Monetary policy transmission mechanisms in the CEECs: How important are the differences with the euro area?

Jérôme Creel, Sandrine Levasseur

Document de travail

MONETARY POLICY TRANSMISSION MECHANISMS IN THE CEECS: HOW IMPORTANT ARE THE DIFFERENCES WITH THE EURO AREA?

N° 2005-02

February 2005

Jérôme Creel

OFCE

jerome.creel@sciences-po.fr

Sandrine Levasseur

OFCE

sandrine.levasseur@sciences-po.fr

Observatoire Français des Conjonctures Économiques
69, Quai d'Orsay 75340 Paris Cedex 07
Tel : 01 44 18 54 00 Fax : 01 45 56 06 15
E-mail: ofce@ofce.sciences-po.fr Web: http://www.ofce.sciences-po.fr

Monetary policy transmission mechanisms in the CEECs: How important are the differences with the euro area?*

Jérôme Creel, OFCE

Sandrine Levasseur, OFCE♦

N° 2005-02

February 2005

Abstract

We use a structural VAR model with short-term restrictions to investigate the relative importance of interest rate, exchange rate and credit channels in the monetary policy transmission (MPT) for the Czech Republic, Hungary and Poland over 1993:1-2004:3. Main results are as follows. First, in the three countries, following a positive shock on the interest rate, prices increase instead of decreasing, due to the immediate depreciation of the nominal exchange rate. The results thus exhibit an "exchange rate" puzzle conducing to the appearance of a "price-puzzle". Second, none channel is very powerful for the MPT in the three countries. Nevertheless, the exchange rate and the interest rate channels play a growing role over the recent period in Poland, compared with the same channels in the Czech Republic and Hungary. As nominal exchange rate fluctuations allow for greater real shocks dampening in Poland, the cost of entering EMU may be more costly for this country than for the Czech Republic or Hungary.

* We are grateful to Benoît Usciati for his able research assistance. The usual disclaimer applies.

♦ Corresponding author: sandrine.levasseur@sciences-po.fr; tel. + 33 1 44 18 54 24; fax. + 33 1 44 18 54 78.

1. Introduction and motivations

A growing empirical literature has been devoted recently to monetary policy transmission (MPT) mechanisms in Central and Eastern European countries (CEECs). Most studies are motivated by the future adhesion of eight (and then ten) of them to the European Monetary Union (EMU)[1]. Indeed, eight of CEECs are new members of European Union (EU) since May 2004 (i.e. the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia). In 2007, Bulgaria and Romania are also due to join. Membership in EU necessitates respecting all the European laws and rules – the *acquis communautaire* – including the single currency project. Hence, sooner or later, new members of EU will have to join EMU[2].

In this context, a good knowledge on MPT mechanisms is particularly important. On the one hand, differences on MPT mechanisms between 'old' EMU members and new ones may hamper the monetary policy decisions-making of the European central bank (ECB) and may trigger an over-restrictive monetary stance within a few years. On the other hand, differences on MPT mechanisms between EMU members and forthcoming ones may also impede the present real convergence process of new EU members over the EMU ones. Thus, this may have destabilizing consequences on the whole EU project: countries desperately lagging behind may find little incentives to cooperate with the 'old' EU countries on topics like better law enforcement, enhanced tax harmonization, etc.

The theoretical and empirical literature considers traditionally three channels for MPT mechanisms: the interest rate, the exchange rate, and the credit channels. While these channels are usually treated separately, the response of ultimate variables (*e.g.* output and its components, inflation, etc.) to a monetary policy shock will depend on combined effects of these three channels. Especially, it will depend on whether the exchange rate and credit channels accentuate or dampen the response of the economy to changes in interest rates[3]. According to the traditional Keynesian view, an increase in the nominal interest rate, by raising the real cost of borrowing, reduces investment and consumption. Then, following the demand fall, price begins to decrease (*direct interest rate channel*). If the increase in the nominal interest rate induces a real exchange rate appreciation (due to a nominal exchange rate appreciation), then net exports decrease, accentuating further the price decline (*exchange rate channel*). Finally, the credit channel operates through the effect of monetary policy on the supply of loans by depository institutions (*bank lending channel*) and through the net worth and the financial position of potential borrowers (*balance sheet channel*).

The current empirical consensus is that the exchange rate is by far the main channel of MPT mechanisms in the CEECs while the interest rate channel dominates in actual EMU members[4]. Moreover, the impact of a policy interest rate shock on ultimate variables would be faster and stronger in actual EMU members than in CEECs. In fact, the transmission of the policy interest rate to lending and deposit rates would be blocked in CEECs due to their (still)

---

[1] There is another motivation than future EMU membership: once main structural reforms are completed in these transition economies, a better knowledge on MPT *per se* will be crucial in order to implement an optimal monetary stance.

[2] Among the CEECs' new EU members, Estonia, Lithuania and Slovenia intend to join EMU as early as in January 2007 while the Czech Republic would be the last one to adopt euro, by 2009-2010. For that purpose, they will have to fulfil the Maastricht criteria, as laid down in the Treaty.

[3] For theoretical developments, see for instance Bernanke and Blinder (1993) and Kierzenkowski (2004).

[4] For a survey on MPT mechanisms in CEECs, see for instance Ganev et al. (2002). For studies focusing on EMU members, see for instance Angeloni et al. (2003).

underdeveloped financial sectors (including the banking one). Nevertheless, some recent studies detect a growing role for both the interest rate and credit channels over the recent years or, at least, conclude in that sense (see, for instance, Gunduz, 2004; Kuijs, 2002).

Our empirical work aims at updating the evidence on MPT mechanisms using the recent available data for the three large new EU members: the Czech Republic, Hungary and Poland. For that purpose, we use a structural VAR, now a standard methodology to analyse MPT mechanisms, and allowing for a direct comparison of results with some previous studies. Before that, we present some key features on financial sectors in the CEECs, including a comparison with EMU countries.

2. Financial sectors and monetary policy frameworks: how do they stand in the CEECs?

2.1. Financial markets in CEECs: an overview

Following most economists, "*the MPT will vary systematically across countries with differences in the size, concentration and health of the banking systems, and with differences in the availability of primary capital market financing*" (Cecchetti, 1999; parts of the quotation underlined by the authors)[5].

The *size* of financial sectors (including the banking one) indicates to what extent they contribute to the financing of economic activities. Clearly, the more developed financial sectors, the more agents can rely upon it for consumption and investment matters. In this context, the extent to which agents are dependent on bank financing is an important factor determining the strength and effectiveness of the *bank lending channel*. Moreover, for this channel to work, a monetary policy tightening must effectively limit banks' ability to supply loans, by reducing bank reserves. If banks can adjust their balance sheets with an alternative source of investment funds (by selling securities or issuing instruments which are not subject to reserve requirement, e.g. bonds or certificates of deposits), they can absorb the monetary policy tightening without reducing the supply of loans. In this respect, a (structural) excess of liquidity for the banking sector is expected to reduce the effectiveness of policy interest rate increases.

The banking sector in the CEECs remains largely under-sized compared to the euro area, even if fast developments have been observed in most CEECs over the last years (Table 1)[6]. For instance, the bank credit to private sector lies between 15% of GDP in Lithuania and 40% in Slovakia and Slovenia, against more than 110% in the euro area. A particular fast growth in bank credit to private sector has been observed in Hungary and Latvia since the late of 1990s. Only the Czech Republic and Slovakia show a decrease in their credit-to-private sector GDP ratio, as a result of the clean up and restructuring of their banking sector.

The underdevelopment of banking sectors in CEECs is not compensated by strong non-bank financial sectors. The stock market capitalisation lies between 3.6% of GDP in Lithuania and 37.5% in Estonia, against more than 100% in the euro area. Hungary, Poland, and to a lesser extent, the Czech Republic have even recorded a decrease in their stock market capitalisation, mostly as a result of de-listed companies. Debt securities markets are neither very developed markets in CEECs. Especially, they are largely dominated by government

[5] The reader will find more details in Bonin and Wachtel (2002), ECB (2002).

[6] They appear undersized also in comparison with the overall degree of development of CEECS, as proxied by GDP per capita (Cottarelli et al., 2003).

papers. In the Czech Republic and Slovenia where monetary financial institutions account for respectively 60 and 40% of total debt securities, it is worth noting that more than 90 % represent short-term instruments issued by the central bank and used for the purposes of monetary policy operations (ECB, 2003). Finally, the presence of private sectors (including also the banking institutions) as issuers on debt markets is very limited[7].

Thus, as evidenced from Table 1, financial systems in the CEECs are more bank-based than they are market-based. While a same conclusion can be drawn from the situation in the euro area (or in the EU-15), the banking dependence of economic agents is by far much greater in the CEECs. Then, with a *lack of liquidity* for the banking sectors, *the bank lending channel* is expected to be powerful for MPT, up to (perhaps) oversize the interest rate or the exchange rate channels.

Consider now in more details the development of banking sectors in CEECs over the most recent years. First, the credit growth to private sector was driven to a large extent by credit to households, which showed very low credit levels compared to enterprises in the late 1990s (Table A, Appendix 1). Then, *opening the credit market to households in recent years could therefore increase the MPT mechanism based on the bank lending channel.* But so long as the bank lending channel will mainly operate *via* firms and, in the case of Poland, strong improvements on labour markets (leading to a lower rate of unemployment and higher effective demand) will not have occurred, this channel will surely prove relatively low.

Second, bank financing of the credit growth to the private sector mainly operated through domestic savings flows (Table B, Appendix 1). Indeed, with the exception of Latvia and Estonia where international borrowing was sizeable, the growth of credit-to-GDP ratio was broadly in line with the growth of deposits-to-GDP. Other exception was Hungary where the strong increase of other net liabilities was due to large declines in reserve requirements between 1999 and 2001 that decreased net assets held at the central bank by the banking sector and then freed funds for credit activities. In most CEECs, the decline (or small increase) of bank credit to the public sector contributed also to the credit growth to private sector. This "crowding-in" effect can be illustrated by the fact that the general-government-deficit-to-GDP ratio in countries with high credit growth was half that of countries with low credit growth (Cotarrelli et al., 2003). In the Czech Republic and Slovakia where the private credit-to-GDP ratio decreases, the (large) drop in other net liabilities reflects the increase in assets held at the central bank, due to large sterilization operations (following large capital inflows). International borrowing contributed to a non negligible extent to the growth in bank credit to public sector in these two countries. Then, the *credit channel* is not only expected to work differently across countries but also in a non-straightforward manner. While the "crowding-in" effect reinforces the credit channel, international borrowing to finance domestic credit allows circumventing operations of the central bank which are aimed at absorbing the excess in liquidity. In turn, modifications in the reserve requirements alter the availability of funds and then the credit channel.

Alongside these general factors, *concentration* and *health of banking systems* are viewed as relevant factors for assessing the strength of the credit channel. Cechetti (1999) argues that larger and healthier banks will be able to adjust to the policy-induced reserve changes more easily than smaller and less healthy banks. Hence, countries with less concentrated and less healthy banking systems are expected to be more sensitive to monetary policy actions of the central bank. However, health of banking sectors deserves special mention in CEECS where

[7] Non-banking financial institutions (e.g. insurance companies, leasing companies) are known as not very sized in the CEECs (except in Estonia for leasing). Nevertheless, due to unavailability of synthetic data, we do not report figures on that point.

the non-performing loans caused financial crises in the 1990s. A monetary stimulus is expected to be rather ineffective if the banking system is over-burdened by non-performing loans. For instance, according to Wagner and Iakova (2001), declines in the policy rates in Slovakia and in the Czech Republic in 1998-2000 did not translate into credit growth for this reason. As banks struggled to meet the stricter provisioning requirements, credit to the private sector continued to decline. More generally, another important indicator of health of banking systems is the capital adequacy ratio (i.e. the Basle capital rules).

As evident from Table 1, banking systems in CEECs are characterised by a high degree of concentration. The five largest banks account for around 50% of assets in Poland and Hungary, and up to 100% in Estonia, with an average of 68% which quite largely contrasts with the euro area average of 52%. Similar figures emerge for concentration of deposits and credit in CEECs. Turning to health indicators, the non-performing loans have been sharply reduced in most CEECs over the last years. Slovakia still exhibits poor performance with a 24.3% share of non-performing loans in total banks while Estonia shows the best performance with a corresponding share of 1.5 %. The Basle capital adequacy ratio is largely met, since to comply with this ratio, a risk-weighted equity ratio of at least 8% must be maintained. In 2001, this ratio lied between 11.9% in Slovenia and 19.6% in Slovakia. This relatively good performance should improve the credit channel.

It is worth noting that both development and improved health in banking sectors are due to privatisations, especially to the sales of previous stated-owned banks to foreign investors, almost originating from EU-15. Foreign owners account for 55% of total banking assets in Slovenia and up to 97.5% in Estonia. As a result, by importing banking expertise from the "old" EU, the efficiency of banks has increased considerably in the past few years. For instance, in September 2003, only Slovenia, Lithuania and the Czech Republic had spreads between lending and deposit rates that remained greater than those in the euro area. Consequently, the banks in CEECs provided agents with financial intermediation services on favourable terms and conditions, comparable to the ones of the euro area.

2.2. Monetary policy frameworks in the Czech Republic, Hungary and Poland: some implications for the MPT

During the period 1993-2003, the Czech Republic, Hungary and Poland have been characterised by a double shift in their monetary policy framework. One the one hand, they moved from fixed to more flexible exchange rate regimes and, on the other hand, from money supply to inflation targets. Of course, these two shifts were not independent of each other. In the beginning of the transition period, a fixed-exchange-rate regime had been adopted in most post-socialist countries as a nominal anchor for stabilisation purposes. Indeed, two-digit – or even three-digit – inflation rates were the rule. Though the shifts in exchange rate regimes and targets might be related to country-specific factors, capital inflows with a fixed exchange rate – leading to a real exchange rate appreciation, which in turn resulted in a significant loss of competitiveness and a worsening of the current account – might be the common story to explain the subsequent shift to a more flexible exchange rate regime over the most recent years (see Halpern and Wyplosz, 1997).

The exchange rate policies followed by the countries might have affected the channels of MPT. Indeed, under a quasi-fixed exchange rate regime, growing capital inflows induced sterilisation operations by the central banks in an attempt to absorb the excess of banking sector liquidity. Then, neither the exchange rate channel (by definition) nor the credit channel might have been significantly at work. Indeed, in case of excess in liquidity, banks abounding with funds can conduct their own interest rate policy, independently of the interest rate policy

followed by the central bank, and especially can sustain low interest rates on credit to gain in market shares. Thus, a shift towards a more flexible exchange rate regime might have allowed the exchange rate channel to increase its importance as a MPT mechanism, but also the credit channel by reducing the banking sector's excess in liquidity. Finally, the structural over-liquidity prevented the central banks of countries under study from adopting the same set of monetary policy instruments than their West counterparts and then ECB, at least up to the end of 1990s. Since then, the harmonization in instruments has been undergone, but essentially under the impetus of future membership in the European System of Central Banks (ESCB) which is effective since May 2004[8]. Indeed, an excess in liquidity constitutes always a salient feature of their banking sectors. Nevertheless, whether the credit channel exists or not in CEECs remains an econometrical matter due to the various (and opposite) forces at work, as described above. This is one of the issues treated in the next section.

3. A VAR model for the Czech Republic, Hungary and Poland

As already mentioned, our primary focus on the Czech Republic, Hungary and Poland is motivated by their early movement towards (official) exchange rate regimes with some degree of flexibility[9]. Such arrangements enable their central banks to follow a relatively "unconstrained" monetary policy. Studying the reactions of key variables to their monetary policies then sheds light on the relative importance of MPT channels. Moreover, it gives some insight on the effectiveness of the nominal exchange rate in absorbing shocks, and then on the costs to give up the national currency for the euro.

For that purpose, a structural VAR is adopted. As Christiano et al. (1999) put it, using a VAR approach permits to focus almost exclusively on the effects of a peculiar shock *per se*, here a monetary shock, and thus, to distinguish in the actions of the monetary policy makers which part is a response to monetary developments in the economy and which part is not. Good knowledge on the effects of a monetary policy shock is of high relevance in the context of monetary integration.

[8] By joining EU, the central bank of a newcomer becomes *ipso facto* a member of the ESCB, but without participating in the monetary policy decisions of the euro area. The central bank must then adjust the principles of its operations to standards and requirements worked out within the ESCB, in view of future EMU membership.

[9] Presently, the exchange rate regimes of countries are classified as follows by the International Monetary Fund: "managed floating" for the Czech Republic; "large bands" of +/-15 % for Hungary; "purely floating" for Poland.

Table 1 : Basic statistics on CEECs financial sectors

	Credit to the private sector (in % of GDP)		Stock market capitalization (in % of GDP)		Debt securities outstanding (in % of GDP)	*Of which*, by type of issuers (in % of total debt securities outstanding)		
	1999	2003	1999*	End 2002 (2000 : euro area)	End 2002**	General government	MFI***	Non-MFI
New EU members CEECs	**31.7**	**33.6**		**17.5**				
Czech republic	61.0	34.0	22.2	20.3	57.0	34.0	60.0	6.0
Estonia	24.3	33.2	34.2	37.3	3.0	50.0	32.0	18.0
Hungary	26.1	43.0	33.7	20.3	55.0	83.0	15.0	2.0
Latvia	14.5	34.6	6.2	8.2	12.0	90.0	10.0	0.0
Lithuania	12.8	20.6	..	10.1	16.0	96.0	0.0	4.0
Poland	26.5	29.1	19.1	13.8	33.0	82.0	7.0	11.0
Slovakia	54.6	32.6	3.7	3.6	34.0	98.0	0.4	1.6
Slovenia	33.9	41.7	10.9	26.3	47.0	59.0	40.0	1.0
Euro area	**101.3**	**112.43**	**..**	**106.2**	**124.8**	**..**	**..**	**..**

Sources : IMF, own computations; *Bonin and Wachtel (2002); **ECB (2003)
Note: *** MFI (Monetary financial institutions).

Table 1 (continued): Basic statistics on CEECs financial sectors

	Share of the five largest banks (in terms of assets)		Non performing loans (in % of total bank loans*		Capital adequacy (equity capital as a % of risk-weighted bank assets)	Foreign owners (in % of total banking assets)		Difference between lending and deposit rates (in % point)	
	1998	End 2000*	1999**	2003	2001***	1999*	2002*	1999	2003 (september)
New EU members CEECs									
Czech republic	66.2	66.1	21.5	13.7	15.4	28.1	90.1	4.2	3.8
Estonia		98.8	2.9	1.5	14.4	90.0	97.5	6.9	2.3
Hungary	50.8	53.3	4.4	3.1	15.6	61.8	65.5	4.4	2.0
Latvia		62.3	6.8	3.1	14.2	78.2	62.6	9.2	2.2
Lithuania		88.5	11.9	7.4	15.5	38.2	83.9	8.1	4.2
Poland	42.9	48.6	14.5	20.1	15.0	47.2	68.4	5.7	3.5
Slovakia		63.4	32.9	24.3	19.6	28.2	81.0	6.7	2.9
Slovenia	64	62.5	8.6	9.2	11.9	47.5	55.0	5.1	4.8
Euro area	**50.0**	**52.0**	**..**	**2.71**	**..**	**..**	**..**	**3.2**	**3.5**

Sources : IMF, own computations; *Gros (2003); ** Bonin and Wachtel (2002); ***Deutsche Bundesbank (2003).

3.1. The VAR specification

The general framework for the VAR representation can be summarized by:

$$(1)\ Y_t = A(L)Y_{t-1} + B(L)X_t + \varepsilon_t,$$

where Y_t is the vector of endogenous variables for each new EU member, and X_t is the vector of exogenous foreign (e.g. European) variables. The vector of exogenous variables contains a policy nominal interest rate (denoted i_t^{euro}), an industrial production index (denoted y_t^{euro}) and a consumer prices index (denoted p_t^{euro}), the two latter including the "old" EU countries, whereas the former stands only for the euro area[10]:

$$(2)\ X_t^{'} = \left[i_t^{euro} \quad y_t^{euro} \quad p_t^{euro} \quad \right]$$

These variables control for the growing real and financial integration of the new EU members with the "old" EU ones; put differently, they control for the economic underlying changes in their main economic partner – the "old" EU. By treating these variables as exogenous, we implicitly assume that there is no feedback from the new EU members to the "old" EU. We also allow for a contemporaneous impact of the exogenous variables on the endogenous new EU member variables.

In the first (baseline) model, the vector of endogenous variables for each new EU member, Y_t, consists of an industrial production index (y_t), a consumer prices index (p_t), a policy nominal interest rate (i_t) and a nominal effective exchange rate (e_t):

$$(3)\ Y_t^{'} = \left[y_t \quad p_t \quad i_t \quad e_t \right]$$

Our focus on the *nominal* effective exchange rate (NEER), rather than on the *real* one, has a twofold justification. First, the exchange rate channel is thus more easily distinguishable from the other channels. Second, concluding on the possible cost of entering EMU for the new EU members is facilitated, since fluctuations in the exchange rate against the euro account for a substantial part of fluctuations in the NEER due to strong trade links with the EU-15.

In the second (variant) model, we include either a monetary aggregate (m_t) or a domestic credit aggregate (dc_t) in the bloc of endogenous variables. Indeed, money developments have played an important role in the monetary policy strategies of the new EU members' states, especially from the beginning of the transition period until the shift to inflation targeting at the end of the 1990s[11]. The inclusion of a monetary aggregate could therefore be helpful in strictly identifying monetary policy shocks *per se*, i.e. distinguishing them from money demand shocks. As for the credit aggregate, its inclusion makes the credit channel explicit in the monetary transmission mechanism. In these two variants of the second model, the vector of endogenous variables can be written respectively as:

$$(4)\ Y_t^{'} = \left[y_t \quad p_t \quad i_t \quad e_t \quad m_t \right]$$

$$(5)\ Y_t^{'} = \left[y_t \quad p_t \quad i_t \quad e_t \quad dc_t \right]$$

---

[10] See Appendix 2 for a precise definition of data. Each of the VAR models also contains a constant and a linear trend.

[11] For a more comprehensive description of monetary policy strategy in the Czech Republic, Hungary and Poland, see for instance Creel and Levasseur (2004).

In both models, structural shocks are recursively identified, through the standard Choleski-decomposition with the variables ordered as in (3), (4) and (5)[12]. The underlying assumptions are then that, in the short-run, shocks on interest rate, exchange rate and money or credit (when the latter are included) have no contemporaneous impact on industrial production and prices due to the sluggish reaction of the real sector (*y* and *p*) to shocks in the monetary and financial sectors (*i*, *e*, *m* or *dc*). The interest rate responds contemporaneously to shocks on industrial production and prices, a situation which can be interpreted as a reaction function of monetary authorities to shocks affecting the real sector. The nominal exchange rate is immediately affected by all types of shocks, except shocks on monetary aggregate or domestic credit aggregate (when they are included in the VAR).

Shocks on *y* can be interpreted as *real demand shocks* (taste shocks, fiscal policy shocks); shocks on *p* as *supply shocks* (productivity shocks); shocks on *i* as *monetary policy shocks*, and shocks on *e* as *financial shocks* (sunspots, portfolio shocks). Shocks on *m* and *c* can be interpreted as *money demand shocks* (innovations in banking and financial sectors along the transition process).

Each VAR model is estimated in levels using monthly data over the period 1993:1-2004:3. The only exception is Hungary when credit or money is included in the VAR. In this case, due to availability of data, estimations are running over 1999:12-2004:3. As usual, the first years of transition from planned to market economy characterised by turbulent fluctuations in economic variables have been dropped.

The choice of a VAR in level rather than in first difference can be justified by the fact that some variables tend to be I(2) and that we detected some cointegration relationships between variables in level[13].

The choice of monthly data has been motivated by the search for accurate estimates but it has self-imposed the use of industrial production data rather than GDP data. All data are seasonally adjusted and expressed in logs, except the interest rates which are kept in percent points. The Schwarz criterion has been used to determine the lag-order of the VARs, which turned out to be of order one[14].

[12] With the five-variable VARs, the ordering of endogenous variables follows Gunduz (2003) to get a direct comparison with his findings.

[13] Vostroknutova (2003) concludes that during the transition period, many variables that are normally I(1) come closer to I(2) processes for considerable periods of time. More precisely, based on monthly data from 1991:5 to 1999:12 for Poland, the unit root hypothesis cannot be rejected for the first differences of consumer prices index, nominal exchange rate, nominal money stock, nominal wage rate and, marginally, for industrial price index. By contrast, indications of I(2) processes are obviously present in the data. Our data set also presents indications of I(2) process (e.g. the prices index, the credit aggregate). Moreover, we have detected cointegration relationships both with the Johansen procedure and with a two-step procedure. Nevertheless, too short time series impede to make explicit cointegration estimations. Thus, we have decided to estimate the VAR in levels rather than in differences as in EFN (2004), Gunduz (2003) or Peersman and Smets (2003) for instance.

[14] Robustness checks with higher lags have been performed and do not change qualitative results.

3.2. Estimation results

3.2.1. The baseline VAR

The impulse response functions (IRFs) of the VAR models with four endogenous variables for the Czech Republic, Hungary and Poland are shown in, respectively, Figures 1, 1/Bis, 1/Ter. For instance, the 4th column of Figure 1 gives the effects of a two-standard-deviation nominal exchange rate shock (or innovation) on industrial production, consumer prices, the interest rate and exchange rate for the Czech Republic, together with a 90 percent confidence band. The 3rd column gives the responses of the same variables to a shock on policy interest rate while the 1st and 2nd columns disclose the impacts of shocks respectively on industrial production and consumer prices.

Focusing on the real demand, supply and financial shocks, it appears that responses are different from one group of countries (the Czech Republic and Poland) to the other country (Hungary). Within the first group, a positive real demand shock produces a significant rise in the nominal interest rate (and in the nominal exchange rate in the Czech case) while a negative supply shock only reduces industrial production. In contrast, both shocks have no significant impact in Hungary. It may be astonishing unless the underlying model is badly fitted for the Hungarian situation whereas it is better fitted for the other two countries. As far as the financial shock is concerned, it appears that an unexpected nominal exchange rate appreciation reduces prices and the nominal interest rate in the Czech Republic and Poland; in the first country, a significant and persistent rise in industrial production at a 1-year horizon is also noticeable. This is presumably the consequence of the long-lasting reduction in the nominal interest rate, coupled with the long-lasting decrease in the price level: these better conditions would presumably help to "stabilize the stabilization efforts" of the Czech authorities. In Hungary, the same financial shock significantly and immediately reduces industrial production; price and interest rate responses are not significant.

Regarding the IRFs of a monetary policy shock in the three countries, differences among them almost disappear. Following an increase in the policy interest rate, prices tend to increase and IRFs thus exhibit the appearance of a "price-puzzle". This result contrasts with some studies on MPT mechanisms applied either to the euro area or to the CEECs (for instance, Peersman and Smets (2003) and EFN (2004) for the euro area; Gunduz (2003) for the Czech Republic; Creel and Levasseur (2004) for the Czech Republic, Hungary and Poland). Exceptions are Ganev et al. (2002) in the Czech case; Anzuini and Levy (2004) for the Czech Republic and Poland (but the "price puzzle" is not robust to the adoption of a shorter sample period); Hericourt and Matei (2004) in the Czech case, and Jarocinski (2004) for a group of CEECs countries.

According to Sims (1992), the price puzzle arises due to an error in identifying the exogenous part of monetary policy. Without an indicator for *future* inflation within the endogenous variables of the VAR, the price rise following a positive shock on the nominal interest rate would appear as a normal response to higher expected inflation: what has been labelled an "exogenous monetary shock" in fact contains some portion of the endogenous response of the monetary authorities to higher future (or expected) inflation. In order to circumvent the "puzzle", it has therefore been advised to incorporate commodity prices as endogenous variables in the VARs; so doing, the truly exogenous component of monetary policy would be more accurately identified.

Two recent contributions to the large literature on the "price puzzle" have recently doubted the favourable incidence of introducing commodity prices in the VARs. Giordani

(2004) shows that the puzzle can be solved if the SVAR model comprehensively mimics the underlying macroeconomic theoretical model: introducing simultaneously the output and the output gap, hence a strict IS curve and a Phillips curve, makes the puzzle disappear. Introducing also a commodity price index does not help. Hanson (2004) finds that the assumed correlation between the commodity price index and future inflation is not straightforward. More generally, he finds "little correlation between an ability to forecast inflation and an ability to resolve the price puzzle". Performing VARs with US data on a sub-sample over which the "price puzzle" is clearly identified, Hanson (2004) cannot resolve the puzzle with whatever indicator used to forecast inflation.

In relation to these two recent contributions, first, it has to be acknowledged that output gap data for the CEECs are unavailable either on a long time span or on a monthly basis. It does not permit to test the Giordani's hypothesis. Second, as far as exchange rates (or commodity prices) are concerned, our results do in fact solve the price puzzle: following the increase in the policy interest rate innovation, the nominal exchange rate depreciates immediately in the three countries and IP growth temporarily resumes in the Czech and Polish cases[15]. The puzzle with the consequence of a positive innovation on the nominal interest rate has thus more to do with the exchange rate than the price level *per se*. These depreciations and, in some cases, the boost on aggregate demand are at the core of the price increases. This is confirmed by the impact on prices of a nominal exchange rate innovation in the Czech Republic and Poland.

Finally, a few words on the evolution of industrial production (IP) after the various shocks may be somewhat enlightening of the long-run efforts these CEECs will have to accomplish in order to perform real convergence towards the EU-countries. In Hungary and Poland, it is peculiarly impressive to see how low and temporary IP responses are to the various shocks. Only in the Czech Republic do innovations on the price index and the interest rate have a non-zero impact on IP. Hence, a monetary policy shock has at best a very thin impact on industrial production in these three countries. Moreover, it has to be acknowledged that either inertia in the IP dynamics is very large in these countries or that factors not taken into account here (institutions, asymmetric information, monetary aggregates) do play a crucial role in the evolution of industrial production.

3.2.2. The variant VARs

Figures 2 and 3 give the results of the VAR models in which we have added respectively money and credit. The 5th column of each figure gives the responses of endogenous variables ordered as in (4) or (5) to an innovation in monetary or credit aggregates.

The five-variable VARs give almost similar results as the baseline VARs, so that it shall be concluded that monetary aggregates were not the missing variable of the baseline case to which the low reaction of industrial production to innovations could have been attributed.

Outcomes with the two variants of the baseline VAR still give small responses of consumer prices and industrial output to shocks on interest rate and exchange rate, on the one hand, and apparent "price puzzles", on the other hand, except in Hungary.

In this country, incorporating either credit or money as an endogenous variable in the VAR makes the price rise insignificant and thus solves (more or less) the "price puzzle". Respective responses of credit and money to a monetary policy shock in Hungary are rather

[15] Similar dynamics can be found in Ganev et al. (2002) and Jarocinski (2004), though with different specifications and models.

counter-intuitive: following a positive innovation in the nominal interest rate, credit and money increase immediately. In fact, the innovation also generates a large and significant nominal exchange rate depreciation that surely boosts aggregate demand (insignificant) as well as demand for credit or money.

In Hungary and Poland, increases in credit aggregates following a monetary tightening are usually explained by the permanent excess in banking sector liquidity over the last decade (Kierzenkowski, 2004; OECD, 2002). This excess in liquidity (defined as the net indebtedness of the central bank towards commercial banks) has been the result of strong capital inflows in the context of relatively fixed exchange rate policies until the late 1990s, leading to large sterilization operations by central banks. According to Kierzenkowski (2004), the consequence of excess liquidity for the MPT mechanism is that banks became less reactive to policy measures. The policy rate (e.g. the rate of open market operations) plays the role of a marginal investment rate rather than that of determining the marginal cost of banks' liabilities. In this context, as soon as there is additional demand for credit, banks can decide to increase their supply of credit even in a context of higher policy rate.

Kierzenkowski (2004) shows that for Poland, over 1996-1999, while the share of loans was equal to, or up to 1.4 times higher than the share of securities in banking assets, the percentage of interest earned on credits was almost 2.5 times higher in banking income than the percentage of interest yielded by securities. As a result, development in credit aggregates (and monetary aggregates) can also be totally disconnected from policy rates, and driven mainly by real considerations. Such seems to be the case in our variant models for Poland and the Czech Republic. As for the latter, although it is characterised by excess liquidity, as noted by Gunduz (2003), the banking clean-up at the late of 1990s may also possibly explain the absence of a significant response of credit to a monetary policy innovation in this country. Hence, the "disconnection argument" should not be overstated: a positive innovation on credit produces a significant reduction in industrial production, a significant price rise and, last but not least, a significant rise in the nominal interest rate which may dampen credit.

To conclude, the small responses of industrial production and prices to both interest rate and exchange rate shocks suggest that these two channels are not very powerful as MPT mechanisms. Following a positive interest rate shock, market participants expect a depreciation in the nominal exchange rate for the future, which generates an immediate, even if small, nominal exchange rate depreciation due to an over-reaction of market participants[16]. Then, industrial production is temporarily boosted and the country imports temporarily some inflation from abroad. In other words, interest rate manipulations are not really efficient in altering both prices and industrial production developments. Similarly, exchange rate manipulations (e.g. an unexpected devaluation) are not very efficient in boosting strongly and durably industrial production. This appears more clearly when looking at variance decompositions.

[16] Other possible explanations for an immediate depreciation of nominal exchange rate are *(i)* a mark-up behaviour by firms and (*ii*) the lack of confidence in monetary policy or, more generally, in economic policies. See below.

3.2.3. Variance decompositions

Table 2 reports the variance decompositions at a twelve-month horizon for the models estimated without money or credit over the full sample (1993:1–2004:3) and a sub-sample (2000:1–2004:3)[17].

Over the full sample, the variance of NEER is mainly explained by financial shocks, ranging from around 75% in Hungary to 95% in Poland (e.g. shocks on *e* in table 2). The fluctuations of NEER due to real shocks are then very low, especially in Poland where real shocks explain less than 1% of NEER variance (e.g. shocks on *y* and *p* in table 2 accounting respectively for real demand shocks and supply shocks). In other words, the nominal exchange rate does not serve to a large extent as a shock absorber[18]. This finding is confirmed by the very low contribution of shocks on NEER to the variance of industrial production, ranging from around 0% for the Czech Republic to 4% in Hungary. Similarly, the contributions of monetary policy shock to the variance of industrial production are very low, ranging from around 0% for Hungary to less than 7% for the Czech Republic (e.g. shock on *i* in table 2). More generally, the variance of industrial production and consumer prices is mainly explained by real shocks. This is especially true for Hungary and Poland, and to a lesser extent in the Czech Republic. Indeed, the Czech Republic is the country in our sample where the interest rate channel (even if small) is the most substantial. Moreover, in the Czech Republic, the interest rate channel dominates the exchange rate channel, thus confirming the finding of Gunduz (2003), though with a different VAR model than ours.

The variance decompositions over the sub-sample (2000:1–2004:3) confirm that the variance of NEER is mainly explained by financial shocks. But, quite interestingly, the contribution of real shocks to the variance of NEER is now substantial. This is particularly true for Poland where real demand and supply shocks together explain around 15% of the variance of NEER for the recent period, against less than 1% over the full sample. For Hungary and the Czech Republic, the total contribution of real shocks to the variance of NEER over the most recent period is superior to 10%. Then, the nominal exchange rate seems to play a growing role in absorbing real shocks, explaining up to 25% of the variance in industrial production in Poland and 16% in Hungary over the most recent period (against respectively 2% and 4% over the full sample). These results confirm the principal outcome of Creel and Levasseur (2004) that the renunciation to nominal exchange rate fluctuations would surely be more costly for Poland than for the Czech Republic and Hungary. Moreover, in Poland, alongside the exchange rate channel, the interest rate channel plays a growing role in the recent period[19].

---

[17] The variance decompositions with a VAR including a monetary aggregate (or credit aggregate) give very similar trends for the Czech and Polish cases. A comparison of the two samples for Hungary, including either money or credit, has proven impossible since money and credit data have only been available since 1999:12.

[18] Borghijs and Kuijs (2004) reach a similar conclusion with a VAR model consisting of industrial production and nominal exchange rate (both variables expressed relative to euro area and taken in first difference) with long run restrictions (only supply shocks have a long run impact on industrial production).

[19] Meanwhile, since the convergence of short-term interest rate on the euro area is still far from being achieved in Poland, the Polish economy will gain from lower short-term interest rate by entering EMU. It contrasts particularly with the Czech Republic where the convergence of short-term interest rates was already achieved 2 or 3 years ago.

3.3. Alternative identification schemes

Our findings are robust to different specifications[20]. First, considering the *real* effective exchange rate rather than the *nominal* one does not alter results, suggesting that the evolution of real and nominal exchange rates are broadly in line. In fact, the real appreciation of exchange rate (due to catching-up process or the so-called "Balassa-Samuelson" effect) as well as the nominal appreciation one can observe from the data are controlled for by a linear trend in the estimations.

Second, considering *dummies* representative of shifts in exchange rate regimes and/or monetary targets (as in Borhijs and Kuijs, 2004, or Creel and Levasseur, 2004) rather than *exogenous European variables* gives similar response functions of endogenous variables to shocks, but with larger confidence intervals[21]. In fact, the vector of exogenous European variables presents much more time-variability than the vector of dummies (e.g. shifts in official exchange rate regime are scarcer) and then results in more accurate estimates.

Third, changing the *ordering of monetary and financial variables* (interest rate, exchange rate, money or credit) does not affect the results. This point was already noted by Gunduz (2003).

Last, considering *more than one lag* does not help to solve the appearance of a "price-puzzle", nor the "exchange-rate puzzle" of monetary-contraction-induced nominal exchange rate depreciation. The presence of an "exchange-rate puzzle" cannot be considered as an econometrical artefact. For instance, the Hungarian experience during June 2003 is particularly illustrative of how even strong increases in the interest rate can fail to induce an (immediate) appreciation in the exchange rate and then to import disinflation[22]. In fact, the increase in the nominal interest rate, in the case of relatively sticky prices, has important consequences on the market participants' perception regarding the future public debt dynamics: a higher interest rate increases the probability of default on the debt and may make domestic public debt less attractive, leading to currency depreciation. Such an outcome is more likely the higher the level of public debt, the higher the proportion of foreign-currency-denominated debt and the higher the price of risk. Within the transition (unstable) period, with a growing official public debt level in the three CEECs under study, and with the risk that implicit and off-budget-deficit induced debt may outperform official figures, the "exchange-rate puzzle" can be expected to occur.

Over-reaction of markets participants due to a lack of confidence in economic policies can induce an immediate depreciation in the exchange rate following a tightening in monetary policy. Interestingly, EFN (2004) observes that loosened fiscal policies were generally followed by tight monetary policies, especially in Hungary and Poland, then possibly breaking the standard MPT mechanisms. In a VAR controlling for fiscal deficit (in Hungary

---

[20] All the results of robustness tests are available from the authors on request.

[21] To some extent, dummies and exogenous European variables are the two faces of a same coin. For instance, a fixed exchange rate regime (as the one chosen in the beginning of the transition period by the three countries under study) is only sustainable when foreign (European) and domestic developments are on line. But once nominal stabilization has been reached, a shift towards a more flexible exchange rate arrangement (as the ones chosen at the end of 1990's by these countries) can be viewed as a mean to gain monetary policy autonomy.

[22] Between the 11 and 30 of June 2003, although the Hungarian central bank increased its key interest rate by 200-point basis (bringing the short-term interest rate differential against the euro to 750 basis points), the depreciation of the Forint against the euro was more than 3% (see Levasseur, 2004). This development intervened in a context of growing twin deficits that may have hampered the credibility of the Hungarian policy mix.

and Poland), EFN (2004) finds that the "price-puzzle" disappears in Hungary and Poland. Nevertheless, the "exchange-rate puzzle" remains with the different specifications we use.

4. Concluding remarks

In contrast with most of previous VARs studies focusing on transition countries[23], we introduce at least two important differences. First, to take into account growing real and financial integration of new EU members with the EU-15 over the last decade, we control all the VARs for exogenous *European* variables. Second, to investigate explicitly the credit channel *versus* other channels, we directly introduce a credit aggregate in some versions of the VARs. The former difference surely has more incidences on the outcomes than the latter. Introducing credit or money aggregates (only) produces the following conclusion: the credit channel of MPT is rather weak, a conclusion that can directly stem from the architecture of the financial and banking sectors in the three CEECs (see also Anzuini and Levy, 2004, on this topic).

As stated earlier, the introduction of control European variables enhances the accuracy of the estimations. Hericourt and Matei (2004) also introduce exogenous variables in their VAR specification, with different groups of exogenous variables depending upon different groups of countries, but they do not discuss the situation without those exogenous variables. Moreover, their model does not include exchange rates and money (or credit) variables, so that their results are not comparable with ours.

Major results ensuing from our different specifications are threefold. First, the price puzzle is in fact an "exchange-rate puzzle" that has to do with the credibility of the entire policy mix. Only in Hungary with the introduction of a money (or credit) aggregate is the price hike following an unexpected tight monetary policy solved, but the "exchange-rate puzzle" remains. Second, in Poland, the exchange rate and the interest rate channels play a growing role in the recent period as monetary policy transmission mechanisms, in comparison with the same channels in the Czech Republic and Hungary. Last, over the whole transition period, from 1993 onwards, industrial production responses to supply, monetary or financial shocks have been astonishingly low. Unless the focus is on the most recent period (Hericourt and Matei, 2004, found a similar outcome), one has to acknowledge an "industrial-production puzzle" within the VAR-type methodology. The low sensitivity of industrial production to a monetary policy shock is also noticeable in Anzuini and Levy (2004)[24] and Jarocinski (2004). An important question could thus be: what drove industrial production in the early stages of transition?

[23] Notably Anzuini and Levy (2004), Borhijs and Kuijs (2004), Creel and Levasseur (2004), EFN (2004), Ganev et al. (2002), Gunduz (2003), Hericourt and Matei (2004), Jarocinski (2004), and Kuijs (2002).

[24] Using the same recursive identification scheme as Anzuini and Levy (2004) (they also perform non-recursive-Kim (1999)-type identification schemes), on the same sample with the same number of lags, but with our own dataset and the nominal effective exchange rate replacing their commodity price index, we have been unable to replicate their IRFs for Hungary and Poland.

Bibliography

ANGELONI I., A. KASHYAP and B. MOJON (eds.) (2003), *Monetary Policy Transmission in the Euro Area*, Cambridge University Press.

ANZUINI A. and A. LEVY (2004), "Financial Structure and the Transmission of Monetary Shocks: Preliminary Evidence for the Czech Republic, Hungary and Poland", *Temi di discussione* no.514, Banca d'Italia, July.

BERNANKE B.S. and A.S. BLINDER (1993), "The Federal Funds Rate and the Channels of Monetary Transmission", *American Economic Review*, 82, September.

BONIN J., WACHTEL P. (2002), "Financial Sector Development in Transition Economies: Lessons from the First Decade", *BOFIT Discussion Papers*, n°9.

BUITER W., TACI A. (2003), "Capital Account Liberalization and Financial Sector Development in Transition Countries", in Age F. P. Bakker and Bryan Chapple (eds.), *Capital Liberalization in Transition Countries: Lessons from the Past and for the Future*, pp. 105-141. Edward Elgar, Cheltenham, UK.

BRADA J., DENIZER C., KUTAN A.M., and YIGIT T.M. (2003), "Is There a Bank Lending Channel in Transition Economies? Evidence from Czech Banks' Balance Sheets", *mimeo*.

CECCHETTI S. (1999), "Legal Structure, Financial Structure, and the Monetary Policy Transmission Mechanism", *FRBNY Economic Policy Review*, July.

CHRISTIANO L.J., M. EICHENBAUM and C.L. EVANS (1999), "Monetary Policy Shocks: What Have We Learned and To What End?", in Taylor J.B. and M. Woodford (eds.), *Handbook of Macroeconomics*, vol.1, Elsevier.

COTTARELLI C., DELL' ARICCIA G., AND VLADKOVA-HOLLAR I. (2003), "Early Birds, Late Risers, and Sleeping Beauties: Bank Credit Growth to the Private Sector in Central and Eastern Europe and the Balkans", *IMF Working Paper*, WP/03/213, November.

CREEL J., and LEVASSEUR S. (2004), "How would a Fixed Exchange Rate Regime Fit the Transition Economies ? The Cases of the Czech Republic, Hungary and Poland", *Revue de l'OFCE*, Special Issue «The New European Union Enlargement», April 2004.

EUROPEAN COMMISSION (2002), "Report on macroeconomic and financial sector stability developments in candidate countries", *Enlargement Papers, Directorate-General for Economic and Financial Affairs*, n°8, April.

ECB (2003), "Bond markets and long-term interest rates in EU accession Countries", European Central Bank, October.

ECB (2002), "Financial Sectors in EU Accession Countries", European Central Bank, July.

EFN (2004), "The Euro Area and the Acceding Countries", Chap.4, *European Forecasting Network Report,* Spring 2004.

GANEV G., K. MOLNAR, K. RYBINSKI and P. WOZNIAK (2002), "Transmission Mechanisms of Monetary Policy in Central and Eastern Europe", *Case Report* no. 52, Warsaw.

GIORDANI P. (2004), "An Alternative Explanation of the Price Puzzle", *Journal of Monetary Economics*, vol. 51, no.6, September.

GROS D. (2002), "Who needs foreign banks", *CEPS Working Documents*, n°185, September.

GUNDUZ B.Y. (2003), "The Monetary Policy Transmission in the Czech Republic", *IMF Country Report*, August.

HALPERN L. and C. WYPLOSZ (1997), "Equilibrium Exchange Rates in Transition Economies", *IMF Staff Papers*, 44(4).

HANSON M.S. (2004), "The 'Price Puzzle' Reconsidered", *Journal of Monetary Economics*, vol. 51, no.7, October.

HERICOURT J. and I. MATEI (2004), "A VAR Description of the Effects of Monetary Policy in CEECs", *mimeo*, May.

JAROCINSKI M. (2004), "Responses to Monetary Policy Shocks in the East and the West of Europe: A Comparison", *mimeo*, October.

KUIJS L. (2002), "Monetary Policy Transmission Mechanisms and Inflation in the Slovak Republic", *IMF Working Paper*, WP/02/80.

KIERZENKOWSKI R. (2004), "The Multi-Regime Bank Lending Channel and the Effectiveness of the Polish Monetary Policy Transmission During Transition", *Journal of Comparative Economics*, forthcoming.

LEVASSEUR S. (2004), "Why not euroisation", *Revue de l'OFCE*, Special Issue «The New European Union Enlargement», April 2004

PEERSMAN G., SMETS F. (2003), "The Monetary Transmission Mechanism in the Euro Area: Evidence from VAR Analysis", in Angeloni et al. (eds.), 2003.

OECD (2002), "Economic studies- Hungary", June.

PUTKURI H. (2003), "Cross-countries Asymmetries in Euro Area Monetary Transmission: the Role of National Financial Systems", *BOFIT Discussion Papers 15.*

SIMS C.A. (1992), "Interpreting the Macroeconomic Time Series Facts: the Effects of Monetary Policy", *European Economic Review*, vol. 36, no. 5.

VOSTROKNUTOVA E. (2003), "Polish Stabilization: What Can We Learn from the I(2) Cointegration Analysis?", *Economics of Planning*, vol. 35, no.3.

WAGNER N., IAKOVA D. (2001), "Financial Sector Evolution in the Central European Economies: Challenges in Supporting Macroeconomic Stability and Sustainable Growth", *IMF Working Papers*, WP/01/41, September.

Appendix 1. Descriptive data on financial sectors

Table A: Bank credit to private sector
(annual real growth rates, by economic sector, 1998-2002)

	1998	1999	2000	2001	2002	Cumulative 1998-2002
Czech republic						
Private sector	-5,1	-4,8	-5,4	-6,1	-0,3	-21,7
Enterprises	-4,6	-5,3	-6,9	-7,8	-3,2	-27,8
Households	-9,5	-0,8	6,7	6,5	17,2	20,1
Estonia						
Private sector	30,5	4,6	10,4	20,4	22,0	87,9
Enterprises	28,9	3,6	8,6	19,5	18,9	79,5
Households	39,0	8,6	18,9	23,9	34,0	124,4
Hungary						
Private sector	10,1	7,2	17,4	16,5	7,6	58,8
Enterprises	12,8	6,4	14,7	12,1	-0,9	45,1
Households	-6,0	13,1	36,7	43,3	45,9	133,0
Latvia						
Private sector	54,5	26,6	17,4	30,8	34,5	163,8
Enterprises	53,2	23,2	12,1	25,8	26,9	141,2
Households	65,6	52,5	50,6	55,3	61,7	285,7
Lithuania						
Private sector	4,5	12,7	-4,7	26,1	29,6	68,2
Enterprises	37,7	10,6	-3,0	26,2	23,7	95,2
Households	37,1	27,0	-14,6	24,9	69,6	144,0
Poland						
Private sector	15,6	17,8	12,9	7,4	4,1	57,8
Enterprises	14,8	16,9	9,4	3,7	0,6	45,4
Households	21,1	22,9	23,3	15,3	9,7	92,3
Slovakia						
Private sector	-1,2	-1,2	-3,8	-14,0	-12,3	-32,5
Enterprises	-2,2	-2,9	-5,8	-17,2	-16,0	-44,1
Households	16,0	24,6	20,8	14,1	13,8	89,3
Slovenia						
Private sector	12,0	19,0	15,1	7,7	5,6	59,4
Enterprises	12,0	15,7	12,6	11,1	8,3	59,7
Households	12,1	26,6	20,9	0,5	-0,5	59,6

Source: Cottarelli *et al*. (2003).

Table B: Financing the growth of bank credit to private sector
(annual average changes in the ratio between balance sheet items and GDP, in percentage points of GDP)

	Reference period	Bank loans to private sector	Bank credit to the public sector	Bank deposits	Net foreign liabilities	Other net liabilities
New EU members CEECs						
Czech Republic	1998-2002	-3.0	1.7	-0.3	3.8	-4.8
Estonia	1992-2002	3.2	-0.0	1.7	0.9	0.6
Hungary	1997-2002	1.5	-0.3	0.4	-0.7	1.5
Latvia	1998-2002	3.3	0.0	2.2	2.1	-1.0
Lithuania	2002	2.6	0.6	2.3	1.2	-0.2
Poland	1998-2002	1.8	-0.2	1.9	0.5	-1.0
Slovakia	1998-2002	-4.0	2.0	0.3	1.0	-3.3
Slovenia	1995-2002	2.3	-0.1	2.2	0.5	-0.3

Source: Cottarelli *et al*., (2003).

Appendix 2. Data (sources and description)

European exogenous variables

p_t^{euro} is the harmonised index of consumer prices (HICP) for the 15 "old" members of EU.

y_t^{euro} is the industrial production index for the 15 "old" members of EU, plus 3 members of EFTA (Iceland, Liechtenstein and Norway).

i_t^{euro} is the policy interest rate of the Bundesbank from 1993:1 to 1998:12, then of the ECB from 1999:1 to 2004:3 (rate on the main refinancing operations).

Data for p_t^{euro} and y_t^{euro} were taken from Eurostat while data for i_t^{euro} were taken from IMF.

Endogenous variables for the Czech Republic, Hungary and Poland

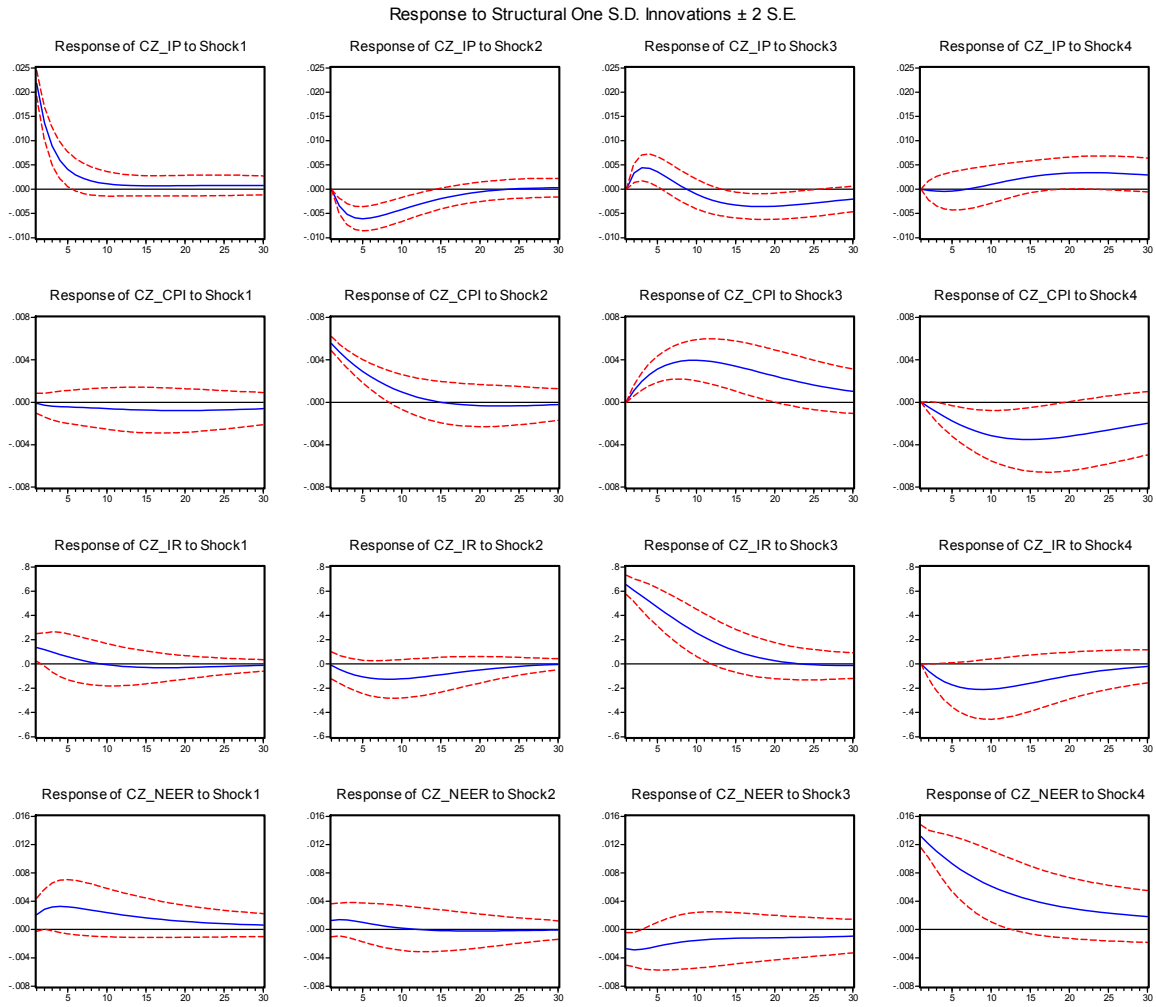
p_t , y_t , i_t and e_t denote respectively the consumer prices index, the industrial production, the policy interest rate and the nominal effective exchange rate for the Czech Republic, Hungary and Poland.

m_t and dc_t denote respectively a broad monetary aggregate (M2) and the domestic credit aggregate for the same three countries.

All endogenous data were taken from IMF.

Appendix 3. Results of the VAR

Figure 1



N.B.: shock 1: innovation on industrial production

shock 2: innovation on the consumer price index

shock 3: innovation on the nominal interest rate

shock 4: innovation on the nominal effective exchange rate

Figure 1/bis

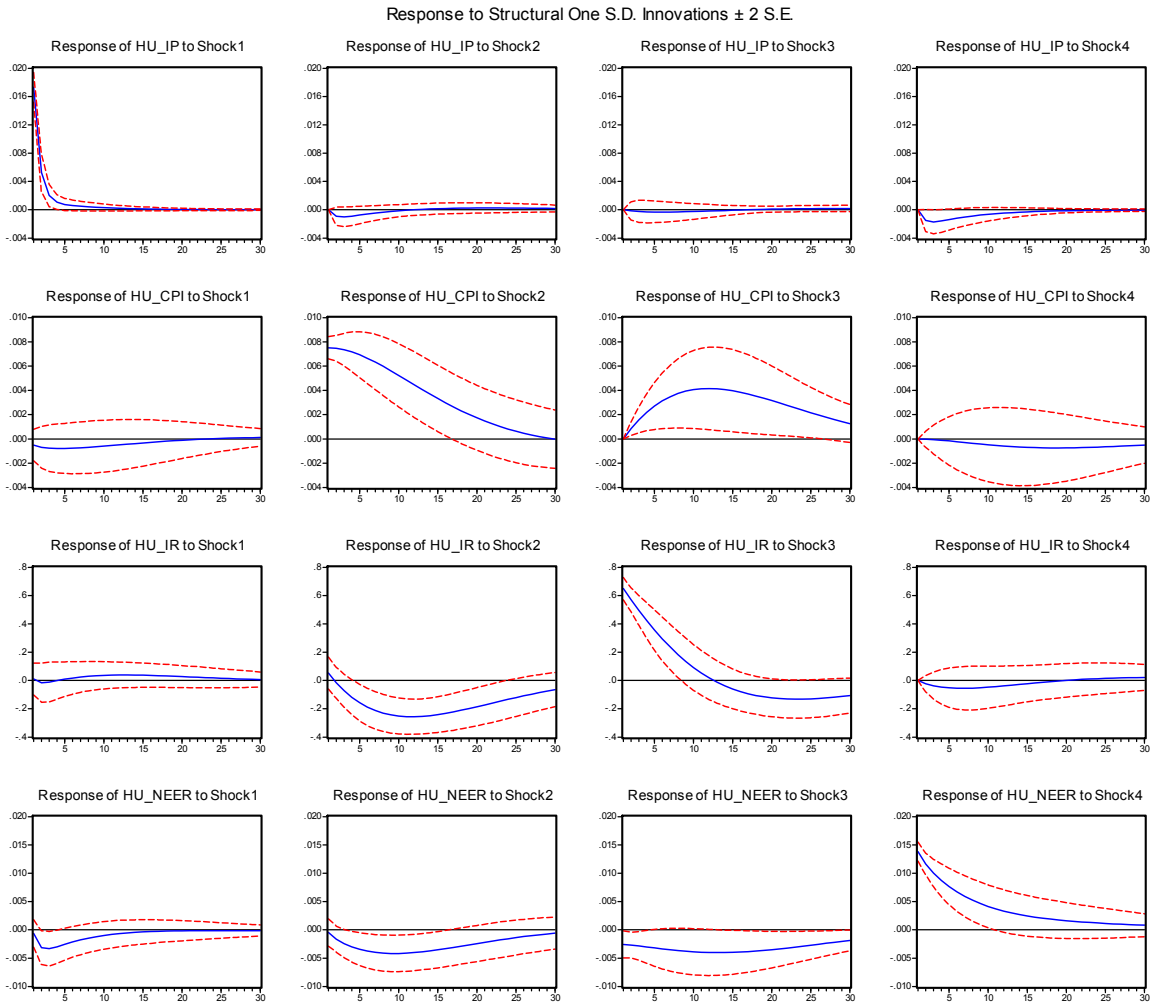

Response to Structural One S.D. Innovations ± 2 S.E.
Response of HU_IP to Shock1
Response of HU_IP to Shock2
Response of HU_IP to Shock3
Response of HU_IP to Shock4
Response of HU_CPI to Shock1
Response of HU_CPI to Shock2
Response of HU_CPI to Shock3
Response of HU_CPI to Shock4
Response of HU_IR to Shock1
Response of HU_IR to Shock2
Response of HU_IR to Shock3
Response of HU_IR to Shock4
Response of HU_NEER to Shock1
Response of HU_NEER to Shock2
Response of HU_NEER to Shock3
Response of HU_NEER to Shock4

Figure 1/ter

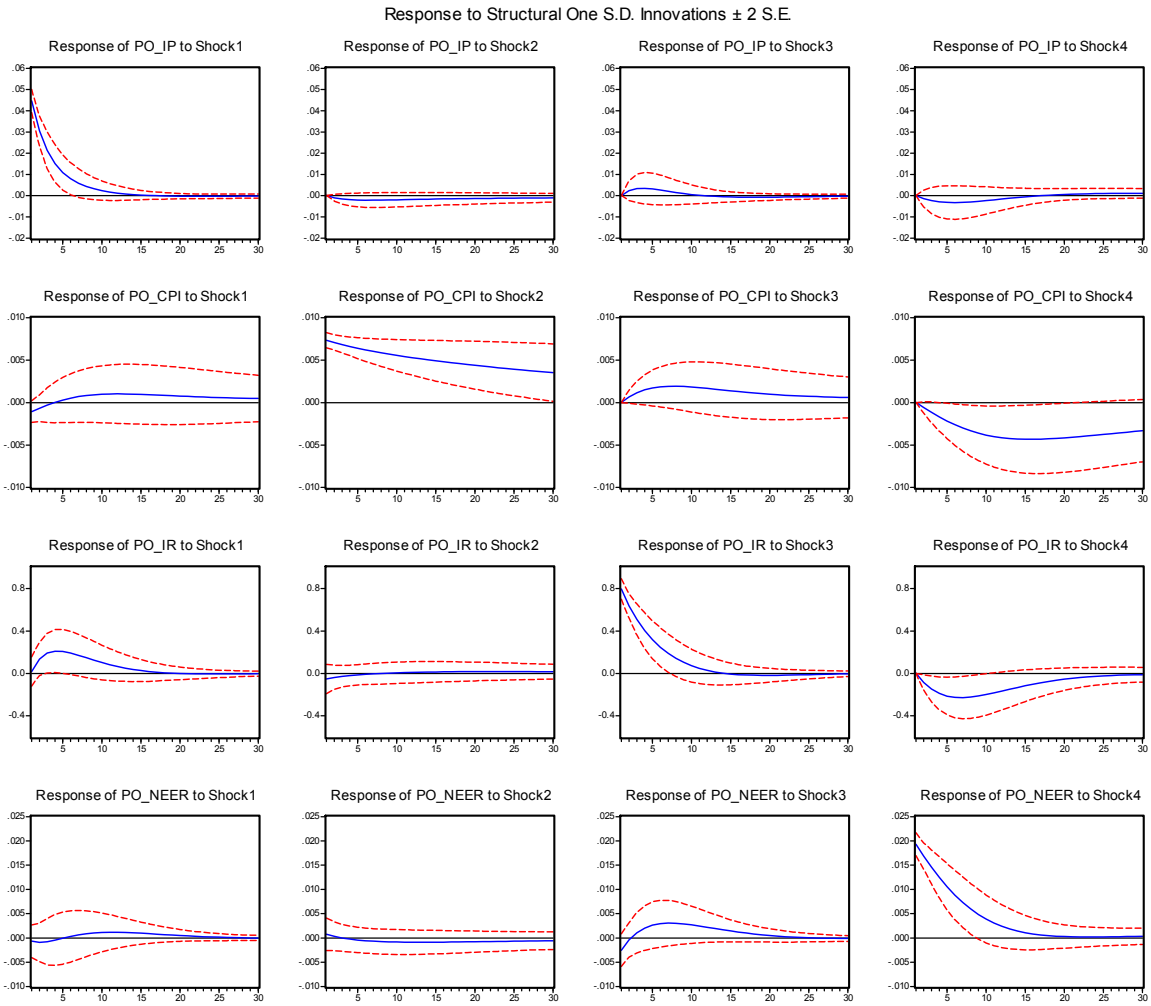
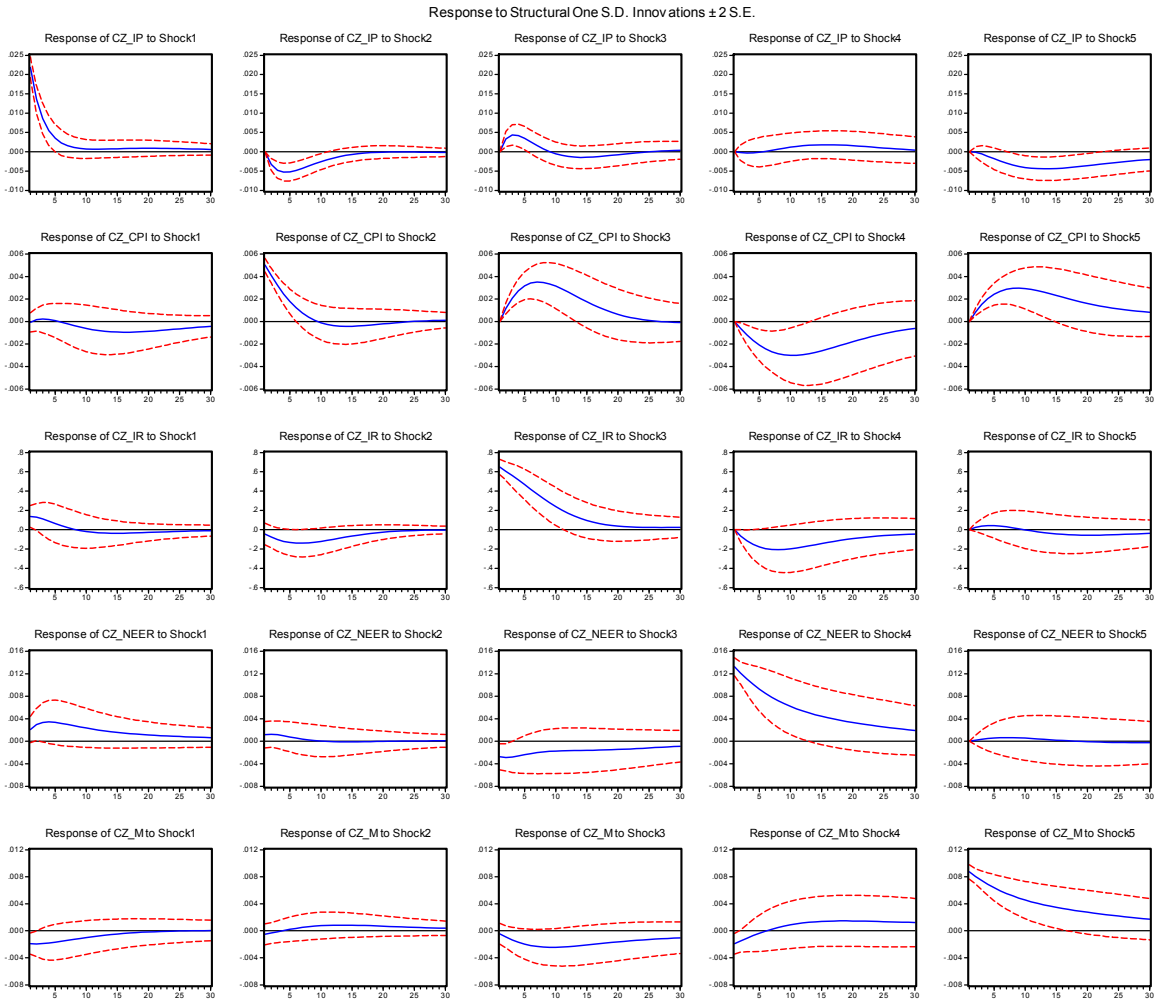

Response to Structural One S.D. Innovations ± 2 S.E.
Response of PO_IP to Shock1
Response of PO_IP to Shock2
Response of PO_IP to Shock3
Response of PO_IP to Shock4
Response of PO_CPI to Shock1
Response of PO_CPI to Shock2
Response of PO_CPI to Shock3
Response of PO_CPI to Shock4
Response of PO_IR to Shock1
Response of PO_IR to Shock2
Response of PO_IR to Shock3
Response of PO_IR to Shock4
Response of PO_NEER to Shock1
Response of PO_NEER to Shock2
Response of PO_NEER to Shock3
Response of PO_NEER to Shock4

Figure 2



N.B.: shock 1: innovation on industrial production

shock 2: innovation on the consumer price index

shock 3: innovation on the nominal interest rate

shock 4: innovation on the nominal effective exchange rate

shock 5: innovation on the money aggregate

Figure 2/bis

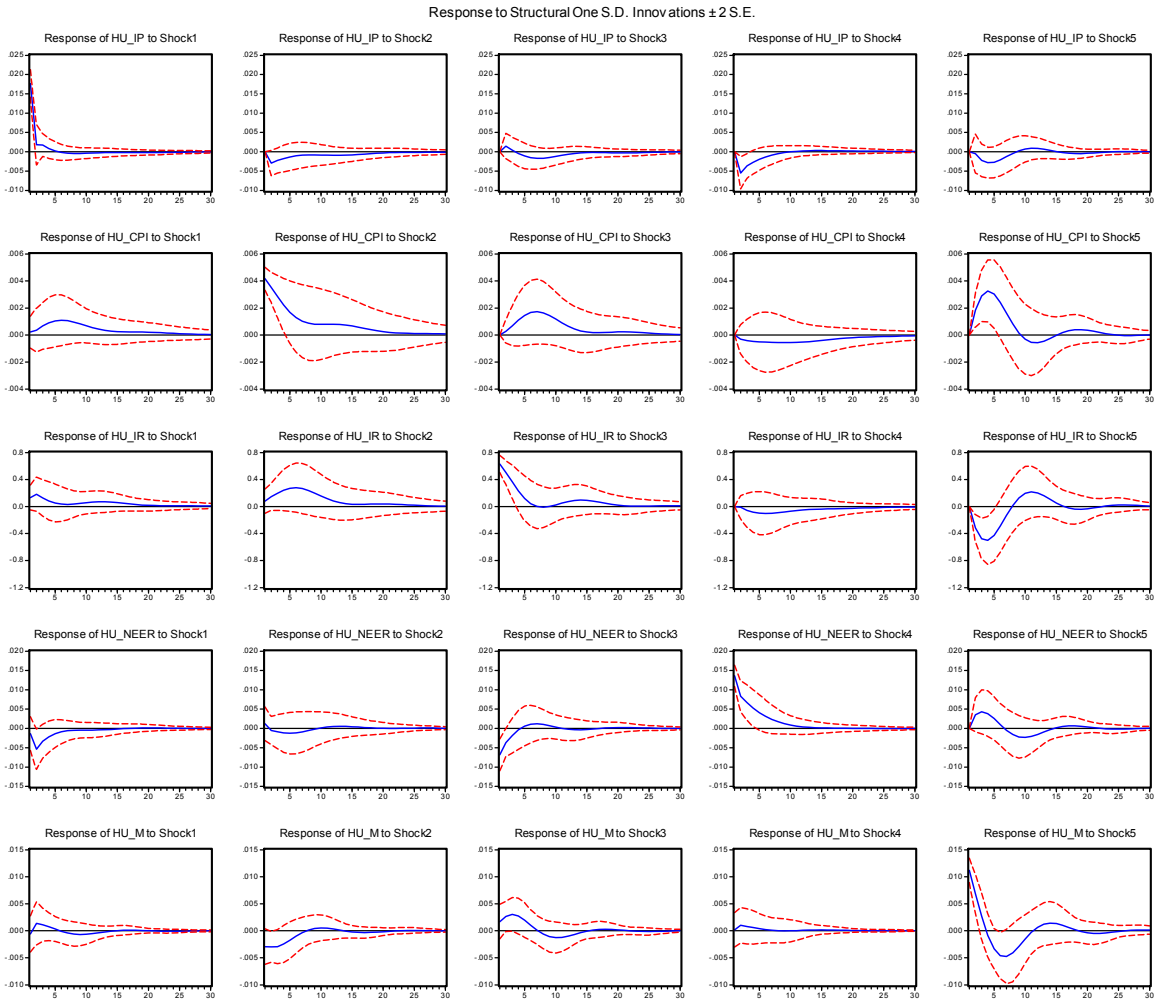

Response to Structural One S.D. Innovations ± 2 S.E.
Response of HU_IP to Shock1
Response of HU_IP to Shock2
Response of HU_IP to Shock3
Response of HU_IP to Shock4
Response of HU_IP to Shock5
Response of HU_CPI to Shock1
Response of HU_CPI to Shock2
Response of HU_CPI to Shock3
Response of HU_CPI to Shock4
Response of HU_CPI to Shock5
Response of HU_IR to Shock1
Response of HU_IR to Shock2
Response of HU_IR to Shock3
Response of HU_IR to Shock4
Response of HU_IR to Shock5
Response of HU_NEER to Shock1
Response of HU_NEER to Shock2
Response of HU_NEER to Shock3
Response of HU_NEER to Shock4
Response of HU_NEER to Shock5
Response of HU_M to Shock1
Response of HU_M to Shock2
Response of HU_M to Shock3
Response of HU_M to Shock4
Response of HU_M to Shock5

Figure 2/ter

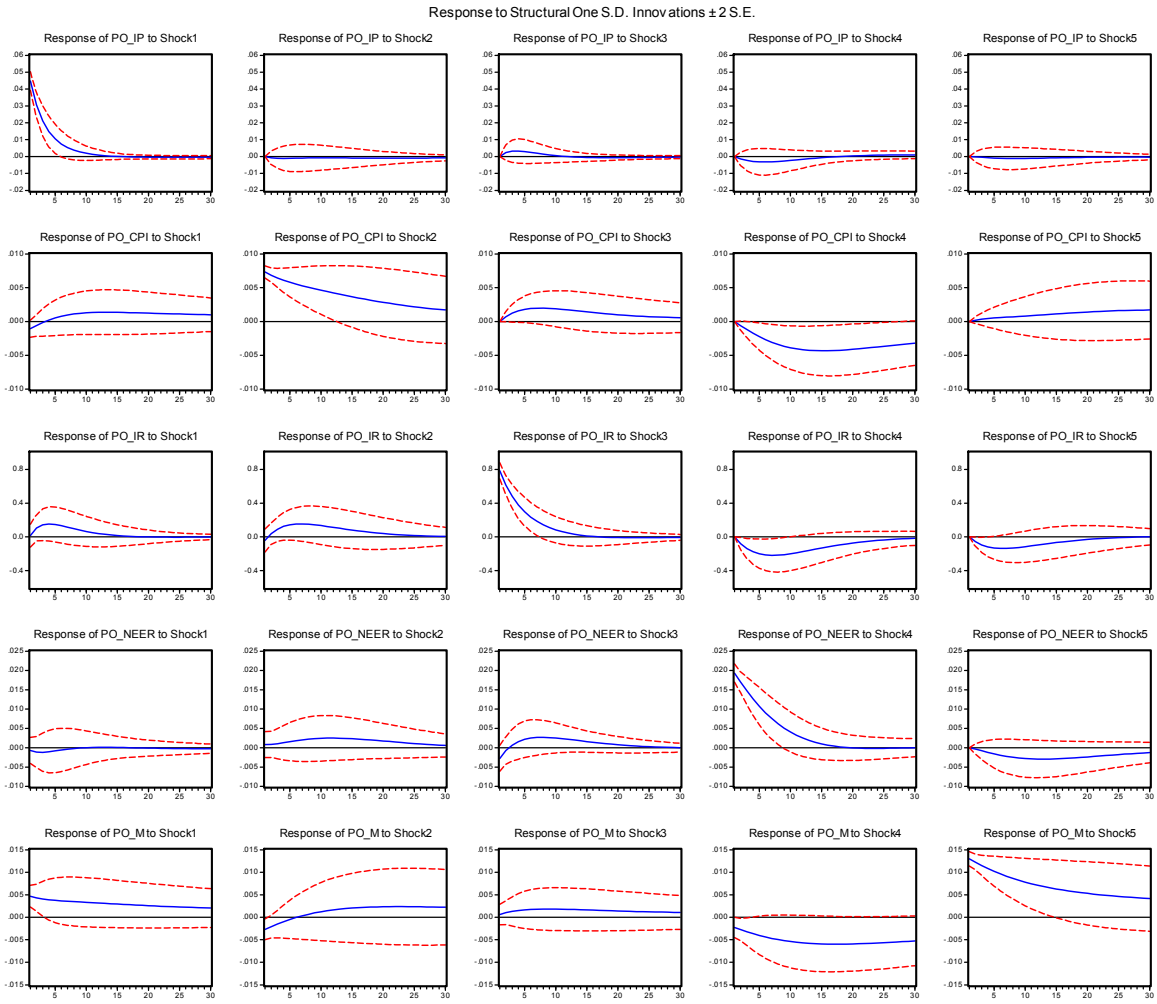
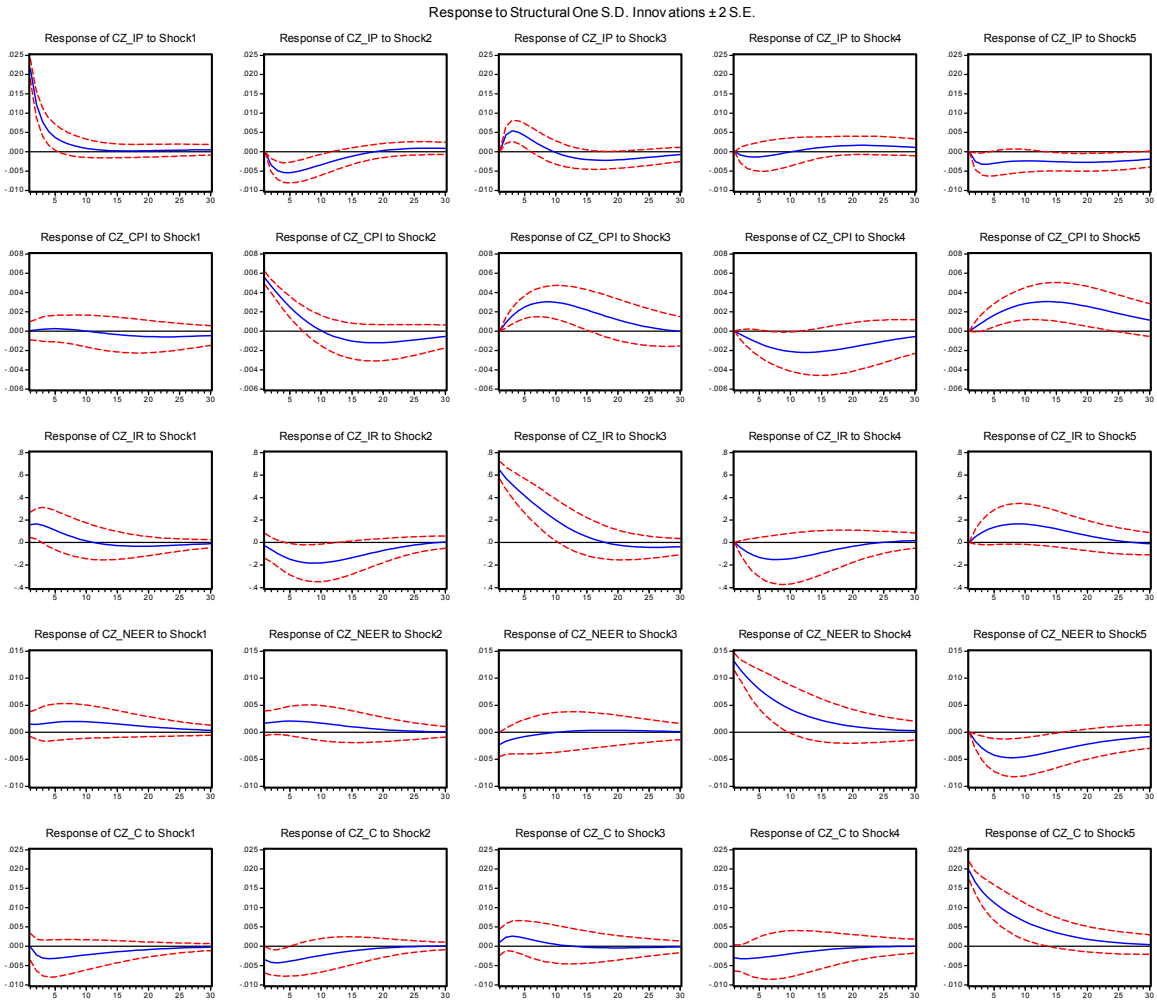

Response to Structural One S.D. Innovations ± 2 S.E.
Response of PO_IP to Shock1
Response of PO_IP to Shock2
Response of PO_IP to Shock3
Response of PO_IP to Shock4
Response of PO_IP to Shock5
Response of PO_CPI to Shock1
Response of PO_CPI to Shock2
Response of PO_CPI to Shock3
Response of PO_CPI to Shock4
Response of PO_CPI to Shock5
Response of PO_IR to Shock1
Response of PO_IR to Shock2
Response of PO_IR to Shock3
Response of PO_IR to Shock4
Response of PO_IR to Shock5
Response of PO_NEER to Shock1
Response of PO_NEER to Shock2
Response of PO_NEER to Shock3
Response of PO_NEER to Shock4
Response of PO_NEER to Shock5
Response of PO_M to Shock1
Response of PO_M to Shock2
Response of PO_M to Shock3
Response of PO_M to Shock4
Response of PO_M to Shock5

Figure 3



N.B.: shock 1: innovation on industrial production

shock 2: innovation on the consumer price index

shock 3: innovation on the nominal interest rate

shock 4: innovation on the nominal effective exchange rate

shock 5: innovation on the credit aggregate

Figure 3/bis

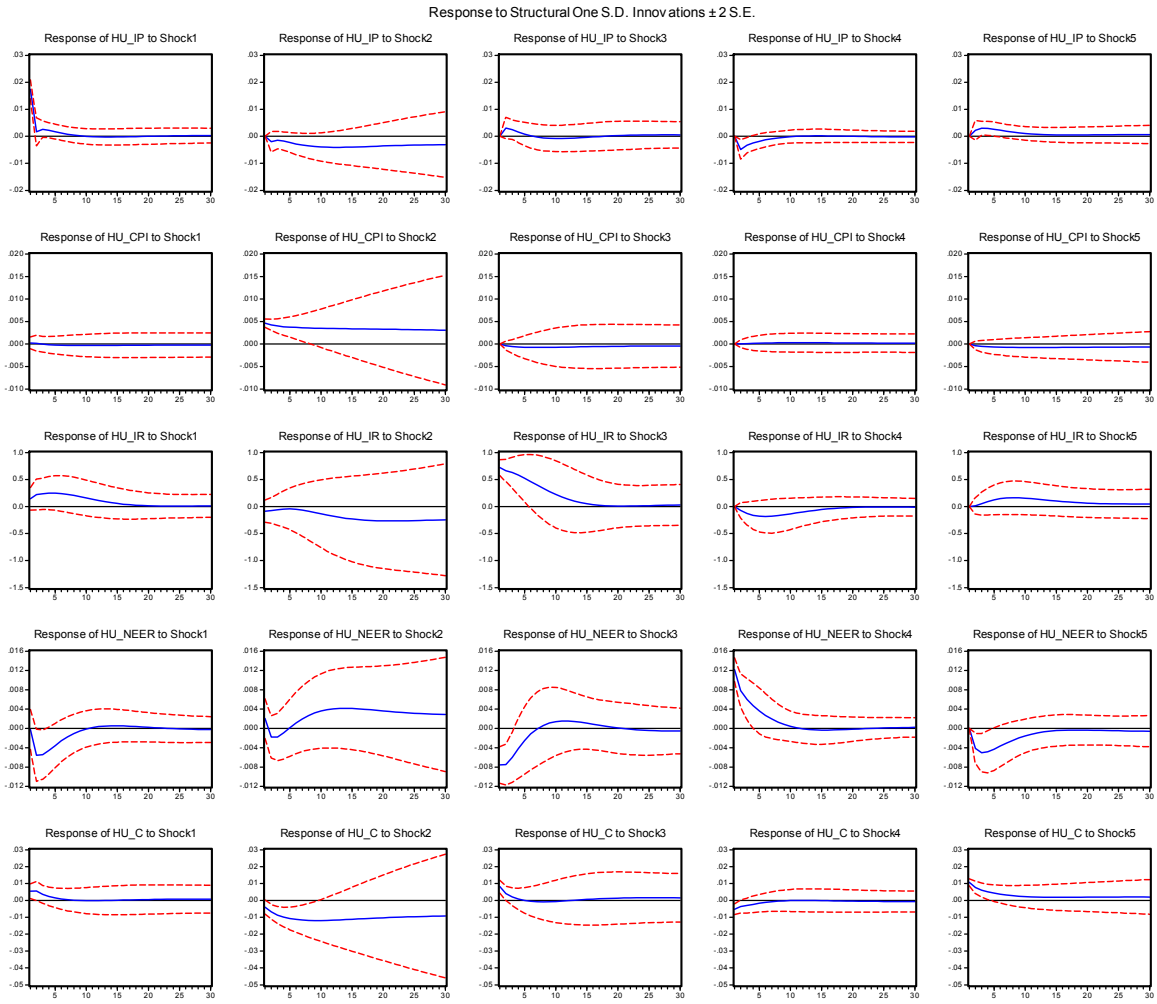

Response to Structural One S.D. Innovations ± 2 S.E.
Response of HU_IP to Shock1
Response of HU_IP to Shock2
Response of HU_IP to Shock3
Response of HU_IP to Shock4
Response of HU_IP to Shock5
Response of HU_CPI to Shock1
Response of HU_CPI to Shock2
Response of HU_CPI to Shock3
Response of HU_CPI to Shock4
Response of HU_CPI to Shock5
Response of HU_IR to Shock1
Response of HU_IR to Shock2
Response of HU_IR to Shock3
Response of HU_IR to Shock4
Response of HU_IR to Shock5
Response of HU_NEER to Shock1
Response of HU_NEER to Shock2
Response of HU_NEER to Shock3
Response of HU_NEER to Shock4
Response of HU_NEER to Shock5
Response of HU_C to Shock1
Response of HU_C to Shock2
Response of HU_C to Shock3
Response of HU_C to Shock4
Response of HU_C to Shock5

Figure 3/ter

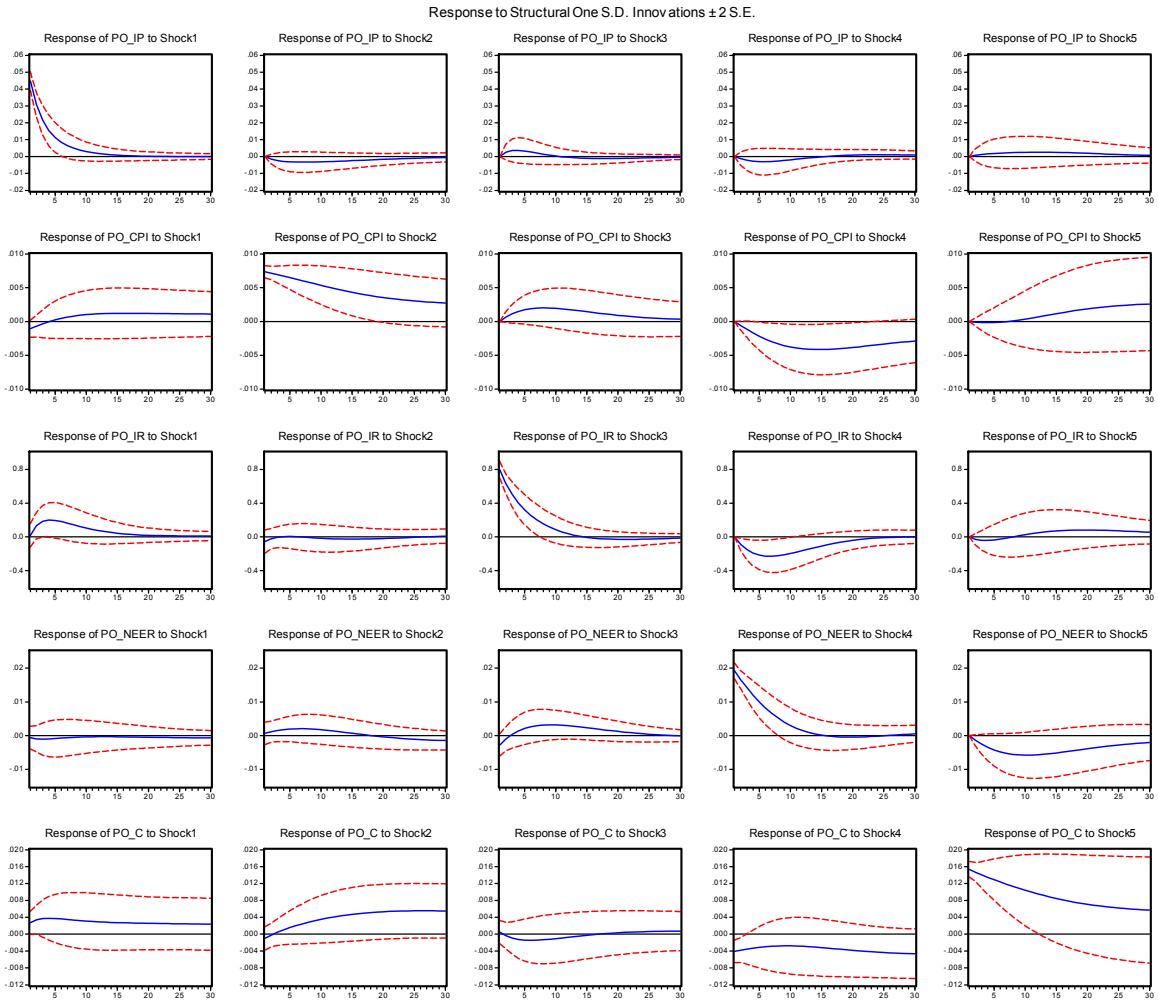

Response to Structural One S.D. Innovations ± 2 S.E.
Response of PO_IP to Shock1
Response of PO_IP to Shock2
Response of PO_IP to Shock3
Response of PO_IP to Shock4
Response of PO_IP to Shock5
Response of PO_CPI to Shock1
Response of PO_CPI to Shock2
Response of PO_CPI to Shock3
Response of PO_CPI to Shock4
Response of PO_CPI to Shock5
Response of PO_IR to Shock1
Response of PO_IR to Shock2
Response of PO_IR to Shock3
Response of PO_IR to Shock4
Response of PO_IR to Shock5
Response of PO_NEER to Shock1
Response of PO_NEER to Shock2
Response of PO_NEER to Shock3
Response of PO_NEER to Shock4
Response of PO_NEER to Shock5
Response of PO_C to Shock1
Response of PO_C to Shock2
Response of PO_C to Shock3
Response of PO_C to Shock4
Response of PO_C to Shock5

Table 2: Variance decomposition

Full sample 1993:1 2004:03

Czech republic

	Decomposition S.E.	Shock IP	Shock CPI	Shock IR	Shock NEER
Industrial production	0,0336	71,8	21,6	6,4	0,2
Consumer prices	0,0156	0,9	43,0	38,5	17,6
Interest rate	1,6153	2,1	4,0	83,3	10,7
NEER	0,0323	7,8	0,9	5,0	86,3

Hungary

	Decomposition S.E.	Shock IP	Shock CPI	Shock IR	Shock NEER
Industrial production	0,0188	94,6	1,2	0,2	4,0
Consumer prices	0,0231	0,9	83,3	15,6	0,1
Interest rate	1,3519	0,3	16,7	81,9	1,1
NEER	0,0313	5,1	11,4	11,1	72,4

Poland

	Decomposition S.E.	Shock IP	Shock CPI	Shock IR	Shock NEER
Industrial production	0,0633	96,1	0,9	1,3	1,7
Consumer prices	0,0224	1,0	81,3	4,9	12,8
Interest rate	1,5157	11,0	0,3	73,5	15,1
NEER	0,0376	0,4	0,3	4,3	95,0

Short sample 1999:12 2004:03

Czech republic

	Decomposition S.E.	Shock IP	Shock CPI	Shock IR	Shock NEER
Industrial production	0,0197	96,4	0,7	0,6	2,3
Consumer prices	0,0083	12,6	73,5	10,2	3,6
Interest rate	0,3174	2,7	14,5	38,1	44,7
NEER	0,0235	7,8	2,6	4,7	85,0

Hungary

	Decomposition S.E.	Shock IP	Shock CPI	Shock IR	Shock NEER
Industrial production	0,0232	73,7	7,5	2,6	16,3
Consumer prices	0,0125	0,0	99,3	0,0	0,6
Interest rate	**1,6271**	8,3	5,4	74,2	12,2
NEER	0,0239	9,1	3,7	16,0	71,3

Poland

	Decomposition S.E.	Shock IP	Shock CPI	Shock IR	Shock NEER
Industrial production	0,0365	50,5	12,6	12,7	24,2
Consumer prices	0,0068	2,3	59,6	26,8	11,3
Interest rate	1,2111	11,4	9,7	66,0	12,9
NEER	0,0401	2,3	12,3	4,6	80,8

IP: Industrial production.
CPI: Consumer price index.
IR: Interest rate.
NEER: Nominal effective exchange rate.