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Shocks and rigidities as determinants of CEE labour markets' performance

A panel SVECM approach[1]

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Abstract

In this article, the impact of real wage, productivity, labour demand and supply shocks on eight Central and Eastern European (CEE) economies from 1996–2007 is analysed with a panel structural vector error correction model. A set of long-run restrictions derived from the dynamic stochastic general equilibrium (DSGE) model is used to identify structural shocks, and fluctuations in foreign demand are controlled for. We find that the propagation of shocks on CEE labour markets resembles that found for OECD countries. Labour demand shocks emerge as the main determinant of employment and unemployment variability in the short-to-medium run, but wage rigidities were equally important for observed labour market performance, especially in Poland, Czech Republic and Lithuania. We associate these rigidities with collective bargaining, minimum wage, active labour market policies and employment protection legislation.

JEL classifications: C32, E24, E32, J20, J60, P23.
Keywords: Unemployment, rigidities, transition economies, cointegration, structural VECM, panel econometrics, DSGE models.

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1. Introduction

Since the early 1990s, most Central and Eastern European countries have managed to transform centrally planned economies and integrate themselves into a global economic system. Particular success was shared by eight states – Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia – who all joined the European Union in 2004. In this article, we focus on that group, the NMS8. In the early 1990s, macroeconomic developments in the NMS8 were driven by transition shocks. With time, however, these were absorbed and business cycles in most of the NMS8 began to follow a coordinated pattern of upturns and slowdowns, typical of free-market economies. At the same time, average GDP growth rates and the amplitude of fluctuations differed within the region. In 1997–1998, the share of unemployed among working-age population in the NMS8 was 6.5 percent on average, and the difference between the lowest (Czech Republic) and highest unemployment country (Slovakia) was less than 4 percentage points.[2] Within two years, the average exceeded 8 percent and the gap between the lowest (Hungary) and the highest (Poland) unemployment country amounted to 10 percentage points. In 2007, average unemployment again fell to 5 percent, and the spread between the lowest (Lithuania) and highest (Slovakia) was once more down to less than 5 percentage points.

An important question to ask is to what extent these different evolutions were due to idiosyncratic disturbances, and to what extent to country-specific, possibly institutionally driven, ability to absorb shocks.[3] In this article, we try to address this question empirically using a structural vector error correction model (SVECM) estimated on the panel of NMS8 for the period 1996–2007. We account for both supply side (productivity, labour supply and wages) and demand side (foreign trade and internal labour demand) shocks. This approach constitutes a generalization of SVAR, the approach initiated by Blanchard and Quah (1989) in their seminal paper and later developed by Gamber and Joutz (1993), Dolado and Jimeno (1997), Balmaseda *et al.* (2000) and others. However, we allow for the non-stationarity of modelled variables and estimate a SVECM with one cointegration relationship. We consider a system of four domestic variables (GDP per worker, real wages, employment and unemployment) and control for fluctuations of foreign demand. As far as domestic variables are concerned, analogous models were applied by Jacobson *et al.* (1997) for three Scandinavian economies, by Breitung *et al.* (2004) for Canada, and Brüggemann (2006) for Germany. In comparison with these articles, we propose four innovations.

Firstly, our dataset covers Central and Eastern Europe (CEE) economies. Secondly, the model is estimated with a panel estimator that is a modification of

[2] We focus on unemployment indicators instead of the unemployment rate because the differences in the latter are also due to differences in participation rates.

[3] This question was studied for OECD countries by, for example, Layard *et al.* (1991), Bean (1994), Blanchard and Wolfers (2000), Nickell *et al.* (2005), Blanchard (2006), Bassanini and Duval (2006), among others.

Breitung's (2005) two-step method. Thirdly, we explicitly control for external factors – foreign demand fluctuations – and these variables are included in the model as quasi-exogenous, that is, they are treated as exogenous, but all multiplier experiments can be conducted as if they were endogenous. Fourthly, identifying restrictions, usually inferred from a multi-equation stylized labour market model (Balmaseda *et al.*, 2000; Jacobson *et al.*, 1997, 1998), are derived from a structural Dynamic Stochastic General Equilibrium (DGSE) model.

This remainder of this article is organized as follows. Section 2 introduces the DSGE model with a non-Walrasian labour market. Section 3 specifies the empirical SVECM, and explains the panel estimation strategy. In this section we also analyse the dynamic properties of the data. Next, in Section 4, impulse responses and historical variance decompositions are presented. In Section 5, we conduct retrospective simulations of the model which allow us to pinpoint the shocks that drove NMS8 labour markets in 1996–2007 to the greatest extent. We distinguish between original shocks and wage rigidities, which we then quantify and correlate with labour market institutions in Section 6. The final section contains our conclusions.

2. The DSGE model of the labour market

2.1 Introduction

To quantify and interpret the shocks driving NMS8 labour markets, we need to establish a set of plausible restrictions to identify structural disturbances in the econometric model. This set should both be based on the economic theory and take into account statistical properties of the analysed time series. The model presented here provides a catalogue of long-term relationships between structural shocks and economic variables. In Section 3 stationarity and cointegration tests are performed, and then the ultimate set of restrictions is chosen. In this regard we follow *inter alia* Dolado and Jimeno (1997), Jacobson *et al.* (1997), Balmaseda *et al.* (2000); however, we do not use a multi-equation stylized model like these authors, but we apply the DSGE framework. There is a direct correspondence between the variables and shocks of the DSGE model and those analysed empirically. It provides a transparent identification of structural shocks in SVECM. We expect that the long-term response to a given shock in the theoretical model should be reflected in its empirical counterpart.

2.2 The structure of the model

We consider a *textbook* RBC model of a closed economy, supplemented with the labour market modelled in a Mortensen and Pissarides (1994) tradition. Variables top-indexed by e and u refer respectively to the employed and unemployed part of population. In time $t \geq 0$ the economy is populated by N_t agents who form a representative dynasty, that in time $t = 0$ maximizes its expected lifetime utility from consumption, c_t and leisure, $1 - h_t$:

$$U_0 = E_0 \sum_{t=0}^{\infty} \beta^t \left[N_t^e u(c_t^e, 1 - h_t^e) + N_t^u u(c_t^u, 1 - h_t^u) \right],$$

where h_t denotes intensive labour supply. Instantaneous felicity function is of the CRRA class. Population is normalized to one in the steady state, that is, $N_t = e^{\xi_t^N}$, where ξ_t^N is the labour supply shock, which equals zero in the steady state. A household is confronted with the following budget constraints:

$$N_t^e c_t^e + N_t^u c_t^u = N_t^e \times W_t \times h_t^e + \psi \times e^{-\xi_t^V} \times V_t \times W_t + \Pi_t$$
$$N_t^e = (1 - \delta_e) \times N_{t-1}^e + \Phi_t h_{t-1}^u N_t^u$$

where W_t is an hourly real wage, Π_t denotes profits transferred from the production sector, and the term $\psi \times V_t \times W_t$ reflects the total vacancy cost paid by firms to households. Parameter δ_e denotes the exogenous rate of job destruction, whereas Φ_t is the probability for an unemployed person of finding a job. Firms own capital K_t and produce final good Y_t with the standard Cobb–Douglas technology. They maximize the present value, $\Pi_0^A = E_0 \sum_{t=0}^{\infty} \Lambda^t \Pi_t$, of the stream of discounted profits, Π_t, where Λ^t, is a *pricing kernel* reflecting that households are owners of firms. At $t \geq 0$ each producer sets level of investment I_t, extensive labour demand N_t^d and the number of open vacancies V_t, being confronted with the budget constraints in the form:

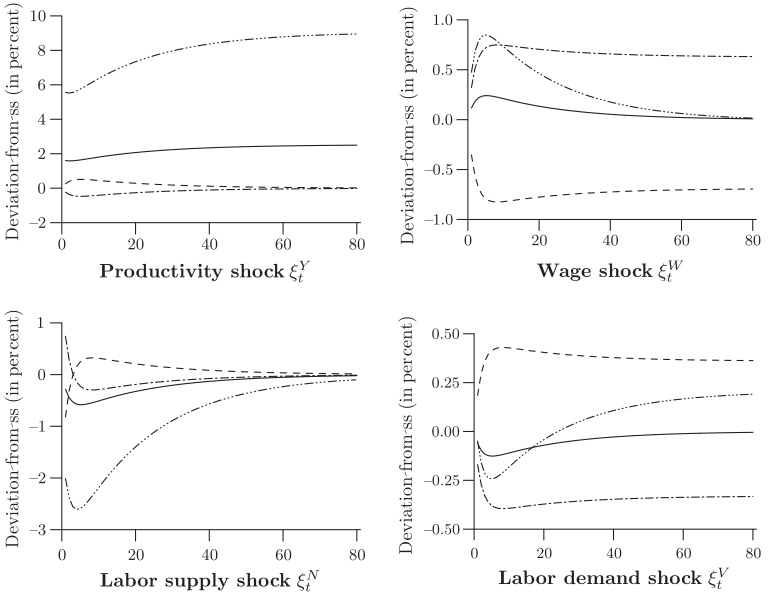
$$\Pi_t = P_t e^{\xi_t^Y} \times K_{t-1}^{\alpha} (N_t^d h_t^d)^{1-\alpha} \qquad - N_t^d h_t^e W_t - I_t - \psi \times e^{-\xi_t^V} \times V_t \times W_t$$
$$K_t = (1 - \delta_k) K_{t-1} + I_t \qquad N_t^d = (1 - \delta_e) \times N_{t-1}^d + \Psi_t V_{t-1}$$

where Ψ_t denotes the probability of filling a vacancy, and ξ_t^Y is a technological shock. Variable ξ_t^V is equal to 0 in the steady state. As it influences the recruitment costs, it can be interpreted as a labour demand shock. We fix $P_t = 1$ as *numeraire*.

As in the empirical analysis, we use variables specified in *per worker* or *per capita* terms, and hours worked are fixed. Wages are negotiated between households and firms in the Nash bargaining. A household's surplus is denoted by $\Gamma_t = \frac{\partial E_0 \mathcal{U}_0}{\partial N_t^e}$, and a firm's by $\Sigma_t = \frac{\partial E_0 \Pi_0^A}{\partial N_t^d}$. When maximizing the total surplus, $(\Sigma_t^V \lambda_t)^{\xi_t^W} (\Gamma_t^N)^{1-\xi_t^W}$, with shadow price of consumption λ_t and recalculating the product into utility units, both parties take into account the first order conditions implied by their optimization problems. These are calculated with respect to job supply N_t^e in case of households, and job demand N_t^d in case of firms. Since the variable ξ_t^W reflects the relative bargaining strength of employees and employers, changes in ξ_t^W can be interpreted as real wage shocks.

Matching technology $M_t = (V_t)^{\theta} (N_t^u)^{1-\theta}$ relates the number of jobs filled M_t to opened vacancies V_t, and total search effort $N_t^u \times h_t^u$. Parameter θ controls the relative importance of each factor. Variable M_t defines the probability of filling a

Figure 1. DSGE model response to permanent structural shocks



Notes: Solid line – labour productivity lp_t; dashed line – employment rate e_t; one-dot line – unemployment indicator u_t, three-dots line – real wages w_t.

vacancy as $\Psi_t = \frac{M_t}{V_t}$, and the probability of finding a job by the unemployed as $\Phi_t = \frac{M_t}{N_t^u}$. Parameters of utility, production and matching functions are calibrated on standard levels. We assume that ξ_t^X, for $X \in \{Y,N,V,W\}$, is governed by the AR(1) process $\xi_t^X = \rho_X \xi_{t-1}^X + \varepsilon_t^X$, where orthogonal disturbances ε_t^X are drawn from normal distributions with mean μ_X, and standard deviation σ_X. Moreover, $\mu_Y = \mu_L = \mu_V = 0$ and $\mu_W = 0.5$, although this choice is generic (other values do not change the long-term properties of the model).

2.3 Long-term properties of the model

Logarithms of labour productivity, employment rate, the unemployment indicator and real wage per worker are denoted by lp_t, e_t, u_t and w_t, respectively. For each $X \in \{Y,N,V,W\}$ if $|\rho_X\| < 1$, the variable in question returns to its steady state level as the shock fades away. It is not the case if $\rho_X = 1$. Jacobson *et al.* (1997) and Balmaseda *et al.* (2000) demonstrate that the number of long-run restrictions in SVECM must be coherent with dynamic properties of the data and the number of cointegrating relationships identified in the system. Tests presented in the next section show that all four domestic variables are non-stationary (in the analysed sample) and suggest the existence of exactly one cointegrating relationship between them. So we set $\rho_Y = \rho_L = \rho_V = \rho_W = 1$.

DSGE model responses to permanent shocks are presented in Figure 1. It can be inferred that in the long run: (1) productivity shock increases wages and labour productivity but is neutral for employment and unemployment; (2) innovation to wage setting process permanently influences employment and unemployment but has no long-term impact on wages and productivity; (3) labour supply disturbance is neutral for all variables; (4) labour demand shock changes the levels of employment, unemployment and wages but is neutral for productivity.

3. The empirical model

We now present the empirical model. Starting with specification of the model and the estimation method, we move to dynamic properties of the data. Identification issues and (reduced form) estimation results are then discussed.

3.1 Specification

Our panel SVECM has the following reduced form:

$$\Delta y_t^n = \alpha^n \beta^T y_{t-1}^n + \sum_{p=1}^{P} \Gamma_p \Delta y_{t-p}^n + d^n + \xi_t^n \tag{1}$$

for $t = 1,2,\ldots,T$, where y_t^n, $n = 1,2,...,N$, stands for a $m \times 1$ vector of n-th country's regressors, r for a dimension of the cointegration space in which basis vectors are stored in a $m \times r$ matrix β, and α^n is a $m \times r$ matrix of loading factors. Γ_ps, $p = 1,2,\ldots,P$, are $m \times m$ matrices and d^n is a $m \times 1$ vector of individual effects. We assume that β and Γ_ps are common across countries.

Formally, all variables in (1) are endogenous. Panel setting, however, requires controlling for common effects (Breitung and Pesaran, 2008). To do so, we partition y_t^n into $y_t^n = (y_t^{n,1}, y_t^{n,2})^T$. Vectors $y_t^{n,1}$ and $y_t^{n,2}$ represent variables called strictly endogenous and quasi-exogenous, respectively.[4] We assume that quasi-exogenous variables are not influenced by strictly endogenous ones, and do not enter cointegration relationships. This approach has several advantages. Dynamic properties of all modelled variables are accounted for within one model. Retrospective experiments based on the Beveridge–Nelson representation of y_t^n allow for quasi-exogenous variables and can be conducted in a standard way. In our case $m = 6$, $m_1 = 4$, $r = 1$ and $P = 1$, and the following exclusion restrictions are imposed:

[4] Their sizes are $m_1 \times 1$ and $(m - m_1) \times 1$, respectively.

$$\Delta\begin{pmatrix} y_t^{n,1} \\ y_t^{n,1} \end{pmatrix} = \begin{pmatrix} * \\ * \\ * \\ * \\ 0 \\ 0 \end{pmatrix} \begin{pmatrix} * & * & * & * & 0 & 0 \end{pmatrix} \begin{pmatrix} y_{t-1}^{n,1} \\ y_{t-1}^{n,1} \end{pmatrix}$$
$$+ \begin{pmatrix} * & * & * & * & * & * \\ * & * & * & * & * & * \\ * & * & * & * & * & * \\ * & * & * & * & * & * \\ 0 & 0 & 0 & 0 & * & * \\ 0 & 0 & 0 & 0 & * & * \end{pmatrix} \Delta\begin{pmatrix} y_t^{n,1} \\ y_t^{n,2} \end{pmatrix} + \begin{pmatrix} * \\ * \\ * \\ * \\ * \\ * \end{pmatrix} + \xi_t^n$$

The reduced form model (1) is estimated with a LS-based procedure. This turns out to be advantageous in comparison with ML-based and non-parametric methods, especially for short time series (Breitung, 2005; Brüggemann and Lütkepohl, 2005). The estimation procedure consists of two steps. In the second step Breitung (2005) is followed. Unlike in Breitung (2005), however, here also the first step involves panel and GLS estimation. To calculate the Beveridge–Nelson representation of y_t^n we follow Hansen (2000). In structural estimation the likelihood is maximized with the Amisano and Giannini (1997) scoring algorithm.

3.2 Data

Our model consists of six variables – four domestic and two foreign ones[5]:

$$y^n = [w^n, (u-n)^n, (e-n)^n, (y-p-n)^n, eu_{HP}^n, cis_{HP}^n]. \tag{2}$$

The domestic block consists of four variables: average real wages, unemployment indicator, employment rate and GDP *per* worker, which follows Jacobson *et al.* (1997), Breitung *et al.* (2004) and Brüggemann (2006). It is modelled as strictly endogenous. Following Breitung and Pesaran (2008) recommendations on controlling for common effects in a panel setting, we include a block of foreign, trade-related variables (eu_{HP} and cis_{HP}, see Table 1), which control for global economic developments, approximated by foreign demand fluctuations. They are modelled as quasi-exogenous.

[5] A balanced panel of quarterly data from 1996 to 2007 is used.

Table 1. Variables and data used

$y-p-e$	Real GDP per worker, measured in Purchasing Power Standards, divided by total employment
$e-n$	Employment rate in population aged 15–64 years
$u-n$	Unemployment indicator (share of unemployed in population aged 15–64 years)
$w-p$	Average real gross wages, in national currency (due to availability of the data) and deflated by HCPI
eu_{HP}	Business cycle (HP filtered) component of exports to the EU15 countries, measured as logarithm of exports in constant prices
cis_{HP}	Business cycle (HP filtered) component of exports to the CIS, measured as logarithm of exports in constant prices

***Notes*:** If not stated otherwise, Eurostat data are used. Average wages in Lithuania for 1996–1997 and in Slovakia for 1996–1999 were calculated from national statistical offices' data. Wages in Poland before 1999 were grossed up. All data on wages had initially been yearly and were disaggregated to quarterly frequency using a Boot-Feibes-Lisman filter. Quarterly labour cost index (Eurostat) was used as a leading variable in filtering.

Due to varying patterns of international trade in the NMS8 economies, their vulnerability to external demand fluctuations can be different.[6] Thus, foreign variables are country-specific. They are calculated as the business cycle component of a given country's exports to major trade partners in the examined period (the EU15 and CIS countries). For the variables' definitions and data description see Table 1.

Now we turn to dynamic properties of the data. Breitung and Pesaran (2008) point out that traditional unit root tests have unacceptably low power in small samples. However, Moon and Perron (2005) indicate that the Pesaran (2007) panel test behaves satisfactorily in small samples. Therefore we use it. Results reported in Table 2 suggest that GDP *per* worker and average real wages should be modelled as I(1) variables. As far as unemployment and employment are concerned, results are not that clear-cut. Generally, tests indicate that these variables should also be modelled as I(1),[7] although it is not in line with empirical studies for other countries.[8] We believe that the non-stationarity of employment and unemployment is a small sample phenomenon.[9] Nevertheless, we proceed assuming that all domestic variables are non-stationary, whereas foreign ones are stationary.

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[6] Illustrated by the Russian crisis in 1998, which caused economic slowdown in Baltic countries but had almost no impact on Slovenia and Hungary.
[7] This was supported by standard univariate tests.
[8] Nelson and Plosser (1982) argued in favour of stationarity of US unemployment; Papell *et al.* (2000) and Johansen (2002) argued in favour of unemployment in several European countries; Camarero *et al.* (2006) and Hurlin (2004) using panel tests rejected the hypothesis that unemployment is I(1) for a range of OECD countries; and León-Ledesma and MacAdams (2004) did so for the CEE economies.
[9] Time series do not reveal sufficient mean reversion in the available (short) sample.

Table 2. Critical probability values of Pesaran (2007) panel unit root test

	I(1) *vs. I*(0)	*I*(2) *vs. I*(1)
GDP per worker	0.165–0.539	0.000
Real wages	0.490–0.994	0.000
Employment rate	0.082–0.180	0.000
Unemployment ind.	0.000–0.283	0.000
EU demand	0.000	0.000
CIS demand	0.000	0.000

***Notes*:** The table reports critical probability values for which the null hypothesis can be rejected. Reported intervals represent ranges for tests with 1 to 3 lags.

To estimate the cointegration rank for the system of domestic variables we apply, country by country, the Saikkonen and Lütkepohl (2000) procedure. Results are reported in Table 3. In five of eight countries, one cointegration relationship was identified. In the case of Latvia and Slovenia, the null of $r = 0$ could not be rejected.[10] For Lithuania, a two or even three-dimensional cointegration space could be considered. However, as $r = 1$ is dominant we condition the following analysis on one homogenous cointegration relationship being identified in the data.[11]

3.3 Estimation results

The common interpretation of a single cointegrating relationship for such a system of domestic variables[12] is that of a wage setting relationship[13]:

$$(w-p) = \underset{(54.19)}{0.701}(y-p-e) + \underset{(7.56)}{0.797}(e-n) + \underset{(6.79)}{0.099}(u-n)\,. \tag{3}$$

One would expect that the GDP per worker coefficient in (3) equals unity, whereas the two remaining ones are zeros. However, the estimation results indicate that in our sample the GDP per worker coefficient is less than 1.[14] GDP per worker growth in the NMS8 might have surpassed labour productivity dynamics because of substantial investment (also in technologically more advanced equipment) in the analysed period.[15] Estimated unemployment and employment coefficients are

[10] Suggesting a VAR in first differences as an alternative.

[11] In line with Jacobson *et al.* (1997)'s result for Scandinavian countries and Brüggemann (2006)'s result for Germany.

[12] Foreign-demand variables are excluded from the cointegrating relationships.

[13] See Breitung *et al.* (2004) and Brüggemann (2006). Cointegration tests suggest that relationship (3) is stationary.

[14] Indeed, as Magda and Szydlowski (2007) show, between 1995 and 2007 GDP per worker grew faster than real wages in all NMS except Lithuania and the Czech Republic.

[15] According to the Eurostat data, the average investment to GDP ratio in 1996–2007 ranged from 21 percent in Poland to 29 percent in Estonia.

Table 3. Critical probability values of Saikkonen and Lütkepohl (2000) cointegration rank test

H_0	Czech Republic	Estonia	Latvia	Lithuania	Hungary	Poland	Slovenia	Slovakia
$r = 0$	0.06	0.00	0.58	0.00	0.00	0.01	0.18	0.01
$r = 1$	0.15	0.28	–	0.00	0.28	0.12	–	0.36
$r = 2$	–	–	–	0.05	–	–	–	–
$r = 3$	–	–	–	0.12	–	–	–	–
r	1	1	0	2	1	1	0	1

***Notes*:** Null is $r = r_0$ and the alternative is $r > r_0$. Results for a test with a constant term and one lagged difference, see Saikkonen and Lütkepohl (2000).

significant which we believe is a small sample phenomenon. The positive unemployment coefficient mirrors the mechanism linking unemployment and average wages: as the unemployment rises, low-productivity, low-wage workers lose jobs relatively more often than high-productivity individuals, so the evolution of average wage in the aftermath of the unemployment increase can be ambiguous.[16]

3.4 Identification

The interpretation of shocks to domestic variables is in line with the DSGE model presented in Section 2. They are thought of as productivity, labour demand, labour supply and wage setting (shifts in the relative bargaining power of employers) shocks, respectively.[17] Innovations to foreign variables are interpreted as foreign demand shocks.

Now we discuss long- and short-run identifying restrictions. One cointegration relationship is accepted, so at least three of four structural shocks can be permanent. In line with the DSGE model (see Figure 1), we assume that: (1) productivity shocks exert only transitory impact on employment and unemployment;[18] (2) wage setting shocks have no long-run effects on average wages;[19] but (3) may influence unemployment and employment in the long-run. Foreign variables do not enter the cointegrating relationship so we assume (4) that they do not influence wages in the long-run. Since they do not cointegrate, (5) they are assumed not to influence each other

[16] Myck *et al.* (2007) show that about $\frac{1}{4}$ of the average wage growth in 1996–2003 in Poland can be attributed to such changes in employment structure.

[17] This interpretation follows Dolado and Jimeno (1997), Jacobson *et al.* (1997), Balmaseda *et al.* (2000), Breitung *et al.* (2004) and Brüggemann (2006).

[18] Thus, we assume a Nickell rule which states that productivity shocks do not influence employment and unemployment in the long-run, and are absorbed by output *per* worker and real wages. This rule was empirically confirmed for a range of developed economies, see Bean and Pissarides (1993), Aghion and Howitt (1994) or Mortensen (2005).

[19] This follows from the DSGE model and is in line with the cointegrating relationship (3).

in the long-run. Finally, (6) domestic variables are restricted to not influence foreign ones in the long-run, in line with quasi-exogeneity of the latter.

Identification is completed with contemporaneous restrictions. We assume that effects of (1) productivity shocks on wages, (2) wage shocks on employment, (3) labour supply shocks on employment, and (4) foreign demand shocks on unemployment, all occur with a lag of at least one quarter.[20]

Long-run (EB) and short-run (B) restriction matrices for $y^n = [w^n, (u-n)^n, (e-n)^n, (y-p-n)^n, eu^n_{HP}, cis^n_{HP}]$ are as follows:

$$EB = \begin{pmatrix} 0 & * & * & * & 0 & 0 \\ * & * & * & 0 & * & * \\ * & * & * & 0 & * & * \\ * & * & * & * & * & * \\ 0 & 0 & 0 & 0 & * & 0 \\ 0 & 0 & 0 & 0 & 0 & * \end{pmatrix} \tag{4}$$

$$B = \begin{pmatrix} * & 0 & * & 0 & * & * \\ * & * & * & * & 0 & 0 \\ 0 & 0 & * & * & * & * \\ * & * & * & * & * & * \\ * & * & * & * & * & * \\ * & * & * & * & * & * \end{pmatrix}. \tag{5}$$

4. Responses to shocks of the NMS labour markets

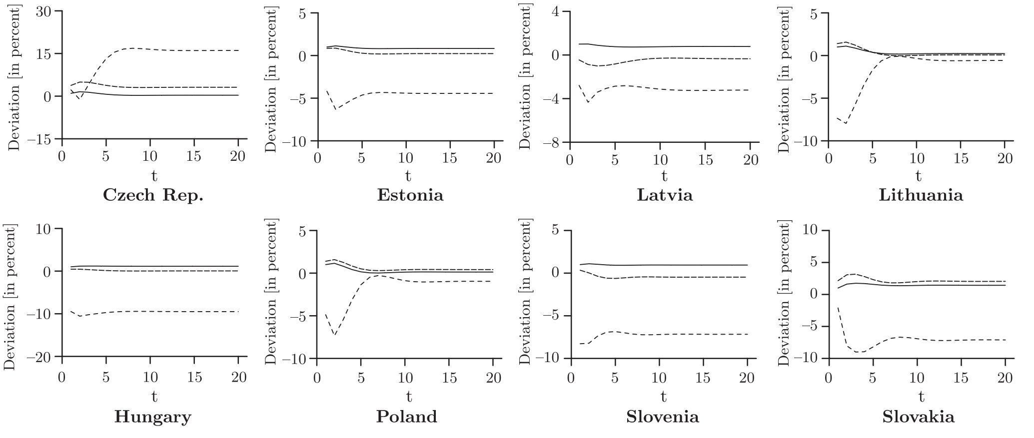
Figures 2–6 show country-specific impulse responses of employment, unemployment, average wages and GDP per worker to structural shocks.[21] In general, propagation of shocks on the NMS labour markets echoes that found in the literature for the OECD countries. Labour demand shocks uniformly increase employment and decrease unemployment in the short-run, and (except for Czech Republic and Lithuania) also in the long-run (Figure 2).[22] In countries like Poland,

[20] So foreign demand shocks directly impact domestic labour market only *via* GDP and employment.

[21] IRFs are normalized in such a way that the initial response of a given variable to its structural disturbance (e.g., employment in case of a labour demand shock) is 1 percent. For clarity of exposition, and to save space, we show only point estimates. Distinctions between significant and insignificant responses in the text are based on bootstrap 90 percent confidence intervals (1,000 replications) which are available upon request.

[22] The long-lasting impact of labour demand shocks was found by Breitung *et al.* (2004) for Canada and Brüggemann (2006) for Germany. Transitory responses in Czech Republic and Lithuania resemble the results by Jacobson *et al.* (1997) for Norway and Sweden. We do not think that this mirrors any institutional features of these two NMS.

Figure 2. Impulse responses to labour demand shock

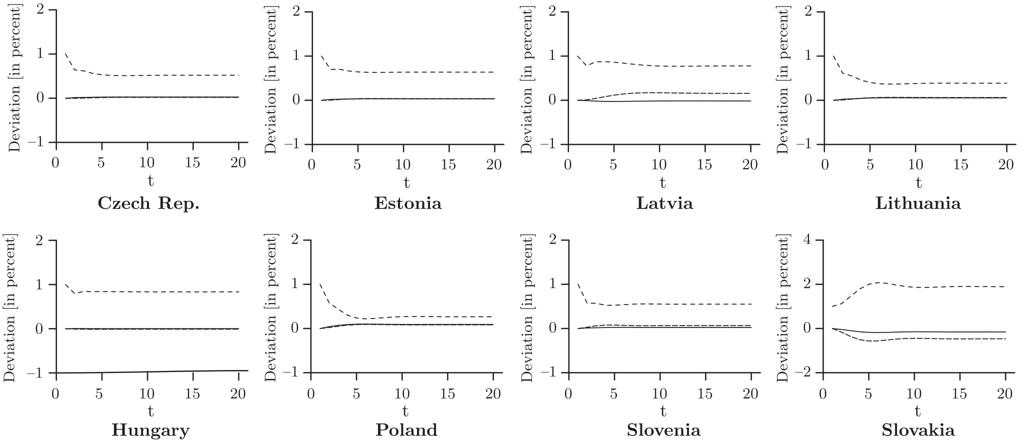


Note: Solid line – employment; dashed line – unemployment; one-dot line – average wages.

Latvia, Lithuania and Slovakia the effect of a labour demand shock on employment is highest after 2–3 quarters and reaches 2–3 percent, the response of unemployment is timed accordingly, but proportionally stronger. Moreover, historical variance decompositions of the main variables of interest, namely employment, unemployment and average wages, indicate that in all countries labour demand shocks are the most important for the variability of employment and unemployment in the short-run (up to 4 quarters).[23] This is consistent with Balmaseda *et al.* (2000)'s results for OECD countries. As the horizon expands, the influence of these shocks stays strong in Estonia, Hungary, Slovakia and Slovenia; they contribute more than half of employment and unemployment variability, whereas in the remaining countries, the contribution of wage shocks is dominant in the medium-term (4–10 years). The response of average wages to a labour demand shock is moderate and pro-cyclical, except for Slovenia and Latvia, where it is slightly counter-cyclical. So in these two countries such shocks might have increased the employment of low-productivity, low-wage workers to a greater extent, resulting in higher employment, but lower average wages. However, in only the Czech Republic and Slovakia, labour demand shocks account for a large part (as much as 70 percent in the Czech Republic) of wages' variability in the short- and medium-term. In Lithuania and Poland their contribution was also noticeable (around 20 percent in the medium-term).

[23] To save space we do not show historical variance decompositions here. The results are available upon request.

Figure 3. Impulse responses to labour supply shock



Notes: Solid line – employment; dashed line – unemployment; one-dot line – average wages.

Unemployment also rises after a positive labour supply shock (Figure 3). Poland stands out as the only NMS8 economy with merely transitory increases,[24] and in Hungary, Slovenia and Latvia, labour supply shocks account for over 50, and in Slovakia for over 30 percent of unemployment variability in the medium-term.[25] Average wages react significantly to a labour supply increase only in Slovakia, Latvia and Slovenia, and in the latter two countries such shocks account for a large part (40 percent) of wages' variability in the short- and medium-term.

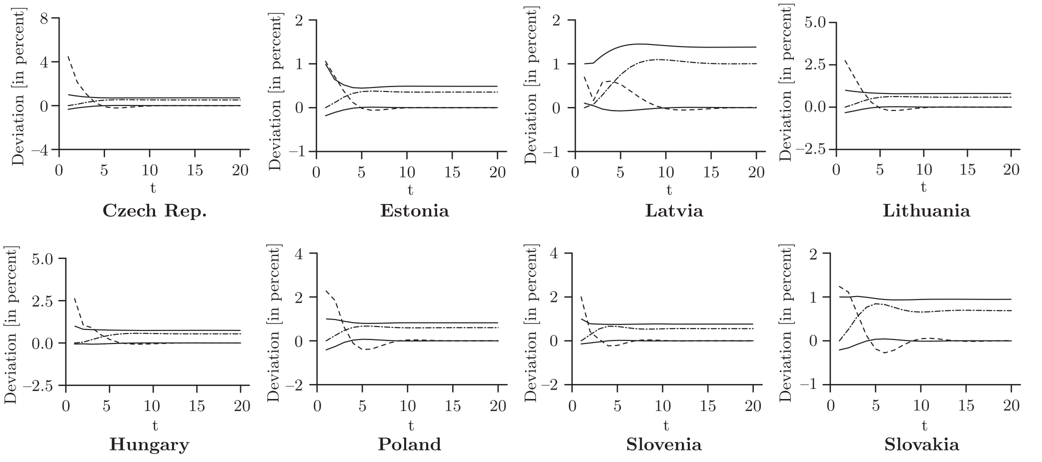
A positive productivity shock temporarily depresses employment and increases unemployment, but in the long run leads to higher output *per* worker and real wages (Figure 4). Hence, the destruction effect of productivity surge initially dominates over the capitalization effect, but in the long term it becomes inferior (Fisher, 2006; Michelacci and Lopez-Salido, 2007).[26] The spike in unemployment vanishes after 3–4 quarters in Estonia, Poland and Slovenia, but after 5–6 quarters in the Czech Republic and Hungary. The latter economies, along with Lithuania, also exhibit the strongest response of unemployment to a

[24] Some of the negative labour supply shocks in Poland were attributed to the welfare system (Bukowski and Lewandowski, 2006; Fortuny *et al.*, 2003) and our result suggests that institutionally driven decreases in labour force participation led to only short-lived reductions in unemployment.

[25] In Hungary, the Czech Republic, Slovakia, Lithuania and Poland the correlation of unemployment indicator and inactivity rate of population aged 15–64 years was negative. This may result from the discouraged workers leaving the labour force, but also from the options for leaving the labour market via welfare and early retirement schemes. In the other NMS8 this correlation was positive, as in most of the EU15 countries and the EU15 overall.

[26] Analogous results were obtained in SVAR/SVECM studies of the US and EU15 economies (Balmaseda *et al.*, 2000; Blanchard and Quah, 1989; Brüggemann, 2006).

Figure 4. Impulse responses to productivity shock



Notes: Solid line – employment; dashed line – unemployment; one-dot line – average wages; three-dots line – GDP per worker.

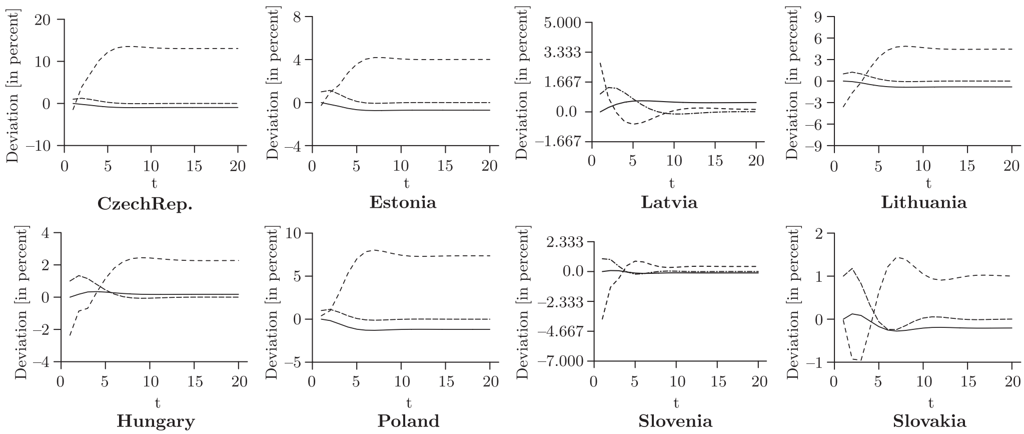
productivity shock (2.5–4.0 percent directly after the shock). In Estonia and Hungary, productivity shocks drive the variability of wages, explaining roughly 60 percent of it even in the ten-quarter horizon.[27] On the other hand, the transmission of such shocks to average wage levels takes the longest in the Czech Republic, Latvia, Slovakia and Slovenia; in these countries wages were much more driven by labour demand or supply shocks.

Thus, although the responses of employment and unemployment to shocks in the NSM8 are found to be very similar to those in the EU15 countries and the United States, the transmission of productivity shocks into wages is more timid which suggests that wages in CEE might have been set with more attention paid to quantitative changes on the labour market and less to productivity developments. Moreover, a positive wage shock reduces employment and increases unemployment in all NMS8, in Lithuania and Poland even in the long-run (Figure 5). Accordingly, in these two countries wage shocks explain over half of unemployment and employment variability within 2 years. Latvia stands out with the highest contribution of wage shocks to the variance of average wages in all horizons.

Figures 6–7 show that responses of the NMS labour markets to shocks in foreign demand are in line with the intuition: a positive exports shock increases GDP per worker, average real wages, employment; and decreases unemployment. However,

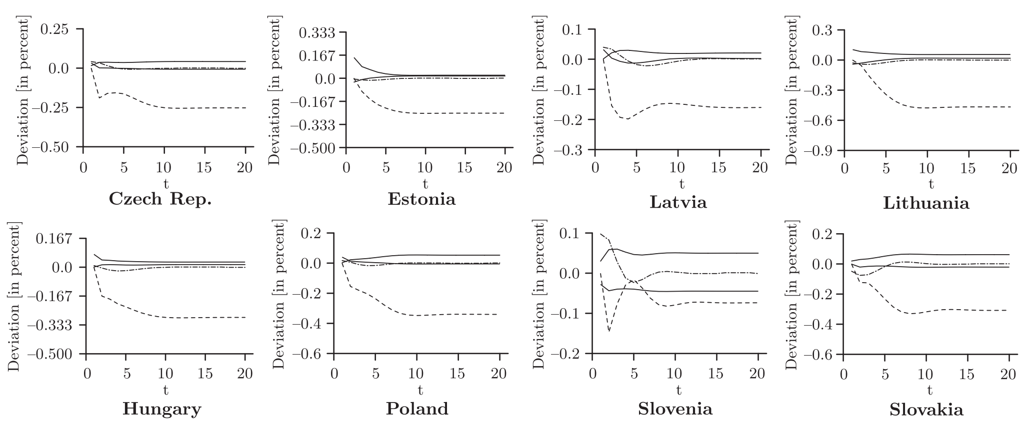
[27] Only in these countries is transmission of productivity into wages comparable to the that found for most OECD countries by Balmaseda *et al.* (2000). Ireland was the only country in that study where labour demand and supply shocks explained the variability of wages to a high degree comparable to that found here for the Czech Republic, Lithuania and Slovenia.

Figure 5. Impulse responses to wage shock



Notes: Solid line – employment; dashed line – unemployment; one-dot line – average wages.

Figure 6. Impulse responses to CIS demand shock

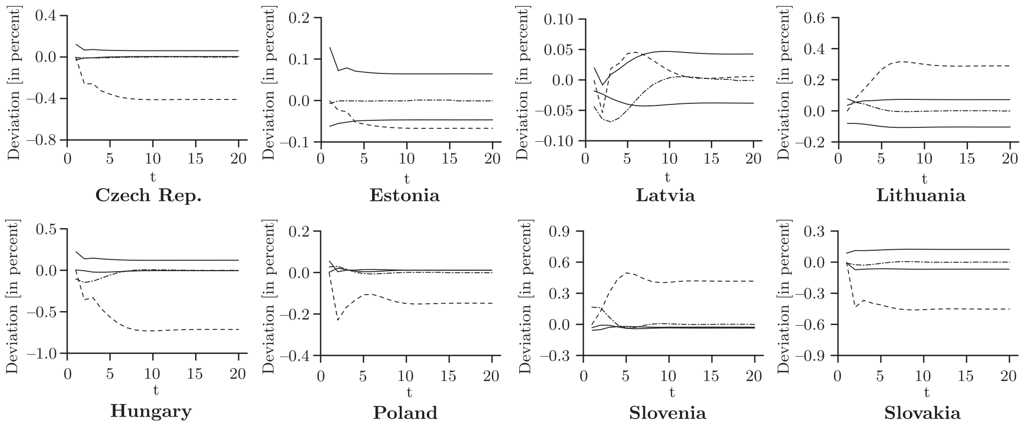


Notes: Solid line – employment; dashed line – unemployment; one-dot line – average wages; three-dots line – GDP per worker.

reactions are rather small. [28] Shocks in trade with the CIS were most important for the Baltic States, Poland and Slovakia. Slovakia is the only country where disturbances in the EU15 exports explain a non-negligible fraction of the unemployment

[28] Structural external demand shocks are constructed as deviations from business-cycle frequency movements of these variables, whereas domestic structural shocks are deviations from variables' movements in all frequencies.

Figure 7. Impulse responses to EU15 demand shock



Notes: Solid line – employment; dashed line – unemployment; one-dot line – average wages; three-dots line – GDP per worker.

and employment variability. However, we think that the long-lasting contribution of foreign demand shocks should be perceived as a small sample phenomenon.

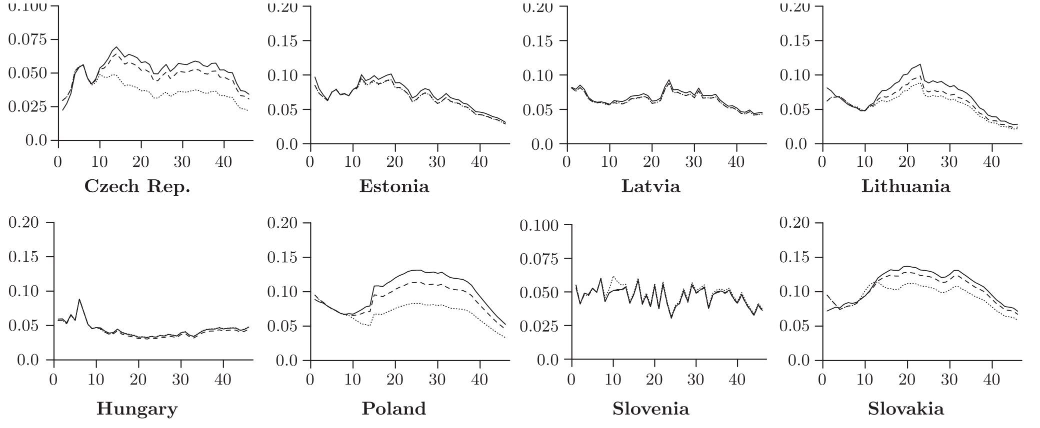
5. What explains the NMS labour markets' performance – retrospective SVECM simulations

The estimated SVECM allows us to extract from the data series of pairwise orthogonal structural shocks for all countries in the panel. Estimation of the Beveridge–Nelson representation of the cointegrated stochastic process (Hansen, 2000) enables us to express the evolution of each variable as a MA process contingent on these shocks. On that basis, the hypothetical evolution of analysed economies, provided that the given shock did not occur in the selected subperiod, is simulated.[29] Such thought experiments allow us to pinpoint the type and timing of shocks which caused swings in the unemployment in the studied sample, and quantify their impact. The focus is on demand-side shocks (in labour demand and exports) as they were found to be important in the previous section, and the literature stresses their impact on the CEE labour markets (Bukowski and Lewandowski, 2006; Paas and Eamets, 2006; OECD country studies).[30] The interactions between these 'primary' shocks and wage

[29] The approach is similar to that of Blanchard and Quah (1989). However, here SVECM is used and certain shocks are set to zero only in chosen subperiods.

[30] Large effects of aggregate demand shocks on the OECD labour markets were identified in both a SVAR setting by, for example, Blanchard and Quah (1989), Balmaseda *et al.* (2000); and in a dynamic panel setting by, for example, Blanchard and Wolfers (2000), Nickell *et al.* (2005).

Figure 8. Impact of foreign demand shocks and innovations in wages between 3q1998 and 2q1999 on unemployment in NMS8 (3q1996–4q2007)



Notes: Solid line – observed evolution of unemployment indicator; dashed line – hypothetical evolution of unemployment indicator provided no shocks in trade with the CIS and EU15 occurred between 3q1998 and 2q1999; dotted line – hypothetical evolution of unemployment indicator provided no shocks in trade with the CIS and EU15, and no wage shocks occurred between 3q199 8and 2q1999.

shocks are also analysed. A positive wage shock identified in the period of an adverse demand-side shock indicates that wages do not react sufficiently to deteriorating market conditions and is interpreted as a downward wage-rigidity.

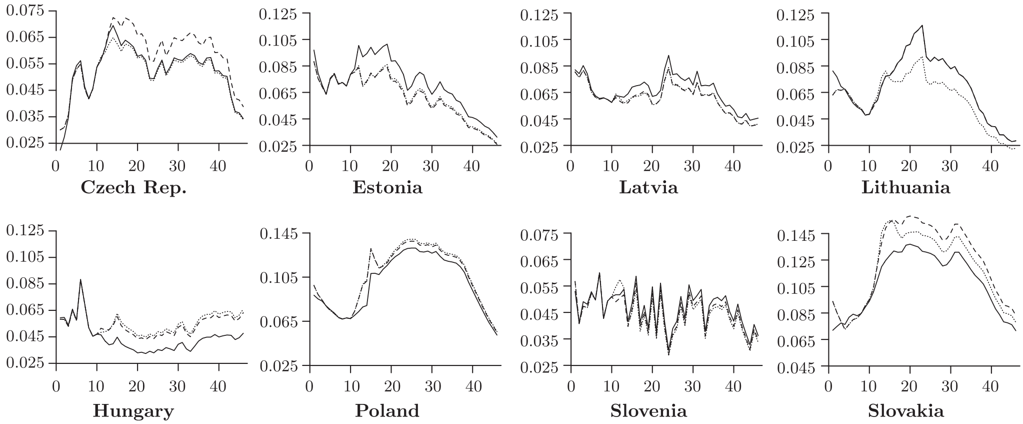
Figure 8,[31] confirms that the contraction of the CIS demand in 1998–1999, caused by the Russian crisis, affected labour markets of the Baltic States, Poland and Slovakia,[32] whereas Hungary and Slovenia were left intact. In Poland that external shock caused a 1 percentage point fall in the employment rate and 3 percentage point rise in the unemployment indicator, which have propagated until the end of the analysed period. Lithuania and Slovakia were also affected quite strongly (1.5–2.0 percentage point increase in the share of unemployed).[33] Estonia and Latvia seem more resilient, but Figure 9 shows that, according to the model, in these countries the effects of exports' collapse were reinforced by the drop in domestic labour demand: its impact amounted to 4 percentage point of unemployment indicator in

[31] Shocks in both exports to the CIS and EU15 between 3q1998 and 2q1999 are set to zero. Separate simulations show that all the joint impact is due to the CIS shocks.

[32] Although the model attributes the increase in Czech unemployment in 1998 to the collapse of CIS imports, it is likely a misidentification. The Czech Republic's economic ties with the CIS have been weak. At the time of the Russian crisis, the Czech economy suffered from the idiosyncratic currency crisis which is not controlled explicitly. Hence the spurious influence of shocks in trade with the CIS on the Czech labour market.

[33] Unemployment in Slovakia increased as early as 1997, because of the currency crisis and two-year long recession in the Czech Republic. The Russian crisis further contracted the demand for Slovakian goods, which increased unemployment as shown in Figure 8.

Figure 9. Impact of labour demand shocks and innovations in wages between 1q1999 and 4q1999 on unemployment in NMS8 (3q1996–4q2007)



Notes: Solid line – observed evolution of unemployment indicator; dashed line – hypothetical evolution of unemployment indicator provided no labour demand shocks occurred between 1q1999 and 4q1999; dotted line – hypothetical evolution of unemployment indicator provided no labour demand shocks and no wage shocks occurred between 1q1999 and 4q1999.

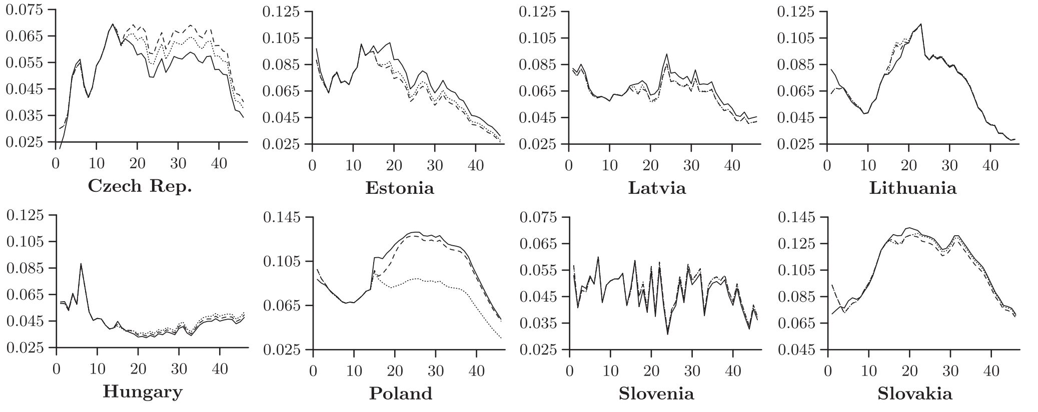
Estonia and 2 percentage point in Latvia. The model implies also that labour demand in the Czech Republic improved in the second part of 1999, and reversed the rise in unemployment.

Simulations show that in five economies where unemployment rose in the late 1990s both demand-side shocks were in force.[34] However, the behaviour of wages could be a crucial factor behind diverse performance of the NMS8 labour markets at the turn of the century. In Poland, Slovakia, Lithuania and the Czech Republic, wage rigidities were likely to intensify the negative impact of demand-side shocks (Figure 8). If wages adjusted flexibly to the increasing unemployment after the 'primary' shocks hit, unemployment would have been significantly lower than the recorded levels: in Poland the estimated difference is 4 percentage points, in Lithuania, Slovakia and the Czech Republic 3 percentage points. The model also suggests that in the Czech Republic upward wage pressures restricted the impact of the rebound labour demand in 1999 (Figure 9). Contrastingly, in Estonia and Latvia no contribution from inflexible wage arrangements is detected, neither when wages are interacted with the adverse external demand shocks, nor with the domestic labour demand shocks.[35]

[34] According to the estimates, in Poland and Slovakia the impact of the CIS shocks was so strong that employment should have declined more than it did. Thus, in these countries the model identifies positive labour demand shocks in 1999.

[35] Paas and Eamets (2006) argue that Estonia and Latvia indeed had more flexible wages (at national and sectoral level) than Lithuania.

Figure 10. Impact of labour demand shocks and innovations in wages between 1q2000 and 4q2000 on unemployment in NMS8 (3q1996–4q2007)



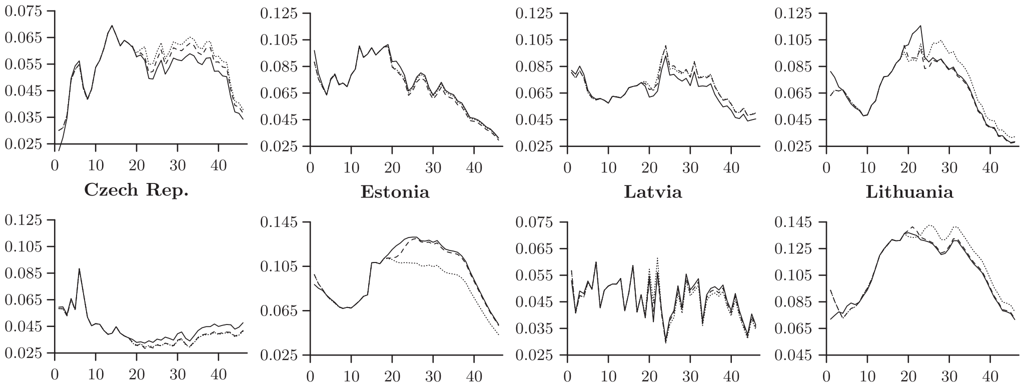
Notes: Solid line – observed evolution of unemployment indicator; dashed line – hypothetical evolution of unemployment indicator provided no labour demand shocks occurred between 1q2000 and 4q2000; dotted line – hypothetical evolution of unemployment indicator provided no labour demand shocks and no wage shocks occurred between 1q2000 and 4q2000.

The divergence among the NMS labour markets continued in 2000–2002. In Hungary and Slovenia fluctuations of employment and unemployment were small, although in Hungary the model identifies an adverse shift in the labour demand in 2001, increasing unemployment by about 1 percent of the working-age population from that year on. The Czech labour market stabilized. In Estonia unemployment peaked in 2000. In Latvia and Lithuania a few quarters later, and in Lithuania, more severely affected by the Russian crisis,[36] at a higher level. Labour markets in Poland and Slovakia deteriorated further. The model indicates that it was due to negative labour demand shocks occurring in 2000, and lasting for few quarters. In 2000, their direct influence was strongest in Poland and Estonia; the model attributes to them unemployment amounting to 2 percent of the working-age population in both countries (Figure 10). Weak labour demand in Poland persisted in 2001, and translated into the unemployment rising till 2003 (Figure 11).[37] In Estonia the shock in 2000 merely delayed the rebound of employment.

[36] Rutkowski (2003) notices that the contribution of firm-exits to job destruction in Lithuania increased after the 'Russian' shock. Real GDP growth turned negative. Neither of these happened in Estonia and Latvia (Paas and Eamets, 2006).

[37] Bukowski and Lewandowski (2006) argue that the aggregate capital productivity in Poland was falling from 1998 till 2003, while the investment to GDP ratio declined from 24 to 18 percent. In the other NMS, investment did not fall below 20 percent of GDP (except for Lithuania in 2000), and in 2000 it started rising (except for the Czech Republic and Slovakia). Barring Latvia and Slovenia, capital productivity improved in that period. Poor performance of capital, both in terms of productivity and accumulation, might explain why the labour demand in Poland was relatively lower than in the other NMS.

Figure 11. Impact of labour demand shocks and innovations in wages between 1q2001 and 4q2001 on unemployment in NMS8 (3q1996–4q2007)



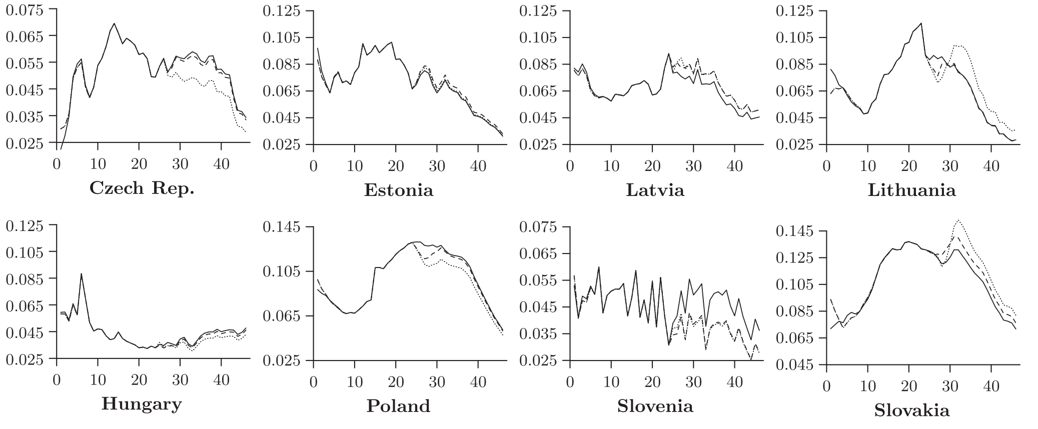
Notes: Solid line – observed evolution of unemployment indicator; dashed line – hypothetical evolution of unemployment indicator provided no labour demand shocks occurred between 1q2001 and 4q2001; dotted line – hypothetical evolution of unemployment indicator provided no labour demand shocks and no wage shocks occurred between 1q2001 and 4q2001.

However, the simulations show (Figures 10–11) that labour demand shocks were only partly responsible for the rise of unemployment after 2000 in the countries which were still struggling. In Poland a substantial share of it (3.5 of 4.5 percentage points) is attributed to positive wage shocks, which we interpret as downward wage rigidities. Short-lived, and noticeably smaller (up to 1 percentage point) contribution of wage rigidities is found in Latvia and Slovakia.[38] On the other hand, Estonia emerges as the country where flexible wages helped to suppress unemployment, as the unemployment indicator after 2000 would have been higher by 0.75–1 percentage points without negative wage shocks. Lithuania which, according to the model, in the late 1990s suffered from rigid wages to a greater extent than the other Baltic countries, experienced a drop in labour demand in 2001. The model shows that it increased unemployment by roughly 3 percent of the working-age population; however, this time wages did not intensify that impulse. In the Czech Republic the impact of wages on unemployment turned from positive to negative in 2001. Along with the improvement in labour demand it reduced the unemployment indicator by 1.5 percentage points.

Employment losses, suffered at the turn of the century by most of the NMS8, were reversed when the world economy recovered from the 2001–2002 slowdown. However, some differences emerge. As shown in Figure 12, positive

[38] The contribution of both labour demand and wages shocks to Slovakian unemployment seems modest in comparison with that of 1998–1999 external demand and wage shocks.

Figure 12. Impact of labour demand shocks and innovations in wages between 3q2002 and 2q2003 on unemployment in NMS8 (3q1996–4q2007)

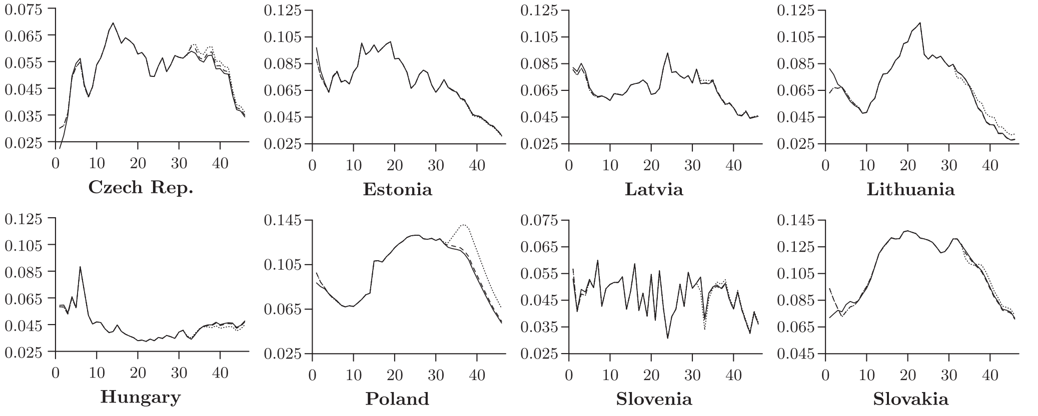


Notes: Solid line – observed evolution of unemployment indicator; dashed line – hypothetical evolution of unemployment indicator provided no labour demand shocks occurred between 1q2000 and 4q2000; dotted line – hypothetical evolution of unemployment indicator provided no labour demand shocks and no wage shocks occurred between 1q2000 and 4q2000.

labour demand shocks initiated the improvement on the Slovakian and Latvian labour markets in the second part of 2002 (shrinking unemployment by about 1 percent of working-age population in both cases). Moreover, in both countries negative wage shocks helped to reduce unemployment at the time by nearly the same amount. We think that these wage shocks can be understood as wage inertia, namely low real wage growth taking place after several quarters of a deteriorating labour market, especially that in both countries wages were driven by quantitative changes on the labour market much more than by productivity shifts (see Section 4). On the other hand, in the Czech Republic upward wage pressures hindered the decline of unemployment; had there been no such shocks, unemployment in 2003–2005 would have been lower by roughly 1 percent of the working-age population.

The inertia of wages seems to have played the largest role in Poland. Their timid adjustment contributed to the rise in unemployment in 1998–2003, whereas the recovery, initiated in 2004 by positive foreign demand shocks, was strengthened by negative wage shocks, and the estimated contribution of the latter was much higher (Figure 13). Indeed, average real wage growth in Poland was below GDP per worker growth from 2001 on (and in 2004 fell to zero). This lowered the labour costs, above all in the tradables sectors and construction (Magda and Szydlowski, 2007), and permitted the aggregate employment growth. In the other NMS, the contribution of wage shocks to the rebound on labour markets is found to be smaller.

Figure 13. Impact of foreign demand shocks and innovations in wages between 1q2004 and 4q2004 on unemployment in NMS8 (3q1996–4q2007)



Notes: Solid line – observed evolution of unemployment indicator; dashed line – hypothetical evolution of unemployment indicator provided no shocks in trade with the CIS and EU15 occurred between 1q2004 and 4q2004; dotted line – hypothetical evolution of unemployment indicator provided no shocks in trade with the CIS and EU15, and no wage shocks occurred between 1q2004 and 4q2004.

6. Measuring real wage rigidities in the NMS8

The final step is to synthetically measure wage rigidities on NMS labour markets in the 1996–2007 period. Indices of wage rigidities for the OECD countries were presented by Layard *et al.* (1991) and Balmaseda *et al.* (2000). They were based on the reciprocal of the estimated response of real wages to unemployment in the wage equation (with other wage-pressure variables being controlled for), and on the long-run relative impact of productivity shocks (only) on unemployment and wages, respectively. Our measures, however, reflect the ability of the economy to restore the cointegration-consistent equilibrium level of real wages, provided that specific structural disturbance occurred. The rationale behind them is as follows. According to the cointegration relationship (3), wages are the outcome of an 'empirical equilibrium' (interpreted as a wage-setting function). The long-run restrictions (4) imply that real wage shocks unsettle the cointegration-consistent level of wages only temporarily. Since various shocks may interact with wage setting in different ways,[39] we postulate that the longer it takes wages to restore the equilibrium level after a given shock, the higher the wage rigidity with respect to that shock is.

Thus, the model is simulated conditional on only one structural endogenous shock being present in the data, and the average time needed for wages to return to

[39] For example, strong insider–outsider effects may prolong adjustment of wages to labour supply shocks, but their presence does not imply that wage shocks themselves are persistent.

Table 4. Wage persistence and wage rigidity indices

Country	$wri_{\xi}w$	wri_{AV}
Czech Republic	0.09	0.35
Estonia	0.11	0.36
Latvia	1.00	0.72
Lithuania	0.39	0.68
Hungary	0.34	0.18
Poland	0.16	0.63
Slovenia	0.00	0.03
Slovakia	0.24	0.14

Notes: $wri_{\xi}w$ – real wage shocks persistence index; wri_{AV} – composite index of real wage rigidity with respect to labour productivity, demand and supply shocks.

cointegration-consistent level is calculated for each country. Obtained values, denoted as $WRI^k_{\xi X}$ (where $X \in \{Y,N,V,W\}$ represents shocks as in Section 2, and k stands for country), are ambiguous to interpret, so they are normalized using the standard formula $wri^k_{\xi X} = \frac{WRI^k_{\xi X} - WRI_{min}}{WRI_{max} - WRI_{min}}$, so $\forall_k wri^k_{\xi X} \in [0,1]$. Higher value means stronger rigidity. Then, $wri_{\xi W}$ measures the persistence of wage shocks, and wri^k_{AV}, defined as $wri^k_{AV} = \frac{1}{3}\sum_{X\in\{Y,N,V\}} wri^k_{\xi X}$, measures the ability of real wages to restore equilibrium when the economy is affected by three other endogenous shocks. It is interpreted as a composite measure of rigidity of wage adjustments to shocks. Table 4 presents the calculated measures.

Latvia stands out with the highest rigidities on both margins – persistency of wage shocks and adjustments of wages to other disturbances – and is followed by Lithuania. On the other hand, Slovenia fared best on both margins. Estonia was also characterized by flexible wage adjustments, especially when the ability to counterbalance innovations in wages is concerned. The same applies to the Czech Republic. Contrastingly, in Hungary, and to a lower degree in Slovakia, capacity to adjust wages to 'equilibrium' after productivity, labour demand and supply shocks was relatively greater than to accommodate innovations in wages. Finally, although in Poland persistence of wage shocks was quite low – only Slovenia, the Czech Republic and Estonia score better – wage rigidities in the aftermath of other domestic disturbances were eminent, especially conditional on labour demand shocks.[40]

Countries with higher wage rigidity experienced larger unemployment shifts (both up and down) than countries with lower wage rigidity affected by comparable shocks, as illustrated by the results for Poland and Estonia in the previous

[40] On the basis of $wri_{\xi N}$ itself, result not shown here but available upon request.

section. Countries with the highest wage rigidity index (Latvia, Lithuania, Poland) also exhibit the highest contribution of disturbances in wages to employment and unemployment variability, especially in the horizon over 2 years. To a lesser extent, it applies also to wage persistence. Real wage rigidity was strengthening the impact of demand-side shocks on the labour market, both positive and negative. Significant changes in unemployment levels may be transitory themselves, but they have social and economic costs and may have an enduring impact of long-term unemployment, discouraged workers and human capital depreciation. As stressed by Blanchard (2007), although the future shocks are unknown, flexibility of wages is crucial for the ability to accommodate them by particular economies.

The question is then about the institutional determinants of these wage rigidities. In attempting to shed some light on it we correlate our indices with various measures of labour market institutions using a modified backward stepwise regression. We regress a given index separately on each of N = 12 standard institutional indices, pick the regression with highest R^2,[41] calculate the residuals and remove this particular institution from the regressors' set. We then regress these residuals on each of the remaining regressors (obtained parameters show the effect of given institution after the impact of the most correlated one is removed) and proceed as in the first step. We repeat the procedure k times until none of the $N-k+1$ parameters is significant (t-statistics) at the 10 percent level. Results are shown in Table 5.

Differences between high and low-wage rigidity countries in the NMS8 were drawn mostly along the collective bargaining and employment protection legislation lines. Countries with higher unionization and collective bargaining coverage were more likely to have more flexible wages, which may illustrate that a high degree of corporatism improves the resilience of the labour market.[42] However, if Slovenia is excluded from the sample,[43] then collective bargaining coverage becomes a much less important correlate of wage persistence. Besides, the higher the minimum wage (in relation to average wage), the higher the wage rigidity in the NMS8, suggesting that wage floors could have been binding in the aftermath of labour demand shocks in the NMS8. Stringency of EPL on temporary work correlates positively with wage persistence which is in line with insider–outsider theory as more strict regulation of temporary work improves the bargaining position of permanent employees and makes wage pressures more enduring.[44] On the other hand, EPL on open-ended contracts correlates negatively with both wage rigidity

[41] Which is equivalent to the square of Pearson correlation coefficient between given index and particular institutional measure.
[42] As argued by, for example, Soskice (1990) and Bassanini and Duval (2006).
[43] Slovenia has been the most unionized NMS with more centralized, coordinated bargaining, and different tradition of social dialogue than the other NMS8 countries.
[44] Bassanini and Duval (2006) show for the OECD countries that stringent EPL, while mitigating the initial impact of adverse shocks, seem to make it more persistent.

Table 5. Wage persistence and wage rigidity vs. labour market institutions in the NMS8

Institution	Stepwise partial correlation with wage persistence	Institution	Stepwise partial correlation with wage rigidity
Collective bargaining coverage	−0.68**	Unionization	−0.58***
EPL on temporary contracts	0.27**	Minimum wage (relative to average wage)	0.24**
EPL on open-ended contracts	−0.28*	ALMP (spending per unemployed relative to GDP per capita)	−0.20**
Centralization of collective bargaining	0.36*	EPL on open-ended contracts	−0.10

***Notes*:** EPL on temporary contracts and open-ended contracts – OECD (1995–2003), Kajzer (2007); minimum wage (relative to average wage) – European Industrial Relations Observatory (EIRO) and Eurostat data, 1995–2004; ALMP (spending per unemployed relative to GDP per capita) – Eurostat and OECD data, 1995–2003 average tax wedge and progression of tax wedge – *OECD Taxing Wages 2004, 2006*; Eurostat (for Slovenia), 1995–2006; welfare spending to working-age population – Eurostat, OECD, 1995–2005. All measures were averaged over time for each country and then standardized across the sample according to the following: $x_i = \frac{X_k - X_{min}}{X_{max} - X_{min}}$ so each regressor is in [0,1].

and persistence which may suggest that there is some trade-off between security of employment and wage claims in the NMS8. Finally, the higher the ALMP spending per unemployed person, the lower the wage rigidity in the NMS8. Of course our results are rather illustrative, and more study of interactions between institutions and adjustments on NMS labour markets is needed. Bassanini and Duval (2006) show that interactions between shocks and institutions account for most of the heterogeneity of unemployment evolutions in the OECD countries, and it is probably the same in the CEE.

7. Conclusions

In this article, dynamic responses of labour markets to macroeconomic shocks in the eight CEE countries are analysed in a panel SVECM. The identification of real wage, productivity, labour demand and supply shocks is based on the DSGE model with labour market modelled after Mortensen and Pissarides (1994). Fluctuations in foreign demand are used as controls for the cross-sectional dependence in a *quasi-exogenous* way. The model is estimated with a modified Breitung (2005) panel procedure. Our main goal is to quantify the propagation of shocks on the NMS8 labour markets, and the pinpoint to disturbances which drove the evolution of these markets in 1996–2007. We find that impulse responses in the NMS8 fairly resemble the mechanisms described in the literature on OECD countries. In particular, positive labour demand shocks increase employment, depress unemployment, and, except for Latvia and Slovenia, raise real average wages. In all countries, these shocks were the main determinant of employment and unemployment variability in the short run. In the medium term, they were dominant in Estonia, Hungary, Slovakia and Slovenia, whereas in the Czech Republic, Latvia, Lithuania and Poland, innovations in wages seem prevalent.

At the turn of the century, such shocks (along with foreign demand shocks in the Baltic States, Poland and Slovakia) triggered the most severe deterioration of labour market situation in post-transition history of CEE. Slovenia and Hungary were not affected by such severe disturbances as the other countries and were spared abrupt escalations of unemployment. Similarly, eventual recovery of particular NMS8 labour markets has depended on the revival of the firm interest in hiring. This conclusion is rather pessimistic from the policy makers' point of view as, in the era of globalization, the protectionist toolbox is rather empty and governments' ability to absorb the external and internal demand shocks is limited. A certain degree of cushioning can be potentially delivered by a sound policy mix focused on the quick absorption of macroeconomic fluctuations by instruments of fiscal and monetary policies. The classical tools of finance ministers and central bankers – controlled budgetary deficit, cyclically adjusted budget balance and a limited public debt, accompanied by flexible exchange rates and a sound interest rate policy – certainly may be helpful. However, not only Central European but also other OECD countries do not deliver many clear examples of successful utilization of macroeconomic policy for this purpose. Therefore, we look rather sceptically on the ability of the macroeconomic policy to successfully tackle unemployment fluctuation.

On the other hand, we show that severity of unemployment in many countries has been largely intensified by the initially slow adjustment of wages to the worsening of the economic conditions. We propose a new synthetic measure of wage flexibility, based on restoring the cointegration-consistent equilibrium in the economy. Distinguishing between wage persistence and wage rigidity, we show that Slovenia and Estonia were most flexible on both margins, and Latvia, Lithuania and Poland struggled on at least one of them. Thus, we find that what distinguishes Estonia from Lithuania, Poland and Slovakia after the Russian crisis is not the severity of the primary impulse, but rather the flexibility of wage adjustments – rigidities in the latter group intensified the detrimental impact of exports' drop. The same applies to the Czech Republic's adjustment to its 1997 currency crisis. In the early 2000s negative labour demand shocks appeared in all NMS8, except the Czech Republic and Slovenia, but their impact was most harmful in Poland because of downward wage rigidities at the time. Slovakia and Latvia also suffered from insufficient wage adjustments, but to a noticeably lower degree. Some countries were able to learn their lessons – wage rigidity intensified the adverse shock in Lithuania in 1998/1999, but did not do so to the same extent in 2001.

We present tentative evidence that differences with respect to wage flexibility can be associated with relevant differences in labour market institutions, like collective bargaining, minimum wage, active labour market policies or stringency of employment protection. Although further research to understand these links is needed, it delivers an important hint for policy makers to concentrate their efforts on reforms in the above mentioned areas, and address poor wage flexibility with shifts in structural policies. The more flexible are wages, the shorter and less severe will be the negative impact of the potential negative labour demand shocks on the unemployment level.

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