

The Flexibility and Efficiency of Central and Eastern European Labour Markets in Accommodating Adverse Macroeconomic Shocks

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Abstract

Using a Markov Switching Vector Autoregressive (MS-VAR) model, we provide empirical evidence that the way labour markets in four major Central and Eastern European (CEE) countries adjust to macroeconomic shocks changed during the period 2000-2014. Under a regime that overlaps partially with the post-crisis period, the four labour markets were more responsive to macroeconomic shocks. We also identify a change in how the policymakers tried to reform the labour market before and after the economic crisis. This builds the case for explaining the change in the behaviour of labour market as the consequence of the change in the behaviour of policymakers.

1 Introduction

We study how labour markets in four major Central and Eastern European (CEE) countries (Czech Rep., Hungary, Poland and Romania) adjust in response to macroeconomic shocks

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in a non-linear model.

Our analysis is relevant on several accounts.

First, what makes analysing the four CEE countries appealing is that, as they will give up exchange rate flexibility, macroeconomic adjustments will not be possible via this channel anymore, which will require shock absorption from the labour market side. The labour market can act as a shock absorber mechanism in times of economic turmoil, especially when other macroeconomic policies ran out of manoeuvre space. Moreover, an efficient labour market exerts its role as an absorber of adverse shocks without additional costs in terms of social exclusion of those individuals affected by the adjustments in employment or wages.

Second, during the period we focus on (2000-2014) the studied economies underwent important changes, such as: EU accession (2004 for the Czech Rep., Hungary and Poland; 2007 for Romania) preceded by preparatory reforms and increased integration with main euro area economies. While this had a major contribution to reducing by a significant extent the gap compared to more developed European economies, it also increased vulnerabilities towards external shocks, as were those originating in the euro area in the context of the global financial and economic crisis. This triggered the need for adjustment of macroeconomic imbalances accumulated as the result of the fast economic growth during the "boom period."

Third, labour markets in all the studied CEE economies underwent important and relatively numerous institutional changes during the analysed period. This was aimed at fostering long run economic growth and enhancing the overall competitiveness of the economy.

Against this backdrop, we investigate the responses of labour market to impulses coming from the main macroeconomic variables. We focus on the dynamics of these responses, especially before and after the financial crisis started to take its toll also on the CEE countries included in our study. Using a Markov Switching Vector Autoregressive

(MS-VAR) model, we provide evidence that the way labour market adjust to macroeconomic shocks changed during the period 2000-2014. The results of the MS-VAR model suggest the existence of two regimes in at least three of the four studied CEE countries (Czech Rep., Poland and Romania). All the four countries are in the same regime most of the period 2010-2014, and occasionally, also in the pre-crisis period. The difference between the two regimes is not limited to the magnitude of the response of the labour market to macroeconomic shocks. In some cases the signs also differ. Thus, our finding that the behaviour of labour markets is not time-invariant has far reaching implications for both the design and implementation of macroeconomic policies in the respective countries.

Our paper is related to the literature that acknowledges that the labour market finds itself in different regimes at different points in time. This fact calls for non-linear tools to model the labour market. One strand of the literature employs Markov switching models applied to various labour market indicators to date the various regimes of the labour market. For the US, Schwartz (2012) points out that labor market indicators behave fundamentally different in each phase of the economy. He identifies the contractionary and expansionary phases of the labor market and shows that they are rather aligned with the official phases of the business cycle, a conclusion previously reached also by Hamilton (2005). The literature that examine the labour market developments for the four considered countries is scarce. The European Commission (2016) does provide some economic rationale on why labour markets in these countries operated under different regimes during the period under review. What these studies do not aim is to study how the interactions between the labour market and the rest of the economy change with each regime and our paper sheds light on this.

The non-linear interactions between the labour market and the rest of the economy have been addressed by studies which estimate the Okun's law. A non-linear relation between unemployment and output has been documented for the advanced economies for which long samples are available (see, for instance, Cuaresma (2003) on the US. Ce-

vik, Dibooglu, and Bariandscedilik (2013) cover two of the countries we study, namely Czech Rep. and Hungary and show that there is merit for a non-linear model also for these economies when it comes to capturing the relation between unemployment and GDP. The same is shown by Caraiani (2012) for the case of Romania. As opposed to this strand of literature, we analyse the non-linear interaction between gross earnings in the private sector and a wider vector of economic variables, including real GDP, HICP inflation, short term interest rate and nominale exchange rate. The use of VAR models to capture the response of labour market variables to shocks has been widely employed (see Hofmann, Peersman, and Straub (2012) or Peersman and Straub (2009) and Jakab and Kaponya (2010) for an application to the Hungarian labour market), but the literature studying non-linear responses is much scarcer.

Our findings suggest that in three of the analysed economies, economic relationships have been unstable during the analysed period, with one of the regime largely associated to the post crisis period. We put forward several possible explanations for this. Changes in the labour market institutions, changes in the regime of monetary policy, shifts in the behaviour of economic agents or permanent effects of the financial crisis of 2007-2008 are, independently and jointly, all plausible candidates. We consider that the former, related to structural reforms, to be a prominent explanation for the results. As our analysis shows, the predominant fields, as well as the direction of labour market reforms implemented in the analysed CEE countries changed significantly. In the post-crisis period the measures adopted with regard to labour markets were even more focused on increasing flexibility (*e.g.* by increasing short-time working schemes). In addition, prompted by the government budgets becoming tighter, new measures were adopted to address the labour market related causes of internal macroeconomic imbalances (*e.g.* reducing public wages).

Hence, policymakers tried to reform labour markets in different ways before and after the crisis. Consequently, this enables us to also speak about two regimes that partially overlap with those we identify using the MS-VAR model.

The impact of structural reforms is hard to quantify, as it is transmitted through many channels and considerable delay, but there is a growing literature suggesting that even in these CEE countries reforms on the labour market did have some impact. The release of the third wave of the micro data within the ESCB Wage Dynamics Network (WDN) survey supported analysis in this respect (see Babecky, Galuscak, and Zigraiova (2015) for the Czech Republic; Strzelecki and Wyszynski (2016) for Poland; Bodnar and Gyongyos (2016) for Hungary and Iordache, Militaru, and Pandioniu (2016) for Romania). While we do not study explicitly the impact of structural reforms, we support the idea that their implementation has changed the framework conditions in which the economy operates, which can imply a structural break in the models previously used.

The structure of the paper is as follows. The next section describes the methodology we use to identify changes in the response of the studied CEE labour markets to macro-economic shocks, as well as the result of estimations suggesting that the behaviour of labour markets is not time-invariant. The third section summarises the labour market reforms in the analysed countries, with the aim to also identify a change in the behaviour of policymakers. The last section concludes.

2 Identifying changes in how CEE labour markets respond to shocks

2.1 Methodology

We employ a MS-VAR model that allows for different sets of values for the VAR coefficients, each one corresponding to an unobserved regime. A model with two regimes can be expressed as:

$$x_t = c_{S_t} + \sum_{k=1}^p A_{k,S_t} \cdot x_{t-k} + B_{0,S_t} \cdot \varepsilon_t, \varepsilon_t \sim N(0, I), t = 1, \dots, T, \quad (2.1)$$

where x_t is the vector of endogenous variables, and $c_{S_t}, A_{1,S_t}, \dots, A_{1,S_t}$ are the matrices of coefficients for each state $S_t \in \{1, 2\}$. The model in equation (2.1) can be estimated using maximum likelihood, in a classical setup, or using Gibbs sampling to obtain the joint posterior distribution, in a Bayesian framework.

2.2 Data and results of the estimation

The estimations are performed using monthly data, spanning the interval 2000:M01-

2014:M12. The set of endogenous variables comprises: a measure of economic activity, 3M money market interest rate, the Harmonised Indices of Consumer Prices (HICP) overall index, nominal exchange rates versus euro (to take into account the importance given by each central bank in the four CEE countries to fluctuations in their domestic currencies, as well as to capture the effects of some external shocks), and gross wages in the private sector (to capture the response of labour market to macroeconomic shocks).

As a measure of economic activity we employ real Gross Domestic Product (GDP), interpolated at monthly frequency. Interpolation from quarterly to monthly frequency was conducted using the Chow and Lin (1971) methodology, adding information at monthly frequency from variables such as industrial output, the volume of construction works and the volume of retail sales. To remove some of the unwanted monthly volatility inherent to data at monthly frequency, variables at higher frequency were used for interpolation after being smoothed by a Hodrick-Prescott filter with a smoothing parameter $\lambda = 0.6$. The results of interpolation are depicted in Figure (2).

The second variable included in the model is the interest rate. We consider that the 3M maturity of the short-term interest rate offers a reasonable tradeoff in terms of reflecting money market developments due to monetary policy, but without being too much influenced by the volatility present in the segment of the term structure defined by shorter time horizons.

On the nominal side, we use the inflation rate based on all item HICP.

A VAR estimation for the four CEE countries is incomplete without including the exchange rate in the list of endogenous variables. This statement is supported by several arguments. First, all the four central banks operate under inflation targeting, with floating exchange rates. Flexibility of the exchange rate was an important channel by which the economies in these countries adjusted to the adverse external shocks triggered by the financial crisis, maybe the most important in some cases. The average annual depreciation of the domestic currency with respect to euro in 2009 ranged between -5.7% for the Czech Rep. and -18.8% for Poland, with Hungary (-10.2%) and Romania (-13.1%) in between. Second, foreign currency denominated loans play(ed) an important role in private lending in these economies. Third, the exchange rate is an important variable in the design of monetary policy. In Romania, where euroization of the economy is still a very vivid phenomenon, the central bank is very wary with respect to fluctuations on the foreign exchange market, while in the Czech Rep. the exchange rate is used since November 2013 as an additional instrument for easing monetary conditions.

We use wages as the variable that captures developments in the labour market. We choose gross earnings in the private sector as a measure of wages due to data availability. Data was available in the OECD's "Main Economic Indicators - complete database," at quarterly frequency for the Czech Rep. and at monthly frequency for Hungary and Poland. For Romania, the data on average monthly gross wage in the private sector was computed as a proxy obtained by combining data on wages in economic sectors that could be considered as mainly private. More specifically, sectors such as "O. Public administration and Defence; Compulsory Social Security," "P. Education," and "Q. Human health and Social work activities" were excluded.

To check the robustness of our findings we use as alternative data: real Gross Value Added (GVA) excluding agriculture, interpolated at monthly frequency, and industrial production as measure of economic activity; HICP at constant taxes, to reflect the dynamics of prices; real effective exchange rate, to capture the importance of the exchange rate,

as well as external shocks; unemployment rate to reflect labour market.¹

The decision to investigate, besides inflation based on all item HICP, also inflation computed based on the index at constant taxes is due to the observation that all four CEE countries witnessed changes in the value added tax (VAT) rate during the period under analysis. The usual pattern of the changes in the VAT rate consisted in a reduction during the boom period (with the exception of Poland), that was reversed in the aftermath of the financial and economic crisis, as a measure contributing to the reduction macroeconomic imbalances. The magnitude of hikes was correlated with the size of macroeconomic imbalances at whose adjustment it should have been contributed: standard VAT rate in Hungary was increased by 5 pp in 2009, and by another 2 pp in 2012, after it was reduced by 5 pp in 2006. Also, standard VAT rate was increased by 5 pp in 2010, after a decline by 3 pp in 2000, in Romania. In Czech Rep. and Poland the modifications in the VAT rate were of a smaller amplitude: in Czech Rep. the standard VAT rate was increased by 1 pp in 2010, and another 1 pp in 2013, after a 3 pp decrease in 2004, while Poland saw only a 1 pp increase in 2011. Modifications in the regime of VAT included also changes in the reduced rate.

We opted for the effective exchange rate computed taking into account the most important 28 trading partners, mostly of them being core euro area countries and other EU Members States, with real values being calculated using as deflator consumer prices. The argument favouring the inclusion in the analysis of the real effective exchange rate is, obviously, that related to being a measure of competitiveness.

At least two measures of unemployment are available for all the four studied CEE countries: registered unemployment rate, compiled using national methodologies, which can differ from country to country, and unemployment rate based on EU Labour Force Survey (LFS) data, which is compatible with the International Labour Organisation (ILO) guidelines, and therefore are comparable across countries. The latter measure is thus more

¹While they are more mixed than those of the specification discussed in the paper, the results obtained using alternative datasets, available upon request, are in line with the overall conclusions.

appropriate to be used in analyzes comprising more countries.

Variables are expressed as annual rates of change, compared to the same month of the previous year and expressed as percentage, except for the interest and unemployment rates, which are in level. Variables used in the analysis are depicted in Figures (3)-(5), and their descriptive statistics are presented in Table (A.1). The features of the data are largely similar across countries, with some exceptions. The most evident is that of prices and short-term interest rate in the case of Romania, which display a much higher volatility compared to the other three countries, and for which the amplitude, measured as difference between the maximum and minimum values, is also much larger. This phenomenon, which is also shared by average monthly gross wages in Romania, is mainly due to the values recorded in the first part of the period and shows, once again, the delay in implementing structural reforms. The descriptive statistics for variables reflecting aggregate economic activity in Poland stand out as another exception when compared to those in the other three countries: the large drop due to the economic crisis is not present and the volatility of the yearly dynamics is substantially lower.

With the exception of the variables used to describe the labour market (unemployment rate and average monthly gross wages in the private sector), for most of the others the widely used ADF test supports the hypothesis of stationarity. The impossibility to reject the null hypothesis of non-stationarity in the case of the unemployment rate is probably the consequence of its high degree of persistence, which can attributed to some extent to the statistical methodology used to obtain monthly data from quarterly surveys. In the case of yearly dynamics of the gross earnings, the impossibility to reject the non-stationarity null hypothesis of the ADF test might be due to the structural shift that was triggered by the economic crisis.

For all the four countries we selected a lag length of 2.

We present the results of the estimations performed using as endogenous variables: real GDP, HICP inflation, short-term interest rate, nominal exchange rate and gross wages.

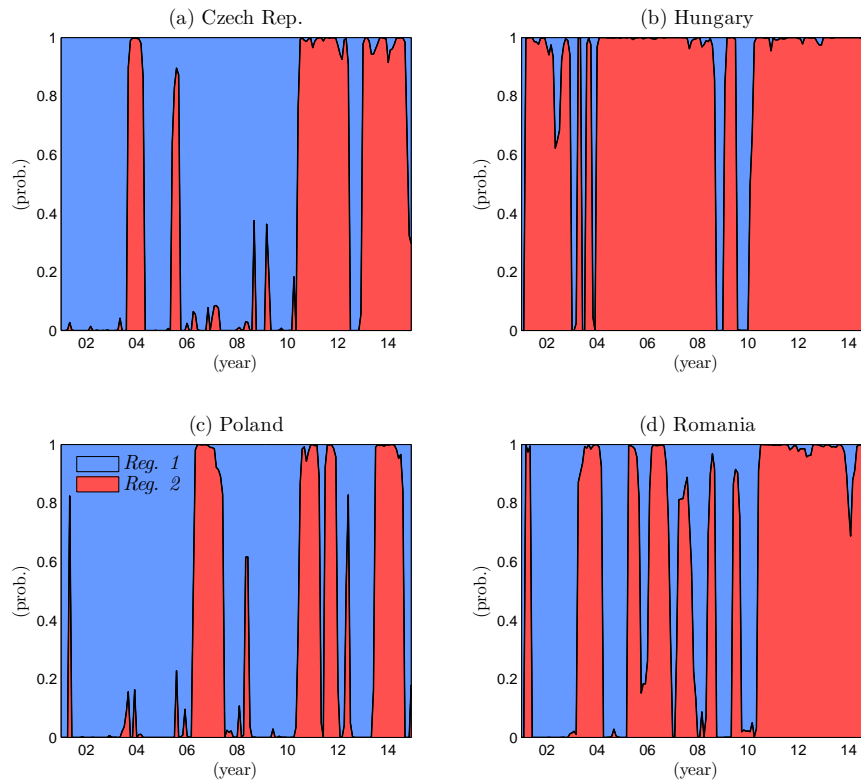


Figure 1: Regimes obtained from MSVAR estimations.

Source: own calculations.

Figure (1) shows the a posteriori probability of being in one of the two regimes for the respective economies at each point in time. The Czech Rep. is the clearest case that the second regime, marked with red in Figure (1), pertains to the post crisis period. This regime seems to dominate in Hungary, which warrants caution regarding the interpretation of results for the first regime, due to the limited number of observations. All the four studied CEE countries are found to be in the same regime most of the period 2010-2014, and occasionally, also in the pre-crisis period.

The response impulse functions in the case of each regime are displayed in Figures (6)-

(9). MS-VAR estimations suggest that the response of gross earnings to macroeconomic shocks was not time-invariant. The response of wages to other macroeconomic variables is not stable throughout time.

An interesting feature of the results for all countries is that in the second regime, which can loosely be labeled as a post-crisis regime, many economic relationships seem to break. Several responses turn closer to zero or the impact appears to be more delayed. This raises some questions regarding linear macroeconomic models which use both pre and post crisis data for these countries. More research is needed to understand in each particular case the interaction between the monetary policy and the nominal side of the economy in this turbulent period.

The response of gross earnings in the private sector to a shock in real GDP is rather similar for all the countries in our sample, being positive under both regimes. The labour market is more responsive to shocks in the economic activity under the second regime, but only in the case of Czech Rep. it responds faster and less persistent than in the first regime. For the other three economies the second regime shows not only a higher impact of a shock in the economic activity on the labour market, but also a more persistent one.

The response of gross earnings in the private sector to a shock in inflation displays a similar pattern only for three of the four countries under investigation. For Czech Rep., Hungary and Romania an increase in the inflation rate results in an increase in the growth rate of wages. The difference between the two regimes is evident only in the case of Romania, where the second regime shows a much larger and persistent reaction of the labour market to a shock in prices. In Poland the same answer it is negative under the first regime, which is counterintuitive, and is not statistically different from zero under the second regime.

The divergences across the four countries are even larger when we look at how the labour market responds to shocks in the interest rate and in the nominal exchange rate. For Czech Rep. an increase in the interest rate leads to an increase in the growth rate of

earnings, the effect being muted in the second regime. For Poland the labour market does not respond to changes in the interest rate in either of the two regimes. Hungary and Romania display a similar pattern of labour market responses to a shock in the interest rate, which can be considered as a monetary policy shock: a negative reaction under regime 1 and a positive reaction under regime 2, with the difference between the two regimes being very clear in the case of Romania.

The response of gross earnings in the private sector to a shock in the nominal exchange rate also follows two regimes. For the Czech Rep. and Hungary it changes from no reaction under one regime to positive response under the other. For Poland the change is from a negative to a positive, although not significant, response. For Romania the difference between the two regimes is less clear. The response of the labour market in Romania to a shock in the nominal exchange rate is negative under both regimes, but the reaction is faster under regime 2.

A common denominator of the analysis on impulse responses is that the labour market is more responsive to shocks in the main macroeconomic variables under the regime that overlaps with the post-crisis period. Under this regime, the labour market reacts more to shocks in the economic activity for all the four CEE countries in our study. In the case of Czech Rep., Hungary and Poland the response of labour market to a shock in the nominal exchange rate becomes significant, while in the case of Romania the response to a monetary policy shock switches signs from negative to positive.

Behind the regime changes that we identify using the MS-VAR model there is a multitude of factors. Among the driving forces that can have such structural effects we can mention changes in monetary policy regime (as it seems to be indicated by the impulse responses in the case of Czech Rep.), long lasting effects of the economic crisis, as well as changes in the labour market institutions. We turn our attention on the latter in the next section.

3 Institutional changes in CEE labour markets

In this section we analyse how the labour market reforms were conducted in the four CEE countries in our study. We look at main policy domains, as well as at the frequency and direction of measures and we try to identify a change in the behaviour of policymakers before and after the economic crisis.

Awakened by the economic downturn that followed the financial crisis of 2007-2008, most EU Member States decided to reform key institutions and regulations of their labour markets, in order to ease the adjustment in the face of asymmetric shocks and to help the correction of macroeconomic imbalances. Most of the reforms aimed to improve the labour market included labour taxation, employment protection, job incentives for unemployment and adjustment-friendly wage setting frameworks (Turrini *et al.*, 2014).

? studied the impact of labor market institutions on labor market developments in European countries, Czech Republic, Hungary and Poland included, with a special focus on the new EU member states. Between 1998 and 2003 they observed an increase in the employment protection strictness in Hungary and Poland and considered that Czech Republic and Poland are less liberal than Hungary. As the effects of labour market reforms are concerned, they found that the employment protection regulations have a significant influence on employment and activity rates, which are also influenced by the minimum wage. Also, the unemployment is affected by variations in active labor market policies spending, and on long term it is also affected by the minimum wage.

A comprehensive list of labour market and welfare reforms carried out between 2000 and 2013 in EU Member States is ensured by the LABREF database, a joint project managed by the European Commission (EC) and the Economic Policy Committee (EPC). Investigation of the LABREF database allow for some broad patterns of reforms to be observed. Labour market reforms adopted in the four CEE countries studied in this paper are synthetised in Tables (1)-(3).

We start by examining the number of reforms for each policy domain. During the

period under investigation, most reforms were undertaken in the active labour market policy (25.3% of total) and labour taxation domains (19.6% of total), while immigration mobility (3.8% of total) and early withdrawal (4.0% of total) are occasional. The interest of policymakers for the domains of active labour market measures (including, among others, training, public employment services, special schemes for youth and employment subsidies) remained relatively unchanged during the interval 2009-2013, compared to 2000-2008.

Table 1.

Number of labour market reforms in Czech Rep., Hungary, Poland and Romania (by policy domain, irrespective of direction)						
Policy domain	2000-2008		2009-2013		2000-2013	
	(number)	(%)	(number)	(%)	(number)	(%)
1. Labour	51	19.2	42	20.1	93	19.6
Taxation						
2. Unemployment	20	7.5	14	6.7	34	7.2
benefits						
3. Other welfare-rel.	27	10.2	27	12.9	54	11.4
benefits						
4. Active labour	69	25.9	51	24.4	120	25.3
market policies						
5. Job Protection	31	11.7	28	13.4	59	12.4
(EPL)						
6. Early Withdrawal	14	5.3	5	2.4	19	4.0
7. Wage Setting	14	5.3	20	9.6	34	7.2
8. Working time	24	9.0	20	9.6	44	9.3
9. Immigration	16	6.0	2	1.0	18	3.8
Mobility						
Total	266	100.0	209	100	475	100

Source: LABREF, own calculations.

Note: data available only starting with 2003 for Romania.

Table 2.

Number of labour market reforms
in Czech Rep., Hungary, Poland and Romania
(by country)

Country	2000-2008		2009-2013		2000-2013	
	(number)	(%)	(number)	(%)	(number)	(%)
Czech Rep.	73	27.4	37	17.7	110	23.2
Hungary	69	25.9	70	33.5	139	29.3
Poland	77	28.9	48	23.0	125	26.3
Romania	47	17.7	54	25.8	101	21.3
Total	266	100.0	209	100	475	100

Source: LABREF, own calculations.

Note: data available only starting with 2003 for Romania.

Table 3.

Top 5 labour market changes, in Czech Rep., Hungary, Poland and Romania
in terms of policy field and taking into account
the direction of the policy measure

I. Based on 2000-2008 interval

Policy measure	2000-2008		2009-2013		2000-2013	
	(number)	(%)	(number)	(%)	(number)	(%)
1. Public Employment Services ↗ (job assistance, job-counselling etc.)	19	7.1	12	5.7	31	6.5
2. Training ↗	16	6.0	14	6.7	30	6.3
3. Employers' social security ↘ contributions	16	6.0	9	4.3	25	5.3
4. Employment subsidies ↗	14	5.3	8	3.8	22	4.6
5. Income tax ↘	12	4.5	6	2.9	18	3.8

II. Based on 2009-2013 interval

Policy measure	2000-2008		2009-2013		2000-2013	
	(number)	(%)	(number)	(%)	(number)	(%)
1. Training ↗	16	6.0	14	6.7	30	6.3
2. Public Employment Services ↗ (job assistance, job-counselling etc.)	19	7.1	12	5.7	31	6.5
3. Employers' social security ↘ contributions	16	6.0	9	4.3	25	5.3
4. Public wages ↘	0	0.0	9	4.3	9	1.9
5. Employment subsidies ↗	14	5.3	8	3.8	22	4.6

Table 3.

Top 5 labour market changes, in Czech Rep., Hungary, Poland and Romania
in terms of policy field and taking into account
the direction of the policy measure

III. Based on the difference 2009-2013 vs. 2000-2008

Policy measure	2000-2008		2009-2013		Difference	
	(number)	(%)	(number)	(%)	(number)	(pp)
1. Public wages ↘	0	0.0	9	4.3	9	4.3
2. Family-related benefits ↗	0	0.0	7	3.3	7	3.3
3. Short time working scheme ↗	0	0.0	6	2.9	6	2.9
4. Family-related ↘ working-time organization	1	0.4	6	2.9	5	2.4
5. Income tax ↗	3	1.1	6	2.9	3	1.8

Source: LABREF, own calculations.

Note: data available only starting with 2003 for Romania.

The frequency of labour market reform increased overall in the period after the crisis. On average, the four CEE countries in our sample taken together adopted almost 42 reforms in each year of the period 2009-2013, compared to about 37 per year in the interval 2003-2008. In most policy domains, there was an increasing number of reforms during the crisis. The domains excluded from this tendency are: unemployment benefits, early withdrawal and immigration mobility.

Judging based on the number of institutional changes during the entire period, we conclude that in Poland and Romania most reforms concerned active labour market poli-

cies, while the Czech Rep. and Hungary reforms mainly dealt with labour taxation. In Romania, the number of reforms in the domain of job protection equals that in the domain of active labour market policies. However, if we go into details of the two subintervals separated by the crisis, 2000-2008 and 2009-2013, we notice a change in preference for some countries. For example, the Czech Rep. seems to be more preoccupied by reforms in the domain of job protection. Also, after being mainly interested in reforms concerning labour taxation, Romania became most interested in active labour market policies after 2008.

The number of institutional changes with respect to labour market doesn't differ too much across the four countries during the entire period, although Hungary distinguishes itself as the champion of labour market reforms, especially in the interval 2009-2013, with about one third of the total for the all four countries. Romania, on the other hand, implemented the smallest number of reforms over the entire period (even when considering for the fact that it was not covered by the LABREF database between 2000 and 2002), but has the second largest number of labour market reforms after 2008.

Regarding the direction of reforms, there are considerable differences across policy domains and across time, see Table (3). For instance, before the crisis the measures were dominated by reforms aimed at strengthening the active labour market policies, by increasing public employment services, increasing training and rising employment subsidies, as well as in reducing labour taxation, by lowering employers' social security contributions and income tax. These measures preserved their prominence in the after crisis period, but, especially after 2010, as government budgets became tighter, the direction changed and reforms raising the tax wedge or reducing benefits generosity became more frequent.

Policy domains with the most significant structural impact were those concerning unemployment benefits, job protection and wage setting.

Before the crisis most measures regarding the unemployment benefits were decreasing

generosity, although the coverage increased. After the crisis started benefits were raised. However, over the recent years the trend reversed.

Within the job protection domain, the measures regarding fixed-term contracts since 2000 were mostly to tight the conditions. A likely explanation would be that although fixed term contracts raise employment, they also create segmentation.

The evidence suggests a shift in the reforms on the wage setting domain. Before the crisis most measures were for wage setting. As the unemployment rate increased due to the economic crisis, most measures were against wage setting.

4 Conclusions

We study how labour markets in four major Central and Eastern European (CEE) countries (Czech Rep., Hungary, Poland and Romania) adjust in response to macroeconomic shocks during the 2000-2014 time period. We use a MS-VAR model to capture the dynamics of the response of labour market (represented in the specification discussed in the paper by gross earnings in the private sector) to shocks in main macroeconomic variables (real GDP, HICP inflation, short term interest rate and nominal exchange rate).

Estimations performed using the MS-VAR methodology provide evidence that the way labour markets in the studied CEE countries adjust to macroeconomic shocks changed during the period 2000-2014. Under a regime that overlaps partially with the post-crisis period, the four labour markets were more responsive to macroeconomic shocks.

Looking at main policy domains, as well as at the frequency and direction of measures taken in the four countries to reform the labour market, we also identify a change in the behaviour of policymakers before and after the economic crisis.

Put together with the findings of the MS-VAR estimations that all the four economies witnessed a switch in the regime of interaction between macroeconomic variables in 2010, the observation that in an overlapping period started in 2009 the policymakers in these countries intensified the number of labour market reforms and modified their direction

and emphasis can only support the hypothesis that the change in the way labour market variables respond to macroeconomic shocks is a consequence of the measures taken during the latter period.

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5 Appendix

Table A.1 Descriptive statistics

I. Measures of economic activity

Real GDP interpolated at monthly frequency (% yoy, s.a.)

Sample: 2001:M01-2014:M12

	Czech. Rep.	Hungary	Poland	Romania
Min.	-6.20	-8.07	-0.14	-8.92
Max.	7.22	5.36	7.51	10.56
Mean	2.40	1.81	3.55	3.56
Median	2.58	2.97	3.56	4.34
Std. dev.	3.10	3.09	1.84	4.26
ADF	-1.90*	-1.84*	-4.59***	-2.57
Spec.	None	None	Intercept	Intercept

Real GVA w/o agriculture

interpolated at monthly frequency (% yoy, s.a.)

Sample: 2001:M01-2014:M12

	Czech. Rep.	Hungary	Poland	Romania
Min.	-7.82	-8.31	-0.01	-7.77
Max.	8.21	6.33	8.21	11.45
Mean	2.60	1.77	3.64	3.40
Median	2.98	2.52	3.67	3.99
Std. dev.	3.49	3.18	1.90	4.35
ADF	-2.72*	-1.65	-2.10	-1.32
Spec.	Intercept	None	Intercept	Intercept

Notes: * denotes significance at 10%, ** at 5%, and *** at 1%;

automatic selection of lag length for ADF test, with max. lags=9.

Table A.1 Descriptive statistics (contd)

I. Measures of economic activity

Industrial output (% yoy, s.a.)

Sample: 2000:M01-2014:M12

	Czech. Rep.	Hungary	Poland	Romania
Min.	-16.88	-24.11	-9.52	-10.65
Max.	14.21	14.67	16.10	15.89
Mean	3.08	3.11	4.40	3.47
Median	4.17	4.76	5.20	3.23
Std. dev.	6.35	7.42	5.80	5.48
ADF	-2.59***	-2.39**	-2.97**	-1.89*
Spec.	None	None	Intercept	None

Notes: * denotes significance at 10%, ** at 5%, and *** at 1%;
automatic selection of lag length for ADF test, with max. lags=9.

Table A.1 Descriptive statistics (con't)

II. Measures of prices

HICP inflation rate, all item (% yoy)

Sample: 2000:M01-2014:M12

	Czech. Rep.	Hungary	Poland	Romania
Min.	-0.63	-0.85	-0.64	0.93
Max.	7.57	10.21	11.04	44.94
Mean	2.27	5.00	3.06	11.07
Median	2.00	4.76	3.03	7.38
Std. dev.	1.76	2.55	2.36	10.36
ADF	-2.66*	-1.99**	-2.56**	-6.38***
Spec.	Intercept	None	None	None

HICP inflation rate, at constant taxes (% yoy)

Sample: 2003:M12-2014:M12

	Czech. Rep.	Hungary	Poland	Romania
Min.	-1.01	-0.18	-0.60	0.51
Max.	5.15	5.81	3.67	12.55
Mean	1.52	3.14	1.69	4.17
Median	1.41	2.84	1.82	3.39
Std. dev.	1.33	1.50	1.26	2.68
ADF	-1.28	-1.44	-2.92**	-3.34**
Spec.	None	None	Intercept	Intercept

Notes: * denotes significance at 10%, ** at 5%, and *** at 1%;
automatic selection of lag length for ADF test, with max. lags=9.

Table A.1 Descriptive statistics (con't)

III. Financial variables

Short-term (3M) interest rate (%)

Sample: 2000:M01-2014:M12

	Czech. Rep.	Hungary	Poland	Romania
Min.	0.34	2.10	2.03	1.69
Max.	5.57	12.81	19.74	80.60
Mean	2.45	7.73	6.65	16.30
Median	2.17	7.64	4.96	9.30
Std. dev.	1.53	2.61	4.58	15.52
ADF	-2.03**	-3.45**	-3.96***	-5.73***
Spec.	None	Trend & intercept	Intercept	Trend & intercept

Nominal exchange rate vs. euro (% yoy)

Sample: 2000:M01-2014:M12

	Czech. Rep.	Hungary	Poland	Romania
Min.	-16.69	-11.66	-17.69	-15.35
Max.	8.59	15.11	28.02	33.79
Mean	-1.94	1.33	-0.06	6.70
Median	-2.87	1.83	-1.77	4.41
Std. dev.	5.55	5.72	9.69	10.94
ADF	-3.66***	-4.90***	-4.35***	-2.66**
Spec.	None	None	None	None

Notes: * denotes significance at 10%, ** at 5%, and *** at 1%;

automatic selection of lag length for ADF test, with max. lags=9.

Table A.1 Descriptive statistics (con't)

III. Financial variables

Real effective exchange rate (% yoy)

Sample: 2000:M01-2014:M12

	Czech. Rep.	Hungary	Poland	Romania
Min.	-7.47	-12.09	-25.73	-34.99
Max.	16.81	10.09	17.22	15.24
Mean	2.07	-1.12	0.18	-6.56
Median	2.29	-2.03	1.43	-4.80
Std. dev.	5.19	5.25	9.18	10.73
ADF	-4.40***	-4.95***	-4.01***	-2.79***
Spec.	Trend & intercept	None	None	None

Notes: * denotes significance at 10%, ** at 5%, and *** at 1%;
automatic selection of lag length for ADF test, with max. lags=9.

Table A.1 Descriptive statistics (con't)

IV. Labour market variables

Unemployment rate (% , s.a.)

Sample: 2000:M01-2014:M12

	Czech. Rep.	Hungary	Poland	Romania
Min.	4.20	5.50	6.80	5.50
Max.	9.20	11.40	20.40	8.80
Mean	7.05	8.01	13.25	7.11
Median	7.20	7.50	10.50	7.00
Std. dev.	1.15	2.06	4.65	0.70
ADF	-2.18	-1.00	-2.49	-2.24
Spec.	Intercept	Intercept	Trend & intercept	Intercept

Average monthly gross wage

in the private sector (% yoy, s.a.)

Sample: 2000:M12-2014:M12

	Czech. Rep.	Hungary	Poland	Romania ²
Min.	-1.58	1.89	1.24	2.49
Max.	10.12	16.17	21.51	43.99
Mean	4.97	7.89	5.51	15.04
Median	5.22	7.40	4.35	14.14
Std. dev.	2.54	3.59	3.32	9.91
ADF	-2.67	-2.18	-2.57	-2.73
Spec.	Trend & intercept	Trend & intercept	Intercept	Trend & intercept

Notes: * denotes significance at 10%, ** at 5%, and *** at 1%;

automatic selection of lag length for ADF test, with max. lags=9.

²2001:M12-2014:M12

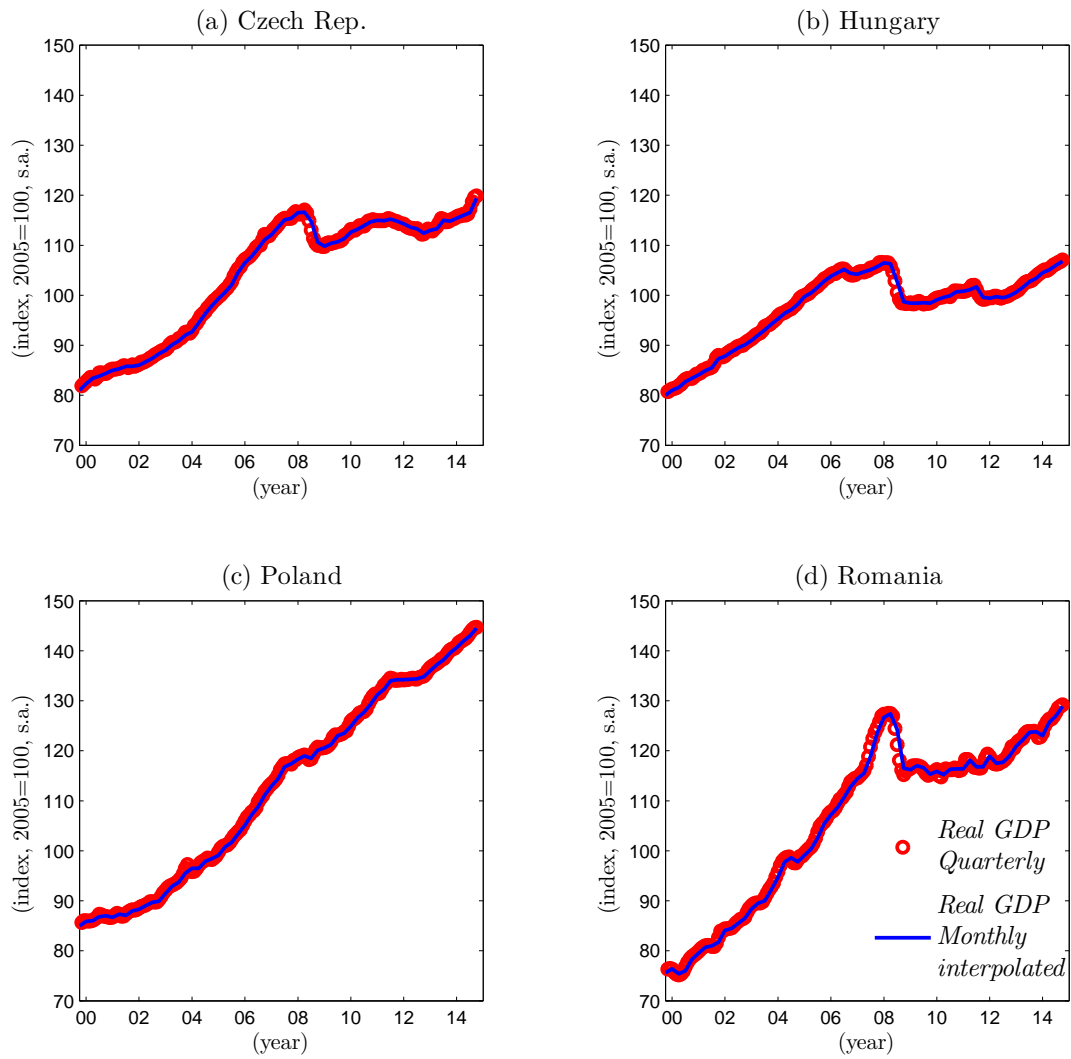


Figure 2: Real GDP, interpolated at monthly frequency.

Source: EUROSTAT, own calculations.



Figure 3: Endogenous variables used in VAR estimations. Measures of economic activity.

Source: EUROSTAT, own calculations.

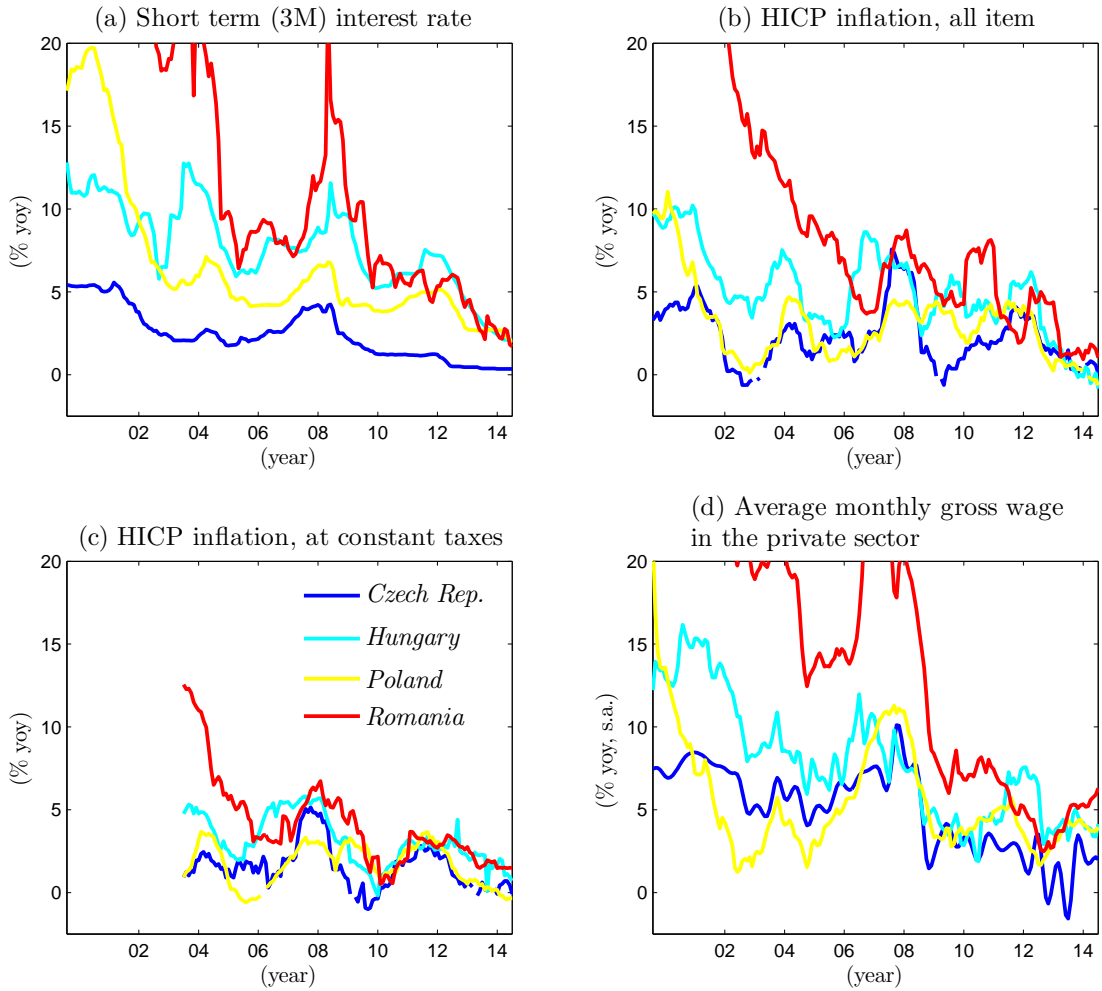


Figure 4: Endogenous variables used in VAR estimations. Interest rates, prices and wages.

Source: EUROSTAT, OECD, national central banks, own calculations.

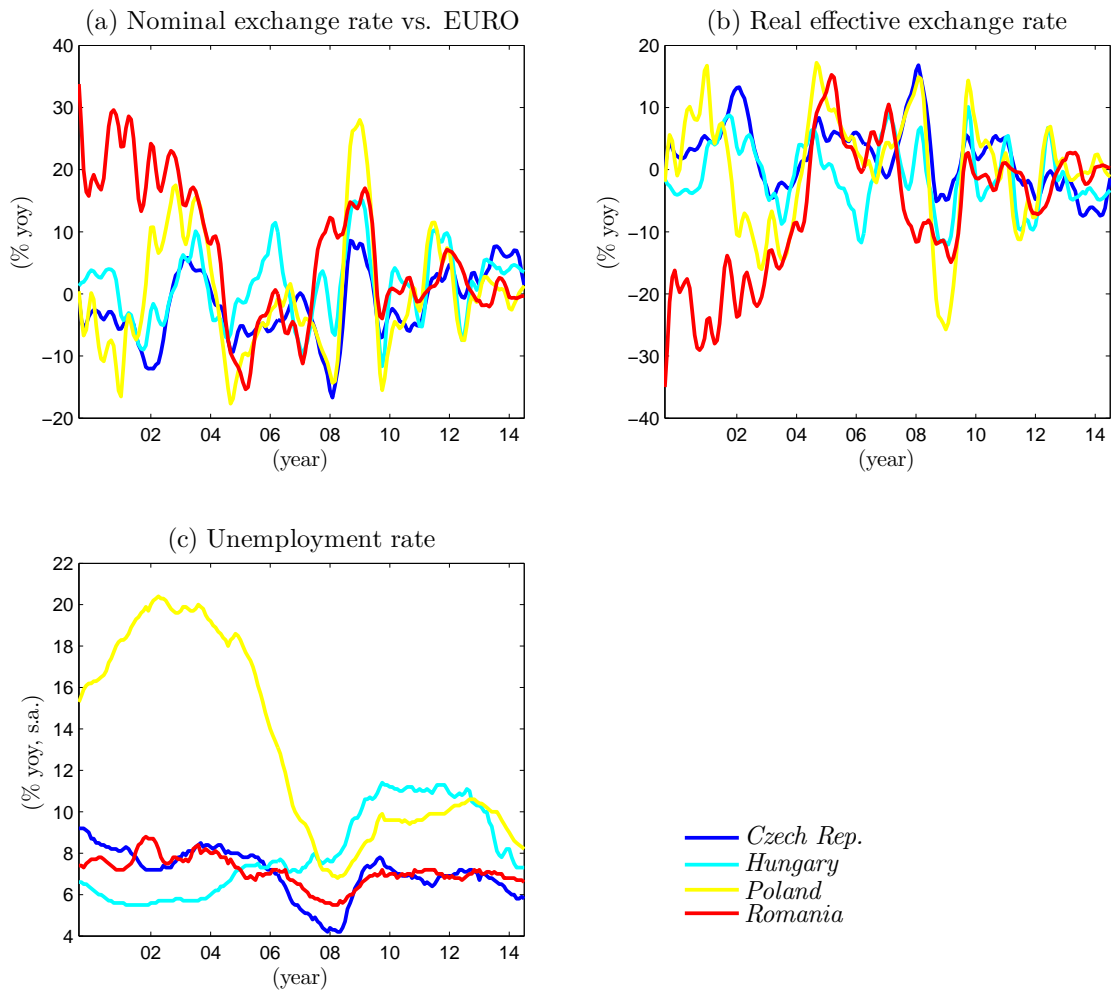


Figure 5: Endogenous variables used in VAR estimations. Exchange rates and unemployment rate.

Source: EUROSTAT, national central banks, own calculations.

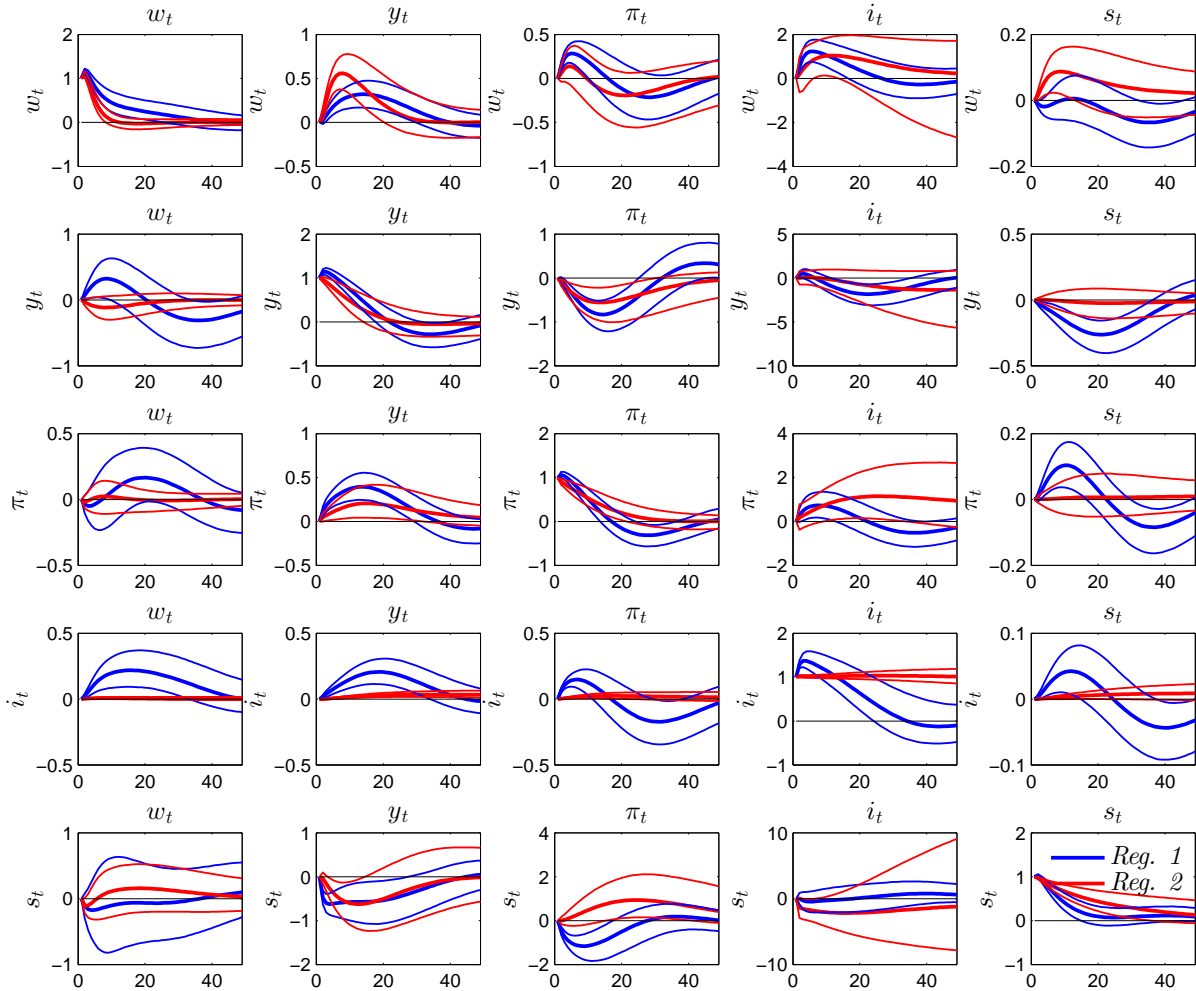


Figure 6: Impulse response functions from MSVAR. Czech Rep.

Source: own calculations.

Note: Response of variable on row to the variable on column. y_t - real GDP; π_t - HICP inflation; i_t - short term interest rate (%); s_t - nominal exchange rate; w_t - gross wages.

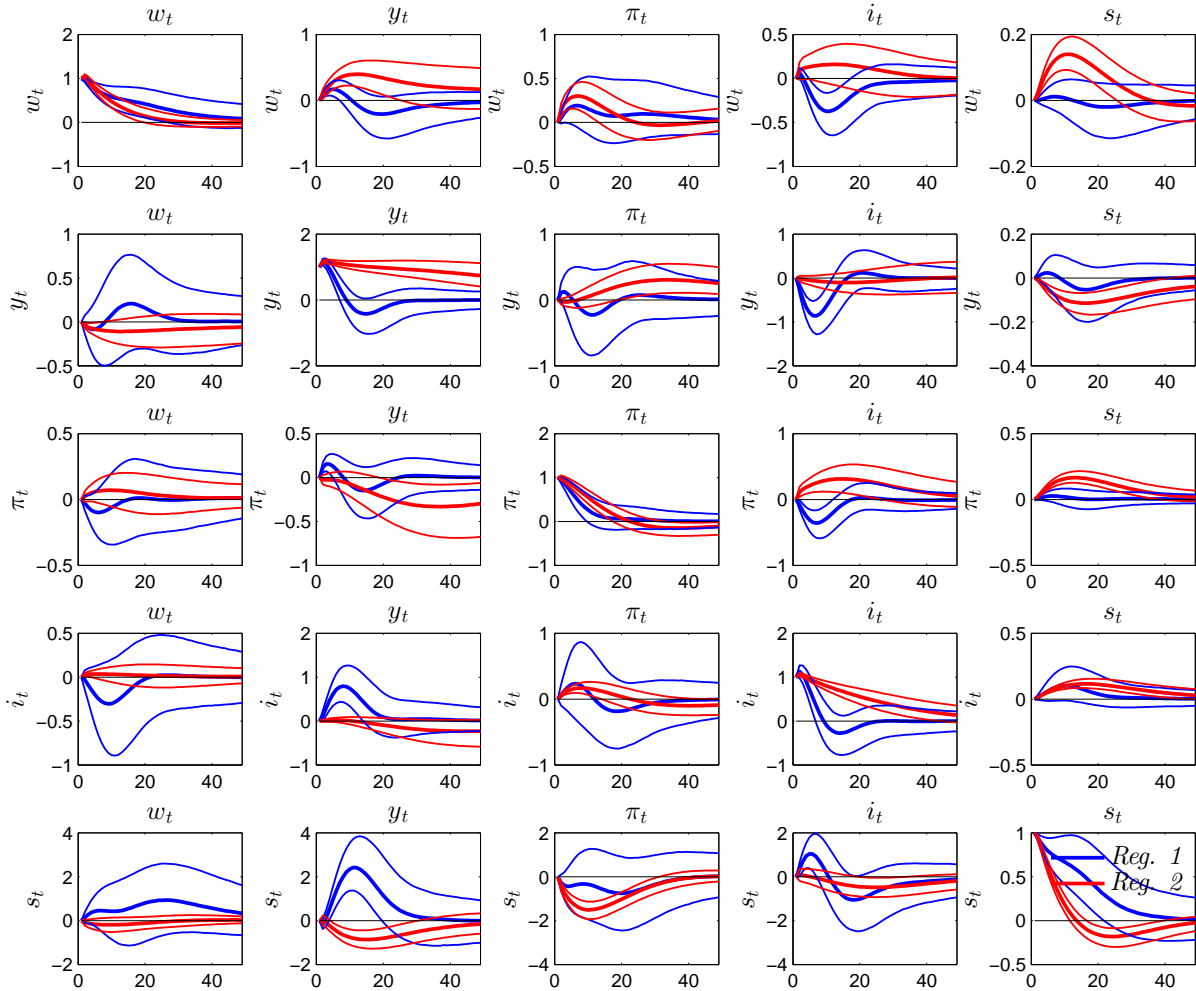


Figure 7: Impulse response functions from MSVAR. Hungary.

Source: own calculations.

Note: Response of variable on row to the variable on column. y_t - real GDP; π_t - HICP inflation; i_t - short term interest rate (%); s_t - nominal exchange rate; w_t - gross wages.

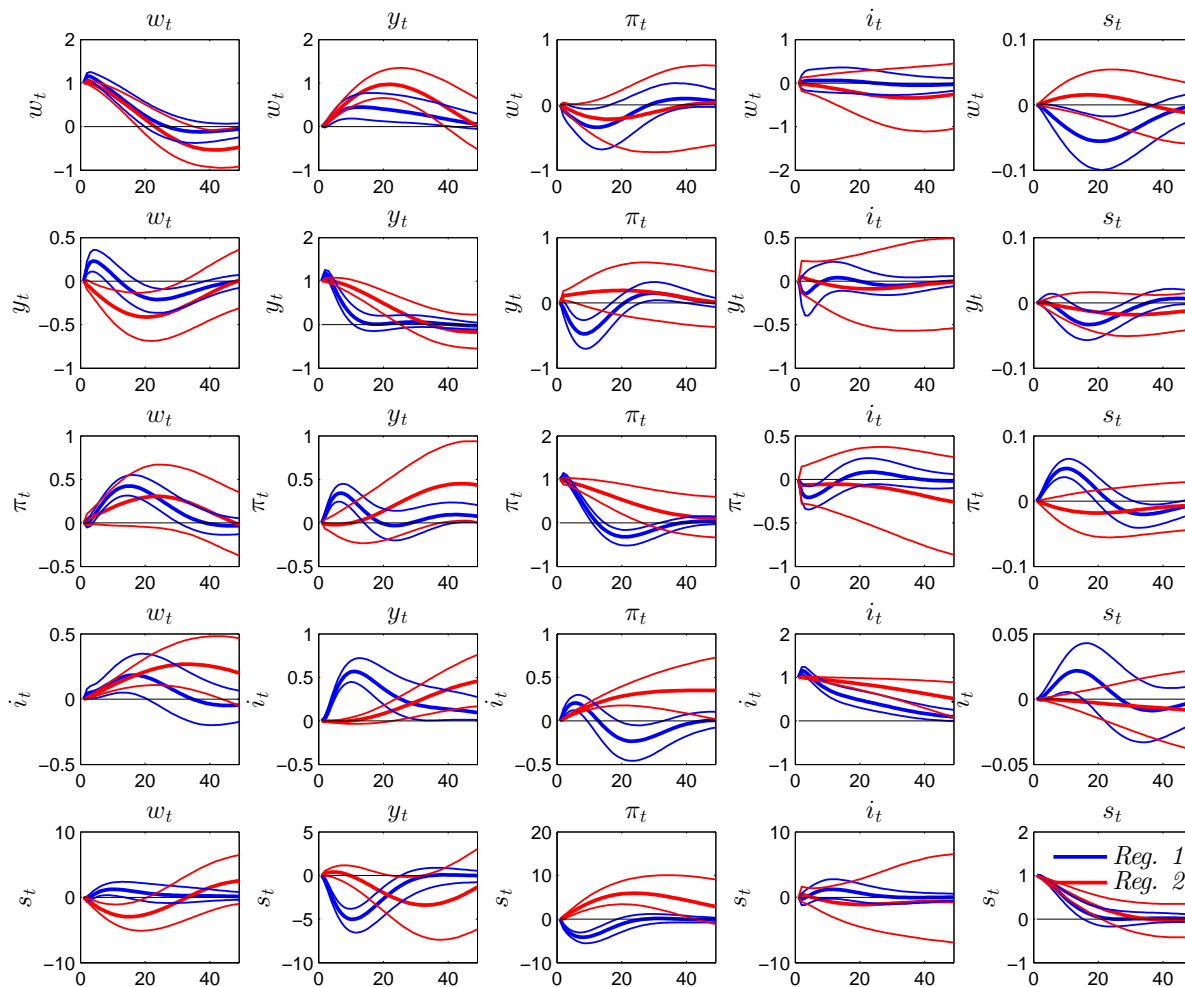


Figure 8: Impulse response functions from MSVAR. Poland.

Source: own calculations.

Note: Response of variable on row to the variable on column. y_t - real GDP; π_t - HICP inflation; i_t - short term interest rate (%); s_t - nominal exchange rate; w_t - gross wages.

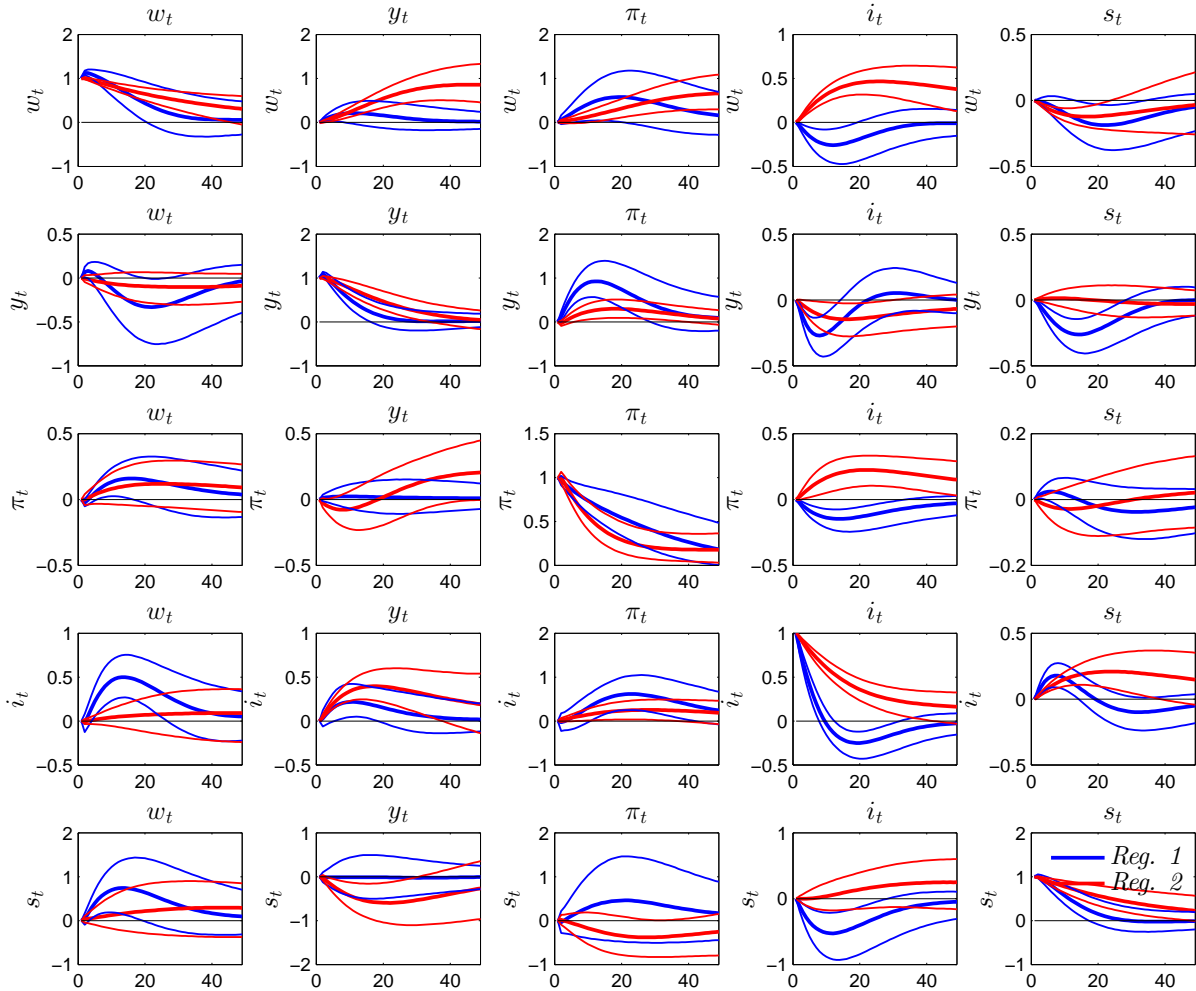


Figure 9: Impulse response functions from MSVAR. Romania.

Source: own calculations.

Note: Response of variable on row to the variable on column. y_t - real GDP; π_t - HICP inflation; i_t - short term interest rate (%); s_t - nominal exchange rate; w_t - gross wages.