The Economic Transmission of Fiscal Policy Shocks from Western to Eastern Europe

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This paper studies the transmission of a foreign fiscal policy shock (assumed to be generated in Germany) to key macroeconomic variables in five Central and Eastern European economies (CEE-5). We use quarterly data from 1995 to 2009 and estimate an open economy structural vector autoregressive (SVAR) model identified by imposing reasonable restrictions on contemporaneous responses in the system. Our model is able to identify well-known episodes of fiscal policy action in the countries under review. We find that a foreign fiscal shock affects domestic fiscal variables and vice versa, which highlights the importance of cross-country coordination of fiscal policies within the EU. All the CEE-5 respond to a fiscal expansion abroad with fiscal easing at home (more strongly on the public spending than on the revenue side). We find negative cross-border fiscal spillovers for Slovenia, the Czech Republic and Slovakia, while in Poland and Hungary, output reacts positively to a fiscal expansion in Germany. For domestic fiscal shocks, which we also explore, we find Keynesian responses in Hungary and Slovakia, while non-Keynesian responses are present in the Czech Republic, Poland and Slovenia. Our results imply that "one-size-fits-all" policy recommendations would be too simplistic for the CEE-5; a deeper understanding of the reasons for cross-country differences in response to fiscal shocks is required to be able to provide adequate information to policymakers in these countries.

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1 Introduction and Motivation

The 2008–09 "Great Recession" has sparked renewed interest in fiscal policy. The extraordinary intensity of the downturn forced the implementation of sizeable fiscal stimulus packages at the beginning of the crisis. Headline fiscal positions strongly deteriorated (not only due to discretionary fiscal expansion but also, if not mainly, due to the operation of automatic stabilizers). A few EU countries, especially those that had maintained elevated public debt levels already in 2008, experienced severe sovereign solvency pressures in 2010. These problems heralded a new stage of the crisis, during which the original private sector solvency problems eventually spilled over to the public sector. As a consequence, all EU countries are currently confronted with the challenge to implement decisive fiscal action to consolidate their budgets, a process that will have to continue in most countries until 2012–13.

Given the scale of both the fiscal stimulus packages during this crisis and the ensuing austerity measures, the obvious question that arises is how effective can fiscal policy actually be in mitigating business cycle fluctuations, especially within the financial and economic architecture of today's highly interdependent world.

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Generally speaking, fiscal multipliers are smaller if there are considerable leakages (i.e. parts of the stimulus are saved, e.g. for precautionary reasons, or spent on imports). Multi-country models show that fiscal multipliers are the smaller, the more open an economy is (see Spilimbergo et al., 2009). Thus it is important to examine not only the impact of domestic fiscal shocks[3] on output, but also to study the channels and the extent of spillovers from fiscal shocks generated in major foreign trading and financial partner countries.

Empirical evidence on the economic effects of domestic fiscal shocks is mostly available for high-income OECD countries (e.g., Blanchard and Perotti, 2002, for the U.S.A.; Perotti, 2004, for the U.S.A., the U.K., Australia and Germany; Giordano et al., 2007, for Italy; de Castro and Hernández de Cos, 2008, for Spain), while there is only scant, mostly preliminary, evidence for the economies in emerging Europe (e.g., Lendvai, 2007, for Hungary; Benčík, 2009, for Slovakia; Mirdala, 2009, for the Czech Republic, Hungary, Poland, Slovakia, Bulgaria and Romania; or Ponomarenko and Vlasov, 2010, for Russia). Moreover, there have been only limited empirical attempts to examine the transmission of a foreign fiscal shock to domestic macroeconomic variables in Europe (among others, Beetsma et al., 2006, or Badarinza, 2008).

This paper focuses on five Central and Eastern European economies (the Czech Republic, Hungary, Poland, Slovakia and Slovenia, in the following referred to as CEE-5)[4] and develops a model that allows not only to examine the impact of domestic fiscal shocks on key macroeconomic variables, but also to check the response of domestic variables to a fiscal shock in an important foreign economic partner country. We chose Germany to be this country, first, because the CEE-5 have strong trade relations with Germany (on average, about 30% of total CEE-5 exports go to Germany) and second, because over the past few years, Germany implemented considerable discretionary fiscal measures,[5] which potentially induced substantial economic spillovers to the CEE-5.

Learning more about such spillovers is also important given that the crisis left only limited room for sizable stimulus packages in the CEE-5 (Hungary even had to implement pro-cyclical consolidation measures amounting to more than 4% of GDP, according to the OECD, 2009) owing to a predominantly pro-cyclical fiscal stance during the pre-crisis boom period and liquidity constraints at government debt markets in many of these countries (see Eller, 2009). It is also interesting to examine what types of responses can be observed in the CEE-5 for the period from 1995 to 2009: Did these countries respond to a fiscal expansion in Germany

[3] *A fiscal shock is defined as an unexpected, random discretionary change in government spending or taxation. Our approach assumes symmetry of results, i.e. we do not impose different reactions to fiscal expansions and to fiscal contractions in our setting. Thus, any argument put forward for a fiscal expansion holds inversely also for a fiscal contraction (see also our qualifications in section 4.2).*

[4] *Other countries from Central, Eastern and Southeastern Europe could not be included due to the lack of satisfactory fiscal data.*

[5] *According to the European Commission (2009), the cumulative 2009–10 net effect of the German fiscal stimulus package is estimated to amount to 1.9% of 2008 GDP (with revenue-decreasing effects outweighing expenditure-increasing ones, and about 70% of the stimulus occurring in 2009 and the rest in 2010). The same study also estimated the size of the corresponding stimulus packages in the CEE-5 (except for Hungary, which implemented a pro-cyclical consolidation package, and Slovakia, which provided a negligibly small stimulus package) to be 1.5% of GDP in Poland and 0.5% of GDP in the Czech Republic and Slovenia respectively.*

with fiscal easing, or did they count on positive cross-border fiscal multipliers in their consolidation efforts?

The structure of this paper is as follows: Section 2 presents the channels of the cross-country transmission of fiscal shocks and describes the development of an open economy structural vector autoregressive (SVAR) model with both foreign and domestic fiscal shocks. This model requires a detailed documentation of the restrictions imposed on contemporaneous responses in the system, which are necessary to achieve identification. Section 3 discusses the preparation of the data series and the empirical specification of the SVAR model. The estimation results and some robustness checks are described in section 4. Section 5 summarizes the basic findings and highlights their implications for policymaking and further research.

2 Theory and Methodology

2.1 Cross-Country Transmission of Fiscal Shocks

Conceptually, the literature in this area relies on the framework of a two-country Mundell-Fleming model with flexible prices to distinguish at least three channels for the cross-country transmission of fiscal shocks (see Beetsma et al., 2006, or Badarinza, 2008).

First, a fiscal expansion in a foreign economy increases aggregate demand and thus also the demand for domestic goods and services through the *trade channel,* which, in turn, has a positive effect on domestic output.

Second, a foreign fiscal expansion affects domestic output via terms-of-trade changes through the *real exchange rate channel.* In the foreign economy, prices increase after a fiscal expansion due to higher aggregate demand; and they are expected to increase more strongly than world market prices since the latter are typically not affected one-to-one by the fiscal action of a single country. As a consequence, the terms of trade of the foreign country improve as the real effective exchange rate appreciates and imports increase (while exports decrease). The domestic economy benefits from this situation in terms of higher output as long as it is a net exporter to the foreign economy.

Third, the *interest rate channel* captures the impact of a rising interest rate in a foreign economy after a fiscal expansion; this interest rate rise could either be due to a non-accommodative monetary tightening to keep inflation in check or due to the pressure on investments induced by higher aggregate demand. The higher foreign interest rate could then translate into higher domestic interest rates (with a negative impact on domestic output), simply due to the fact that a higher foreign interest rate attracts more capital imports from the domestic economy, reducing domestic exchange reserves and thus also domestic money supply.

The specific sign and size of the cross-border fiscal multiplier depend on the interaction between these different channels. The overall impact of a fiscal expansion abroad on domestic output is expected to be positive if the trade and exchange rate effects outweigh the negative interest rate effect. Certainly, the actual cross-border effect depends on a number of country-specific characteristics, such as the degree of bilateral trade integration, the structure of bilateral trade balances, the exchange rate system, the size of the country where the expansion is generated, the degree

of capital mobility, or the behavior of the central bank.[6] This theoretical ambiguity calls for answers from an empirical investigation. Using the methodological framework described below, we investigate how domestic macroeconomic variables respond to a foreign fiscal impulse. While the interest rate channel can be explicitly considered in this framework, the trade channel and the exchange rate channel can be addressed only implicitly (via the direct domestic output response) given that we do not include trade volumes in our setting to keep the model tractable.[7]

2.2 Open Economy Structural VAR Model with Fiscal Shocks

To get information on the size of fiscal multipliers, a structural vector autoregressive (SVAR) model in the tradition of Blanchard and Perotti (2002) has frequently been implemented. Building on this approach, we develop an open economy SVAR model accounting for both foreign and domestic fiscal shocks, imposing contemporaneous restrictions to achieve identification.

We consider the structural form of a vector autoregressive (VAR) model:

$$A_0 x_t = A(L) x_{t-1} + B\varepsilon_t, \tag{1}$$

where A_0 is the $m \times m$ matrix of contemporaneous effects, $A(L)$ represents the impact of lagged effects (matrix lag operator notation[8]) and B is an $m \times m$ structural form parameter matrix. Our $m \times 1$ vector of endogenous variables x_t consists of the following variables: foreign fiscal balance (f_t^*),[9] domestic government purchases of goods and services (g_t), domestic net taxation (τ_t), domestic output (y_t), nominal effective exchange rate (e_t), domestic inflation (π_t) and a short-run interest rate (i_t), i.e. $x_t = (f_t^* \; g_t \; \tau_t \; y_t \; e_t \; \pi_t \; i_t)'$. The structural shocks, denoted by ε_t, are assumed to be linearly related to the structural model residuals with zero mean and a diagonal variance-covariance matrix, i.e. $\varepsilon_t \sim \left(0, \Sigma_\varepsilon = \mathrm{diag}\left\{\sigma_i^2\right\}\right)$. The corresponding reduced form VAR model is given by:

$$x_t = R(L) x_{t-1} + u_t, \tag{2}$$

where $R(L) = A_0^{-1} A(L)$ and $u_t = A_0^{-1} B\varepsilon_t$. Using this relation between reduced form residuals and structural shocks, we can now specify the model for innovations $A_0 u_t = B\varepsilon_t$ as follows:

[6] *Simulations by Breuss (2006), applying both a calibrated two-country Mundell-Fleming model with flexible prices and the Oxford Economic Forecasting World Model, have shown that the cross-border effect will be bigger if the fiscal shock is generated in a large economy, if there is a fixed exchange rate system (as in this case the output increase is not reduced by an appreciation, which would be implemented in a flexible exchange rate system to counteract increasing domestic prices) or if the central bank pursues an accommodative policy.*

[7] *Even if we were able to include trade-related variables, it would be difficult to empirically disentangle the exchange rate channel from the trade channel (see Badarinza, 2008) as, in the end, both of them affect output via changes in trade volumes. Moreover, we do not incorporate a real exchange rate but a nominal one, which enters into a type of arbitrage equation for the foreign exchange market (in line with Dungey and Fry, 2009, and Kožluk and Mehrotra, 2009).*

[8] $A(L)x_{t-1} = A_1 x_{t-1} + A_2 x_{t-2} + \ldots + A_q x_{t-q}$, *where* A_j *are* $m \times m$ *matrices for each* $j = 1,\ldots,q$.

[9] *Note that the foreign fiscal balance is scaled to GDP and inversely defined to interpret an increase in* f_t^* *as a fiscal expansion, i.e.* $f_t^* = (g_t^* - \tau_t^*)/y^*$. *We do not distinguish between a spending and a net tax shock in the foreign country to keep the model tractable.*

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0.5 & 0 \\ 0 & 0 & 1 & -0.8 & 0 & -0.5 & 0 \\ -\alpha_{yf^*} & -\alpha_{yg} & -\alpha_{y\tau} & 1 & 0 & 0 & 0 \\ \alpha_{ef^*} & -\alpha_{eg} & -\alpha_{e\tau} & -\alpha_{ev} & 1 & -\alpha_{e\pi} & -\alpha_{ei} \\ 0 & 0 & 0 & -\alpha_{\pi y} & 0 & 1 & 0 \\ -\alpha_{if^*} & -\alpha_{ig} & -\alpha_{i\tau} & 0 & -\alpha_{ie} & -\alpha_{i\pi} & 1 \end{pmatrix} \begin{pmatrix} u_t^{f^*} \\ u_t^g \\ u_t^\tau \\ u_t^y \\ u_t^e \\ u_t^\pi \\ u_t^i \end{pmatrix} =$$

$$\begin{pmatrix} \beta_{f^*f^*} & 0 & 0 & 0 & 0 & 0 & 0 \\ \beta_{gf^*} & \beta_{gg} & 0 & 0 & 0 & 0 & 0 \\ \beta_{\tau f^*} & \beta_{\tau g} & \beta_{\tau\tau} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \beta_{yy} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \beta_{ee} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \beta_{\pi\pi} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \beta_{ii} \end{pmatrix} \begin{pmatrix} \varepsilon_t^{f^*} \\ \varepsilon_t^g \\ \varepsilon_t^\tau \\ \varepsilon_t^y \\ \varepsilon_t^e \\ \varepsilon_t^\pi \\ \varepsilon_t^i \end{pmatrix}, \tag{3}$$

with the innovations (reduced form residuals) that may be correlated, i.e. for any k,l-pair of endogeneous variables, we could have $\mathrm{cov}(u_t^k, u_t^l) \neq 0$, and the structural shocks that are uncorrelated, i.e. $\mathrm{cov}(\varepsilon_t^k, \varepsilon_t^l) = 0$. A_0 contains the contemporaneous responses of variable k to an innovation in variable l, and α_{kl} can thus be interpreted in terms of an elasticity. For the fiscal variables, α_{kl} captures both the automatic response (automatic stabilizers) and the systematic discretionary response to innovations in the other system variables. B, on the other hand, contains the contemporaneous responses of variable k to a structural (exogenous) shock in variable l. The structural fiscal shocks ($\varepsilon_t^{f^*}, \varepsilon_t^g, \varepsilon_t^\tau$) represent the random discretionary shocks to fiscal policies (for this type of classification see Perotti, 2004).

2.3 Restrictions on Contemporaneous Responses in the System to Achieve Identification

In line with the order conditions by Breitung et al. (2004), $2m^2 - m(m+1)/2$ restrictions have to be imposed to achieve just-identification of equation (3). In our case $m = 7$, i.e. we need a total of 70 restrictions on A_0 and B. One can see in equation (3) that we have actually imposed 73 restrictions – the validity of this over-identifying situation will be tested later on by means of a likelihood ratio test. The restrictions and the underlying economic assumptions are discussed in detail below.

2.3.1 Restrictions on Fiscal Responses

In our model the domestic economy is assumed to be small and open (CEE country) and strongly integrated with a large foreign economy (euro area, Germany as

proxy as discussed already in the introduction) so that a fiscal shock in the foreign country could have a considerable impact on the domestic economy (but not necessarily the other way round). We assume that the large foreign country is a "fiscal leader" and does not react – at least not in the same quarter – to changes in variables of the domestic economy. Consequently, $\alpha_{f^*l} = 0, \forall l \neq f^*$ in the first row of equation (3). A similar reasoning is provided by Kožluk and Mehrotra (2009) to model the spillover of a monetary policy shock in a large foreign country (China) to small and open trading partner economies (Southeast Asia).

The second and third rows in equation (3) describe the domestic fiscal responses to innovations in the other system variables. We build on a series of closed economy fiscal SVARs that have been implemented for a small but growing sample of OECD countries using the identification approach developed by Blanchard and Perotti (2002). The key to identification here is the observation that it takes typically more than a quarter for fiscal policymakers to respond to, say, an output shock because of decision lags. The systematic discretionary response contained in α_{kl} can therefore be set to zero when using quarterly data. As a result, we are left with the automatic response only, for which we can use available external information or reasonable assumptions on the elasticity of public spending and net taxes.

Let us first identify the structural fiscal shocks on the right-hand side of equation (3). Like Giordano et al. (2007), who also investigated an SVAR with three fiscal variables, we achieve a Cholesky-type identification by imposing assumptions on the ordering among the structural fiscal shocks. As mentioned before, we assume that the large foreign country is the fiscal leader, and thus the decision on the foreign fiscal balance "comes first." That is, $\beta_{f^*g} = \beta_{f^*\tau} = 0$, while both β_{gf^*} and $\beta_{\tau f^*}$ are expected to be different from zero, allowing domestic fiscal policy to react contemporaneously to a foreign fiscal shock. We further assume that spending decisions by the government are taken before taxes are set, i.e. $\beta_{g\tau} = 0$ while $\beta_{\tau g} \neq 0$.

In a second step we can now make additional assumptions on the elasticities of the domestic fiscal variables with respect to the macroeconomic variables in the system (relevant for the restrictions in matrix A_0 and to be interpreted as automatic response of fiscal variables to innovations in the macroeconomic variables):

– *Output elasticity of public spending:* Under the EU's fiscal surveillance framework, the European Commission (2004) estimates budgetary elasticities of the EU Member States on a regular basis. According to these estimates, a 1% decline in GDP drives up government spending on average by nearly 0.1% in the CEE-5. The lion's share of this pretty inelastic response of public spending to output can be attributed to unemployment benefits, which are not included in our spending measure but enter with a negative sign into the net tax variable (see also section 3.1). Our spending variable consists of the sum of government consumption and government gross fixed capital formation, of which public wages account for, on average, nearly 50%. Typically, public wages show a certain inertia in adjusting to business cycle fluctuations. For example, a temporary output decline does not induce immediate lay-offs of public sector employees. Given all these facts, we feel safe to assume that $\alpha_{gy} = 0$.
– *Output elasticity of net taxes:* Existing fiscal SVAR investigations for various OECD countries mainly follow the approach of Blanchard and Perotti (2002) and compute elasticities for different types of taxes and transfers. Weighted

averages are then calculated over these sub-elasticities to get $\alpha_{\tau y}$. The following tax revenue categories are distinguished: personal income taxes, corporate income taxes, indirect taxes (e.g. VAT), social security contributions and all other current and capital transfers that government receives (e.g. property or inheritance taxes). The literature uses a mixture of assumptions and estimations to get the elasticity for each of these categories. For instance, de Castro and Hernández de Cos (2008) regress the growth rate of each tax base on GDP growth and take the estimated slope coefficient as the output elasticity.[10] Perotti (2004) and Giordano et al. (2007) employ similar regressions but also use some simplifying assumptions, such as an elasticity of one for indirect taxes, an elasticity of zero for corporate income taxes if they are collected with a lag longer than a quarter (e.g. in Germany), an elasticity of zero for property and inheritance taxes as they are likely to be inelastic to output at a quarterly frequency, or an elasticity of –0.2 for transfers.[11] The resulting value for $\alpha_{\tau y}$ is 0.5 in Italy, 0.62 in Spain, 0.76 in the U.K., 0.92 in Germany and 1.85 in the U.S.A. In the case of Germany, the calibration of $\alpha_{\tau y}$ is primarily determined by the assumption of unit-elastic indirect taxes as the estimated output elasticity of personal income taxes is statistically not different from zero (see Perotti, 2004). In this paper we assume for the CEE-5 a benchmark elasticity of $\alpha_{\tau y} = 0.8$. This is supported by the European Commission's estimates of the output elasticity of total government revenues, ranging from 0.88 in Slovakia to 1.02 in Hungary and Slovenia (reported in Eller, 2009), and mildly corrected downward because of the small output elasticity of transfers. Furthermore, the share of indirect taxes in total general government revenues is comparatively high in the CEE-5 (on average clearly above 30%), which also backs a value for $\alpha_{\tau y}$ that is not too far away from that of Germany.

– *Price elasticity of public spending:* Following Perotti (2004), we can distinguish the wage component from the non-wage component of public purchases of goods and services. On the one hand, public wages may be indexed to inflation; however, it is quite unlikely that this indexation occurs within a quarter. This implies a quarterly elasticity of real public wages to inflation of –1, i.e. in real terms (we are using real-valued variables in the estimations) public wages shrink proportionally to the increase in inflation. On the other hand, we can assume that a considerable part of the non-wage component of public spending is indexed to the price level within a quarter, implying an elasticity of zero in real terms for these spending categories. Given that in the CEE-5 public wages account for nearly 50% of the employed spending measure (except for the Czech Republic and Slovakia, for each of which a share of about 30% applies), Perotti's benchmark of $\alpha_{g\pi} = -0.5$ provides a reasonable upper bound, which we use in our baseline specification, assuming that the whole non-wage component is indexed to the price level within a quarter. At the other extreme – under the assumption that there is no quarterly price indexation for

[10] *However, besides GDP growth, only a time trend is included as explanatory variable, making the estimations susceptible to omitted variable biases. This is admittedly difficult to resolve given a considerable degree of model uncertainty in these estimations.*

[11] *The number is not higher as, basically, only unemployment benefits respond to output changes within a quarter, and they account only for a small share in total primary expenditures.*

all spending categories – we get $\alpha_{g\pi} = -1$ as a lower bound. Thus, a range of parameters for $\alpha_{g\pi} \in [-1, -0.5]$ can be considered; the impact of different calibrations will be checked in the robustness section.

– *Price elasticity of net taxes:* Existing fiscal SVAR studies calculate $\alpha_{\tau\pi}$ analogously to $\alpha_{\tau y}$ by distinguishing between different tax categories. While the elasticity for personal income taxes and social security contributions is typically estimated ($\alpha_{dirtax,\pi}$), some simplifying assumptions are used for the other categories, such as a price elasticity of zero for real corporate income taxes and for real indirect taxes (corresponds to unitary elasticities in nominal terms). For transfers, a similar argument as for public wages is applied, namely a lack of quarterly price indexation and thus a price elasticity of –1 in real terms. As a result, the literature gets a positive value for $\alpha_{\tau\pi}$, which is largely driven by the negative transfer elasticity and is 0.78 in Spain (de Castro and Hernández de Cos, 2008), 0.87 in Germany, 1.21 in the U.K. and 1.25 in the U.S.A. (Perotti, 2004). Given the stated assumptions, $\alpha_{\tau\pi} = 0$ if $\alpha_{dirtax,\pi} = -1$, $\alpha_{\tau\pi} = 1$ if $\alpha_{dirtax,\pi} = 0$, and $\alpha_{\tau\pi} > 1$ if $\alpha_{dirtax,\pi} > 0$. In this paper we start with the benchmark of $\alpha_{\tau\pi} = 0.5$ (i.e. $\alpha_{dirtax,\pi} = -0.5$) and then try different calibrations within reasonable ranges (see section 4.2).
– *Exchange rate elasticities of fiscal variables:* We set $\alpha_{ge} = \alpha_{\tau e} = 0$ because the contemporaneous response of domestic fiscal variables to exchange rate innovations is deemed to be negligible. This assumption is also backed by Dungey and Fry (2009) – one of the rare papers that include exchange rates into a fiscal SVAR to identify jointly fiscal and monetary shocks (for New Zealand).
– *Interest rate elasticities of fiscal variables:* We set $\alpha_{gi} = \alpha_{\tau i} = 0$ because our revenue and expenditure data do not include property income or interest payments on public debt (in line with Perotti, 2004).

2.3.2 Restrictions on Non-Fiscal Responses

In the fourth row of equation (3) we let real GDP respond contemporaneously to the fiscal variables, while output does not respond to prices, interest rates and exchange rates within a quarter. For the former assumption, one could argue that it takes more than a quarter for fiscal policy to affect the economy because of implementation lags (argument put forward by Fatás and Mihov, 2001). However, as Perotti (2004) emphasized, government spending is a component of GDP, and if we set α_{yg} to be zero, we would implausibly assume that an increase in public spending crowds out private GDP one-to-one. A similar argument can be put forward for net taxes, as they are a component of disposable income, and for the foreign fiscal balance, if we assume that a foreign fiscal shock has an immediate effect on domestic exports, which are, again, a component of GDP.

In rows five and seven of equation (3) we treat the interest rate and the exchange rate as "fast" financial variables that immediately react to innovations in the other system's variables, with one notable exception: $\alpha_{iy} = 0$. This restriction is, as in the case of the fiscal policy response, backed by the assumptions that it takes more than a quarter for the central bank to react to an output shock due to decision lags or due to the lack of real-time output data (therefore the systematic discretionary response is zero) and the automatic response (say, a reduction of interest rates due to less credit demand in the case of a slowing economy) does not immediately materialize as commercial banks set their interest rates more in line with

central bank rate adjustments than in response to short-run credit demand fluctuations.

Finally, in row six we apply a "sticky" Calvo pricing scheme,[12] analogously to Kožluk and Mehrotra (2009), and assume that inflation does not respond within a quarter to innovations in the other system's variables, except for a non-zero response to output that can be motivated by automatic price markups in the case of soaring aggregate demand.

3 Data and Empirical Specification

3.1 Data Issues

There is a broad discussion in the literature whether different types of public expenditures and revenues have a different impact on economic output. This discussion is based on, inter alia, a branch of endogenous growth theory that distinguishes between "productive" and "non-productive" public spending as well as "distortionary" and "non-distortionary" taxation and assigns a different long-run growth impact to these categories (see, e.g., Devarajan et al., 1996). Investigations for Hungary (Horváth et al., 2006, and Lendvai, 2007) show that the composition of domestic fiscal shocks is particularly important when it comes to evaluating the effects of fiscal policy.

Given that we have only a limited degree of freedom in our model due to comparatively short data series for the CEE-5, we chose to address these composition arguments by a two-way breakdown of the government budget and use a narrow definition of government spending and taxation to fit more clearly the direct impact of a fiscal action on the use of resources by the private sector (in line with Perotti, 2004). We argue that public spending on goods and services has effects different from those of transfers: Only the former affects directly the use of resources. Hence, our variable for government purchases of goods and services (g_t) consists of government consumption plus government investment, while transfers are subtracted from government revenues to get our variable for net taxes (τ_t). The inclusion of net taxes should capture the net impact on the private sector and is supported by the view that in the short and medium run fiscal policy operates mostly via a demand channel. The foreign fiscal balance is also constructed according to these definitions and scaled to GDP.

For the fiscal variables we use quarterly budgetary data from the Quarterly Non-Financial Accounts for General Government (QNFAGG) of Eurostat's Government Finance Statistics. Several characteristics of this dataset are of relevance for our empirical investigation. First, compilation practices differ across countries and across different expenditure and revenue items (for an overview, see European Communities, 2006). Basic data are transformed by Eurostat to fully comply with the European System of Accounts 1995 (ESA 95) and to ensure comparability between countries. Second, raw data series are collected at different frequencies. While tax data are available from tax offices at monthly frequency, a few items are missing at quarterly frequency (e.g. public wages in kind) and are estimated based on previous years' data or on budget data. Third, adjustments are implemented in the compiled data to deliver satisfactory accrual figures (e.g. cash-

[12] *Price stickiness helps to obtain an increase in the real interest rate that also brings about a monetary contraction.*

based tax data are time-adjusted with a one-month delay to obtain accrual data). The use of accrual figures (an expense is recorded when goods are delivered or services are rendered) is important for our setting as they capture the effective economic response to a fiscal shock better than cash data. Fourth, QNFAGG data have been available for the CEE-5 only since 1999, and thus we use annual figures for the years 1995 to 1998 and the seasonal pattern of the years 1999 to 2009 to interpolate quarterly values for j = 1995,...,1998, i.e.

$$F_{ij} = F_j \cdot \sum_{k=j+1}^{T} \frac{F_{ik}}{F_k} \frac{1}{T-j}, \tag{4}$$

with F representing the respective fiscal variable, i denoting quarters and T = 2009. Finally, concerning the overall quality of QNFAGG data for the CEE-5, the quality report of Eurostat (2008) confirms considerable advances (compared to 2006) with regard to the consistency between quarterly and annual data, the timeliness and coverage of data, or the estimation of accrual data on a quarterly basis. Further improvements are requested for budgetary revisions, whose impact should be reduced further.

In the estimations we use quarterly data (from the first quarter of 1995 to the fourth quarter of 2009) that are real-valued, seasonally adjusted and denominated in local currency. Output, fiscal variables and the nominal effective exchange rate are expressed in logs. The fiscal variables are available in nominal terms only and so we deflated them by using the CPI. Both output and fiscal variables show a strong seasonal pattern; hence they were seasonally detrended by applying the Tramo-Seats procedure (also used by, among others, Giordano et al., 2007). Table A.1 in the appendix describes the calculation of the variables and their data sources in detail.

3.2 Empirical Specification of the Model

The reduced form VARs are estimated by ordinary least squares in levels form, allowing cointegration between the variables. The choice of lag length for the models reflects the use of quarterly data and a rather short estimation sample. We also consider the results from misspecification tests, in particular in order to avoid residual autocorrelation. The resulting lag lengths amount to 2 in the case of the Czech Republic, Hungary, Poland and Slovenia, and to 3 for Slovakia. All models include a constant and a linear trend as deterministic terms.[13] The estimation samples for the individual economies are as follows: Q1 1995 to Q4 2009 for the Czech Republic, Hungary and Poland, and Q1 1996 to Q4 2009 for Slovakia and Slovenia.

The structural form VARs are then estimated by maximum likelihood and a scoring algorithm, using the estimated variance-covariance matrix from the reduced form VAR (see Breitung et al., 2004).[14] Attaining convergence is compli-

[13] *One constant only is included in the case of Poland to attain convergence in the estimation of the structural form coefficients. A shift dummy variable is also included in the cases of Poland, Slovenia and Slovakia, taking the value 1 from Q2 2000 to Q4 2000 and 0 otherwise in order to deal with residual outliers (due to the selling of UMTS licenses in Germany in this period, which had a considerable non-discretionary one-off effect on the German fiscal balance).*

[14] *For the SVAR estimation we use the software JMulTi, developed by Lütkepohl and Krätzig (2004), downloadable from http://www.jmulti.de.*

cated in our system due to the relatively large number of variables in relation to the sample size. A slight variation of the specification across countries helped to resolve this issue. In the cases of Poland, Slovakia and Slovenia we smoothed the domestic fiscal variables using four-quarter moving averages to account for short-term volatility, which was not fully eliminated by the Tramo-Seats seasonal adjustment procedure. Further, in the case of Poland, the foreign fiscal shock is specified as a shock to the primary general government fiscal balance-to-GDP ratio.

The validity of the three overidentifying restrictions is tested by a likelihood ratio test. The overidentifying restrictions are rejected at a 5% significance level only in the case of Slovenia.[15] The impact of structural fiscal shocks is evaluated by impulse responses. In order to account for parameter uncertainty, we use Hall percentile 95% confidence intervals, obtained by bootstrapping methods with 1,000 replications (see Benkwitz et al., 2001). As our main interest is in the long-run impact of fiscal shocks, we examine the accumulated impulse responses over time.

4 The Economic Effects of Fiscal Shocks

4.1 Baseline Results

In this section we analyze the effects of fiscal shocks implied by the model estimates. The structural VAR approach allows the empirical assessment of many potential links between macroeconomic variables, but in this study we concentrate on the reactions to structural fiscal shocks, both foreign and domestic. We start by analyzing cross-country fiscal spillovers and then turn to the reaction of domestic variables to domestic fiscal shocks.

The estimated structural fiscal shocks for the CEE-5 and Germany (available from the authors upon request) reassemble well-known periods of fiscal tightening (such as in Germany in 2000 and 2007, in the Czech Republic in 2005, in Poland in 2005 and 2007, in Slovakia in 2002–03, and in Slovenia in 2002) and fiscal easing (in Germany in 2002–03 and 2005, in Poland in 2004, in Slovakia in 2000, in Slovenia in 2001, and in Hungary in 2006). In the context of the 2008–09 crisis, expansionary fiscal shocks can be observed in all these countries, except for Hungary, where the pro-cyclical fiscal consolidation is reflected by – on average – positive shocks to net taxes and negative shocks to government spending. Negative tax shocks are most pronounced in this period in the Czech Republic, while positive spending shocks predominate in both the Czech Republic and Poland.

The results in terms of how variables respond to temporary structural shocks in fiscal variables (both domestic and foreign) are presented in tables 1 to 3, charts 1 to 3 and charts 5 and 6. The tables show the cumulative reaction of each variable to each of the structural fiscal shocks of the system after two, four and eight quarters. The charts are cumulative impulse-response functions depicting the reaction of real GDP and domestic fiscal variables to temporary structural (1%) shocks in foreign and domestic fiscal variables.

[15] *The test statistic from the likelihood test amounts to 0.711 for Poland (p-value: 0.871), 2.627 (p-value: 0.453) for the Czech Republic, 5.038 (p-value: 0.169) for Hungary, 2.141 (p-value: 0.544) for Slovakia, and 17.584 (p-value: 0.001) for Slovenia. Although the results of the test for Slovenia would imply that probably we should work with a just-identified model, we decided to use the overidentified model for consistency reasons.*

Table 1

Cumulative Responses to a Foreign Fiscal Shock

		Czech Rep.			Hungary			Poland			Slovakia			Slovenia		
		2	4	8	2	4	8	2	4	8	2	4	8	2	4	8
Government spending	g	0.6	2.4*	7.8*	2.2*	6.0*	14.8*	0.6*	1.1*	1.8*	1.2	3.1*	3.9	0.3	0.3	–0.6*
Net taxes	τ	–8.1*	–12.4*	–16.2*	–0.5	–1.0	–2.0	–0.6	–1.1	–1.9	–0.4	–3.4	–11.8*	–0.5	–1.6	–3.1*
Output	y	–0.6*	–1.6*	–4.0*	–0.1	0.3	2.6	0.9*	1.3*	2.6*	–3.7*	–6.1*	–4.3*	–1.2*	–2.0*	–2.4*
Exchange rate	e	1.3*	2.3*	1.7	0.9	2.7*	6.0*	–0.9	–1.1	–1.5	–0.8	–1.9*	–2.5	0.3	0.1	–1.0
Inflation rate	π	–0.0	–0.4	–1.5*	–0.2	–0.6	–1.4	–0.8*	–1.2*	–1.7*	–0.6	–0.5	–4.3*	–0.4	–0.9*	–1.5*
Interest rate	i	0.3	0.8	1.4*	–0.3	–0.7	–1.1	–0.5	–1.4*	–2.5*	–0.4	–1.2	1.0	–0.4*	–0.5*	–0.8*

Source: Authors' estimations.

Note: This table shows the cumulative response (in %) of the endogeneous variables at quarters 2, 4, and 8 after a temporary shock in the German fiscal balance-to-GDP ratio (easing of the German fiscal balance by 1% of GDP). An asterisk indicates statistical significance in the sense that the 95% Hall percentile confidence interval (obtained by bootstrapping methods with 1,000 replications) does not include a zero impulse response.

Table 2

Cumulative Responses to a Domestic Spending Shock

		Czech Rep.			Hungary			Poland			Slovakia			Slovenia		
		2	4	8	2	4	8	2	4	8	2	4	8	2	4	8
Foreign fiscal balance	f*	0.20*	0.78*	2.10*	–0.28*	–0.62*	–1.06*	0.26	0.73*	1.73*	–0.06	–0.17	–0.42	–0.02	0.30	1.09*
Net taxes	τ	–0.01	–0.03	–0.05	0.05*	0.07*	0.06*	–0.01	–0.02	–0.05	–0.00	–0.01	–0.05	–0.01	–0.01	–0.04*
Output	y	–0.00*	–0.01*	–0.04*	0.01*	0.02*	0.01	–0.00	–0.01*	–0.02*	–0.01*	–0.01	0.00	0.01	0.00	–0.01
Exchange rate	e	0.01	0.03*	0.03*	0.03*	0.05*	0.06*	0.02*	0.03*	0.01	0.02*	0.02*	–0.00	–0.01	–0.02	–0.03*
Inflation rate	π	2.50*	2.20*	0.23	3.12*	4.64*	6.42*	2.46*	3.36*	3.82*	3.04*	1.86*	–0.01	1.45*	1.56*	1.32*
Interest rate	i	0.66*	0.51	–0.39	0.85*	1.72*	3.37*	1.47*	2.27*	2.43*	0.76*	1.18*	1.96	0.28	0.26	–0.06

Source: Authors' estimations.

Note: This table shows the cumulative response (in %) of the endogeneous variables at quarters 2, 4, and 8 after a temporary 1% shock in domestic public purchases of goods and services. An asterisk indicates statistical significance in the sense that the 95% Hall percentile confidence interval (obtained by bootstrapping methods with 1,000 replications) does not include a zero impulse response.

Table 3

Cumulative Responses to a Domestic Taxation Shock

		Czech Rep.			Hungary			Poland			Slovakia			Slovenia		
		2	4	8	2	4	8	2	4	8	2	4	8	2	4	8
Foreign fiscal balance	f*	–0.12	–0.48*	–1.55*	0.34*	0.85*	1.71*	–0.73*	–1.73*	–3.90*	0.38*	1.33*	3.20*	–0.06	–0.44*	–0.95*
Government spending	g	0.01*	0.02*	0.02	0.02*	0.03*	0.05*	0.01*	0.02*	0.04*	0.02*	0.03*	–0.01	0.01*	0.01*	0.01*
Output	y	0.00	0.01	0.03*	–0.00	–0.01	–0.01	–0.00	0.00	0.02*	–0.02*	–0.05*	–0.10*	0.01*	0.02*	0.02*
Exchange rate	e	0.01	0.01	0.01	0.01	0.01	0.02	–0.00	–0.00	0.04	–0.01	–0.02*	–0.03*	–0.00	–0.01	–0.01
Inflation rate	π	–0.01	–0.16	0.34	–0.49	–1.12*	–1.69*	0.19	0.88*	3.18*	0.88*	2.25*	2.51*	0.15	0.84*	1.46*
Interest rate	i	–0.22	–0.59	–0.90*	–0.18	–0.19	–0.40	–0.04	0.43	3.00*	–1.00*	–2.42*	–5.33*	–0.12	0.38	0.77*

Source: Authors' estimations.

Note: This table shows the cumulative response (in %) of the endogeneous variables at quarters 2, 4, and 8 after a temporary 1% shock in domestic net taxes. An asterisk indicates statistical significance in the sense that the 95% Hall percentile confidence interval (obtained by bootstrapping methods with 1,000 replications) does not include a zero impulse response.

We find that there are considerable feedback effects between the foreign fiscal variable and the two domestic fiscal variables. On the one hand, if Germany implements a fiscal expansion, all the CEE-5 will respond with an expansion of public purchases of goods and services (the response is particularly strong in Hungary and the Czech Republic); in Slovenia, the response is reversed after the second year of reaction (see chart 1).[16] The Czech Republic and Slovakia respond with a sizeable cut in taxes and Slovenia with a fairly small one, while in Hungary and Poland net taxes do not respond to the foreign shock (see chart 2). On the other hand, our model estimates imply that the German fiscal balance responds to fiscal shocks in the CEE-5 as well (see tables 2 and 3). This result is, however, not that robust when we use alternative specifications (see section 4.2).

Fiscal shocks in Germany and the reactions in the CEE-5's GDP apparently involve both negative and positive cross-border spillovers (see chart 3). In Slovenia, Slovakia and the Czech Republic, output reacts negatively to a fiscal expansion in Germany (in Slovakia, this response is statistically significant only up to the second year after the shock). The effect is strongest in Slovakia and the Czech Republic, where after a temporary 1 percentage point shock in the German fiscal balance-to-GDP ratio real GDP contracts by 4% cumulatively over two years. In both countries, foreign fiscal expansion is accompanied by an increase in domestic government spending and interest rates,[17] both of which have a negative impact on output (see also below). Thus, on the one hand, this result corroborates the view that the negative interest rate channel outweighs the potentially positive trade and exchange rate channels in these two countries. On the other hand, the negative cross-border fiscal multiplier is transmitted here also via a non-Keynesian output response to a foreign-induced domestic fiscal expansion. The interest rate channel does not play a clear-cut role in Slovenia as interest rates respond negatively to foreign fiscal expansion and there is no response of output to interest rates. However, as in the Czech Republic, the foreign fiscal expansion results in cuts in net taxes, which have a negative impact on Slovenian output.[18]

In Poland and Hungary, a fiscal expansion in Germany has a positive impact on domestic output (in Hungary, the impact is statistically significant only ten quarters after the shock), pointing to a more dominant role of the trade and exchange rate channels here. The positive cross-border fiscal spillover in Hungary is consistent with spending reacting positively to the foreign fiscal expansion and resulting in a positive output response. The positive transmission of a foreign fiscal expansion to Poland can also be traced back to a negative response of the interest rate (policy-mix coordination could be the reason), which, in turn, has a positive effect on output.

It could be argued that the quantitative importance of the trade channel may be related to the degree of trade integration between each one of the CEE-5 and Germany. Chart 4 presents a scatterplot showing the level of trade integration

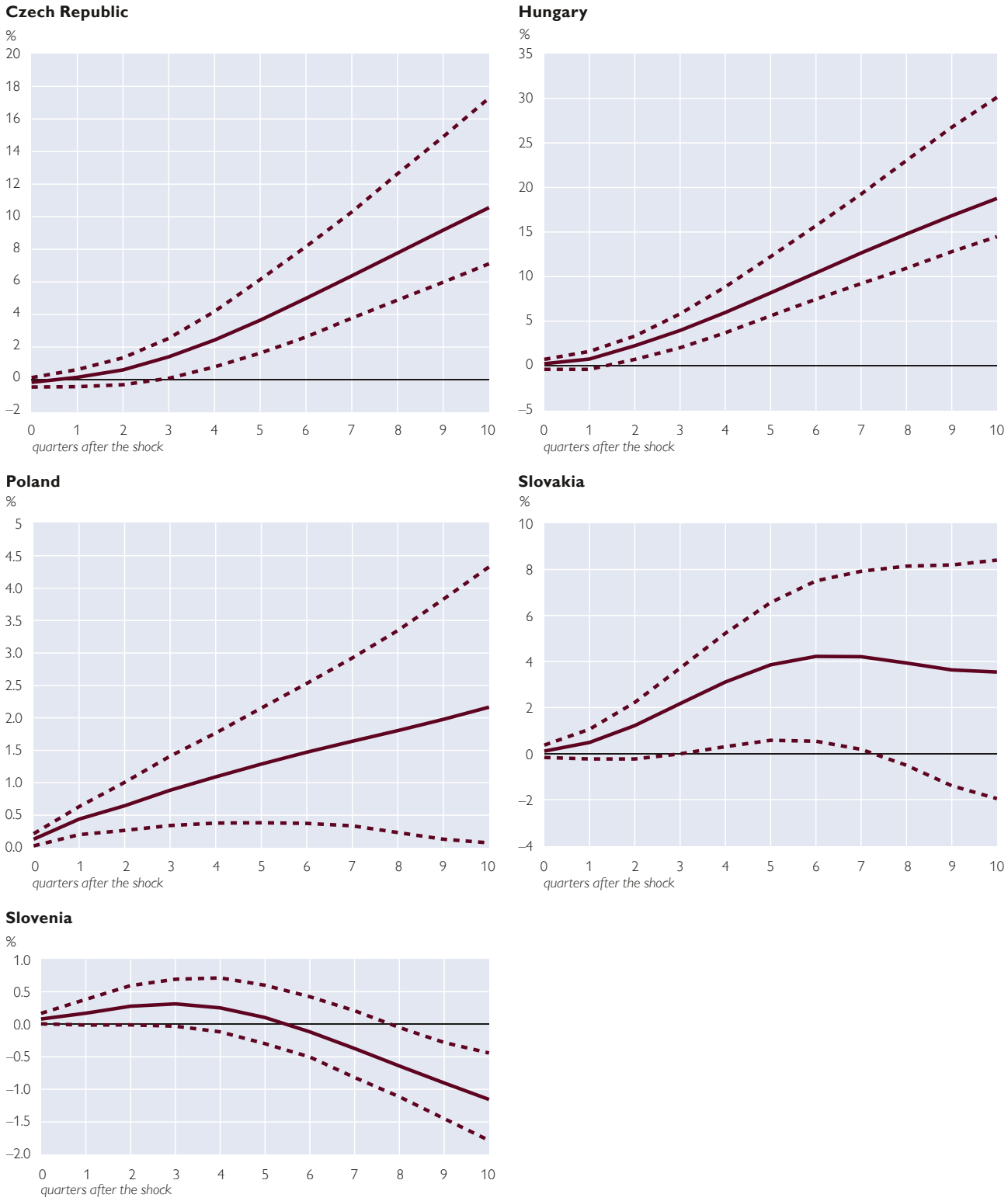
[16] *Such an empirical mechanism concerning the propagation of fiscal shocks in the euro area to the Polish economy is also found in Kolasa (2009), who uses a DSGE framework.*

[17] *The positive response of the interest rate to a fiscal shock in Germany is statistically significant in Slovakia when a 90% instead of a 95% confidence interval is used.*

[18] *It should be noted that the results for Slovakia and Slovenia are based on a sample which is dominated by the period when they were not members of the euro area. Current and future interest rate reactions are expected to be strongly influenced by the currency union framework.*

Chart 1

Response of Public Purchases of Goods and Services to a Foreign Fiscal Shock

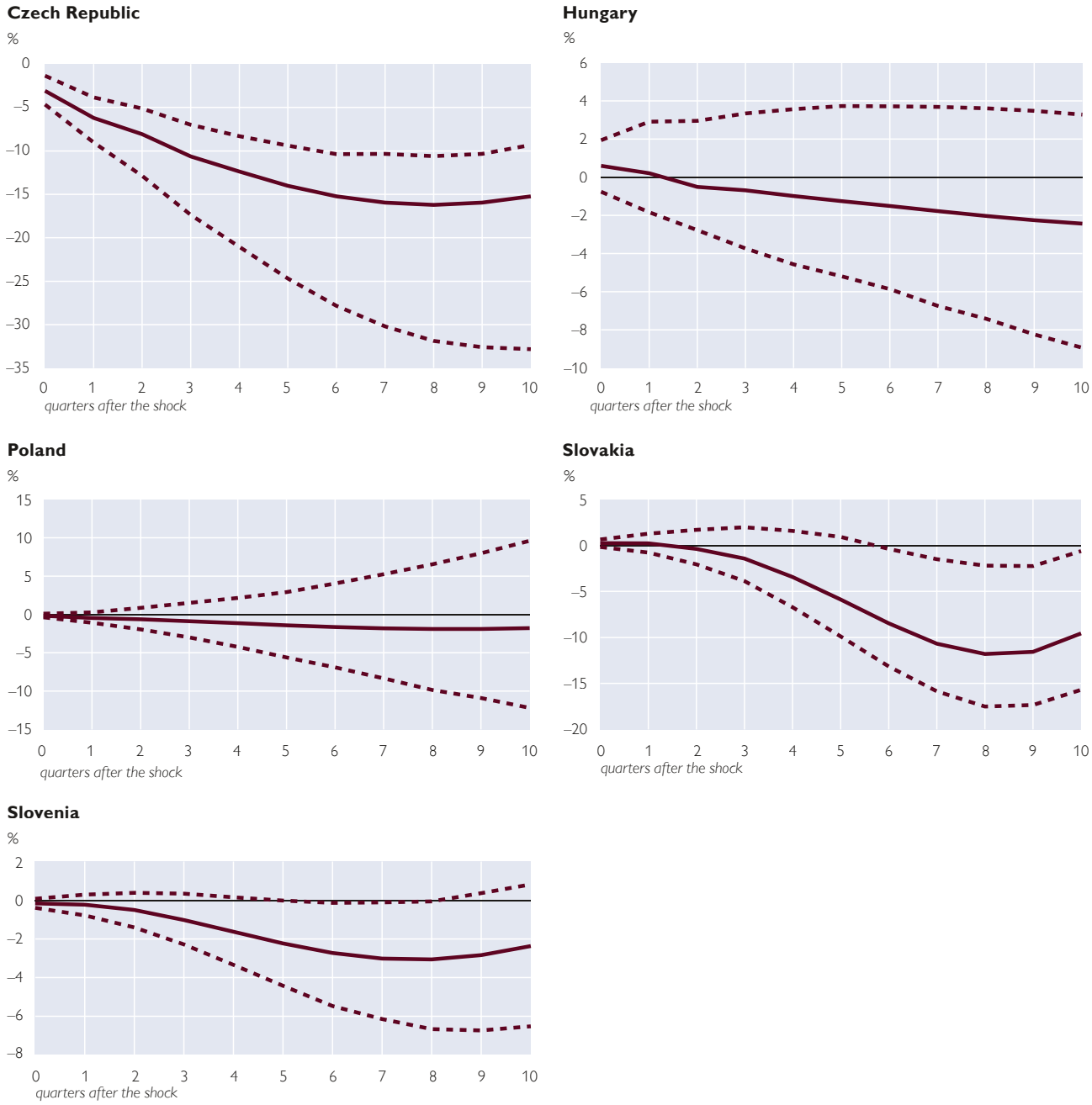


Source: Authors' estimations.

Note: The curves represent the cumulative median response of domestic government spending to a temporary shock in the German fiscal balance-to-GDP ratio (easing of the German fiscal balance by 1% of GDP) and the 95% Hall percentile confidence bands (dotted lines), obtained by bootstrapping methods with 1,000 replications.

Chart 2

Response of Net Taxes to a Foreign Fiscal Shock



Source: Authors' estimations.

Note: The curves represent the cumulative median response of domestic net taxes to a temporary shock in the German fiscal balance-to-GDP ratio (easing of the German fiscal balance by 1% of GDP) and the 95% Hall percentile confidence bands (dotted lines), obtained by bootstrapping methods with 1,000 replications.

between the CEE-5 and Germany (average share of exports to Germany in total exports for the period from 1999 to 2009 against the (median) accumulated reaction of output to a fiscal shock in Germany after two years. The relationship between these two variables is rather weak, indicating that the role that integration plays as a factor modulating the propagation effects of foreign fiscal shocks is overcome by other transmission channels.[19]

The results concerning domestic fiscal multipliers show a mixture of both Keynesian and non-Keynesian responses of output to domestic fiscal expansions (see charts 5 and 6). Output in Hungary tends to increase when fiscal policymakers implement a fiscal expansion. These reactions are, however, not very precisely estimated for net taxes and only statistically significant in the first year for spending; therefore they are relatively short-lived.[20] We can also observe a strong Keynesian response in Slovakia for the revenue side, where real GDP contracts by 0.1% cumulatively over two years after a (temporary) 1% shock to net taxes. Output in Poland and the Czech Republic, by contrast, responds in a non-Keynesian manner to a domestic fiscal shock: It decreases after a rise in public purchases of goods and services or a cut in net taxes. This also holds for Slovenia, but only for the revenue side. Non-Keynesian output responses to fiscal shocks – in particular to fiscal contractions with the argument that fiscal tightness mitigates concerns about debt sustainability and reduces the expected tax burden on the private sector, thus stimulating private sector demand – were also found for the CEE-5 by Rzońca and Ciżkowicz (2005), for emerging market economies by Kandil and Morsy (2010) and for a sample of EU countries by Giudice et al. (2007).

Further conclusions[21] concerning the response of fiscal policy to monetary shocks can be drawn from investigating the impulse-response functions corresponding to the reaction of government expenditure and net taxes to structural interest rate shocks. Accommodative fiscal policy on the expenditure side can be observed in the Czech Republic, Hungary and, to a lesser extent, the Slovak Republic, where public spending decreases after a positive interest rate shock. In the Czech Republic and Hungary, by contrast, net taxes respond negatively to a shock in the interest rate. The net effect evaluated at the median response indicates that the non-accommodating effect tends to be slightly higher than the reduction of government expenditure following a contractive interest rate shock.

Turning to the reaction of monetary policy to fiscal policy shocks (see also tables 2 and 3), all countries, with the exception of Slovenia, tend to react to an expansion of public spending by increasing their interest rates (in Slovakia and the

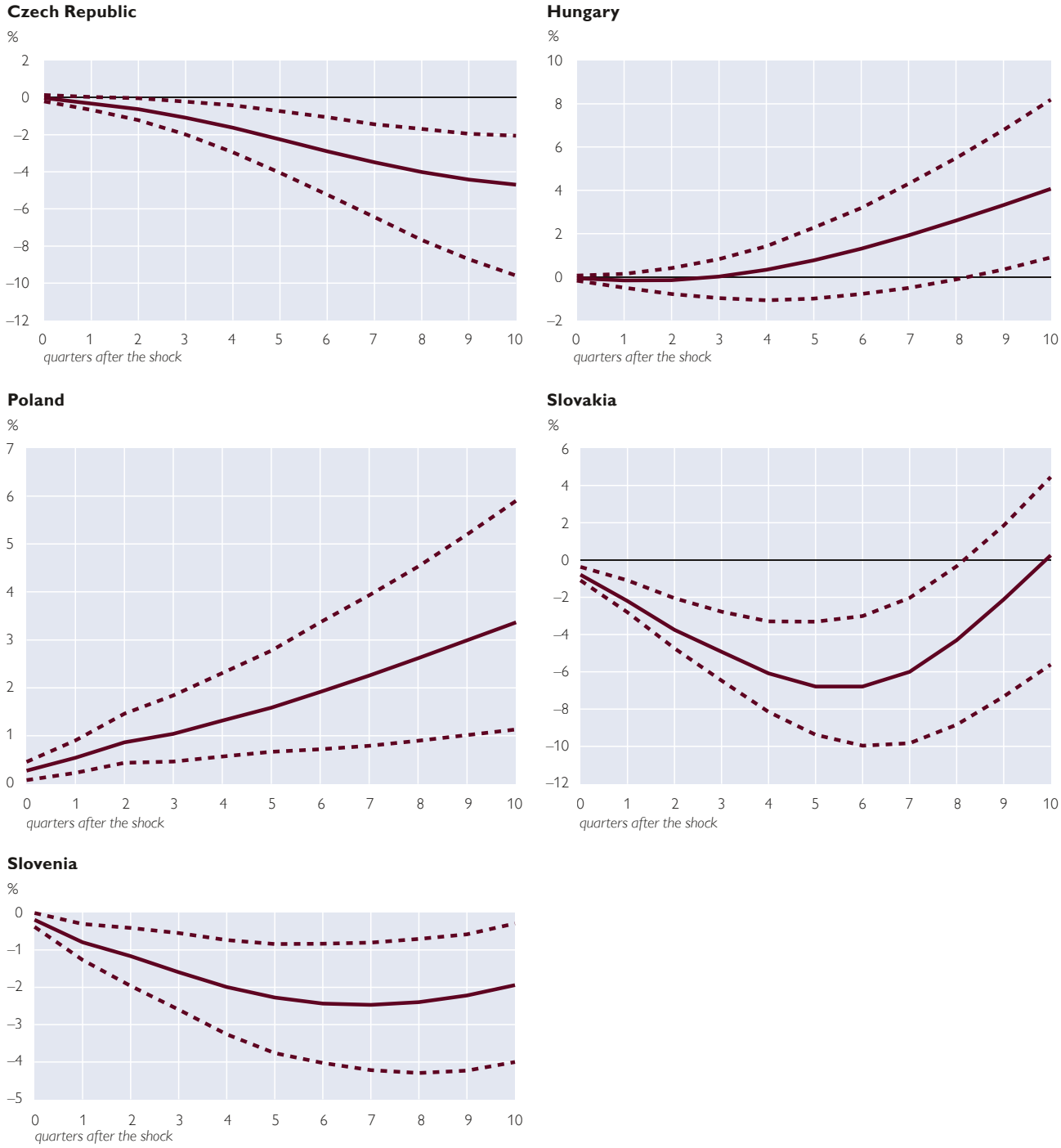
[19] *To examine cross-country differences in the response of domestic output to a foreign fiscal shock in a more instructive manner, it would be useful to present partial regression plots where the conditional correlation between the cumulative impulse response and the variable of interest is shown and relevant country-specific characteristics are used as control variables (such as the structure and governance of fiscal policy, the degree of economic integration and openness, the size of and distance between the economies under investigation, the exchange rate system or the type of monetary policy reaction). However, this exercise makes only sense in a cross-section setting with considerably more than five observations. This is also why chart 4 – an unconditional correlation between the output response and trade integration – is shown here primarily for suggestive reasons.*

[20] *It should be noted that our results for Hungary differ from those of Lendvai (2007), who finds for the period Q1 1997 to Q4 2005 that increasing government expenditure leads to a contraction in GDP, using a structural VAR with a "Cholesky" identification scheme á la Fatás and Mihov (2001).*

[21] *In the following, we discuss further interesting impulse responses without presenting the respective charts, which are, however, available from the authors upon request.*

Chart 3

Response of Real GDP to a Foreign Fiscal Shock



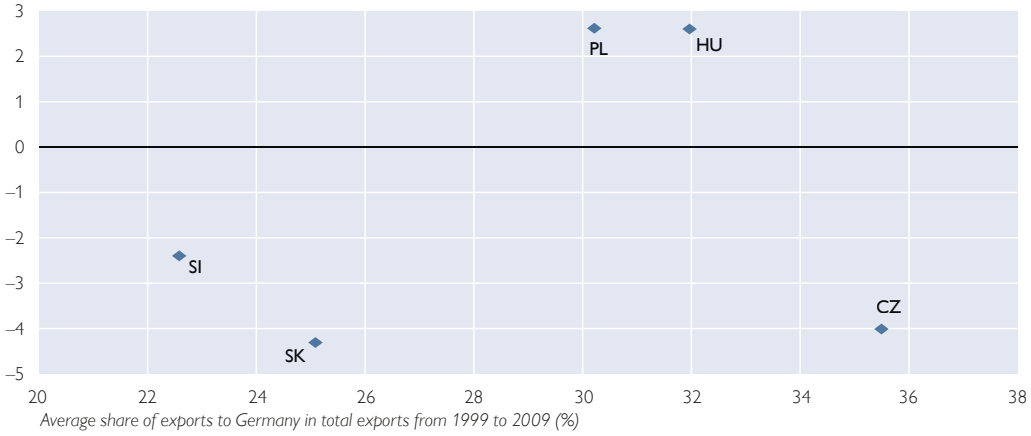
Source: Authors' estimations.

Note: The curves represent the cumulative median response of domestic real GDP to a temporary shock in the German fiscal balance-to-GDP ratio (easing of the German fiscal balance by 1% of GDP) and the 95% Hall percentile confidence bands (dotted lines), obtained by bootstrapping methods with 1,000 replications.

Chart 4

Cross-Border Spillover of a Foreign Fiscal Shock and Degree of Trade Integration

Cumulative output reaction to a temporary fiscal shock in Germany after 2 years (%)



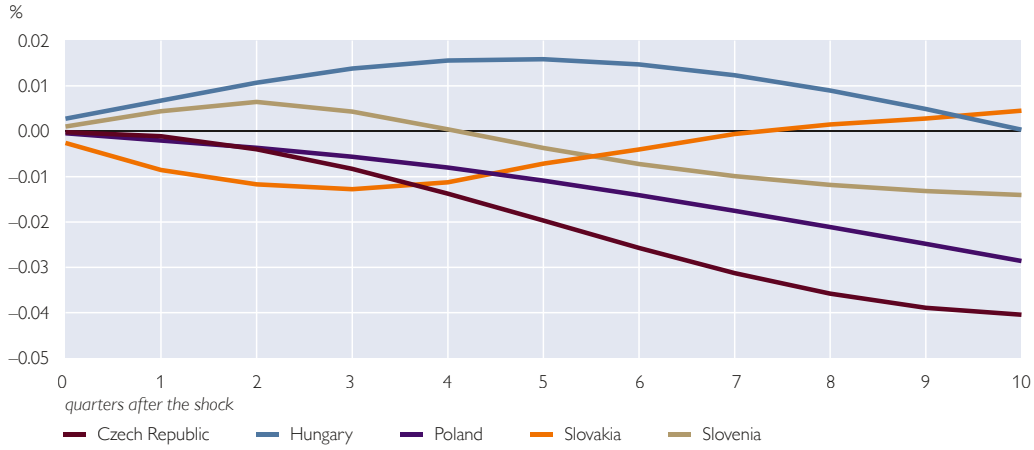
Source: Authors' estimations, Eurostat.

Czech Republic this response is statistically significant only up to half a year after the shock). The reactions to shocks to net taxes are more heterogeneous across the CEE-5 economies: Accommodative monetary policy (increase in the interest rate after a positive net tax shock) can be observed in Slovenia and Poland after the second year, and non-accommodative reactions are present in the Czech Republic.

The analysis of the reaction of domestic fiscal variables to structural output shocks identifies well-functioning responses related to automatic stabilizers. A positive shock in output tends to reduce government expenditure and increase net taxes in practically all cases under study. The strong positive reaction of inflation

Chart 5

Response of Real GDP to a Shock in Domestic Government Spending

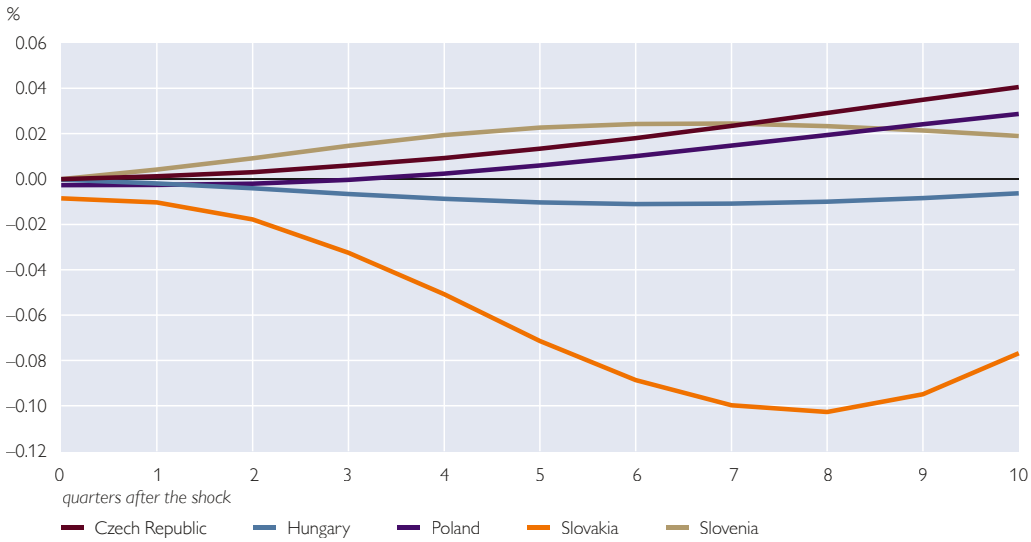


Source: Authors' estimations.

Note: The curves represent the cumulative median response of real GDP to a temporary 1% shock in domestic government spending. Based on 95% Hall percentile confidence bands (which are not shown here to get a better overview), statistical significance is given in the Czech Republic, in Poland and in Hungary up to five quarters after the shock, and in Slovakia up to three quarters after the shock.

Chart 6

Response of Real GDP to a Shock in Domestic Net Taxes



Source: Authors' estimations.

Note: The curves represent the cumulative median response of real GDP to a temporary 1% shock in domestic net taxes. Based on 95% Hall percentile confidence bands (which are not shown here to get a better overview), statistical significance is given in Slovakia and Slovenia for all shown quarters after the shock, in the Czech Republic starting six quarters after the shock and in Poland starting eight quarters after the shock.

to public spending shocks can also be easily framed in the setting of simple aggregate supply-aggregate demand models.

4.2 Robustness Checks and Caveats

Before concluding, we present various robustness checks that have been executed to ensure that the baseline results still hold when alternative specifications are taken into account.[22]

First, we account for the concern that the identified fiscal shocks might actually have been anticipated. Given that government expenditure or tax changes have considerable legislative lags and are widely publicized prior to their implementation, economic agents may adjust their behavior as soon as these changes are announced and not necessarily at the time they are implemented. Such a phenomenon may distort the impulse responses shown in the previous section (for a technical underpinning, see Canova, 2009).

In order to check to what extent fiscal foresight may be an issue in our sample, we follow Perotti (2004) and assume that publicly available forecasts for fiscal and macroeconomic variables reflect government announcements of future expenditure and tax changes. We then check whether such forecasts are systematically correlated with our VAR-based innovations in order to reveal their predictability. Table 4 shows the replication of Perotti's preferred specification, with the estimated reduced form residuals from equation (2) for government spending and net taxes being regressed on vintage projections of the growth rate of government consump-

[22] *Detailed robustness check results, which are not explicitly shown in this section, are available from the authors upon request.*

tion and GDP for the countries in our sample (taken from various issues of the OECD Economic Outlook). With the exception of the Czech Republic, where a robust correlation with GDP growth forecasts can be found for net taxes, we cannot confirm the predictability of VAR innovations in our setting.[23] This corroborates the findings of Perotti (2004) for five high income OECD countries.

The lack of statistically significant fiscal foresight can be explained by the fact that economic agents indeed respond when discretionary measures materialize and not when they are announced, as budgetary announcements are most likely not taken at face value due to their preliminary character. This view is also supported by Johnson et al. (2006), who found, using data from the U.S.

Table 4

Predictability of Fiscal News

A. Reduced Form Residuals for Government Purchases of Goods and Services

	GC_1	GC_2	GDP_1	GDP_2	Number of observations	R^2
Czech Rep.	0.002 (0.30)	–0.002 (0.26)	0.001 (0.59)	–0.001 (0.74)	49	0.04
Hungary	–0.004 (0.15)	0.008** (0.04)	0.000 (0.92)	–0.002 (0.71)	49	0.11
Poland	0.000 (0.97)	0.002** (0.03)	–0.001 (0.38)	0.000 (0.80)	49	0.12
Slovakia	0.001 (0.51)	0.002 (0.27)	–0.000 (0.82)	–0.000 (0.73)	35	0.07

B. Reduced Form Residuals for Net Taxes

	GC_1	GC_2	GDP_1	GDP_2	Number of observations	R^2
Czech Rep.	–0.002 (0.79)	–0.000 (0.98)	0.016** (0.02)	–0.013 (0.14)	49	0.16
Hungary	0.002 (0.82)	–0.003 (0.78)	–0.006 (0.52)	0.007 (0.66)	49	0.01
Poland	0.001 (0.73)	0.002 (0.38)	–0.001 (0.55)	0.001 (0.64)	49	0.03
Slovakia	–0.002 (0.34)	0.001 (0.86)	0.001 (0.48)	0.001 (0.85)	35	0.08

Source: Authors' estimations using data from the OECD Economic Outlook, various issues since 1997/1 (the earliest available forecasts for the four listed countries).

*Note: These projections are not available for Slovenia, which has become an OECD member only in 2010. Coefficients are estimated with OLS. p-values for the null hypothesis of a coefficient equal to zero are in parentheses. ** indicates significance at the 5% level. All regressions contain a constant (not reported). The dependent variables are the estimated reduced form residuals from equation (2) for government purchases of goods and services (panel A) and net taxes (panel B). GC and GDP represent the projected real annual growth rate of government consumption and GDP, respectively. „_1" and „_2" refer to the two most recently published forecasts: „_1" („_2") indicates that for annual growth in a given year j, we use the projections published in December (June) of year j-1 for the first quarter, the projections published in June of year j (December of year j-1) for the second and third quarters, and the projections published in December (June) of year j for the fourth quarter.*

[23] *The significant correlation between government consumption forecasts and government spending innovations vanishes for Hungary and Poland when we use alternative specifications, i.e. when we replace government consumption forecasts with projections for the general government financial balance as a percentage of GDP or when we include – besides forecasts for the current year j – also forecasts for the year j+1.*

Consumer Expenditure Survey, that private consumption displayed large contemporaneous responses to income tax rebates and changes in social security taxes although both of them were announced well in advance.

Second, we address the issue to what extent the responses of fiscal and macroeconomic variables in the CEE-5 are truly due to a fiscal shock in Germany or to a different common exogenous shock not incorporated in the empirical model (such as global business cycle or trade shocks). Estimates based on data from before the Great Recession indicate that these responses were at least partly driven by the observations corresponding to the recession year 2009.[24] Moreover, analogously to Kožluk and Mehrotra (2009), we include a world price for crude oil (average quarterly price for Brent oil in USD per barrel) as the eighth variable into the system, assuming that all the endogenous variables – including the foreign fiscal balance – respond within the same quarter to a shock in oil prices, while the oil price does not instantaneously react to any shock in the system.[25] The baseline results change only slightly: The mean responses are generally slightly smaller, and the positive cross-border fiscal multiplier in Poland becomes statistically insignificant. While the response of the German fiscal balance to domestic fiscal shocks partly vanishes – especially in the case of spending shocks – the oil price itself responds unexpectedly strongly to some of the fiscal shocks. This indicates that this specification is not able to fully capture a global (probably non-energy related) shock that has a common impact on the variables in our model. As an issue for future research, a global VAR (GVAR) approach à la Dées et al. (2007) might be a practicable approach to obtain more satisfactory answers in this respect.

Third, the baseline results are based on estimated structural VAR models whose restrictions are partly calibrated using elasticities imported from existing studies, which are justified in section 2.3.1 above. We re-estimated several models using restrictions with other plausible values for the implied elasticities of the domestic fiscal variables, based on upper and lower bounds of existing estimates. The results were left qualitatively unchanged.

While the setting used in the model allows the specification of very rich dynamics in the variables composing the VAR, a few caveats related to our modeling strategy should be mentioned. As in the case of unrestricted linear VAR models, our structural VAR specification does not allow different responses to positive versus negative structural shocks. In principle, a model could be specified in which different parameters are active depending on the sign (and eventually the size) of a structural shock. In our case, the complexity of such a specification for the limited amount of data available makes it impossible to include such nonlinearities in the model.

Moreover, the difficulties in reaching convergence in the estimation of the structural form coefficients (see section 3.2) prevented various additional modifications, such as restricting the sample to the pre-crisis period (in this case we attained convergence for Slovakia only), or scaling domestic spending and net

[24] *For instance in the case of Slovakia, when we use data only up to Q2 2008, a shock in net taxes has not a significant impact on the foreign fiscal balance and a foreign fiscal shock has not a significant impact on domestic public spending anymore.*

[25] *This specification delivers five overidentifying restrictions, whose validity was confirmed for Hungary, the Czech Republic and Poland, while it was rejected for Slovakia (at the 1% level). For Slovenia we were not able to attain convergence when estimating the structural form coefficients.*

taxes to GDP (in this case we attained convergence for the Czech Republic only). Nevertheless, we feel that our model allows an examination of rich dynamics in response to fiscal shocks, in contrast to smaller systems, where the structural form estimation may have been an easier task.

5 Conclusions and Further Research

In this study we analyze the economic impact that an unexpected, discretionary change in fiscal policy both in the domestic economy and in an important trading partner country (Germany) has on five Central and Eastern European economies (CEE-5: the Czech Republic, Hungary, Poland, Slovakia and Slovenia) from the first quarter of 1995 to the fourth quarter of 2009. For this purpose, we develop an open economy structural vector autoregressive (SVAR) model that incorporates both foreign and domestic fiscal shocks. To the best of our knowledge, this is one of the first SVAR models that explicitly accounts for the transmission of a foreign fiscal shock to key domestic macroeconomic variables in CEE. To identify our seven-variable SVAR model, we restrict the contemporaneous responses in the system; the restrictions are calibrated by referring to existing (closed economy) fiscal SVAR models and by importing available estimates for fiscal elasticities in the CEE-5. Our model is able to reassemble well-known episodes of fiscal policy action in the countries under investigation.

We find that the fiscal policy stance in the CEE-5 is affected by fiscal policy changes in Germany. If Germany undertakes a fiscal expansion, all the CEE-5 will react with fiscal easing too – more on the public spending than on the revenue side. At the same time, in a few specifications, fiscal shocks in the CEE-5 have an impact on the German fiscal balance as well. There are indications that common reactions to the recession in 2009 prompted responses in both ways.

The evidence is less homogeneous for cross-country fiscal multipliers. The negative economic transmission of a fiscal shock in Germany to the Czech Republic and Slovakia is apparently due to a stronger weight of the negative interest rate channel in comparison to the potentially positive trade and exchange rate channels. In Poland and Hungary, in turn, the positive response of real GDP to a fiscal shock in Germany points to a more dominant role of the trade and exchange rate channels in these economies. There is also some evidence for an impact on the policy mix in Poland and Slovenia, where the short-term interest rate responds negatively to a foreign fiscal expansion. Not only the response to a foreign fiscal shock is heterogeneous, but also the response to a domestic fiscal shock. In particular, Keynesian responses can be found in Hungary and Slovakia, while non-Keynesian responses are present in the Czech Republic, Poland and Slovenia.

This evidence implies that fiscal policy in an important foreign economic partner country is a matter of common concern, underlining the importance of formal and informal coordination within the EU. However, given the heterogeneity in the domestic responses, "one-size-fits-all" policy recommendations would be too simplistic for the CEE-5. To learn more about the distribution of the costs and benefits of fiscal shocks and to promote a better understanding of country-specific policy preferences, it would be useful to examine more closely the reasons for the heterogeneity across countries. In order to find out whether various country-specific characteristics explain cross-country differences in the impulse responses in a statistically significant manner, it would be indispensable to expand the sample

and include additional countries with satisfactory fiscal data (e.g. a panel consisting of OECD countries).

Potential nonlinear effects related to the interaction of budget deficits and the level of public debt may be a promising avenue explaining the differences in responses to fiscal shocks in the CEE-5. High levels of public debt coupled with high deficits, for instance, may be a trigger for non-Keynesian effects. A thorough analysis of such effects using nonlinear structures would be an important issue of further research. Moreover, a generalization of our proposed model in order to consider responses to different components of government spending and revenues could also shed light on the source of the cross-country differences found in this analysis.

Finally, it should be noted that different identification and estimation methods from those used in this study could have been used to assess our research question. In particular, sign restrictions have often been implemented to identify structural shocks in similar frameworks (for example in Dungey and Fry, 2009). Notwithstanding the recent criticism of this identification method – particularly as regards the estimation and interpretation of impulse-response functions (see Fry and Pagan, 2011) – its application may prove fruitful in future research efforts. Caldara and Kamps (2008), for instance, showed that the effects of spending shocks do not really change across different identification approaches, while the differences in the way tax shocks are identified is important. Further extensions with regard to the estimation method could be Bayesian vector autoregressions (BVAR), as in Afonso and Sousa (2009) or Kamal (2010), or structural factor-augmented VAR (SFAVAR) models. These methods are quite data intensive and computationally challenging; hence we leave their application to our setting to future research.

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Annex

Table A1

Description of Variables

Variables		Description and calculation	Unit	Treatment	Source
Foreign fiscal balance	f*	Fiscal balance-to-GDP ratio in Germany, calculated as f*=(g*-t*)/y*; definitions for g*, t*, and y* follow those for g, t, and y below; the balance is inversely defined to interpret an increase in f* as a fiscal expansion	%	Seasonal adjustment	Eurostat, Government Finance Statistics, Quarterly Non-Financial Accounts for General Government
Government spending	g	Government purchases of goods and services = government consumption + government investment = compensation of public employees (ESA-code D.1) + intermediate consumption (ESA-code P.2) + government gross fixed capital formation (ESA-code P.51); general government sector	log domestic currency millions	Interpolation for 1995-1998, deflation using CPI, seasonal adjustment	Eurostat, Government Finance Statistics, Quarterly Non-Financial Accounts for General Government
Net taxes	τ	Net taxes = government revenues - transfers = indirect taxes (ESA-code D.2) + direct taxes (ESA-code D.5) + social security contributions (ESA-code D.611) – social benefits and social transfers in kind (ESA-code D.62 + D.6311 + D.63121 + D.63131) – subsidies (ESA-code D.3); general government sector	log domestic currency millions	Interpolation for 1995-1998, deflation using CPI, seasonal adjustment	Eurostat, Government Finance Statistics, Quarterly Non-Financial Accounts for General Government
Output	y	GDP at 2000 market prices (chain-linked volume)	log domestic currency millions	Seasonal adjustment	Eurostat
Exchange rate	e	Nominal effective exchange rate (41 trading partners), period-average; an increase corresponds to an appreciation	log index (1999=100)		Eurostat
Inflation rate	π	Year-on-year change of the nationally defined consumer price index (all-items HICP is only available starting from 1996)	%		wiiw
Interest rate	i	Short-term interest rate, period average, corresponding to the three-month interbank offered rate in the Czech Republic, Slovakia and Poland, to the money market rate in Slovenia, and to the treasury bill rate in Hungary	% per annum		Eurostat, Bloomberg, IMF

Source: Authors' compilation.