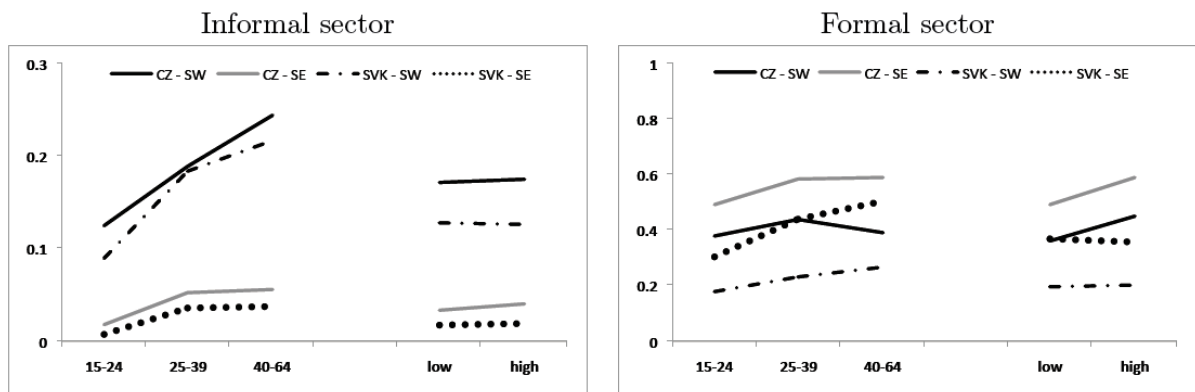
Figure 8. Shares of formal sector and GDP
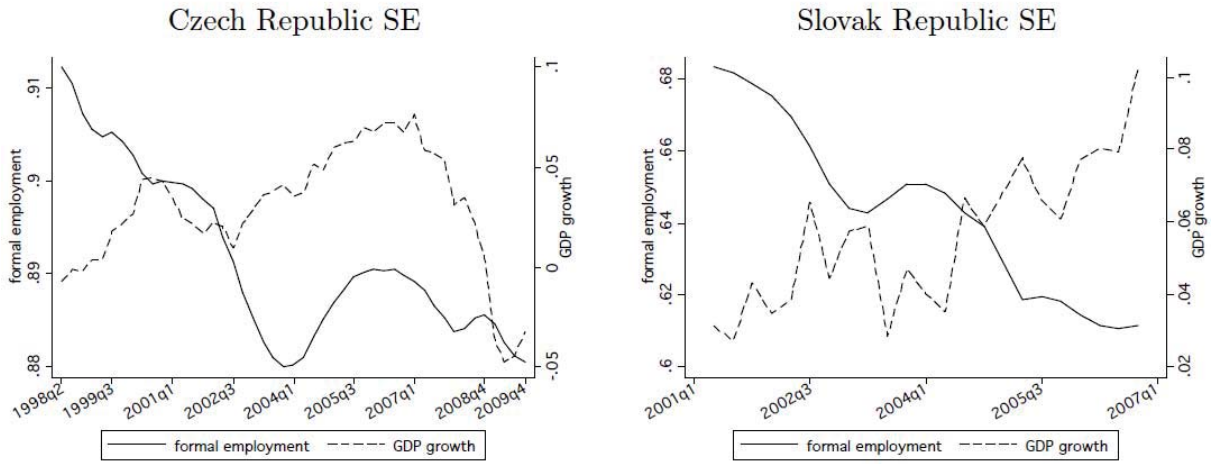
Note: Formal employment denotes the ratio of formal sector size to total employment. Source of GDP growth: OECD.StatExtracts available at http://stats.oecd.org

Figure 9. Unemployment rate and GDP
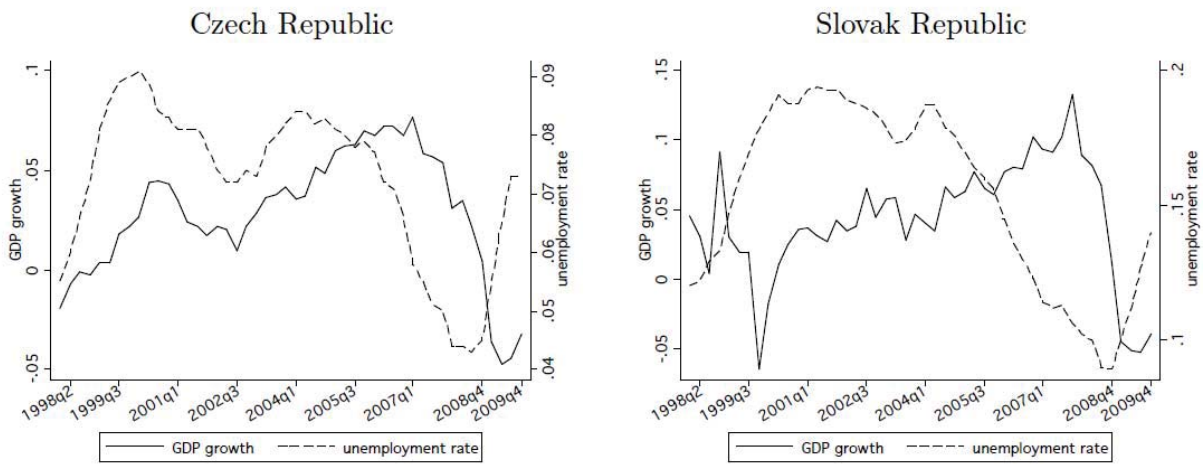
Note: Source of GDP growth and Unemployment rate: OECD.StatExtracts available at http://stats.oecd.org

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Figure 10. Shares of informal economy in labor force

Czech Republic SW (10)

Czech Republic SE

Slovak Republic SW (10)

Slovak Republic SE
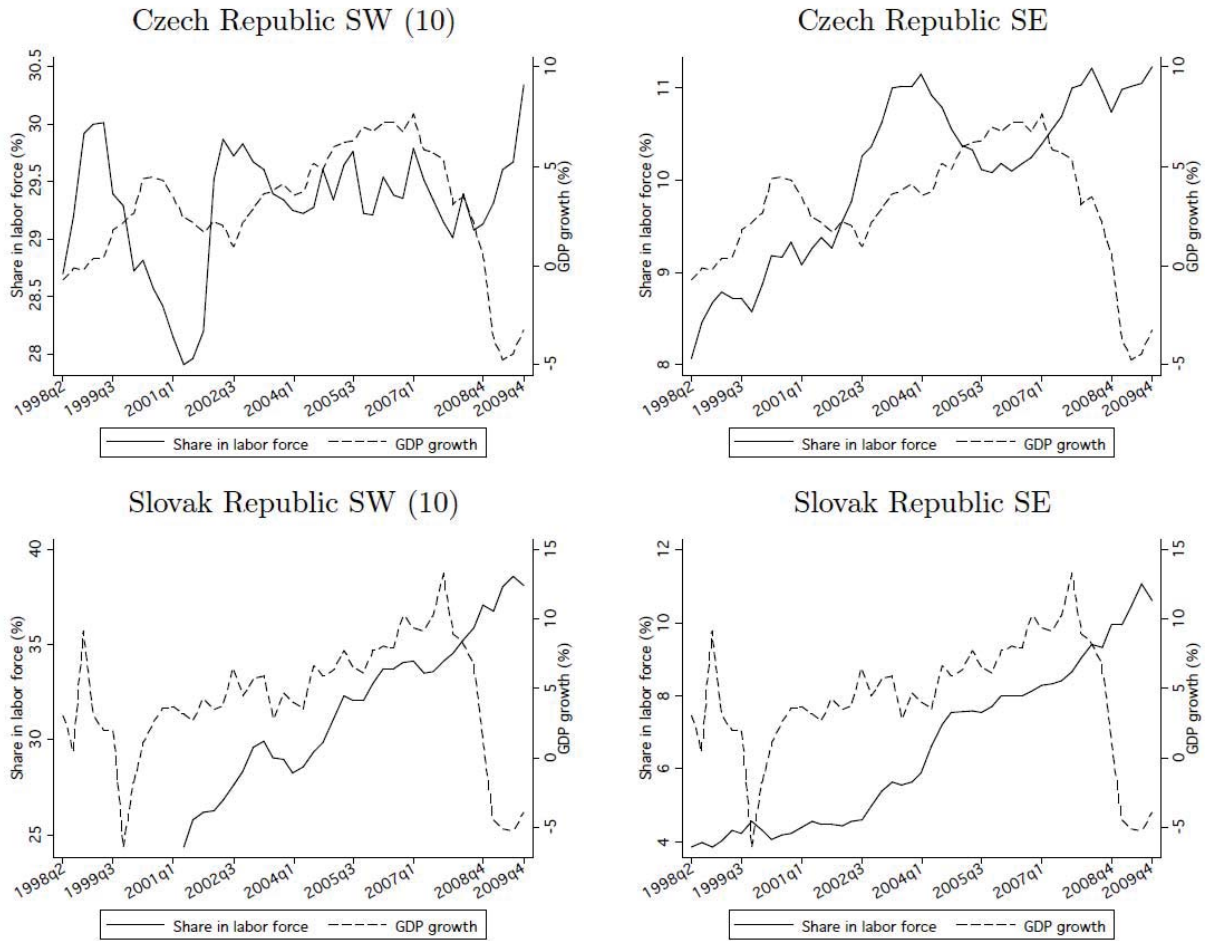
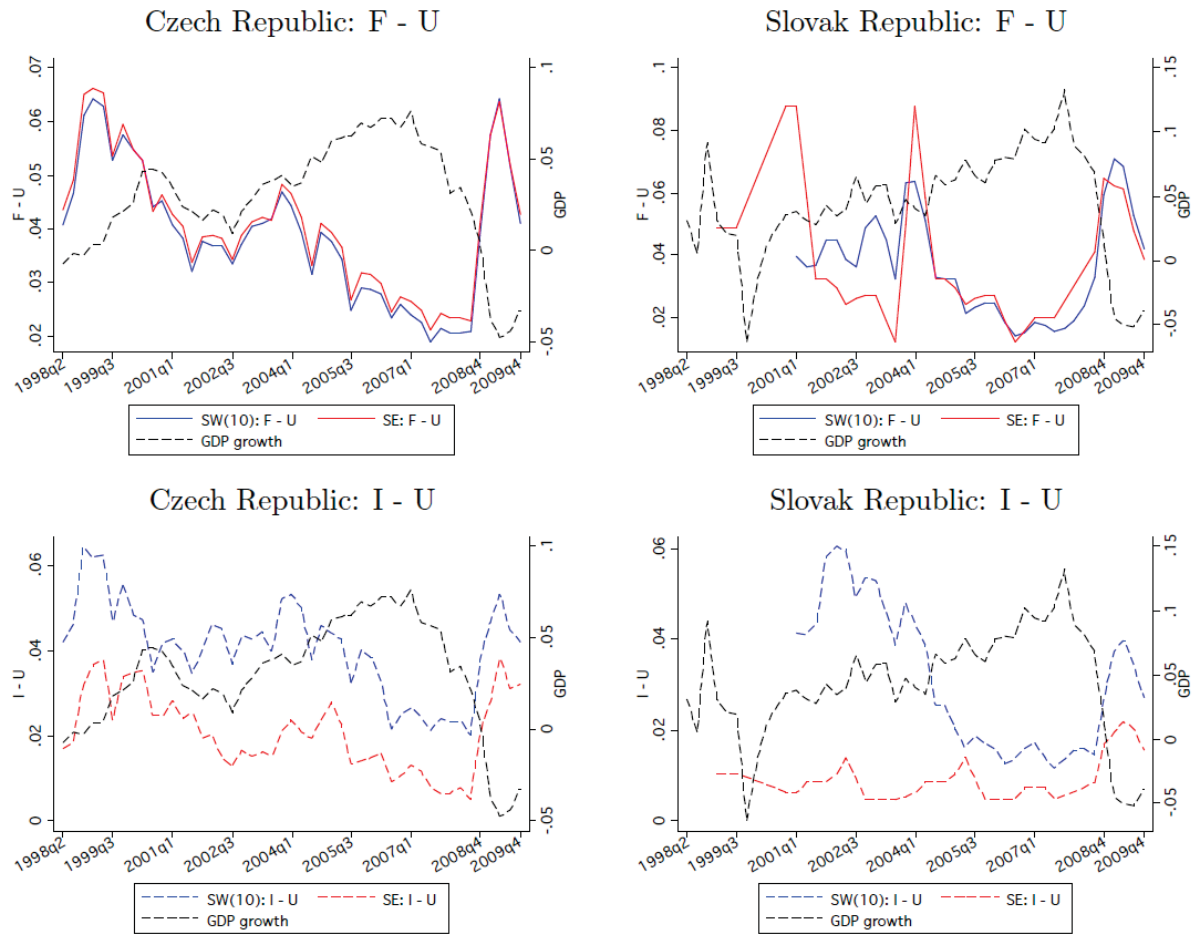**Figure 11. Transitions between formal and informal employment**
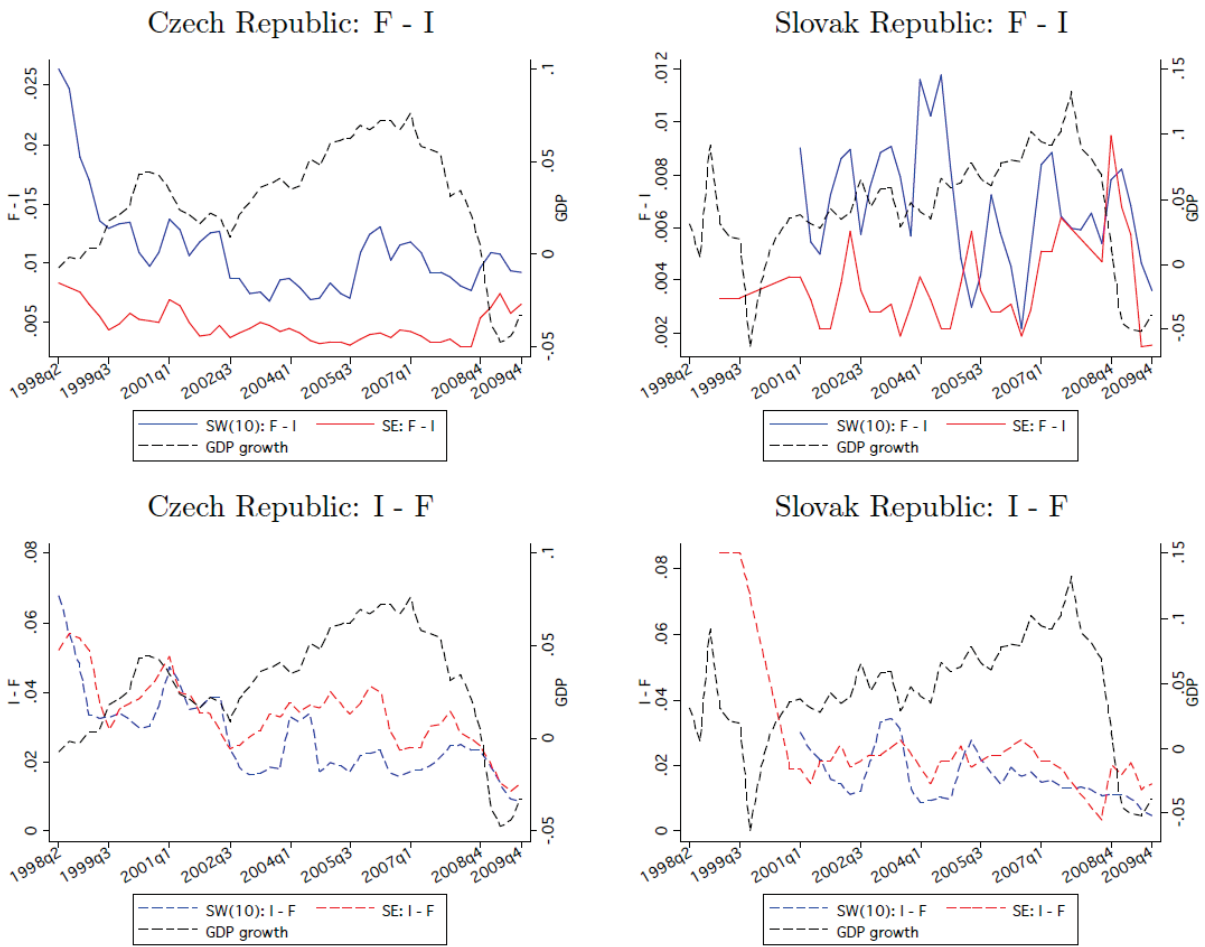
Note: F - I: transitions from formal into informal sector. I - F: transitions from informal into formal sector. The underlying transitions are computed from the intensity matrices computed separately for every quarter and denote the raw instantaneous probability of transition between the respective states.
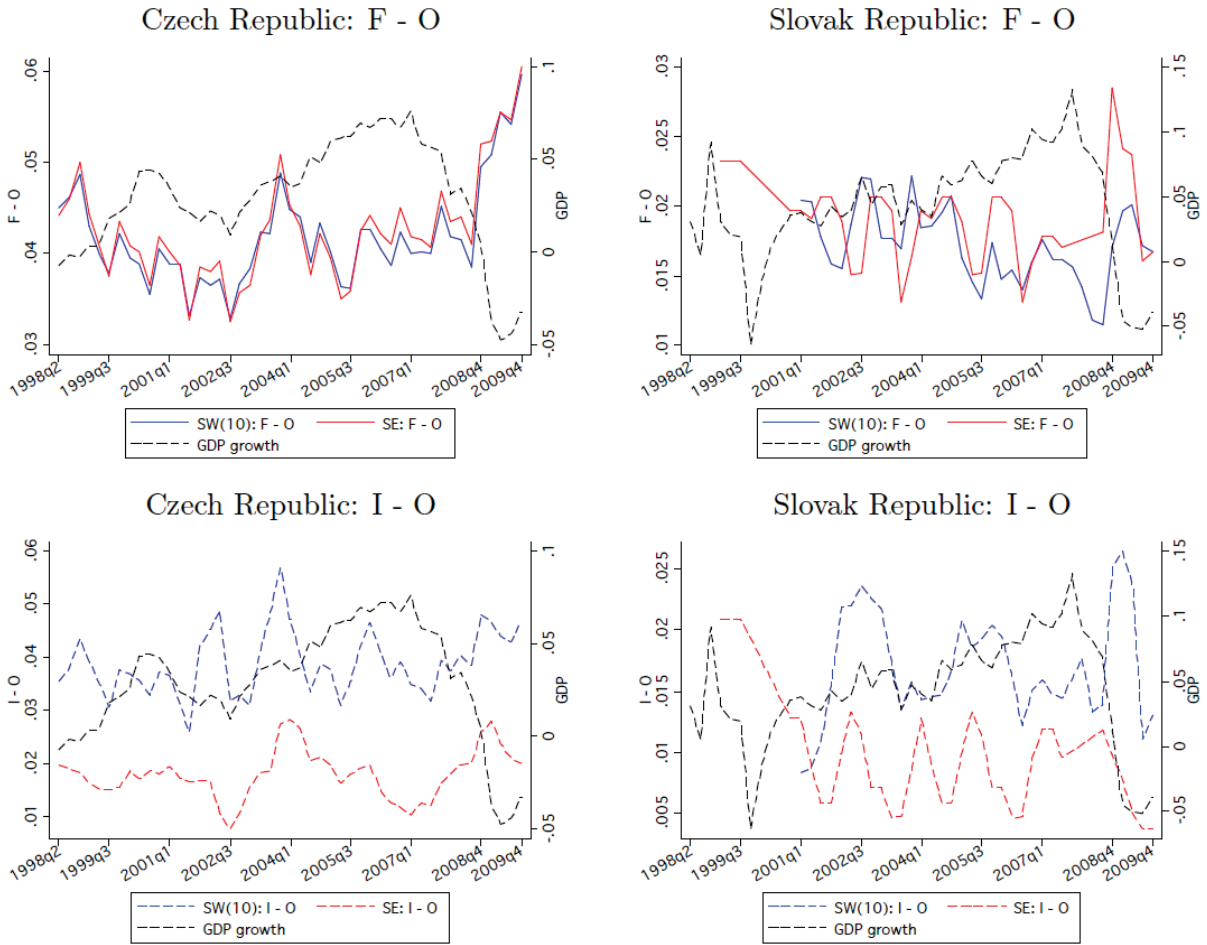
Figure 12. Transitions between formal employment and unemployment
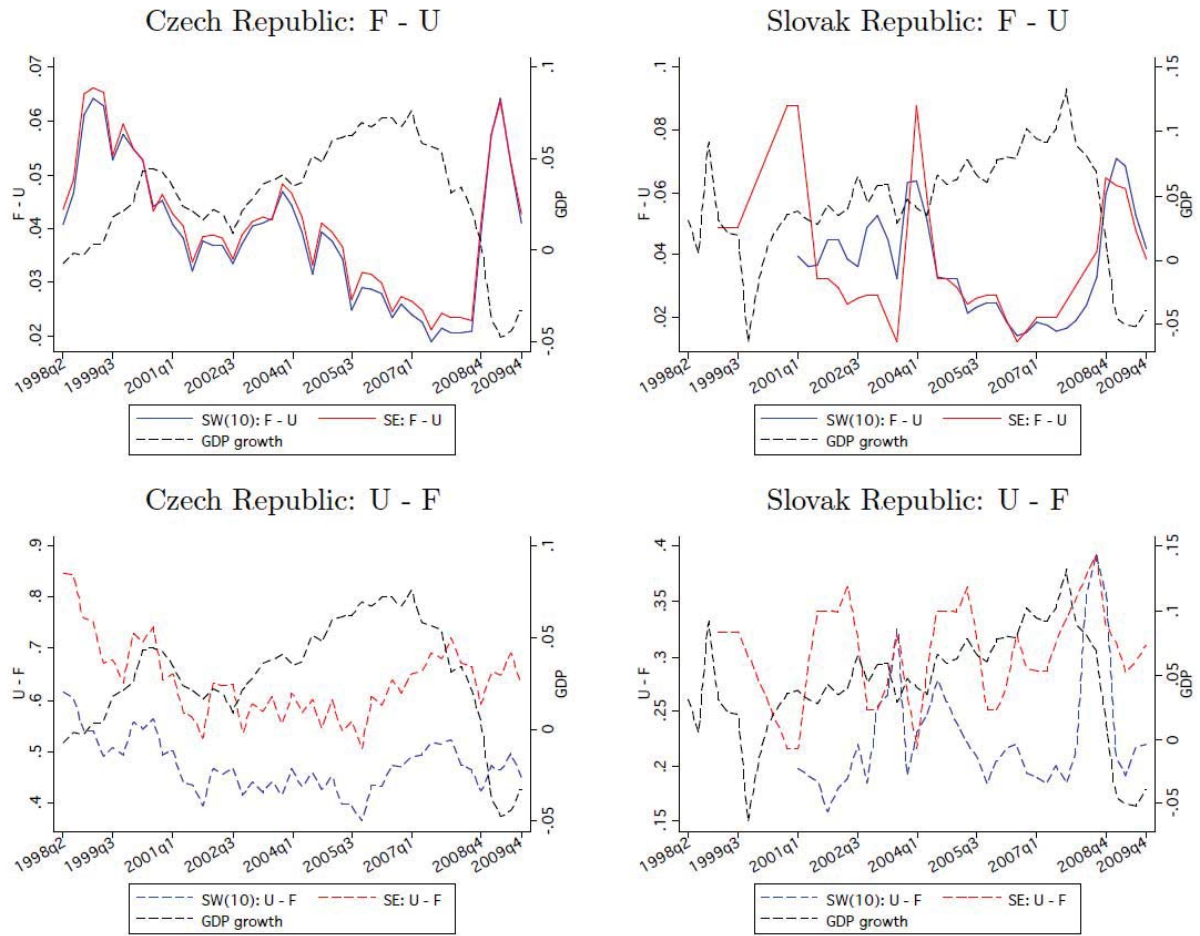
Note: F - U: transitions from formal sector into unemployment. U - F: transitions from unemployment into formal sector. The underlying transitions are computed from the intensity matrices computed separately for every quarter and denote the raw instantaneous probability of transition between the respective states.

Figure 13. Transitions between formal employment and out of labor force
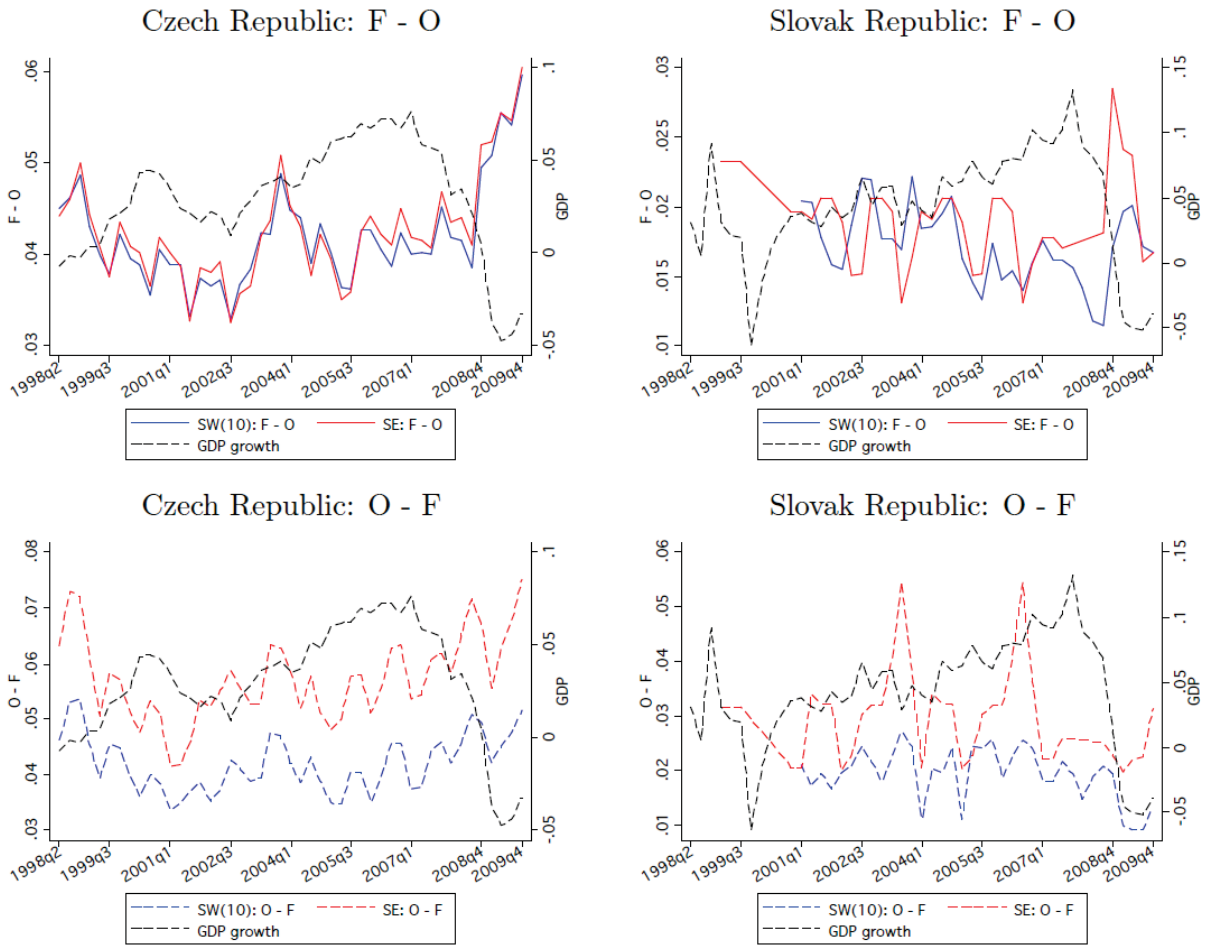
Note: F - O: transitions from formal sector into Out of labor force state. O - F: transitions from Out of labor force state into formal sector. The underlying transitions are computed from the intensity matrices computed separately for every quarter and denote the raw instantaneous probability of transition between the respective states.

Figure 14. Transitions between formal and informal sectors and unemployement
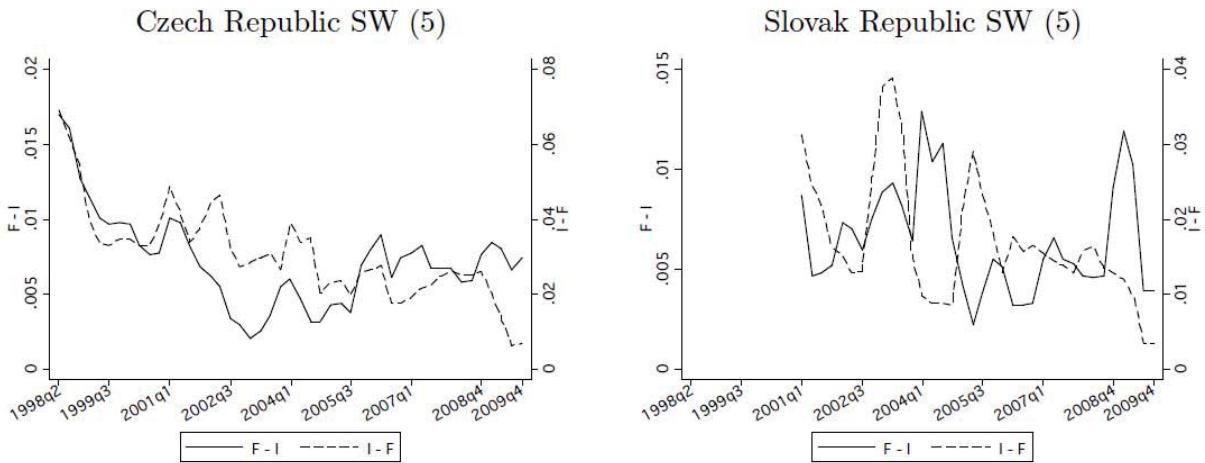

Note: F - U: transitions from formal sector into unemployment. I - U: transitions from informal sector into unemployment. The underlying transitions are computed from the intensity matrices computed separately for every quarter and denote the raw instantaneous probability of transition between the respective states.

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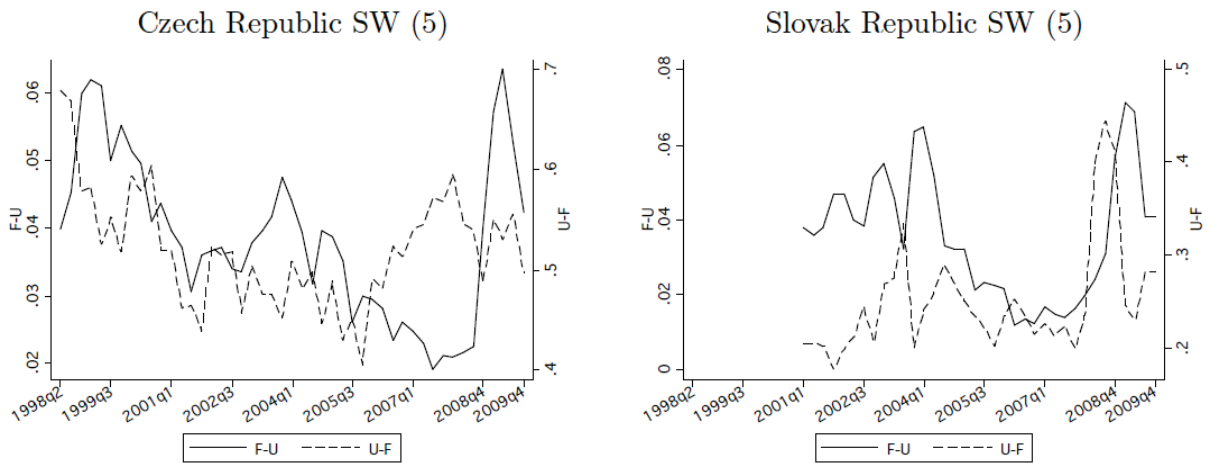**Figure 15. Transitions between formal and informal sectors and out of labor force**

Note: F - O: transitions from formal sector into Out of labor force state. I - O: transitions from informal sector into out of labor force state. The underlying transitions are computed from the intensity matrices computed separately for everyquarter and denote the raw instantaneous probability of transition between the respective states.

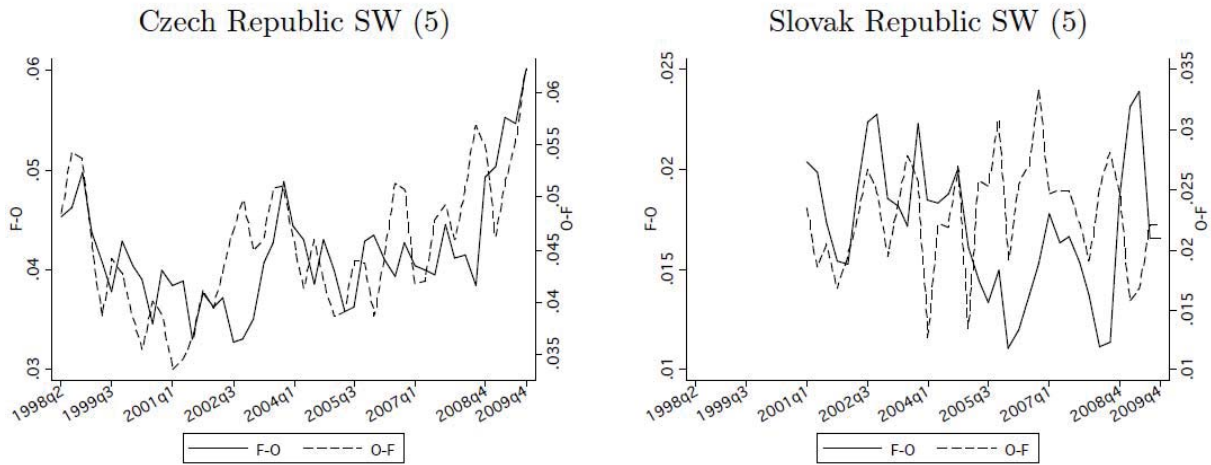**Figure 16. Transitions between formal and informal employment**

Note: F - I: transitions from formal into informal sector. I - F: transitions from informal into formal sector. The underlying transitions are computed from the intensity matrices computed separately for every quarter and denote the raw instantaneous probability of transition between the respective states.

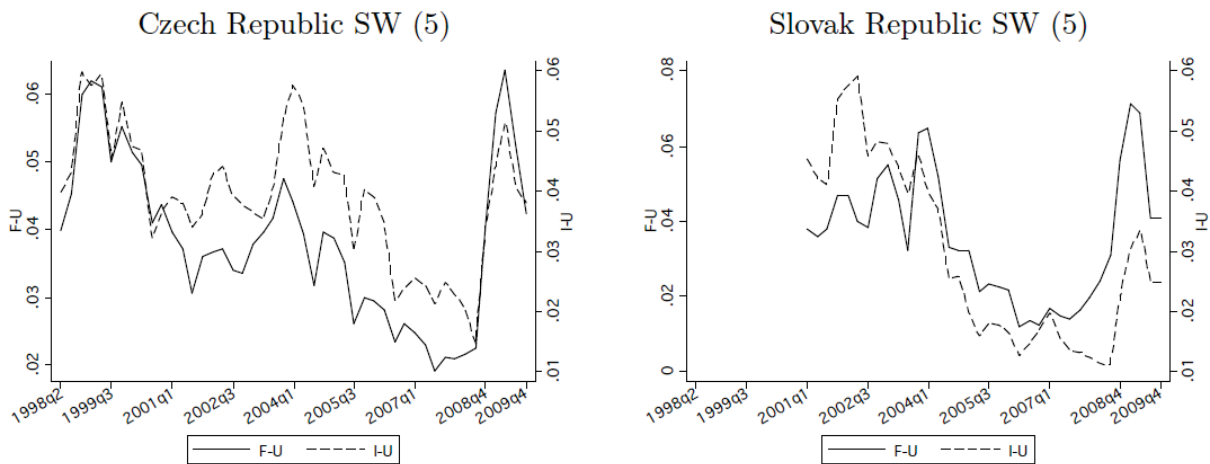**Figure 17. Transitions between formal employment and unemployment**

Note: F - U: transitions from formal sector into unemployment. U - F: transitions from unemployment into formal sector. The underlying transitions are computed from the intensity matrices computed separately for every quarter and denote the raw instantaneous probability of transition between the respective states.

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Figure 18. Transitions between formal employment and out of labor force

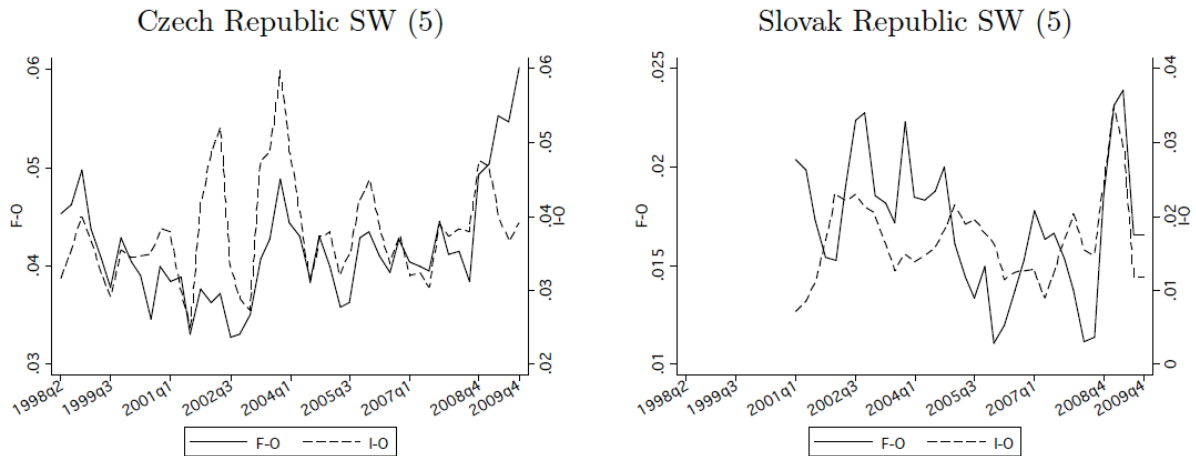Czech Republic SW (5)   Slovak Republic SW (5)

Note: F - O: transitions from formal sector into Out of labor force state. O - F: transitions from Out of labor force state into formal sector. The underlying transitions are computed from the intensity matrices computed separately for every quarter and denote the raw instantaneous probability of transition between the respective states.

Figure 19. Transitions between formal and informal sectors and unemployment

Czech Republic SW (5)   Slovak Republic SW (5)

Note: F - U: transitions from formal sector into unemployment. I - U: transitions from informal sector into unemployment. The underlying transitions are computed from the intensity matrices computed separately for every quarter and denote the raw instantaneous probability of transition between the respective states.

Figure 20. Transitions between formal and informal sectors and out of labor force

Czech Republic SW (5)   Slovak Republic SW (5)

Note: F - O: transitions from formal sector into Out of labor force state. I - O: transitions from informal sector into out of labor force state. The underlying transitions are computed from the intensity matrices computed separately for everyquarter and denote the raw instantaneous probability of transition between the respective states.