Credibility-flexibility trade off and the transmission of asymmetric shocks: future prospects for CEE acceding countries

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Abstract

The purpose of the paper is to study the influence of exogenous shocks (supply, demand and nominal) on the economic policy of CEECs. The aim is to analyze the main channels of monetary transmission in CEE countries and to explain their importance in case of possible shocks on the way towards EMU. The choice of monetary regime is found to be a significant factor how different shocks are transmitted through the economy. The regime choice is directly related with the type of monetary policy different CEE countries will follow and the establishment of appropriate central rate. A credible monetary policy is a prerequisite for EMU accession and requires strong commitment in advance. Before such commitment has been made, the magnitude of the vulnerability to external shocks has to be taken into account. The analysis attempts to determine to what extent an external shock can be source of fluctuations in different regimes in terms of the open economy macroeconomic framework presented by Clarida and Gali (1994). Two different VAR models are applied in order to check the robustness of the results to the econometric methodology. The results support inflation targeting enhanced by managed floating which lessen the impact of external shocks on domestic economies. This can be recommended as a transition strategy for bigger acceding countries without credibility problems. The main conclusions are related to development of a multilateral monetary policy co-ordination in the presence of idiosyncratic shocks and independent fiscal policy.

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Key words: EU enlargement, shocks, Structural and Bayesian VAR

I. Introduction

Globalization makes small open economies dependant on changes in the international financial system. Up to now, European monetary union (EMU) has important influence on transition countries independently from the fact that they are not full members. In the future the transition process will be challenged by the exogenous disturbances CEE economies face which can create a potential for financial instability[1].

The costs incurred partly depend on the nature, frequency and correlation of shocks that will hit the euro area. They can have permanent or temporary asymmetric effect in CEECs depending on the different transmission mechanisms. After CEECs countries have entered EU (in May 2004) at some point in time they will join EMU, as no possibility of derogation is given. Some of the transition countries like Hungary, Slovenia and Estonia take on a rapid strategy and clearly announce their desire to enter ERM II[2] and to adopt the Euro, as soon as possible[3]. Others like the Czech Republic prefer to delay. The policy position of the governing Council of ECB also warns about "the risks implied by premature rigidity of the exchange rate" and recommends that "it might be appropriate for some new Member States to only consider applying for ERM II membership after a further degree of convergence has been achieved"[4]. In addition the Governing Council states that "this is particularly advisable when an early rigidity could precipitate disorderly realignments with potentially disruptive economic consequences, including for the credibility of the mechanism as a whole". The goal of the ERM II is to enhance the macroeconomic stability thus fostering real and nominal convergence. On the one hand the period after EU accession and before joining ERM II cannot be prolonged too much and countries have to consider their timetables for joining the Monetary Union. On the other hand once in the ERM II in the event of shocks, the monetary policy tools of the central banks will be restricted. Hence, there is an important need for empirical understanding of the dynamic behaviour of the macroeconomic variables in transition in the period before joining the EMU. The questions are whether the structural adjustments will be speed up or slowed down by an early participation in EMU, what should be the optimal transitions strategy for EU acceding countries and should countries follow a rigid regime or it is optimal to keep some sort of flexibility in the pre EMU phase. The timing

[1] Exogenous disturbances are events over which the authorities in particular country have no direct control but which can have permanent or temporary asymmetric effect depending on the economic structure

[2] ERM II is a multilateral agreement of fixed but adjustable exchange rates with a central rate and a standard fluctuation band of +/-15%

[3] See the Central Banks announcements

[4] "Policy position of the governing council of the ECB on the exchange rate issues relating to the acceding countries" http://www.ecb.int/press/03/pr031218en.htm

of entry mostly depends on the financial development and the real macroeconomic stabilization. Significant structural reforms, ability to advance convergence through sound economic policy and exchange rate regime compatible with ERM II, are viewed as prerequisites for participation in the mechanism. During this period there will be only limited exchange rate flexibility in the context of full capital mobility, which increases the probability of financial crises. Countries should answer to the question what is the probability to be a subject of asymmetric shocks vis-à-vis the EMU members. Furthermore, we test if the macroeconomic situation is robust and the fiscal policy is capable of responding to shocks.

The choice of monetary strategy (and the exchange rate arrangement as a part of the monetary regime) after EU accession is a responsibility and prerogative of the Members States concerned[5]. Naturally, there is no superior exchange rate regime that can be applied to all countries in transition as countries differ greatly in their economic structure[6]. Hence, during the transition to EMU there is considerable latitude open for monetary policy. Countries should also consider to what extent limiting the exchange rate flexibility will help credibility and anchoring expectations. It is obvious also to compare the economic developments of the potential new members of EMU with Estonia and Bulgaria - countries that had already introduced currency boards and fixed their exchange rates to the euro.

The probability of financial convergence with regard to the Maastricht criteria is related to the monetary regime CEEC have chosen in the pre-acceding phase and the fiscal instruments applied at national level. In order to achieve an early membership, acceding countries must implement monetary policy which targets low inflation rates. On the one hand, certain level of flexibility is necessary because output do not respond efficiently to external shocks in the presence of sluggish prices and wages. On the other hand the exchange rate stability with the euro is a priority for all acceding countries and is subordinated to the primary objective of price stability. The intramarginal interventions used by the countries that have chosen to participate in ERM II from the very beginning are decided by their national central banks. However, a formal decision of narrowing the fluctuation band of +/-15% (related to the marginal interventions) is deemed to be exceptional and could be considered at a very advantageous stage of convergence[7]. This implies the importance of certain level of flexibility within ERM II before locking the exchange rate permanently and adopting the

[5] Report by the (ECOFIN) Council to the European Council in Nice on the exchange rate aspects of enlargement, Brussels, 8.11.2000, Council of the European Union press release no 13055/00

[6] To be noted is that there was not in the past single path for the current EMU members either. Incompatible with ERM II are the cases of free floating or managed floats (without mutually agreed central rate), crawling pegs and pegs against anchors other than the euro.

[7] Denmark participates in ERM II with multilaterally agreed bands of +/- 2.25%

euro[8]. An interesting issue is how monetary institutions should be designed and what monetary policy instruments they should use in order to reduce the costs of entry in EMU.

Macroeconomic transition in Eastern Europe is characterized by volatility in capital flows, high terms of trade shocks and large structural transformations Real and/or financial shocks[9] (reversal of capital flows allocation, increase of international interest rates, financial contagion) have significant implication on the economic policy of CEE countries. Moreover, as an uniform response to common shocks will not yield an uniform impact and due to the regional differences, enlargement itself acts like an exogenous shock leading to variations also in the EU. This could disturb the process of business cycle synchronization and might impair monetary policy in the Euroland after the Eastern enlargement of the EU.

Despite the insightful literature on the subject, the question of the interdependence of the monetary regime and the exposure to exogenous disturbances during the process of enlargement has been underestimated. The role of ERM II is viewed as a phase for testing both the central rate and the convergence. Shocks pose difficult problems, as they are transmitted by higher interest rates and low investment level[10].

The impact can be asymmetric on country as well as on regional level. By increasing volatility, external shocks can also lead to financial crises and postpone the euro adoption. An emergence of common institutions and policies has to flatten the existing structural asymmetries. Credible institutions including sound fiscal discipline and financial regulations, adequate legal framework regarding bank defaults, as well as the implementation of necessary structural changes could speed up the process of convergence.

This paper empirically investigates the link between a credible monetary policy and the external shock transmission in small open economies. It evaluates the importance of external shocks and the type of monetary regime for avoiding instability in the pre EMU phase[11]. The aim of the research is to analyze the main channels of monetary transmission in CEE countries and to explain their importance in the transmission in case of possible shocks. We separate the effects of different shocks and compare the effect of the destabilization risk under various monetary/exchange rate regimes. An emphasis is placed on the occurrence of external shocks in relation to different monetary targeting as well as the role of the exchange

[8] During the transition period CEEC will be highly vulnerable to financial instability, which could be avoided by full euroization, not allowed by Treaty

[9] In a "taxonomy of shocks" of the European Commission (1997) four distinction are made:
between exogenous and policy-induced shocks, between real and financial shocks, between temporary and permanent shocks, between country-specific and sector-specific shocks

[10] Exchange rate and interest rate volatility have negative effect on the economic growth in the developing world. For details on this point see Reinhart and Reinhart (2001), Hausmann, et al. (1999)

[11] According to the Article 124 of the Treaty countries with derogation for an euro introduction have to regard their exchange rate polices as a matter of common interest

rate. The study answers to the question how well prepared are the acceding countries to absorb shocks and can national or/and supranational regulation smooth them. The purpose is to examine the main challenges the acceding countries will confront and the policy measures that will ensure successful monetary integration. The paper is organized as follows: Section II discusses the theoretical literature. Section III makes analysis of the economic policy under exogenous shocks in CEE countries and EMU members in the light of future EU enlargement. Section IV assesses the link between credibility and shock transmission. Section V explains and estimates an econometric model. Section VI concludes.

II. Theoretical review

The theoretical literature distinguishes between two main views concerning the relationship between the exchange rate and the shock exposure -- exchange rate as an absorber of shocks or a source of shocks.

Friedman (1953) and Mundell (1961) view traditionally the exchange rate as an absorbing mechanism for isolating the economy from external price shocks. In case of a sudden increase in international prices, only the appreciation of the domestic currency will isolate the country from an import of foreign inflation. Abandoning the exchange rate adjusting role has been regarded as one of the main costs of the common currency area or the policy of euroization. This important question was underlined in the optimum currency area approach (OCA) by Mundell (1961), Kenen (1969) and McKinnon (1963)[12]

According to the OCA theory, conditions for creating a currency union are favourable when individual countries face symmetrical disturbances (as type, direction and speed of adjustment), if their bilateral trade is significant and if the factors of production are mobile**.** Sharing of these properties would reduce the role of the nominal exchange rate, as an adjustment tool i.e. business cycle fluctuations would be outweighed by the gains from sharing a single currency. In contrast to the traditional OCA approach, Buiter (2001) introduces new arguments to the OCA theory and finds that exchange rate is not just a shock absorber, or part of the transmission mechanism for fundamental shocks originating outside

[12] The theory of OCAs is a collection of various economic indicators determining how a currency area will function after bilateral exchange rates are fixed. The most famous criteria of the OCA are:
degree of factor mobility and similarity of production structures (see Mundell, 1961), openness of the economy (see McKinnon, 1963), degree of commodity diversification (Kenen, 1969), price and wage flexibility (Eichengreen, 1993), low inflation rates differentials (Haberler,1970; Fleming,1971) The latter criteria served as a background for the Maastricht convergence criterion on price stability

the foreign exchange markets, but a source of excess volatility, unnecessary shocks, instability and misalignment. Fidrmuc (2002) assesses the optimality of currency union using two types of criteria. First, countries exposed to symmetric output shocks will tend to have synchronized business cycles. Second if shocks are largely asymmetric, effective adjustment mechanisms can facilitate the slipovers of shocks to the rest of the union and thus mitigate their effect.

Dornbusch (1985) noted the high welfare costs associated with external shocks. Mundell (1973) points out those countries which introduce single currency could mitigate the effects of asymmetric shocks through income diversification and adjustment in wealth portfolio. Devereux (2002) examines the behaviour of flexible exchange rate as a shock-absorber in a utility based model. The main conclusion is that flexible exchange rates lead to perfect absorption and elimination of the impact of nominal rigidities. However, this paper finds flexible exchange rates to be welfare dominated by fixed exchange rates in utility terms. When international financial markets are incomplete, world demand shocks will not be efficiently offset by changes in output. Hence flexible exchange rates ensure stable level of output but do not maximize welfare, which is not an efficient response of the world demand shocks. Belke (2002) points that the problem of appreciation or depreciation in response to economic shocks generally is welfare improving relative to less exchange rate volatility in the face of the same shock. Van Foreest and De Vries (2002) find empirically that the exchange rate regime is of secondary importance for achieving monetary stability and real growth.

A study by Artis and Ehrmann (2002) analyzes if shocks are symmetric or asymmetric in order to identify if the exchange rate acts as a shock absorber or a source of shocks. Using SVAR technique they look at how strongly the exchange rate responds to asymmetric supply and demand shocks and conclude if it helps to stabilize the economy. The paper also takes into account if the exchange rate is driven by shocks in the exchange rate market and whether these shocks have the potential to distort output or prices.

Another topic of interest is the source and type of shocks which are most likely to occur in CEEC. In order to distinguish between different types of shocks, Khan (1986) undertakes an analysis of the behaviour of the real exchange rate in a group of developing countries. He considers a combination of exogenous shocks such as worsening term of trade, falling growth rates in industrial countries and sharp changes in the costs and availability of external financing (e.g. rise in international real interest rates). Eichengreen, Rose and Wypolsz (1995) and Kaminsky and Reinhart (1999) model the influence of external conditions by focusing on the country specific variables. The impact of supply and demand shocks also related to the monetary policy (e.g. the slopes of IS, LM and BP curves) has been

extensively studied by Fry and Lilien (1986), Bayoumi and Eichengreen (1993), Gross (2001), Fidrmuc and Korhonen (2003). Devereux (2002) points out the importance of three sources of shocks - interest rate (or capital flow) shock, terms of trade shock and domestic demand shocks in the non traded goods sector.

Accession countries are likely to face increased vulnerability of their financial systems before joining the EMU. Moreno and Trehan (2000) prove that common external shock explains between sixty to eighty percent of the variation in the total number of currency crises over the post Bretton woods period. Begg et al. (2002) warn of the danger of enlarged capital flows which can increase the probability of crisis if reversed or of overheating and disinflation if do not reversed. Capital inflows lead to lending boom, which deteriorates the quality of assets and increases the fragility of financial system in the face of economic shocks. Such financial crisis will slow the process of transformation and their integration in the European Union.

In summary, the academic debate around the European Monetary Union enlargement has mainly focused on several issues:

- One of them is dealing with the appropriate monetary/ exchange rate strategy for accession countries in the pre EMU phase. The main conclusions are related to the country specific approach in dealing with the appropriate monetary policy before euro adoption.
- The second aspect is related to a cost - benefit analysis for participation in the euro area. Long term gains are envisaged; however the loss of independent monetary policy increases the costs in the first years after the euro introduction. The cost are also related to the similarity of business cycles and the shocks most likely to hit the euro area and the acceding countries. The type of exchange rate regime is regarded as an important absorption mechanism of external shocks. Its role is increasing when shocks are largely asymmetric. In contrast abandoning the monetary policy adjustment tools carries welfare gains but makes the economy vulnerable to external shocks.
- Another question is when the accession countries will be able to fulfil the Maastricht criteria. An important issue is the difficulty to fulfil the inflation and exchange rate stability criteria due to the higher productivity growth.
- The last issue is related to the increasing capital flows and the probability of currency and financial crises in Eastern Europe.

III. Credibility/flexibility trade-off and the transmission of asymmetric shocks in CEEC

Conditions for common monetary policy within the union require countries to share price stability, similar inflation rates and similar operation of the monetary policy transmission mechanisms. Compare with the starting situation, all acceding countries made considerable progress[13]. However, the macroeconomic situation in transition is characterized by real sector structural adjustments and unstable financial sector (see Tables 1, 2, 3, 4 for some financial and macroeconomic indicators in CEECs).

[Tables 1, 2, 3, 4, 5 here]

Table 5 shows that there is still distance from the EU average, concerning inflation and budget deficit criteria. The growth of GDP is higher than the EU average but the higher agriculture and industry sectors imply large fiscal requirements. This has an influence on the monetary policy. Most often the money growth and inflation were fuelled by the considerable need of seigniorage. Large current account deficits and the considerable amount of non-performing bank loans suggests the possibility for currency and banking crises. There is a clear trade off between the stabilization of output (relative to its natural level) and the inflation stabilization. Hence, the choice of monetary instruments gains special significance for avoiding financial instability in the transition economies during the pre-EMU phase.

III. 1) Synchronization of the economic cycles between acceding countries and the Euro area

Cost-benefit analysis emphasises the importance of similarity between the business cycles in the euro area and the acceding countries. The empirical evidence by EFN[14] can be summarized as follows: During the nineties the economic cycles of most acceding countries were strongly correlated with the euro area. However, the synchronization with the euro zone has been worsened by the economic slowdown 2000-2003. The EFN report provides evidence that the Accession countries business cycle (except Slovenia) is less synchronized with the euro area aggregate than the monetary union members before the introduction of the Euro, but also than the non - EMU members. The fluctuations of inflation and growth rates were higher in average in the Acceding countries than the EU (see Table 6). The comparison between two sub periods (1996.1 – 1999.4) and (2000.1-2002.4) shows that there is a positive increase for

[13] The annual Transition Report of EBRD provides continuous monitoring
[14] See EFN Autumn Report – Annex ch. 5, www. efn.uni-bocconi,it/Annex _to_chapter_5.pdf

Czech Republic, Slovenia and Estonia, and decrease of correlation for Hungary, Lithuania and the Slovak Republic.

Table 6. Correlation of GDP and prices between acceding countries and EU countries

	1996.1-2002.4		1996.1 – 1999.4		2000.1-2002.4	
	GDP	Prices	GDP	Prices	GDP	Prices
Czech Republic	0,11	-0,15	-0,31	0,32	0,48	0,41
Estonia	0,18	0,18	0,22	0,86	0,65	0,71
Hungary	-0,07	-0,01	0,51	0,91	-0,36	0,25
Latvia	0,17	0,19	0,32	0,95	0,26	0,15
Lithuinia	-0,27	0,20	-0,06	0,92	-0,65	0,36
Poland	0,55	-0,04	0,11	0,92	0,81	-0,07
Slovak Republic	-0,28	-0,16	-0,18	-0,28	-0,82	-0,26
Slovenia	0,48	0,58	0,31	0,78	0,63	0,31
Denmark	0,45	0,30	0,32	0,04	0,45	-0,28
Sweden	0,43	0,67	0,66	0,33	0,33	0,62
United Kingdom	0,76	0,20	0,37	0,05	0,95	-0,14
Accession countries	0,11	0,10	0,11	0,67	0,13	0,23
Non-Monetary Union	0,55	0,26	0,45	0,14	0,58	0,07

Sounrce: EFN autumn report (2003)

The short transition period, however, implies that only a single business cycle can be covered, which doubts the reliability of the results. Also according to the Lucas critique it is troublesome to analyse ex ante policies based on ex post data, because economic policies can lead to changes in the economic structure. Moreover it could be expected that the cycle synchronization with monetary union will increase in the years before entering in the EMU, given the example of countries such as Italy and Spain.

III. 2) Correlation of shocks between the transition countries and Euro area

The differences in the business cycle synchronization can be due to the exposure to different shocks or to the different transmission mechanisms and the difference in the response. Some exogenous shocks(like oil shock) can have long-run effect depending on the exchange rate regime. Asymmetric supply shocks arguably have been the reason behind the collapse of the most fixed exchange rate systems. Unarguably, however, there exist shock asymmetry between current EMU members and the transition countries (see Fidrmuc and Korhonen, 2003; Horvath, 2002).

Candidate countries continue to encounter supply shocks that are very low correlated or uncorrelated with those affecting the core EMU (with exception of Hungary). A common conclusion from Table 7 and 8 is that correlation of shocks is still very low compare to EMU countries. Most of the coefficients for CEECs are close to zero with positive or negative variation. The countries on the EMU periphery (Greece, Ireland) also show low coefficients. This implies that countries which couldn't meet OCA criteria ex ante can not meet it so far ex post and need longer period for convergence.

Table 7. Correlation of supply and demand shocks between candidate countries and EU countries

Supply Shocks	**Germany**		**France**		**EMU**	**UK**
	a)*	**b)****	**a)***	**b)****	**b)****	**a)****
Bulgaria	n.a	0.13	n.a	-0.29	-0.03	n.a
Czech Rep.	-0.05	-0.02	-0.06	0.13	0.04	-0.14
Estonia	0.08	0.34	-0.05	-0.06	0.25	-0.15
Hungary	**0.28**	-0.10	-0.02	0.65	0.46	-0.30
Latvia	-0.07	0.10	0.18	0.07	0.30	0.16
Lithuania	-0.16	0.00	-0.31	-0.17	-0.11	-0.04
Poland	0.00	-0.04	0.07	-0.17	0.08	0.17
Romania	n.a	-0.08	n.a	-0.02	0.02	n.a
Slovakia	-0.04	0.11	0.26	-0.04	0.05	-0.03
Slovenia	0.02	-0.04	**0.28**	-0.20	0.15	0.28
Demand Shocks	**Germany**		**France**		**EMU**	**UK**
	a)*	**b)****	**a)***	**b)****	**b)****	**a)****
Bulgaria	n.a	-0.17	n.a	0.12	0.03	n.a
Czech Rep.	0.10	-0.30	0.09	0.11	-0.15	0.03
Estonia	0.05	-0.15	0.19	0.20	0.12	0.09
Hungary	-0.40	-0.01	0.26	0.44	0.25	0.52
Latvia	0.11	-0.09	-0.21	-0.16	-0.49	-0.11
Lithuania	**0.33**	0.32	0.18	-0.24	-0.49	-0.03
Poland	0.14	0.24	0.07	0.30	0.28	0.23
Romania	n.a	-0.05	n.a	0.08	0.03	n.a
Slovakia	0.04	-0.29	-0.31	-0.27	-0.05	-0.10
Slovenia	0.03	0.14	**0.29**	0.36	-0.18	0.10

Source: **a)** Horvath (2002b). Notes: * Computed with quarterly GDP data over 1993:1-2000:3 (Hungary 1995:1-2000:3). Bold figures indicate significance at 5% level

b) Fidrmuc and Korhonen (2003) Notes: ** Computed with quarterly GDP data over 1994:1-2000:4 (Bulgaria, Czech Republic, Hungary 1995 -2000, Baltic Republics 1996 – 2000, Romania 1992 - 2000).

It is naturally to compare the correlation between the supply and demand shocks in the perspective new members of the EMU with currency board countries that had already fixed their exchange rates to euro for several years. The figures show that fixing the exchange rate is of secondary importance for shock correlation in the short run. Moreover, smaller EMU members (Austria, Belgium or the Netherlands) are much far ahead in their economic convergence compare to acceding countries. This is supported by Babetski, Boon and Maurel (2002) who find that demand shocks have become more similar over time, whereas supply shocks have diverged. *Frankel and Rose (2002)* argue that the OCA criterion of symmetry of shocks should not be considered as static because it is endogenous in the degree of economic

integration. This implies that costs and risks will be gradually reduced, as asymmetries will disappear in time. However, the timing for potential gains also is unsure. After joining EMU the monetary instruments for dealing with asymmetric shocks will be reduced. Moreover, if the labour markets cannot adjust easily to shocks (given the low responsiveness of labour mobility to regional unemployment and wages), then an early participation in EMU will need stronger adjustment efforts in short term. Hence, it could make the monetary union more fragile and be potentially costly both in economic and political terms, also for current members.

Table 8. Correlation of supply and demand shocks between EU countries and the aggregate of the Euro area, Germany and France

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Country	Supply shocks		Demand shocks	
	Euro area	**Geramany**	**Euro area**	**Geramany**
Austria	0.38	0.48	0.08	0.33
Belgium	0.53	0.18	0.00	0.21
Finland	0.30	0.17	0.06	-0.19
France	0.69	0.44	0.30	0.35
Germany	0.66	1.00	0.18	1.00
Greece	0.05	0.05	-0.01	-0.07
Ireland	-0.14	-0.12	0.13	-0.14
Italy	0.52	0.25	0.57	0.27
Netherlands	0.47	0.11	0.04	0.29
Portugal	0.45	0.23	0.09	0.28
Spain	0.22	0.35	0.16	0.35
Denmark	0.18	0.30	0.13	0.09
Sweden	0.24	0.00	0.09	0.08
UK	0.21	0.12	-0.13	-0.07

Source: Fidrmuc and Korhonen (2003)

An incidence of asymmetric shocks, differences in the economic structure or swings in the foreign financing might bring serious deviations from the criteria if countries rely only on credibility. The conclusion stemming from the literature (see Rogoff, 1995) is that the trade-off between higher flexibility (hence less shock exposure, more real stabilization) and the credibility gains of a rigid exchange rate regime will apply during the pre-EMU phase. The question is which monetary instruments will increase the prospects for convergence ex-ante in each country.

The ability to respond to idiosyncratic disturbances without independent monetary policy is reduced for the new members. On the one hand, monetary policy coordination has been strengthened in order to promote closer integration. On the other hand, so far have never been observed long lasting monetary unions without strong political integration. Another argument challenging the "optimality" of the common currency area between the CBA and EU countries is the long term real appreciation of the national currencies vis-à-vis the euro (Balassa-Samuelson effect), caused by the different productivity growth during the catching-up period. Furthermore, price liberalization strengthens the convergence to the EU price level. An analysis of the main macroeconomic indicators shows that under currency board the real exchange rate appreciation results in an increase in the level of inflation, higher than the EU average, which cannot be offset by depreciation of the real exchange rates. This implies problems to meet the inflation convergence criteria as stipulated in the Maastricht treaty. External changes may affect the foreign trade transactions in the EMU-11 and CEEC comparably. But different in scale and a presumably passive reaction of the ECB imply de facto an asymmetric character of these shocks. Growth and Stability Pact also restricts the possibility to implement independent fiscal policy and further reduces the ability to respond to asymmetric shocks. A country hit by a large asymmetric shock has to rely on its fiscal policy to deal with the negative effects. Growth and Stability Pact imposes limits on the public deficit and debt levels. For the countries close to violating these limits it introduces a pro cyclical bias into national fiscal policy[15]. Further asymmetries will be reduced by the financial integration. Nevertheless, a high incidence of asymmetric shocks, differences in the economic structure or swings in the foreign financing might bring serious deviations from the criteria if countries rely only on credibility. The conclusion stemming from the literature (see Rogoff,1995) is that the trade-off between higher flexibility (hence less shock exposure, more real stabilization) and the credibility gains of a rigid exchange rate regime will apply during the pre-EMU phase. The question is which monetary instruments will increase the prospects for real convergence ex-ante in each country.

On the road to EMU, CEECs analyze possible benefits and threats in terms of optimal exchange rate policy. An appropriate arrangement guarantees stability and enhances chances for fast acceding. The choice decision of optimal path and time strategy for Euro adoption lies between managed floating, fixed peg or currency board. Monetary policy targeting offers also scope for diversity -- real product changes vs. inflation vs. price level targeting. The type of

[15] For details on the fiscal risk sharing in the EMU, see Fidrmuc (2002)

the monetary regime is one of the major determining factors how external shocks are transmitted to the economy[16].

This is particularly important for the small open economies as most of the acceding countries are considered to be. It also gains a special significance for avoiding financial instability. The difference between the monetary transmission mechanisms of CEECs also can constitute a source of asymmetric shocks. Dehejia and Rowe (2001) model fixed exchange rates vs. inflation targeting vs. price level targeting. The difference is explained in terms of unforeseen observed price shock. Under price level targeting the Central bank will try to push the price level back in the period following the shock. Under inflation targeting the price level will follow a random walk (or a random walk with drift under a positive inflation targeting). In contrast to the traditional literature, the authors do not emphasis on the source of shocks but whether a given shock is observed or unobserved. Price level targeting best stabilizes output and the expected real exchange rate and enables the central bank to respond to observed shocks. Before entering the EMU, as required, transition countries will choose system that combines capital mobility with fixed but adjustable regimes. CEE countries will try to operate in the environment of common monetary policy, idiosyncratic shocks and independent fiscal policies. ECB do not want to impose any monetary regime. Higher level of heterogeneity is consistent with the enlarged ERM II. The observed trend implies moving to more fixed regimes, as stability with euro is a central priority for acceding countries. However, from the theoretical point of view (see Friedman, 1953; Poole 1970; DeGrauwe 1996; Chang and Velasco, 1998) fixed exchange rates are more vulnerable to external shocks. In case of shocks when exchange rates cannot adjust easily, the real interest rate or output has to adjust. According to the theory, real shock leads to more variability in the output at fixed exchange rate and financial shock are better offset at a fixed exchange rate. On one hand it is hard to guarantee soft pegs once capital mobility is liberalized. On the other hand choosing a more flexible regime can affect monetary credibility. The trade-off between higher (and hence less shock exposure) and the credibility gains of fixed exchange rate regime is an important question in the light of EMU enlargement.

Gali and Monacelli (2003) employ a version of Calvo sticky price model to analyze the implications of shocks on three alternative monetary policy regimes: inflation and CPI targeting and an exchange rate peg. Results show that the domestic inflation targeting regime achieves full stabilization of output gap and inflation but at the cost of larger volatility of nominal and real exchange rates. Both CPI targeting and the exchange rate peg imply large

[16] The definition of monetary transmission mechanism follows Taylor (1995, p.11) "the process through which monetary policy decisions are transmitted into changes in real GDP and inflation".

welfare losses as the exchange rate peg amplifies both the output gap and the inflation. Higher degree of openness requires stable relative prices and has a negative effect on the volatility of the real exchange rate. The exchange rate channel operates very fast in small economies and the changes in the exchange rate affect directly domestic prices of imports and with a short lag the prices of domestic goods, containing imported inputs. In response to shocks, under inflation targeting, when nominal exchange rate appreciates, the overall inflation falls. However, with fixed exchange rates, the real appreciation is achieved only by domestic price inflation. The key constraint (see Devereux, 2002) is that with differences in productivity performance across countries, the fixed exchange rate cannot achieve inflation convergence.

Table 9. Standard deviations under alternative monetary rules

Standard deviations	Flexible wages and prices	Inflation targeting	Taylor rule	Taylor rule (CPI)	Exchange rate rule
Baselane					
Output	1.6	2.4	1.1	1.7	5.1
Inflation	2.0	1.3	1.5	1.3	0.5
Real ex. rate	2.8	2.9	2.8	2.7	1.5
Real int rate	2.6	2.5	2.8	2.6	2.1
Price flexible					
Output	1.6	2.4	1.6	1.8	3.8
Inflation	2	1.3	1.8	1.5	2.1
Real ex.rate	2.8	2.9	2.9	2.8	2.9
Real int. rate	2.6	2.5	2.6	2.5	2.4
Wage flexible					
Output	1.6	1.6	1.3	1.5	2.3
Inflation	2	1.2	1.7	1.5	0.5
Real ex.rate	2.8	2.8	3.0	2.8	1.3
Real int. rate	2.6	2.6	2.9	2.6	2.1

Source: Devereux (2002)

A calibrated model by Devereux (2002) illustrates the effect of price and wage rigidities on the economic volatility. In case of non-traded goods price rigidity, an inflation targeting rule is the fully optimal rule. In case of wage rigidity, the performance of fixed exchange rate is related to a lower volatility of output, but higher volatility of inflation in comparison to Taylor rule or inflation targeting. The conclusion is that wage rigidities

mitigate the trade off associated with output stability versus inflation stability. Moreover, having a fixed nominal exchange rate does not imply a constant real exchange rate or stable prices. CEE economies are also not sheltered from exchange rate variability from the other than EMU trading partners or variations between G3 countries (see Krugman and Obstfeld 2003). What still matters is the real convergence, i.e. a similarity of economic cycles in the countries whose intention is to peg their exchange rates to each other. An appropriately chosen monetary regime paves the way to the fulfilment of the Maastricht criteria and allows the possibility for EMU participation as early as possible.

A currency union represents the most credible fixed exchange rate regime. Alesina and Barro (2000) argue that the membership in a currency union is an efficient way to address credibility. According to McCallum (1995) sharing a common currency can be seen as a much more serious and durable commitment than having an independent central bank. A uniform currency area has costs (as the omission of some stabilization instruments), as well as advantages - the reduction of transaction costs and the possibility to gain credibility by following stable monetary policy. It is a form of signal to international financial markets, which can foster foreign direct investments and business cycle synchronization ex post. Moreover, the credibility issue relates the de facto exchange rate regime with the prudent monetary policy. So the main issue for CEECs is not to choose the most credible regime but rather which monetary regime will increase the prospects for real convergence ex ante, taking into account the vulnerability to external shocks.

To what extent operating such a regime is close to reality? As stated by all acceding countries, full membership in EMU is the target regime once EU membership has been achieved. On the one hand, in the two years period before EMU acceding introducing 15% fluctuation bands can affect credibility and substantiality of current regimes. On the other hand, CEE countries are facing Mundell's "Incompatible holly trinity" - which states that independent monetary policy, perfect capital mobility and fixed exchange rates are mutually exclusive. Speculations, as far as the central parities are not announced long before, can ruin stability and introduce high expectation margin. How to switch to a more flexible exchange rate without loosing credibility is the most relevant question for the future EMU members.

In this sense, EMU participation requires stronger adjustment efforts than that of EU. Buiter and Grafe (2001) regard that the achievement of the whole set of Maastricht targets[17] is

[17] Maastricht Conditions for EMU Membership
Inflation: (no more than 1.5% above average of three lowest inflation countries).
Nominal interest rate: (no more than 2.0% above the average of the three countries with the lowest interest rate)
Nominal exchange rate:

not under the control of the national monetary authority. The argument is that the interest rate and inflation targeting put restrictions on the real interest rate; and the nominal exchange rate targeting put restrictions on the real exchange rates. These real values are affected by the developments on the international financial markets and are only partly under the control of national monetary authorities. Hence, external economic shocks are part of the costs which the membership in a currency union brings with for the acceding countries.

III. 3) Types of risks and shocks specific for acceding countries

Besides of the real external disturbances, which are common for emerging market (for example external oil shock), transition countries may face specific risks and shocks related to their accession in EMU. The risks can be divided in two types:

a) ***Exchange rate risks***, which can cause exceeding the limits of the band. The negative consequences are loss of credibility, probability of changes in the central parity and longer time than the minimum two years in ERM. II Increased capital inflows, due to accession, bring real appreciation and may be viewed as a pure portfolio shock. The convergence play is stimulated by the interest and exchange rate expectations of the investors. Holders of debt instruments expect higher prices, due to the lower currency risk premium. The increased prices allow them to reap capital gains. This will require interest rate reduction in the country exposed to capital inflows. The related problem is twofold: on one side an interest rate reduction will conflict with the inflation target, on the other side if the monetary policy does not intervene, the large capital inflow will lead to currency appreciation and balance of payment problems. Once in the ERM II, the central banks of CEECs will be unable to use their exchange rate policy to close the uncovered interest rate parity. In the event of shocks, the interest rates used at national level can not be significantly different from the ECB rates. The capacity of fiscal policy and the labour markets should be explored in this case, which are not as flexible as the monetary policy.

.

Respect normal fluctuation margins for ERM II without severe tensions for at least 2 years before the examination. Council of Ministers decides conversion rate.
Fiscal criteria:
budget deficit should not be higher than 3% of GDP
public debt should not be higher 60% of GDP
Central Bank independence

b) ***Macroeconomic risks*** which can increase the volatility of the macroeconomic variables (increased inflation, budget and balance of payment deficit). Increase in trade openness, capital inflows or productivity of the tradable sector as well as if the government spending move from tradable to non-tradable goods could be thought of as a supply shock in the domestic economy. Lower interest rates and higher credibility can cause an increase in the aggregate demand, higher inflation, real appreciation of the national currency and higher balance of payment deficit.

The increase of the trade openness, which is a specific feature of the transition countries, means that the exports increase faster than the imports as a percent of GDP. This can be viewed as a supply shock, which causes trade imbalance and requires appreciation of the REER.

The productivity growth, which is a characteristic feature of transition economies, also produces real exchange rate appreciation by nominal appreciation or higher inflation. In case of fixed exchange rate, the exchange real appreciation is achieved by appreciation in the non-traded sector. This could be interpreted as a productivity shock, which increases the prices of non-tradable due to the Balassa-Samuelson effect. It can be viewed as a sustainable equilibrium phenomenon which does not require monetary policy response. However, with sharp differences in the productivity performance among countries and fixed exchange rates, inflation convergence cannot be achieved. According to Devereux (2002) this is the key constraint of CEECs in the setting post – accession inflation targets.

III. 4) Channels of monetary transmission

Based on the above considerations EU and CEEC have to take into account the most important channels of shock transmission in order to be able to conduct comprehensive monetary policy. Mishkin (1996) makes overview of the channels of monetary transmission starting with traditional interest rate channels, going on to the asset prices channel, and then on to the so-called credit channels. The transmission can be conducted in two ways

- from the monetary environment to some intermediate variable such as monetary deposit rates or lending rates
- from the intermediate variables to the aggregate macroeconomic variables such as inflation, GDP and external balances

CEECs need to examine carefully the link between the changes in the monetary policy and the economic process in order to guarantee sustainable growth and to reduce the

convergence costs. External disturbances mainly affect trade and FDI, as well as capital and labour markets. Foreign trade is usually regarded as the most important channel of external shock transmission. Therefore, the degree of trade openness, i.e. the share of imports and exports to GDP, determines the impact of external disturbances on domestic economic activity. On the one hand the more open the country is the more vulnerable is to external shocks. On the other hand, trade openness suggests increasing business cycle correlation and hence reducing asymmetry among union members. Ganev at al. (2002) by analysing ten transition courtiers find that exchange and interest rate channels operate in all countries but the exchange rate channel in generally is stronger and more stable. For most countries the response of inflation in disturbances of exchange and interest rates were according to the theory –inflation was low by interest rate rise and was boosted by exchange rate depreciation. In majority of countries output was boosted by depreciation.

IV. Framework

IV . 1. Theoretical Model

Here we set out the theoretical framework of our empirical analysis based on the model by Clarida and Gali (1994). The structure is two-country stochastic rational expectations macro model in the the spirit of Dornbush (1976) and Obstfeld (1985). It identifies the structural shocks - to demand, supply and money using the approach pioneered by Blanshard and Quah (1989). The following exogenous variables are specified in the model:(i) aggregate supply shocks;(ii) real demand shocks and (iii) nominal shocks. The model studies the dynamics of the relative output, prices and the real exchange rate. It presents short run results with sluggish price adjustment to demand, money and supply disturbances but also includes long run macroeconomic equilibrium when prices adjust fully to all shocks. The framework of the model has been often used in literature therefore we will only briefly discuss it. The flexible price equilibrium is represented by the following three equations:

$$y_t^e = y_t^s;$$
$$q_t^e = \left(y_t^s - d_t\right)/\eta + \left[\eta(\eta+\sigma)\right]^{-1}\sigma\gamma\delta_t;$$
$$p_t^e = m_t - y_t^s + \lambda(1+\lambda)^{-1}(\eta+\sigma)^{-1}\gamma\delta_t.$$

The model specifies a random walk stochastic process for the shocks to supply and money. This means that shocks to supply and money are assumed to be only permanent. However, the relative demand shock is having permanent, as well as a transitory component.

$$y_t = y_{t-1} + z_t$$
$$d = d_{t-1} + \delta_t + \gamma\delta_{t-1}$$
$$m_t = m_{t-1} + \nu_t$$

The short run effects of the structural disturbances are not constrained. Due to the stochastic sticky price theoretical model, we would expect that real demand and nominal disturbances to have only short run effect on the level of output and are neutral in the long run. We also expect nominal disturbances to induce transitory depreciation of the real exchange rate. Thus, we can compare the theoretical assumptions from the model with the empirical estimations in order to see if the results of the model are reasonable.

Clarida and Gali (1994) model has important long-run implications for the effect of the disturbances. It is assumed that only supply disturbances can have long term effect in the level of output. In addition the real exchange rate is determined in the long run only by aggregate supply and real demand disturbances. To sum up, the model imposes three long-run restrictions: only supply shocks affect output in the long run, while real exchange rate is affected by both supply and demand shocks. Hence nominal disturbances have no long run effect on output and real exchange rate, and the effect of real demand disturbances on the output in the long run is also zero. In case of sluggish prices shocks to money influence the REER even though they do not have influence at the flexible price level. Compare to the flexible price real exchange rate level, the sluggish price adjustment implies that the real effective exchange rate undershoots in response to real supply and demand shocks.

IV . 2. Econometric methodology - structural VAR analysis

This section presents an empirical analysis of the impact of the external shocks on five East European countries (Estonia, Hungary, Poland, Slovenia and the Czech Republic)[18] with comparable available data and different nominal exchange rate regime. The countries sample have been chosen according to the availability and reliability of comparable economic time series data. The question we answer is how different monetary regimes in CEEC5 interact with external shocks and what are the sources of fluctuations is the output, prices and the real exchange rates[19]. The economic theory cannot measure qualitatively the size of the transmission effects and cannot tell the speed of adjustment to the steady-state position after shocks. Moreover we empirically test the hypothesis that monetary shocks can spill over and that fixed exchange rates are superior to the floating in case of monetary shocks. We try to find empirical evidence for the dynamic behaviour of the variables, the effects of which are delayed or persist over time. The response to shocks is distributed through several periods.

There are some difficulties, however, to apply this method to the CEECs, where the sample size is relatively small. This has influence on the dimensionality of the estimated autoregressive model. Countries were chosen in order to represent a broad classification of nominal regimes as currency board (ultimately fixed), intermediate and floating.[20]

[18] Due to data restrictions Latvia, Lithuania and Slovakia would not be included in the analysis

[19] Following (Sims, 1980) we also modelled Cholesky decomposition with there dependent variables – REER, the ratio of M2 to foreign reserves and the trade openness (export+import/GDP) and found that trade openness is the most important transmission channel for transition countries.

[20] De jure classification of IMF is as follows: Fixed - currency board, conventional peg, narrow band, Intermediate -- tightly managed, broad band, Float - managed float and free float

Under managed floating we understand a direct central bank targeting the interest rate on the domestic markets and the real exchange rate targeting on the forex market. So far such regime was followed only by Hungary (unfortunately not strictly) and by Slovenia during the researched period. We empirically estimate the effect of the external shocks applying structural VAR (SVAR) approach on a cross sectional data set with reported observations over time for the same countries. SVAR is a type of VAR where the theory is used to impose restrictions on the contemporaneous correlations into orthogonal components. The choice of econometric methodology is based on the powerful performance of SVAR in smaller systems. It has been an important tool in the recent research following Doan, Litterman, Sims (1984),Blanchard and Quah (1989) and Amisano and Giannini (1997). The advantage of SVAR is that it can describe the dynamics of the data that is not changing even in case of interventions - the variance-covariance matrix of the disturbances contains all contemporaneous correlations among the variables. In this case the lagged values for at least one year should be included on the right-hand side of the regression. SVAR investigates how shocks affect the dynamic behaviour of the variables. It also has been used to identify which variables can predict better some specific variables.

The structural form is given by:

$$By_t = BA_1 y_{t-1} + ... + BA_p y_{t-p} + Mu_t,$$

The structural errors are assumed to be uncorrelated so that the covariance matrix Ω of the resulting innovations is diagonal. SVAR methodology models the dynamic behaviour of economic variables by considering several endogenous variables together each explained by its own lagged values, as well as the lagged values of other variables. Sims (1986) considers six variables -- GNP, Investment, Price index, Money supply, Unemployment and Treasury rate. He ran VAR imposing the above ordering in the cause and effect. Green (2000) views VAR model as a reduced form of the dynamic structural model. There are two different strategies: the traditional Blanchard and Quah (1989) methodology as well as the more recent one based on sign restrictions (see Peersman 2002). The difference is that the later do not impose contemporaneous restrictions on the matrix neither shocks with long run effects. As shown by Faust and Leeper (1997) without theoretical model such restrictions can be highly misleading.

Here further we estimate a three dimensional structural VAR model (see Hamilton, 1994, Green, 2003) with three dependent variables -- industrial production, CPI, real effective

exchange rate (REER)[21]. Germany is taken as a benchmark, as the variables are in relative terms because we are trying to analyze the sources of exchange rate fluctuations. Therefore, we take the logarithms of the data and than the difference between the respective log variables and the Germany log variables.

All series are expressed at constant prices and monthly sampled over the period 1994Jan – 2003Dec.

[Graphs 1 – 4 here]

Before proceeding we have adjusted time series seasonally and took out the missing values. The data are taken from International Financial Statistics and WIIW. An important issue is to determine the appropriate lag length to avoid model misspecification and/or waste in the degrees of freedom. In order to determine how many lags to use, several selection criteria were used as the Akaike Information Criterion (AIC) and the Schwarz' Bayesian Information Criterion (SIC/BIC/SBIC). The SVAR model is specified with 4 lags according to the results using L.R test. Some of the series were found non stationary for the five countries. According to Phillips-Perron and ADF tests the data series were found to be integrated in order one I (1) at 5% significance level (see Table 10).

[Table 10 here]

We also perform Granger causality Wald test in order to see if the lagged values of our independant variable have explanatory power in a regression of the dependant variable on the lagged values of the dependant and independent variables.

[Table 11 here]

. We proceed to estimate SVAR in first differences of the logs.[22] In this three variable case matrix C is a 3x3 matrix and if Yt = (Δy, q, Δp), where y, q and p are the relative output, the REER and the relative prices if $\varepsilon = (z_t, \delta_t, v_t)$ where the three shocks would be supply, demand and nominal shocks, than the restrictions are $C_{12}= C_{13}= C_{23}= 0$.

$$\begin{bmatrix} \Delta y \\ \Delta q \\ \Delta p \end{bmatrix} = \sum_{i=0}^{\infty} \begin{bmatrix} c_{11} & 0 & 0 \\ c_{21} & c_{22} & 0 \\ c_{31} & c_{32} & c_{33} \end{bmatrix} . \begin{bmatrix} z_t \\ \delta_t \\ v_t \end{bmatrix}$$

Only supply shocks have long run effect on the level of the industrial production y. All shocks have short-run effect on the output, REER and inflation

[21] It can be constructed from the relative price variable and the real exchange rate variable

[22] The first difference of the natural logarithm of a variable can be viewed as an approximation of the percentage change in that variable.

IV . 2. 1. Impulse response analysis

The simulation properties of the structural VAR model were assessed by conducting impulse response analysis with respect of innovations in the relative output, real exchange rate and the relative prices. According to the theory, the impulse response of the output level on supply shock should be positive and that of the price level should be negative. Nominal and demand shocks should increase the level of output and inflation. In addition nominal shock should lead to depreciation of the real exchange rate. In all countries there is positive response in the relative output due to supply shocks. In Poland however the response of the relative prices is not properly identified. The relative output in Czech Republic, Hungary and Estonia decreases in response to a positive nominal shock and the effect wears after time, as expected

[Fig. 1c , 2c and 5c here]

There is an initial increase in Poland and Slovenia. A positive demand shock leads to decrease in the relative output in Czech Republic and Hungary. There is an initial increase in Poland and Slovenia followed by decrease. In Estonia a positive demand shock is not properly identified for the relative output. A positive demand shock leads to initial appreciation of the real exchange rate in all transition countries and to slight permanent appreciation only in the Czech Republic. Due to a positive nominal shock, the real exchange rate depreciates in the short run in Poland, Slovenia and Estonia but as expected returns to its initial level in the long run. There is, however, initial appreciation in Hungary and the Czech Republic. On the other hand, a positive nominal shock leads to an increase in the relative prices and the effect dies out in the long run. The nominal shock is not properly identified for relative output of the Czech Republic, Slovenia and Estonia as the output decreases. However, the effect disappears in long run as expected. There is also "unreasonable" reaction of the relative inflation due to nominal shock in Hungary and Slovenia – the inflation decreases. An increase in the output in transition countries relative to Germany is accompanied with decline in the relative price level on Hungary, Slovenia and Estonia. This response is consistent with the predictions of Clarida/Gali model – a supply shock drives output and prices in opposite direction. In the Czech Republic prices are very weakly affected and in Poland relative prices even increase. The real exchange rate appreciates slightly in response to a supply shock in Czech Republic and Hungary without following long-run deprecation predicted by the model. We observe long-run depreciation in Poland and Slovenia, which is consistent with the theoretical model. The impulse response analysis demonstrated that the demand disturbances have the strongest

impact on the real exchange rate in transition countries. In contrast to the Czech Republic and Poland, nominal shocks appear to have a strong effect on the REER in Hungary leading to depreciation..

In our impulse response analysis we especially concentrate on Estonia, which followed currency board regime until 1992. It is expected that the shock symmetry is higher as Estonia follows fully fixed exchange rate regime. Demand shocks lead to long-run appreciation of the real exchange rate, compare to nominal shocks, which are stabilized after 16 months.

[Figure 1-5b here]

In Figure (1-5b) we plot the response to a positive real demand disturbance. In Czech Republic, Hungary and Estonia there is an increase in the output level due to a demand shock. In all transition countries there is initial real exchange rate depreciation followed by depreciation as predicted by the model.

Supply shocks explain most of the variability in relative output at all horizons, while nominal shocks contribute to the variability up to five months. Almost all the variation is in the real exchange rate is explained by demand shocks. Nominal shocks do not account for any variation in the real exchange rate. As demand shocks could possibly lead to higher appreciation, it is important for transition countries to target the real exchange rate in order to maintain the competitiveness in their exports.

[Table 12 here]

Table 12 reports the time periods of different dummies The Argentinean, Russian and Asian crises dummies were found to be significant at 10 % level for the price endogenous variable and the Argentinean dummy at 5% for the output variable in Hungary. The Argentinean crisis dummy is significant at 5% level for the real exchange rate equation in Poland. The Russian crisis dummy is significant at 5% level for the output equation in Estonia. This result is consistent with previous findings.

Czech Republic, Hungary and Poland have moved from a pegged to a more flexible exchange rate regime along the transition process, and have adopted inflation-targeting monetary policies. We control for the shift in the exchange rate regime and test to what extent the exchange rate regime matters for the long-run response to shocks see Fig (1-3d). As suggested by the empirical results inflation targeting comparatively performs better to pegged monetary regimes, in higher extent reduces the shock asymmetry in short term. This shows that the two corner solutions are preferably only in the presence of very restrictive conditions and not in the presence of shocks. Inflation targeting in some of the bigger transition countries like Czech Republic and Poland will help to meet the Maastricht criteria and to alleviate the

main risks in the pre EMU phase. In addition, the central banks of transition countries learn how to operate in an inflation targeting regime, which will help them to play more active and positive role at ECB once they adopt the euro.

IV . 3. Econometric methodology - Bayesian VAR analysis

Many of the previous studies on CEE transition countries have suffered of restricted data sample, which did not allow making assertive conclusions. The main drawback of VAR is its inefficient parameterization. Additionally, the lagged values y_{t-1},...y_{t-n} , which enter as independent variables tend to be highly correlated, which leads to biased parameter estimates. In order to have more efficient and reliable estimates and because of the relatively short transition period we use Bayesian VAR (see Litterman 1979, Doan, Litterman and Sims, 1984) . We would like to examine how Bayesian VAR can be used to improve the estimates of the VAR equations by incorporating prior information. In a Bayesian setting, data are combined with prior beliefs in order to produce a posterior probability density function (pdf) for parameters. Introducing prior information in the VAR model will help to recover more precisely the shock transmission mechanism in transition countries. The essentials of a Bayesian set-up require to specify a probability model with a prior knowledge about the parameters, which are unknown. The model is conditioned on the observed data. The value of parameters is considered as random and unobservable. The "prior" information is formalized as a prior distribution $p(\theta_i)$. The real and prior information are combined by the means of Bayes' theorem[23].

$$\rho(\theta/\mathrm{y}) = \rho(\theta)\rho(\mathrm{y}/\theta)/[\rho(\theta)\rho(\mathrm{y}/\theta)\mathrm{d}\theta] = \rho(\theta)\rho(\mathrm{y}/\theta)/\mathrm{p}(\mathrm{y}) \propto \theta(\theta)\rho(\mathrm{y}/\theta)$$

where the distribution of $\rho(y/\theta)$ is a "joint posterior distribution", which measures the uncertainty of the parameter. The posterior pdf is used to obtain the point estimate. A basic assumption is to specify a parametric form for the unknown parameters. The value of the model is found in the parameter distribution in the probabilistic terms.

[Figure 6 a-d here]

The BVAR literature deals with a prior distribution (Minnesota prior) which has unit prior mean for the first lag coefficient of each equation whereas all other parameters are given zero prior mean. The prior means and variances take the following form:

[23] Bayes' theorem states that the probability that event A occurs, given that event B has occurred, is equal to the probability that both A and B occur, divided by the probability of the occurrence of B.

$$\beta_i \sim N(1,\sigma_{\beta i}^2)$$

$$\beta_i \sim N(0,\sigma_{\beta j}^2)$$

where β_i denotes the lagged dependant variable in each VAR equation and β_j represents any other coefficient. The lagged dependant variables are believed to have high explanatory power. All other coefficients are viewed as less important. Because of the large number of parameters, the standard deviations are generated by a small set of hyper parameters - θ,φ and a weighting matrix $\omega(i,j)$ The idea is that not only the data has a distribution, but also do the parameters by assumption. The second moments of the prior distribution are specified according to a formula for θ,φ,ω, which are assumed to be uncorrelated a priori.

$$\sigma_{i,j,k}=\theta\omega(i,j)k^{-\varphi}((\sigma_{uj})/(\sigma_{ui}))$$

where θ is the standard deviation of the prior on the first lag of the dependant variable. The $k^{-\varphi}$ term is the lag decay function, where φ reflects the shrinkage of the standard deviation with increasing lag length. The idea is that the more distant the lags are, the less important is the variable for the model. The standard Minnesota prior has values $\theta=0.1,\varphi=1.0$ with the following weighting matrix:

$$W=\begin{bmatrix} 1 & 0.5 & \dots & 0.5 \\ 0.5 & 1 & & 0.5 \\ \dots & & & \\ 0.5 & 0.5 & \dots. & 1 \end{bmatrix}$$

The impulse response functions are similar to SVAR responses to supply, demand and nominal shocks and support the robustness of the results. Bayesian VAR deserves further investigation. We would like to know whether should be applied different prior variance (uncertainty) for important and unimportant variables as well as to variables with different lag length. This requires computation of the Bayesian VAR with different than the Minnesota prior mean.

Conclusion

Our analysis indicates that CEECs in large extent continue to be exposed to asymmetric shocks. Moving to a relatively fixed regime in the pre-EMU phase is likely to increase the asymmetries as theory suggests. After joining EMU these countries will be further restricted in using an independent monetary policy as an adjustment mechanism to shocks. Moreover, the official proposal for decision making in EMU restricts the possibility of small countries to promote specific monetary policy measures. The Stability and Growth Pact additionally confines their counter cyclical policy through fiscal policy. The evidence suggests that mobility is very low and will be restricted for several years after joining EU, which reduces the available adjustment mechanisms. Finally, there is no fiscal risk sharing among EMU countries. This suggests that entering in EMU, as soon as possible after joining EU is not the optimal exchange rate strategy for some of the acceding countries. This is recommended only for countries with inflation bias where fixed peg is better in order to gain credibility; however in order to gain real stabilization in countries without inflation problems the exchange rate channel shouldn't be underestimated. The case-by-case approach is especially important, because acceding countries differ in the nominal and real convergence already achieved.

A structural long-run VAR is estimated in line with the economic theory. The results are consistent with the theoretical implications for open economies such as those of the five acceding countries. We find empirical support for the hypothesis that the higher the extent of convergence among candidates before the entry, the lower are the costs of their participation in EMU. These costs will be outweighed by the long term positive benefits of sharing a common currency.

For transition countries joining the euro area is an ultimate economic and political goal. They will benefit from the monetary credibility and trade openness of the union. However they are also expected to contribute to the euro area macroeconomic stability. Therefore costs for the transition countries as well as for the current members should be minimized (ex ante) before entry into EMU. This coincides with the official position of the governing council of ECB. Thus our analysis highlights the monetary regime in transition countries as a matter of multilateral coordination in the light of EMU enlargement.

SEE APPENDIX

Table 1. Current accounts in CEEC (as percent of GDP)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Bulgaria	-4.2	-10.1	-0.3	-1.5	1.7	10.1	-0.5	-5.0	-5.6	-6.2	-4.6
Czech Rep.	n.a.	1.3	-1.9	-2.6	-7.1	-6.7	-2.2	-2.7	-5.3	-4.6	-3.4
Hungary	0.9	-11.0	-9.8	-5.7	-3.7	-2.2	-4.9	-4.4	-2.9	-2.1	-4.3
Poland	-0.2	0.3	-2.5	-0.1	-4.8	-6.1	-6.9	-8.5	-10.3	-9.0	-7.9
Romania	-7.7	-4.7	-1.5	-5.0	-7.3	-6.1	-6.9	-3.6	-3.7	-5.9	-5.2
Slovakia	n.a.	-4.4	4.4	2.0	-10.2	-9.3	-9.0	-4.8	-3.4	-8.6	-8.4
Slovenia	7.4	1.5	4.0	-0.5	0.2	0.1	-0.7	-3.9	-3.4	-0.4	-1.2
Estonia	3.5	1.3	-7.2	-4.4	-9.1	-12.2	-9.1	-5.7	-5.6	-6.1	-10.2
Latvia	14.2	19.2	5.5	-0.4	-5.5	-6.1	-10.7	-9.9	-6.9	-9.7	-9.2
Lithuania	n.a.	-3.2	-2.2	-10.2	-9.2	-10.2	-12.1	-11.2	-6.0	-4.8	-6.1
CEECs average	2.0	-1.0	-1.1	-2.8	-5.5	-4.9	-6.3	-6.0	-5.3	-5.7	-6.1

Source: The Economist intelligence country data 2002

Table 2. CEEC - current economic situation 2000-2001

	External debt/GDP	*External debt/Exports*	*FDI /GDP*	*Current Account/ GDP*
Bulgaria	**86.4**	**148.3**	**8.3**	**5.9**
Czech	**42.8**	**56.2**	**9.1**	**4.8**
Estonia	**61.4**	**64.6**	**6.4**	**6.8**
Hungary	**67.3**	**97.3**	**2.6**	**3.9**
Latvia	**65.9**	**144.0**	**5.6**	**6.8**
Lithuania	**42.9**	**95.1**	**3.3**	**6.0**
Poland	**42.9**	**214.5**	**5.9**	**6.3**
Romania	**27.0**	**81.7**	**2.7**	**3.7**
Slovakia	**56.3**	**76.5**	**10.7**	**3.7**
Slovenia	**34.3**	**58.1**	**0.2**	**3.3**
avg. CEECs	**52.7**	**103.6**	**5.5**	**5.1**

Table 3. Volatility in CEEC countries

	GDP	Terms of trade**	Real effective exchange rate**	Real interest rate**	Gov't revenue/GDP
*CEECs**	4,10	4,40	12,66	6,34	2,31
Latin America	3,74	8,70	18,00	13,18	2,19
Emerging Asia	4,11	5,92	8,65	2,52	1,82
Advanced countries	2,09	3,73	5,90	2,07	1,02

*1993-2001
**Only Czech republic, Hungary, Poland and Romania

Source: Datastream

Table 4. Maastricht criteria in CEEE

Criterion	Inflation	Interest	FX rate	Deficit	Debt
Reference value	**2001 3.3**	**10Y 7.4**	**Deviation ±15%**	**2001 - 3.0%**	**2001 60.0%**
Bulgaria	**7.9**	**5.2**	**-1.3**	**-0.9**	**72.5**
Czech	**4.7**	**5.6**	**-5.5**	**-3.2**	**29.0**
Estonia	**5.8**	**4.7**	**-1.2**	**1.1**	**6.2**
Hungary	**8.5**	**7.0**	**-4.4**	**-3.2**	**64.4**
Latvia	**2.5**	**10.7**	**2.6**	**-1.9**	**12.2**
Lithuinia	**1.3**	**7.9**	**8.6**	**-1.4**	**29.0**
Poland	**5.6**	**8.3**	**-8.2**	**-4.0**	**38.0**
Romania	**34.5**	**34.9**	**-33.3**	**-3.7**	**31.2**
Slovak Rep	**7.3**	**7.8**	**-1.8**	**-7.2**	**42.7**
Slovenia	**8.5**	**-**	**-7.4**	**-1.3**	**25.4**

Source: Datastream

Table 5. Structural Convergence Indicators (2002, estimated)

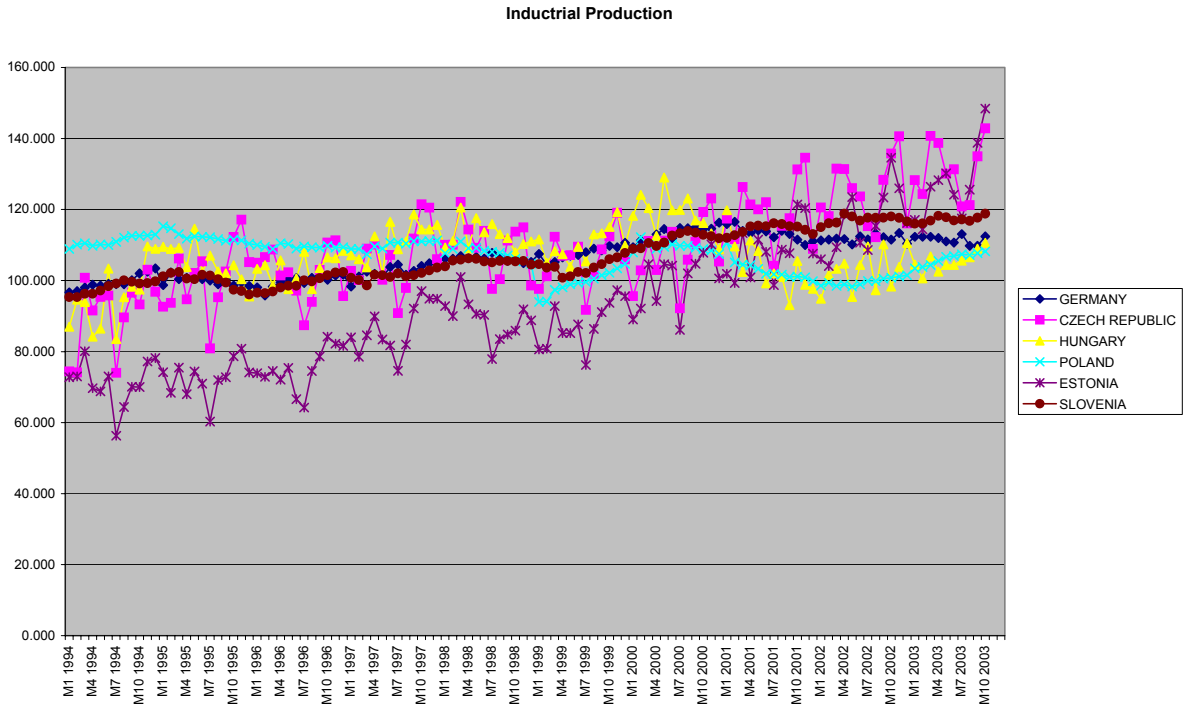
	EU	BG	CZ	Est.	HU	Lat	Lith	PL	Rom	Slvk	SL
GDP gr	0.7	4.0	2.2	4.4	3.5	5.5	4.8	1.2	4.3	4.0	2.8
Prod. gr	0.3	5.4	4.2	4.4	3.2	6.5	7.2	4.5	5.3	3.3	2.5
Unemp.	8.3	17.4	9.2	12.5	5.8	8.0	12.0	17.8	10.5	18.3	11.5
CPI	2.2	6.0	1.8	3.8	5.3	2.3	1.1	2.1	24.0	3.3	7.5
Fisc.bl	-1.5 (-3.0)	-0.8	-4.1	-0.4	-9.4	-1.8	-1.8	-5.4	-1.1	-1.0	-2.8
Gov.debt	62.5(60.0)	57.3	23.3	5.1	53.3	13.9	28.4	48.0	29.2	34.5	31.0
Curr. Acc. def	0.3	-5.1	-5.9	-7.9	-5.5	-8.4	-5.7	-4.3	-4.9	-7.2	0.0

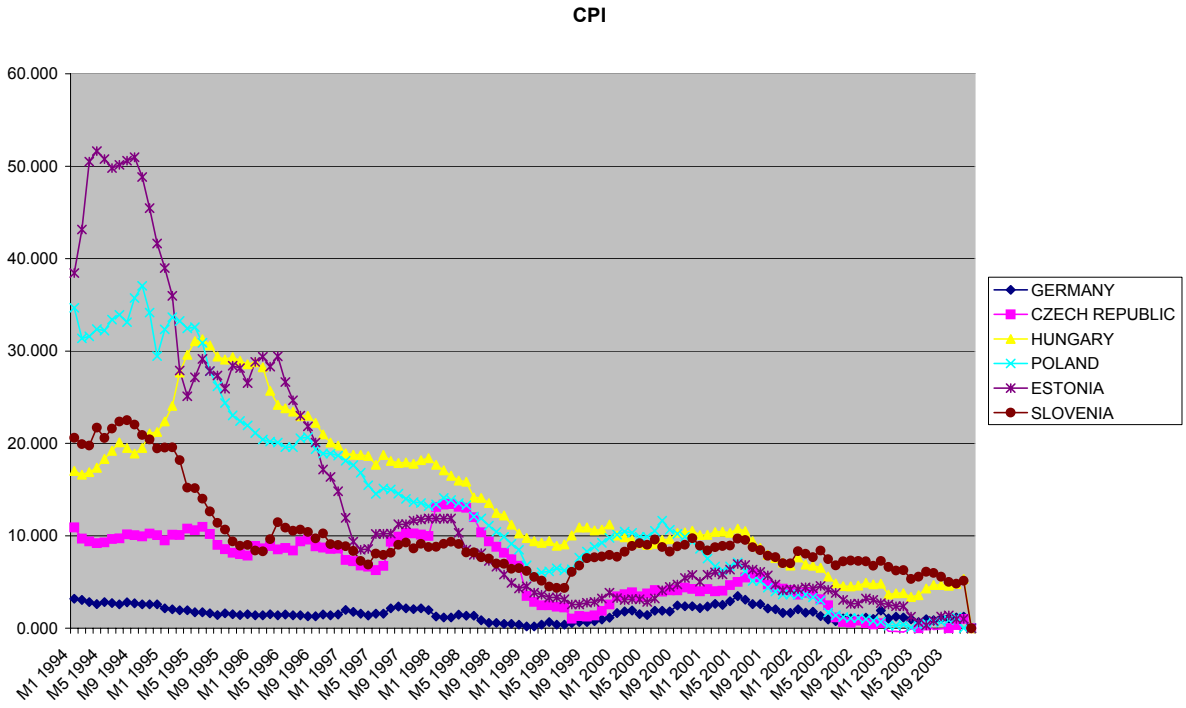
Source: Deutsche bank (2003), Hefeker (2003)

Notes: Data in parenthesis are the reference values

Table 12. Currency and regime-specific dummies

Country	Variable name	Dummy	Begin date	End date
all	Asian crisis	Dumasia	1997:9	1998:4
all	Russian crisis	dumrussia	1998: 5	1999:1
all	Argentina crisis	Dumarg	2001:9	2002:5
		Dumcz		
Czech Republic	Fixed	0	1994:1	1996:1
	Bands	1	1996:2	1997:4
	Managed float	2	1997:5	2003:12
	Infl. targeting	Dumczinf=1	1998:1	2003:12
Hungary		Dumhu		
	Peg	0	1994:1	1995:3
	Crawling peg	1	1995:4	2001:5
	Crawling band	2	2001:5	2003:12
	Infl. targeting	Dumhuinf=1	2001:5	2003:12
Poland		Dumpl		
	Peg	0	1994:1	1995:4
	Bands	1	1995:5	2000:3
	Float	2	2000:4	2003:12
	Infl. targeting	Dumplinf =1	1998:9	2002:11


Inductrial Production
160.000
140.000
120.000
100.000
80.000
60.000
40.000
20.000
0.000
M1 1994
M4 1994
M7 1994
M10 1994
M1 1995
M4 1995
M7 1995
M10 1995
M1 1996
M4 1996
M7 1996
M10 1996
M1 1997
M4 1997
M7 1997
M10 1997
M1 1998
M4 1998
M7 1998
M10 1998
M1 1999
M4 1999
M7 1999
M10 1999
M1 2000
M4 2000
M7 2000
M10 2000
M1 2001
M4 2001
M7 2001
M10 2001
M1 2002
M4 2002
M7 2002
M10 2002
M1 2003
M4 2003
M7 2003
M10 2003
GERMANY
CZECH REPUBLIC
HUNGARY
POLAND
ESTONIA
SLOVENIA


CPI
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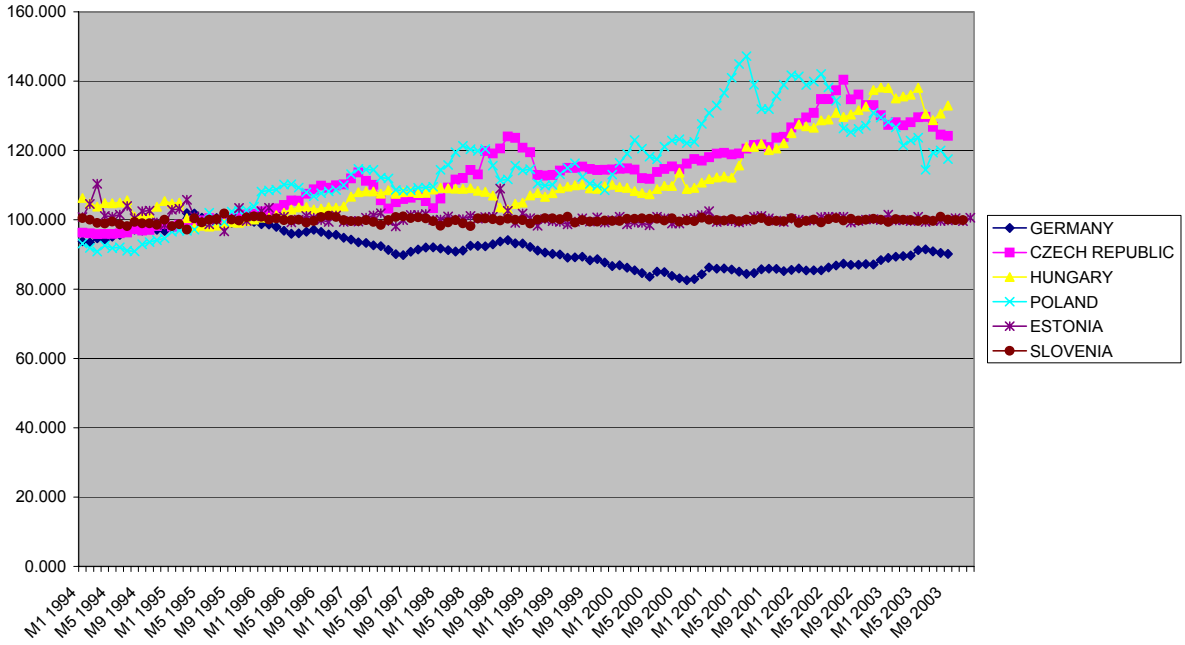
50.000
40.000
30.000
20.000
10.000
0.000
M1 1994
M5 1994
M9 1994
M1 1995
M5 1995
M9 1995
M1 1996
M5 1996
M9 1996
M1 1997
M5 1997
M9 1997
M1 1998
M5 1998
M9 1998
M1 1999
M5 1999
M9 1999
M1 2000
M5 2000
M9 2000
M1 2001
M5 2001
M9 2001
M1 2002
M5 2002
M9 2002
M1 2003
M5 2003
M9 2003
GERMANY
CZECH REPUBLIC
HUNGARY
POLAND
ESTONIA
SLOVENIA

REER


160.000
140.000
120.000
100.000
80.000
60.000
40.000
20.000
0.000
M1 1994
M5 1994
M9 1994
M1 1995
M5 1995
M9 1995
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M1 2000
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M1 2001
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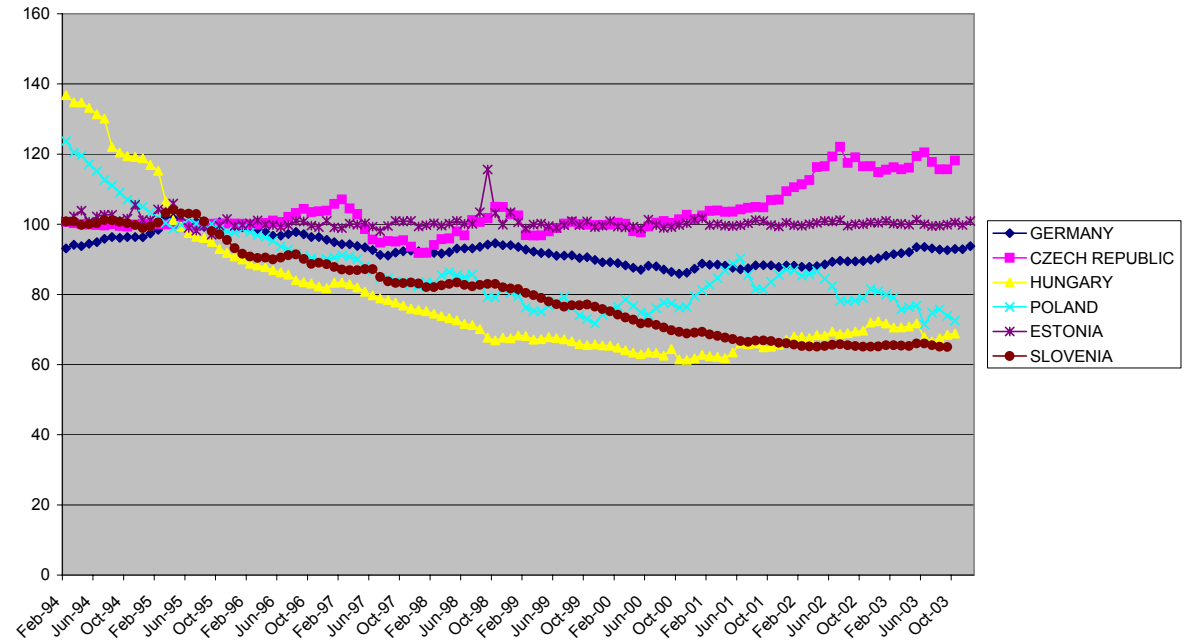
GERMANY
CZECH REPUBLIC
HUNGARY
POLAND
ESTONIA
SLOVENIA

NEER


160
140
120
100
80
60
40
20
0
Feb-94
Jun-94
Oct-94
Feb-95
Jun-95
Oct-95
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Jun-96
Oct-96
Feb-97
Jun-97
Oct-97
Feb-98
Jun-98
Oct-98
Feb-99
Jun-99
Oct-99
Feb-00
Jun-00
Oct-00
Feb-01
Jun-01
Oct-01
Feb-02
Jun-02
Oct-02
Feb-03
Jun-03
Oct-03
GERMANY
CZECH REPUBLIC
HUNGARY
POLAND
ESTONIA
SLOVENIA

Table 10. Time series properties of the data

Time series		ADF	Phillips-Perron	Order of integration
CZ	y	-3.474**(c,t)	-4.803***	I(0)**
	d.y	-17.143***(c)	-18.764***	I(0)
	p	-2.486 (c,t)	-2.694	I(1)
	d.p	-9.659***(c)	-9.650***	I(0)
	q	1.515 (c,t)	-2.252	I(1)
	d.q	-8.028***	-8.214***	I(0)
HU	y	-3.783**(c,t)	-6.571***	I(0)**
	d.y	-18.518***(c)	-24.016***	I(0)
	p	-2.220(c,t)	-2.237	I(1)
	d.p	-9.504***(c)	-9.498***	I(0)
	q	-2.103(c,t)	-2.267	I(1)
	d.q	-9.855***(c)	-9.853***	I(0)
PL	y	-2.262(c,t)	-2.897	I(1)
	d.y	-12.706***(c)	-13.138***	I(0)
	p	-3.156*(c,t)	-3.242*	I(0)*
	d.p	-11.564***(c)	-11.593***	I(0)
	q	-2.181(c,t)	-2.297	I(1)
	d.q	-8.028***	-7.832***	I(0)
ES	y	-3.573**(c,t)	-4.705**	I(0)**
	d.y	-14.030***(c)	-14.890***	I(0)
	p	-2.578(c,t)	-2.598	I(1)
	d.p	-9.458***(c)	-9.457***	I(0)
	q	-2.165(c,t)	-2.238***	I(1)
	d.q	-14.675***	-16.269***	I(0)
SL	y	-3.864**(c,t)	-5.418***	I(0)**
	d.y	-16.325***(c)	-20.476***	I(0)
	p	-2.995(c,t)	-2.972	I(1)
	d.p	-9.879***(c)	-10.020***	I(0)
	q	-7.864***(c,t)	-7.882***	I(0)
	d.q	-14.322***	-17.833***	(0)

Source: Model estimates

Notes: d. is the first difference operator, y denotes the relative output, p the relative prices and q the real exchange rate. The asterisks indicates the rejection of the null hypothesis at the 10%(*), the 5%(**) and the 1% (***) level. The critical values of ADF test statistic is -3.540(**) and for the PP test is -2.890(**). The brackets indicate the inclusion of a trend (t) and /or a constant(c)

Table 11. Granger causality Wald tests

Country	Equation	Excluded	F	Prob > F	Equation	Excluded	F	Prob > F	Equation	Excluded	F	Prob > F
CZ			0.2969	0.8792			0.2567	0.9048			0.2975	0.8788
HU	Δy	Δp	0.9543	0.4369	Δp	Δy	1.7884	0.1385	Δq	Δy	0.0694	0.9910
PL			0.9611	0.4332			1.9533	0.1089			4.0020	**0.0050**
SL			1.4204	0.2341			0.2486	0.9098			1.8827	0.1208
ES			1.3695	0.2512			1.0877	0.3678			0.8773	0.4811
CZ			1.5728	0.1888			2.4375	0.0531			2.0362	0.0964
HU	Δy	Δq	0.6408	0.6348	Δp	Δq	0.5210	0.7205	Δq	Δp	1.5771	0.1877
PL			4.0917	**0.0044**			0.3939	0.8125			4.6541	**0.0019**
SL			0.3559	0.8392			0.1055	0.9803			0.8005	0.5281
ES			1.4096	0.2376			2.0867	0.0895			1.7231	0.1523
CZ			0.9064	0.5152			1.2539	0.2784			1.1585	0.3336
HU	Δy	**ALL**	0.7018	0.6890	Δp	**ALL**	1.1527	0.3372	Δq	**ALL**	0.9136	0.5093
PL			2.5768	**0.0143**			1.2836	0.2628			4.3081	**0.0002**
SL			0.8412	0.5691			0.2268	0.9851			1.1608	0.3322
ES			1.3588	0.2263			1.7199	0.1052			1.4534	0.1864

Source: Model estimates

Notes: The null hypothesis that y does not Granger-cause x is rejected if the test statistic is higher than the 5% critical value.

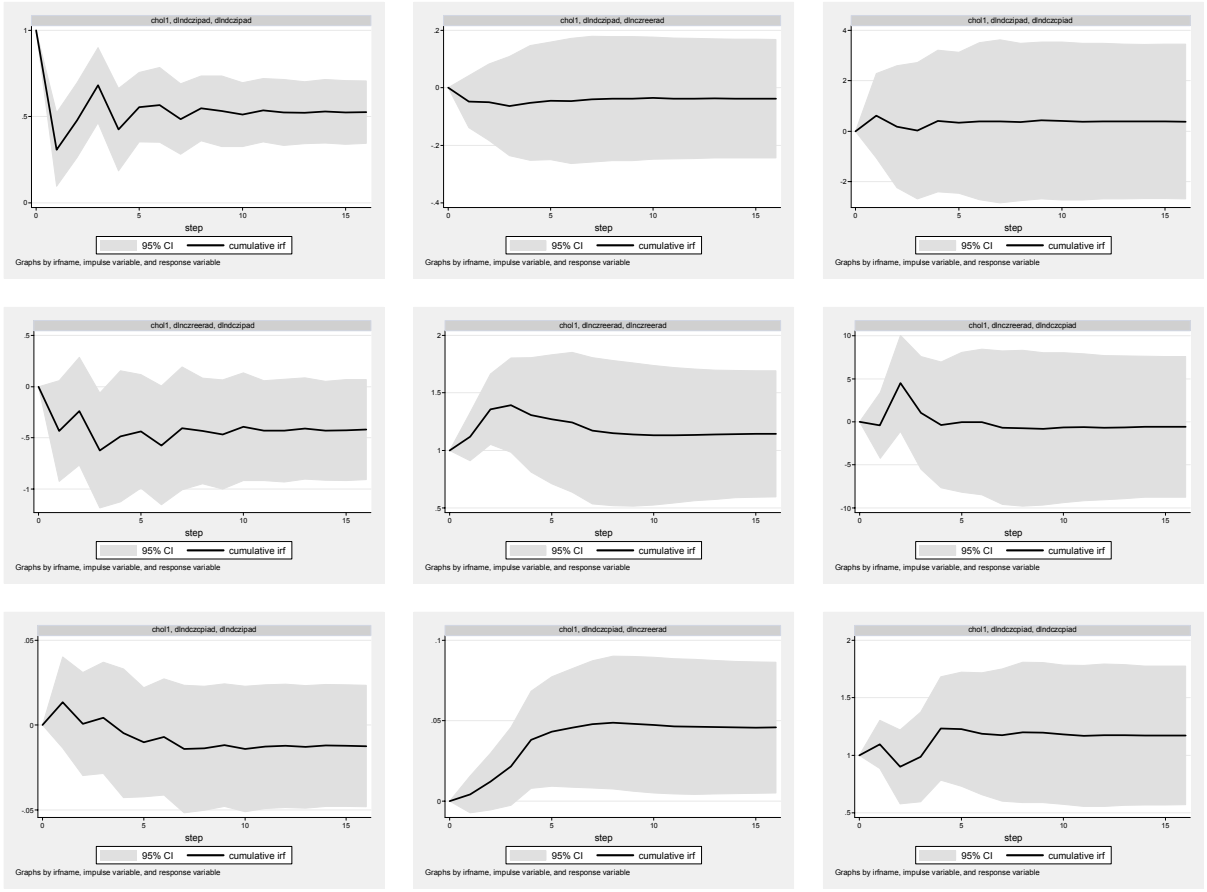
Figure 1. Forecast error variance decomposition and graphical representation of IRFs

1a.CzechRepublic

	(1)			(2)			(3)		
step	output	REER	Prices	output	REER	Prices	output	REER	Prices
1	1	.018421	.00112	0	.981579	.004315	0	0	.994565
2	.973273	.027608	.006258	.019757	.966725	.004491	.006971	.005667	.98925
3	.964474	.026025	.005862	.022603	.949043	.059886	.012922	.024933	.934252
4	.949984	.026205	.007664	.037074	.923681	.085528	.012942	.050113	.906808
5	.947454	.024194	.008042	.03728	.855492	.083737	.015266	.120314	.908221
6	.946897	.024059	.008078	.037024	.849377	.083918	.016078	.126564	.908004
7	.944867	.024052	.008135	.038745	.848212	.08381	.016388	.127735	.908055
8	.940992	.023939	.008143	.040994	.84772	.084784	.018014	.128341	.907073
9	.941045	.023924	.008165	.040975	.847516	.084747	.01798	.128559	.907088
10	.940838	.023918	.00822	.041063	.847417	.084764	.018099	.128664	.907016
11	.940186	.023925	.008218	.041554	.847283	.084793	.018259	.128793	.906989
12	.940034	.023927	.008227	.041653	.847132	.084784	.018313	.128941	.906989
13	.940033	.023927	.008232	.041649	.847112	.084785	.018318	.128961	.906983
14	.93998	.023927	.008233	.04169	.847098	.084788	.018331	.128974	.906979
15	.939918	.023928	.008233	.041729	.847086	.084796	.018353	.128987	.906971

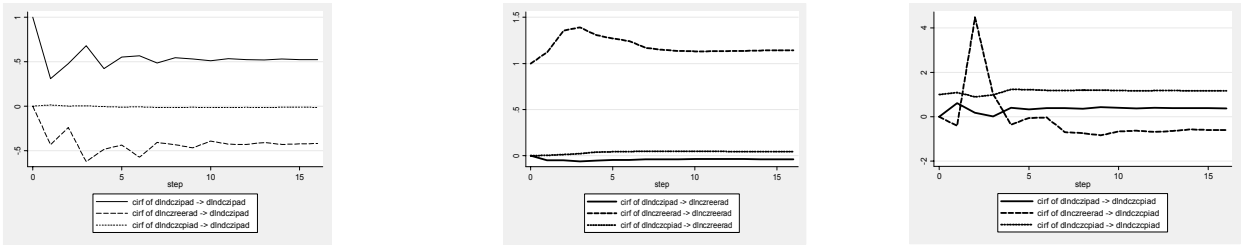
Notes: (1) Forecast error variance decomposition due to supply shock, (2) Forecast error variance decomposition due to demand shock, (3) Forecast error variance decomposition due to nominal shock

1b.



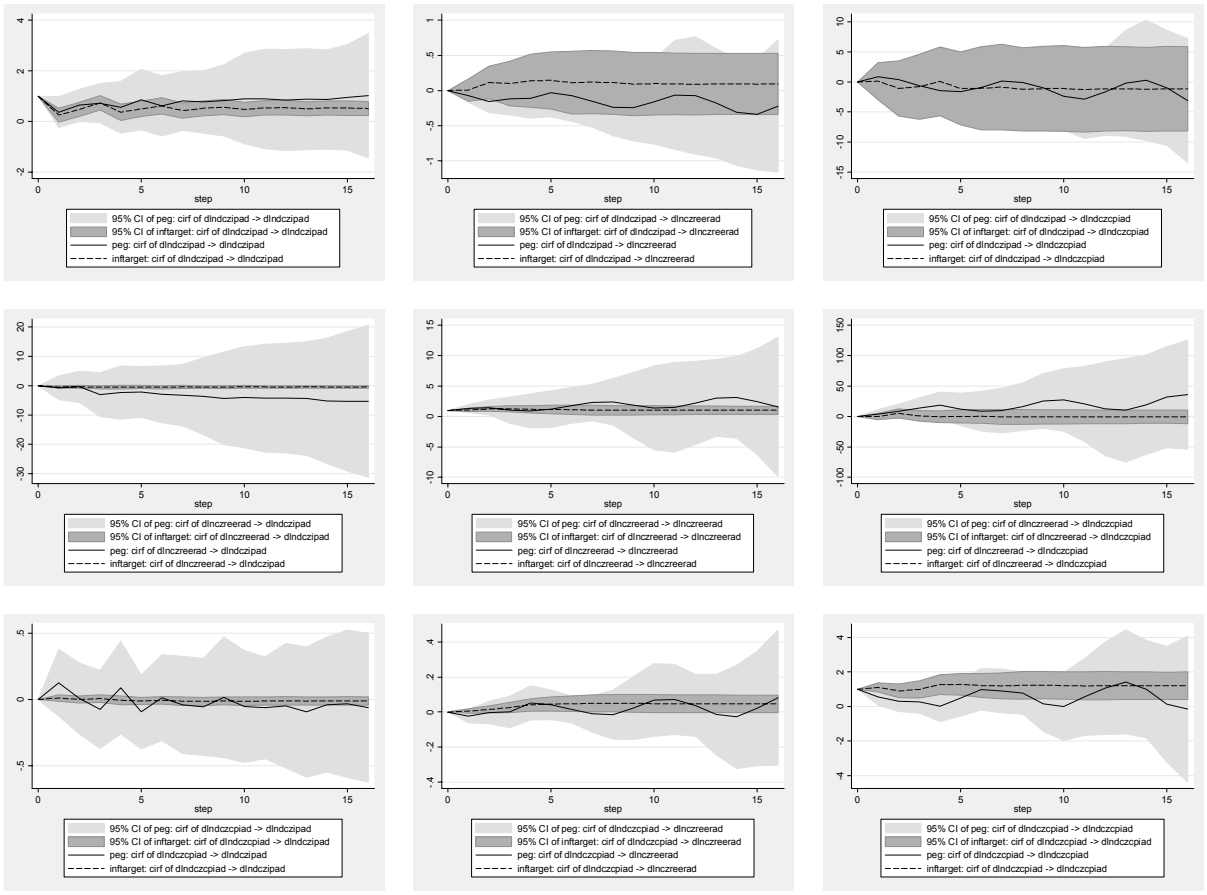
Note: (i) Response of relative output, real effective exchange rate and prices to supply, shocks; (ii) Response of relative output, real effective exchange rate and prices to demand shocks; (iii) Response of relative output, real effective exchange rate and prices to nominal shocks

1c. (a) (b) (c)



(a) Response of relative output to supply, demand and nominal shocks (b) Response of real exchange rate to supply, demand and nominal shocks (c) Response of relative prices to supply, demand and nominal shocks

1d.



Note: ─ pegged regime, ----- inflation targeting i) Response of relative output, real effective exchange rate and prices to supply, shocks in pegged regime and in inflation targeting; (ii) Response of relative output, real effective exchange rate and prices to demand shocks in peg and in inflation targeting; (iii) Response of relative output, real effective exchange rate and prices to nominal shocks in peg and inflation targeting

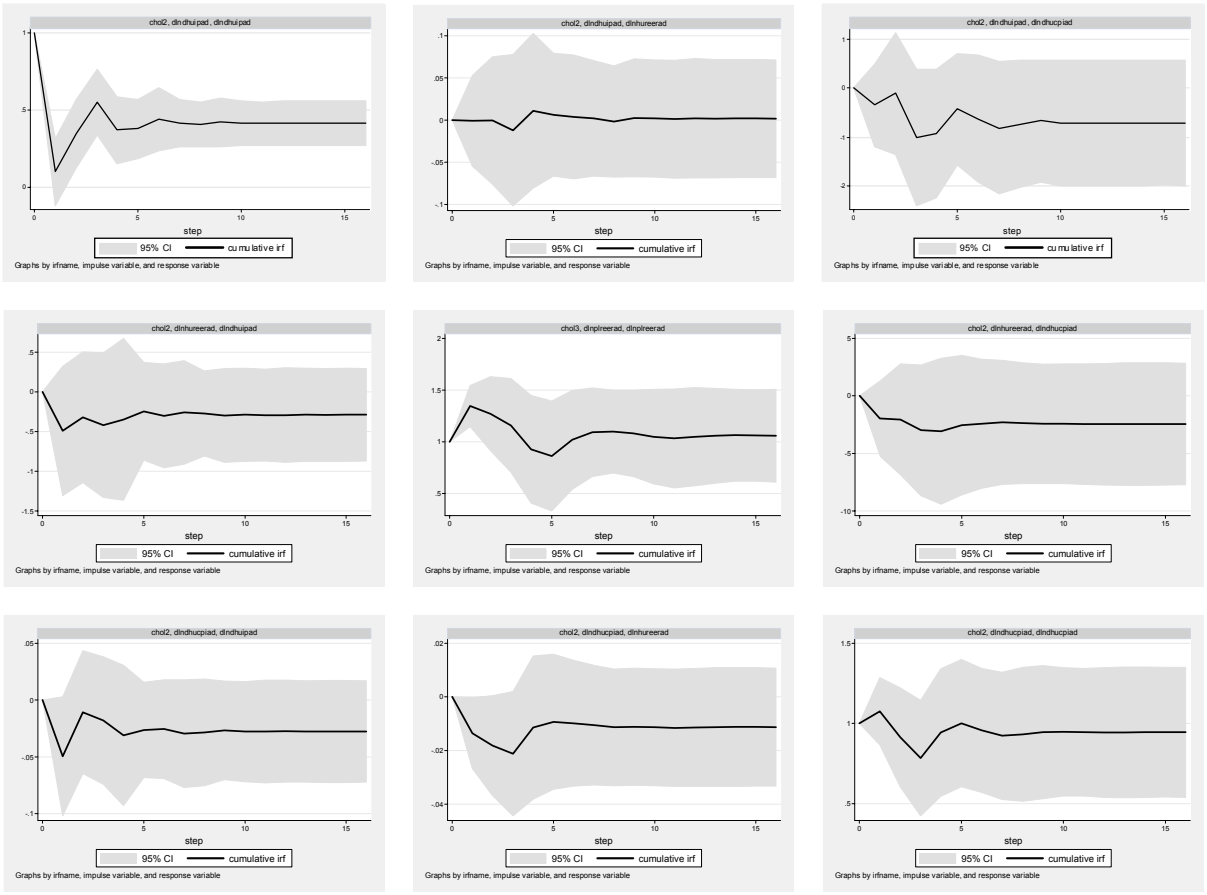
Figure 2. Forecast error variance decomposition and graphical representation of IRFs

2a.Hungary

	(1)			(2)			(3)		
step	output	REER	Prices	output	REER	Prices	output	REER	Prices
1	1	.001726	.015499	0	.998274	.000089	0	0	.984412
2	.970514	.002148	.024648	.008192	.954243	.015195	.021295	.04361	.960157
3	.958272	.002297	.029925	.008771	.94947	.014742	.032957	.048233	.955332
4	.958434	.00385	.066714	.008906	.945955	.016912	.03266	.050195	.916374
5	.957611	.007289	.065285	.008946	.924365	.016579	.033443	.068345	.918135
6	.957139	.007744	.07633	.009269	.923	.017208	.033592	.069257	.906462
7	.957116	.007818	.077616	.009354	.922884	.017204	.03353	.069297	.90518
8	.956948	.007843	.078925	.009409	.922755	.017215	.033643	.069401	.90386
9	.956935	.007972	.079238	.009415	.922577	.017228	.03365	.069451	.903534
10	.956896	.008226	.079335	.009435	.922336	.017236	.033669	.069438	.903429
11	.956884	.00823	.079387	.009439	.922327	.017235	.033677	.069444	.903378
12	.956882	.008237	.079386	.009441	.922312	.01724	.033677	.069451	.903374
13	.956882	.008246	.079386	.009441	.9223	.01724	.033677	.069453	.903374
14	.956881	.008248	.079387	.009442	.922296	.01724	.033678	.069455	.903373
15	.956881	.008248	.079387	.009442	.922295	.01724	.033678	.069457	.903372

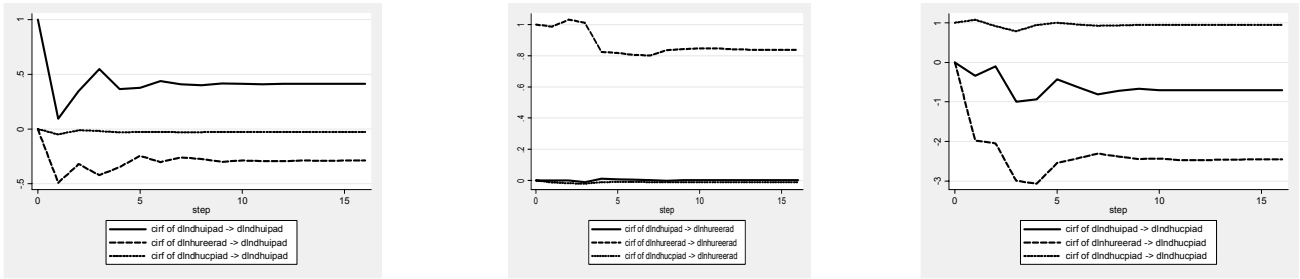
Notes: (1) Forecast error variance decomposition due to supply shock, (2) Forecast error variance decomposition due to demand shock, (3) Forecast error variance decomposition due to nominal shock

2b.



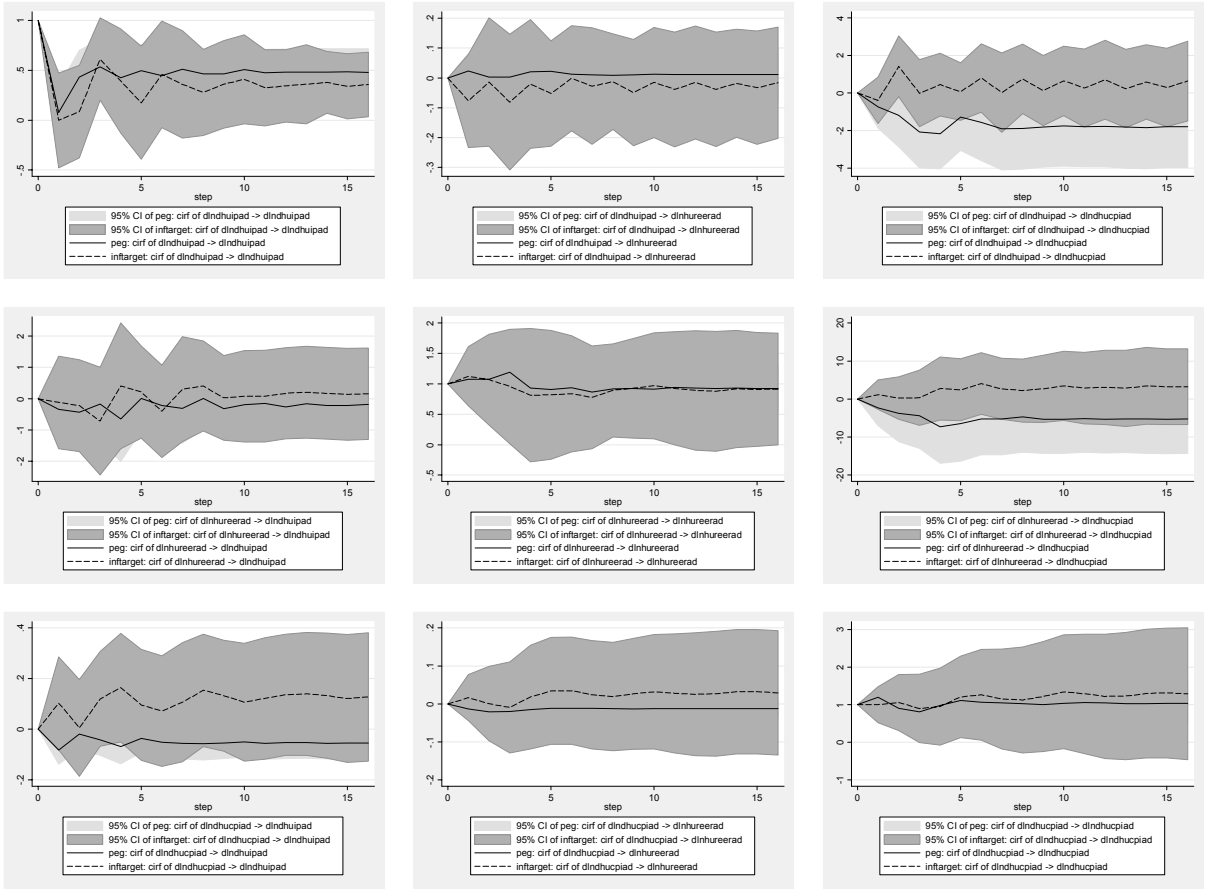
Note: (i) Response of relative output, real effective exchange rate and prices to supply, shocks; (ii) Response of relative output, real effective exchange rate and prices to demand shocks; (iii) Response of relative output, real effective exchange rate and prices to nominal shocks

2c.(a) **(b)** **(c)**



(a) Response of relative output to supply, demand and nominal shocks (b) Response of real exchange rate to supply, demand and nominal shocks (c) Response of relative prices to supply, demand and nominal shocks

2d.



Note: : ─ pegged regime, -----inflation targeting (i) Response of relative output, real effective exchange rate and prices to supply, shocks in pegged regime and in inflation targeting; (ii) Response of relative output, real effective exchange rate and prices to demand shocks in pegged regime and in inflation targeting; (iii) Response of relative output, real effective exchange rate and prices to nominal shocks in pegged regime and in inflation targeting

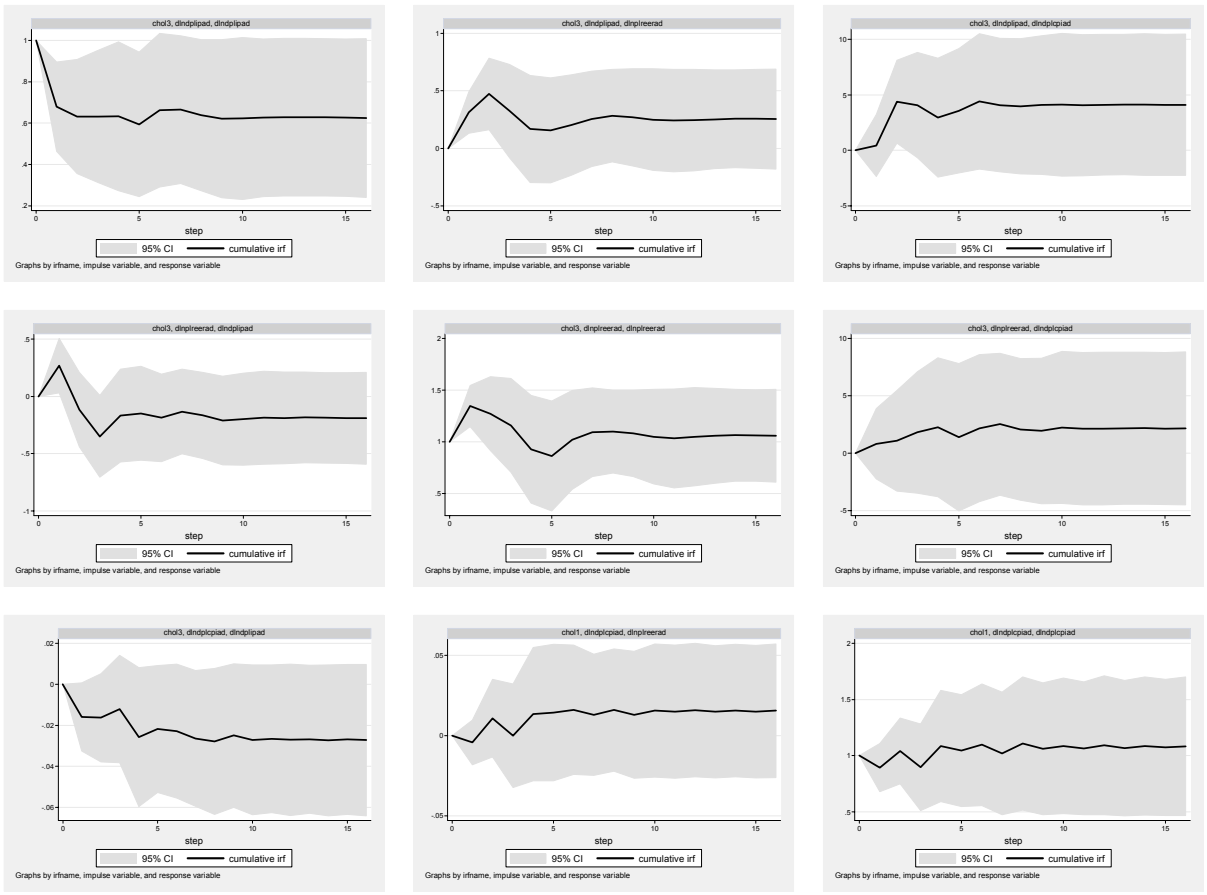
Figure 3. Forecast error variance decomposition and graphical representation of IRFs

3a.Poland

	(1)			(2)			(3)		
step	output	REER	Prices	output	REER	Prices	output	REER	Prices
1	1	.000838	.07016	0	.999162	.000335	0	0	.929506
2	.924323	.115081	.072566	.041965	.881687	.002919	.033712	.003231	.924516
3	.848956	.121994	.130839	.120101	.837098	.003018	.030943	.040908	.866143
4	.822815	.129347	.128459	.145072	.812668	.00477	.032113	.057985	.866771
5	.79235	.152534	.138929	.155673	.769073	.005385	.051976	.078393	.855686
6	.791233	.152243	.14099	.155266	.769477	.008004	.053501	.07828	.851006
7	.791312	.150793	.142172	.155327	.771849	.010197	.053361	.077357	.847631
8	.789054	.153154	.141486	.156349	.768718	.0105	.054597	.078127	.848014
9	.788496	.153158	.141257	.15675	.767565	.011061	.054754	.079277	.847681
10	.787142	.152954	.14136	.157344	.766693	.011098	.055514	.080354	.847542
11	.786709	.153311	.141257	.157308	.765606	.011405	.055983	.081083	.847338
12	.786633	.153299	.141203	.157362	.765574	.011445	.056005	.081127	.847352
13	.78662	.153252	.141136	.157357	.765502	.011441	.056022	.081247	.847424
14	.786608	.153313	.141116	.157365	.765317	.011437	.056028	.08137	.847447
15	.786576	.153302	.1411	.157366	.765257	.011434	.056058	.081441	.847466

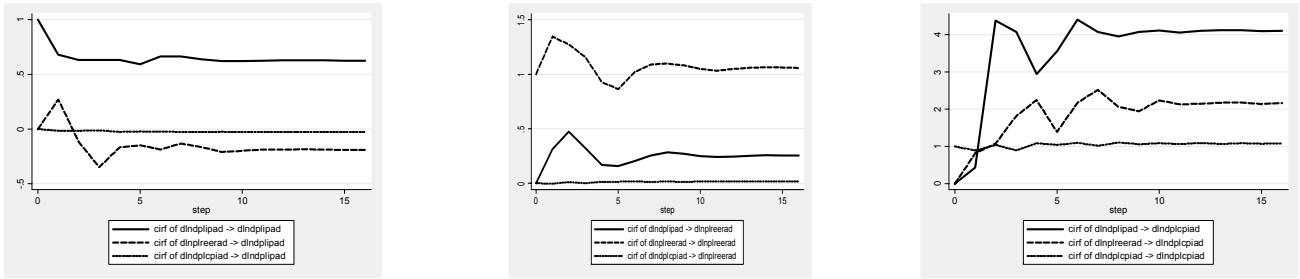
Notes: (1) Forecast error variance decomposition due to supply shock, (2) Forecast error variance decomposition due to demand shock, (3) Forecast error variance decomposition due to nominal shock

3b.



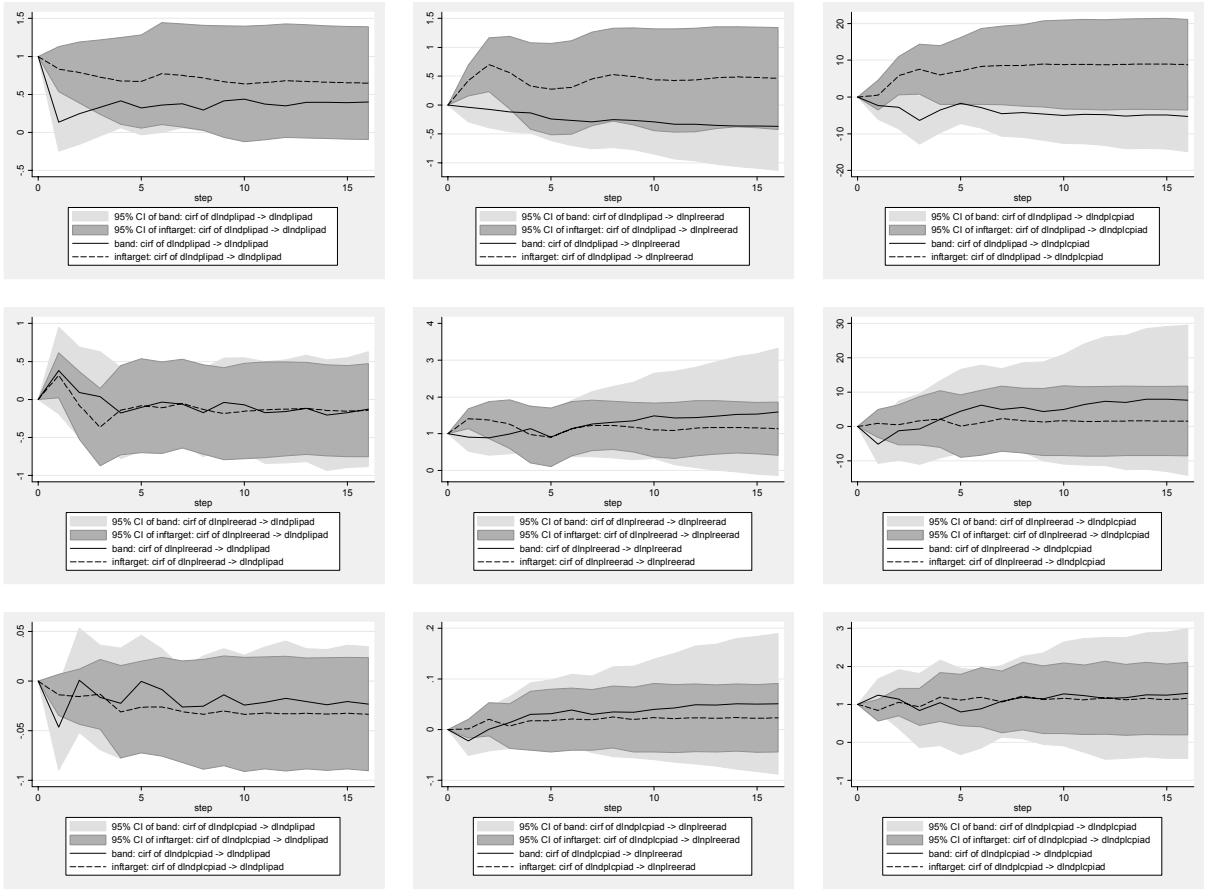
Note: (i) Response of relative output, real effective exchange rate and prices to supply, shocks; (ii) Response of relative output, real effective exchange rate and prices to demand shocks; (iii) Response of relative output, real effective exchange rate and prices to nominal shocks

3c. **(a)** **(b)** **(c)**



(a) Response of relative output to supply, demand and nominal shocks (b) Response of real exchange rate to supply, demand and nominal shocks (c) Response of relative prices to supply, demand and nominal shocks

3d.



Note: : - band, ----- inflation targeting (i) Response of relative output, real effective exchange rate and prices to supply, shocks in pegged regime and in inflation targeting; (ii) Response of relative output, real effective exchange rate and prices to demand shocks in pegged regime and in inflation targeting; (iii) Response of relative output, real effective exchange rate and prices to nominal shocks in pegged regime and in inflation targeting

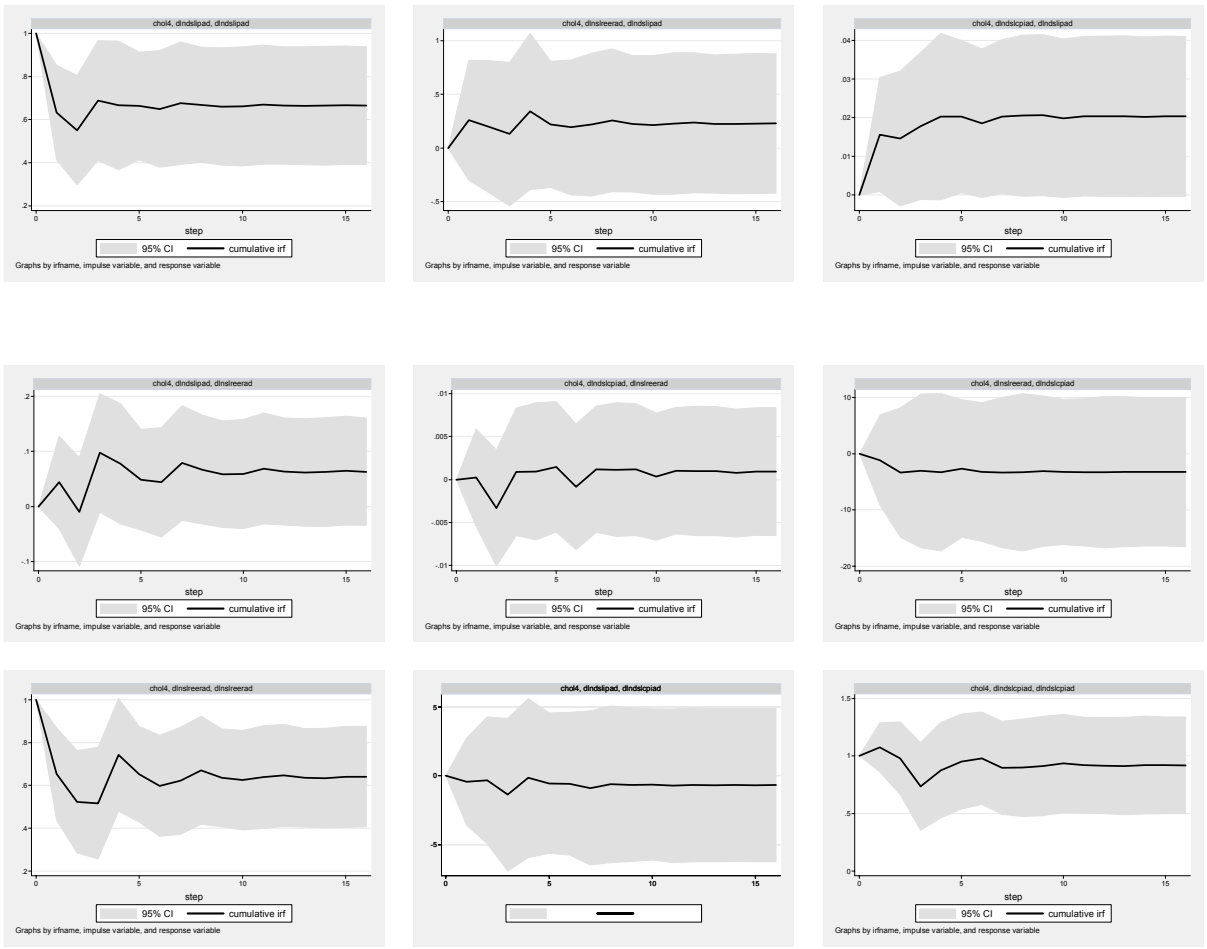
Figure 4. Forecast error variance decomposition and graphical representation of IRFs

4a. Slovenia

	(1)			(2)			(3)		
step	output	REER	Prices	output	REER	Prices	output	REER	Prices
1	1	.043974	.026648	0	.956026	.018355	0	0	.954997
2	.957202	.068215	.027686	.003609	.931728	.019867	.039189	.000057	.952447
3	.956912	.07307	.028544	.003942	.91283	.02155	.039146	.014101	.949906
4	.955161	.119008	.027983	.004693	.849479	.021976	.040146	.031513	.95004
5	.950107	.121114	.030916	.009091	.848754	.02211	.040802	.030132	.946974
6	.948564	.12265	.032365	.010702	.847235	.022003	.040734	.030115	.945632
7	.948108	.121955	.032339	.010738	.842888	.022345	.041154	.035157	.945316
8	.947674	.124854	.032184	.010765	.836213	.022269	.041561	.038932	.945547
9	.947521	.125716	.032463	.010915	.835461	.022265	.041564	.038823	.945272
10	.9474	.125728	.032485	.011041	.835488	.022272	.041558	.038784	.945244
11	.947313	.125677	.032469	.011044	.834905	.022305	.041643	.039418	.945226
12	.947266	.125842	.032475	.011055	.834321	.022301	.041678	.039836	.945224
13	.947261	.125981	.032491	.011062	.834191	.022301	.041677	.039828	.945208
14	.947247	.125971	.032491	.011076	.834205	.022304	.041677	.039824	.945205
15	.947242	.125973	.03249	.011076	.834149	.022306	.041682	.039877	.945204
6	.948564	.12265	.032365	.010702	.847235	.022003	.040734	.030115	.945632

Notes: (1) Forecast error variance decomposition due to supply shock, (2) Forecast error variance decomposition due to demand shock, (3) Forecast error variance decomposition due to nominal shock

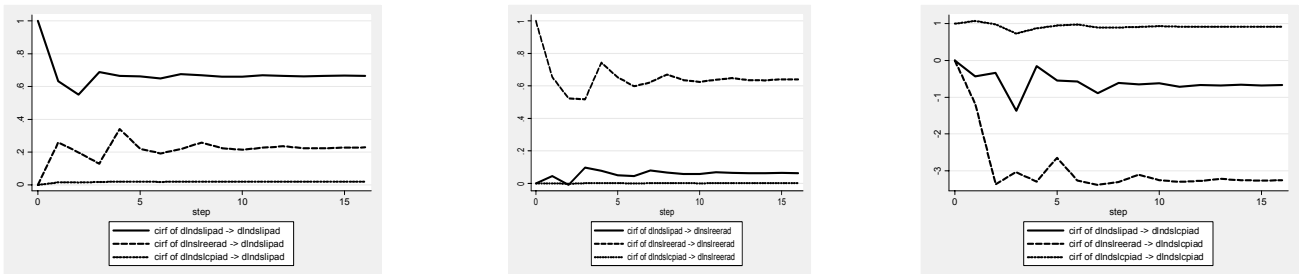
4b.



Note: (i)Response Response of relative output, real effective exchange rate and prices to supply shocks; (ii) Response of relative output, real effective exchange rate and prices to demand shocks; (iii) Response of relative output, real effective exchange rate and prices to nominal shocks

4c.

(a) **(b)** **(c)**



(a) Response of relative output to supply, demand and nominal shocks (b) Response of real exchange rate to supply, demand and nominal shocks (c) Response of relative prices to supply, demand and nominal shocks

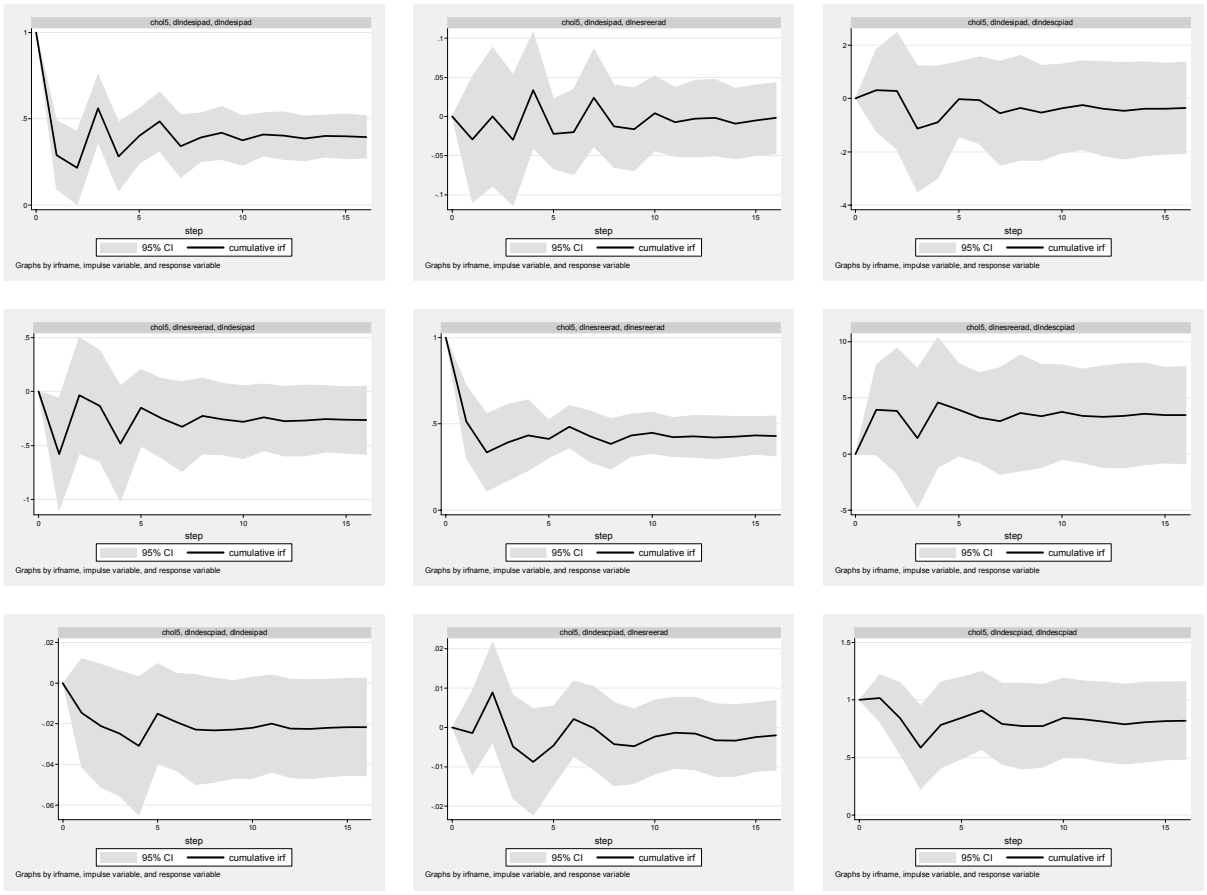
Figure 5. Variance decomposition and graphical representation of IRFs

5a.Estonia

	(1)			(2)			(3)		
step	output	REER	Prices	output	REER	Prices	output	REER	Prices
1	1	.003011	.006243	0	.996989	.014567	0	0	.97919
2	.952626	.004001	.006695	.039255	.995389	.054945	.008119	.00061	.938359
3	.924594	.007208	.006631	.066058	.962553	.054032	.009348	.030238	.939337
4	.928487	.009129	.026649	.062384	.912288	.069657	.009129	.078583	.903694
5	.919473	.027357	.025117	.070667	.892095	.094237	.00986	.080548	.880645
6	.901877	.041097	.034103	.080629	.875569	.093639	.017494	.083334	.872258
7	.900852	.040477	.034022	.0812	.866222	.093897	.017948	.093301	.872081
8	.900943	.04901	.035757	.080909	.857566	.093369	.018148	.093424	.870874
9	.900303	.052975	.036181	.081585	.850563	.094176	.018113	.096462	.869642
10	.90026	.052968	.03657	.081631	.850669	.094289	.018109	.096363	.869141
11	.900294	.054223	.036568	.081593	.848348	.094452	.018114	.097429	.86898
12	.900062	.054698	.03679	.081716	.847729	.094691	.018222	.097573	.868519
13	.899783	.054773	.036935	.081827	.847651	.094675	.01839	.097576	.868389
14	.899792	.054755	.036981	.081818	.847095	.094646	.01839	.098151	.868373
15	.899778	.054974	.037017	.081828	.846896	.094708	.018395	.098129	.868275

Notes: (1) Variance due to supply shock, (2) Variance due to demand shock, (3) Variance due to nominal shock

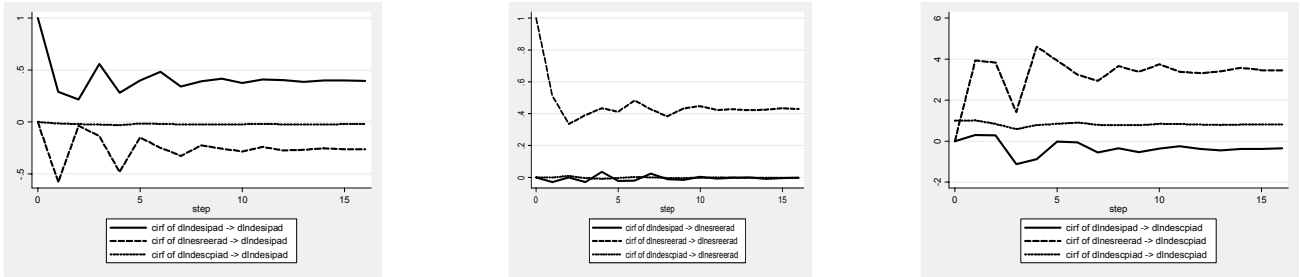
5b.



Note: (i) Response of relative output, real effective exchange rate and prices to supply, shocks; (ii) Response of relative output, real effective exchange rate and prices to demand shocks; (iii) Response of relative output, real effective exchange rate and prices to nominal shocks

5c.

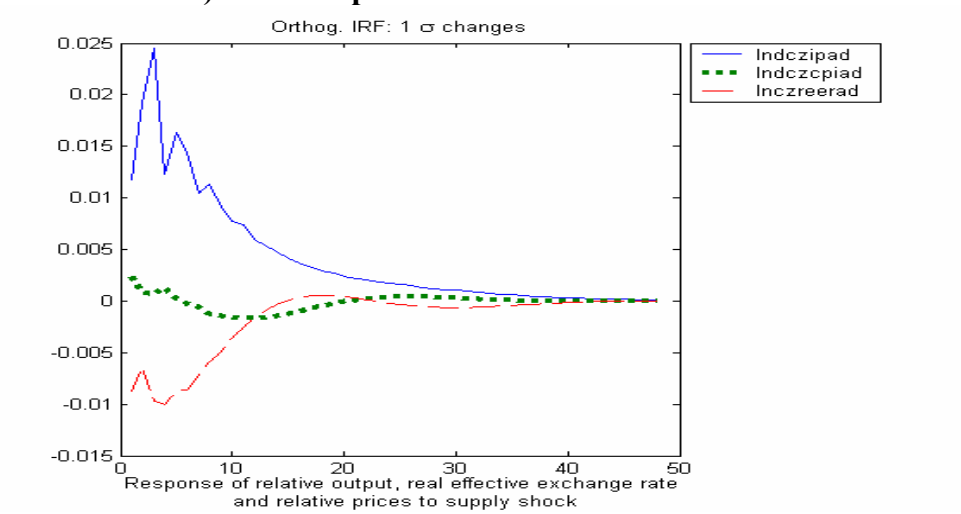
(a) **(b)** **(c)**

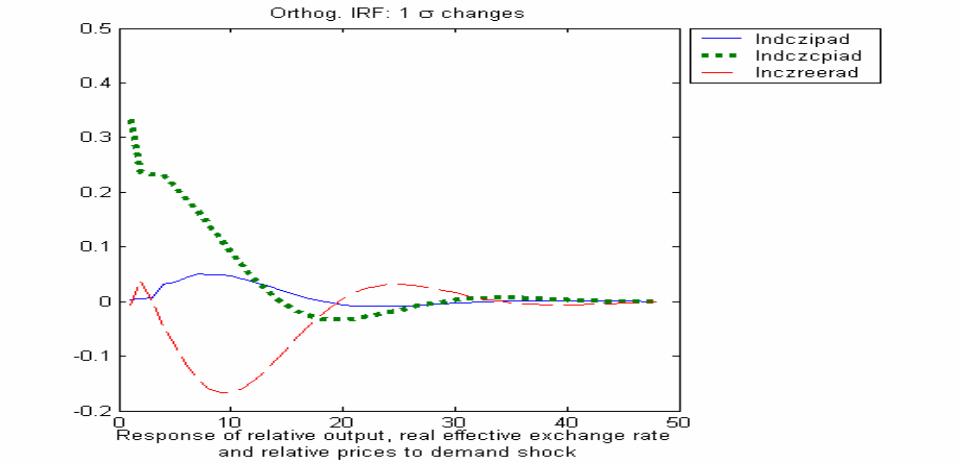


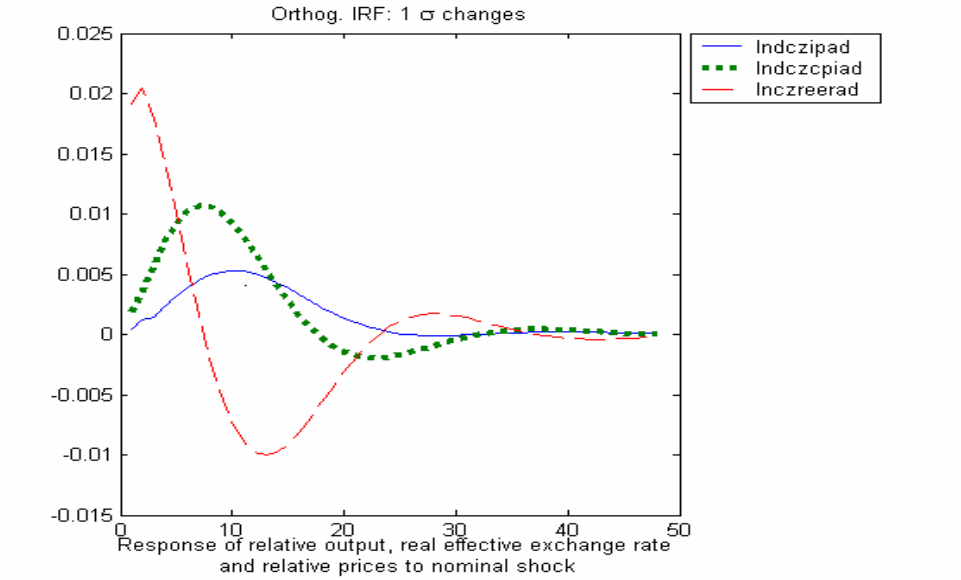
(a) Response of relative output to supply, demand and nominal shocks (b) Response of real exchange rate to supply, demand and nominal shocks (c) Response of relative prices to supply, demand and nominal shocks

Figure 6 . Bayesian VAR

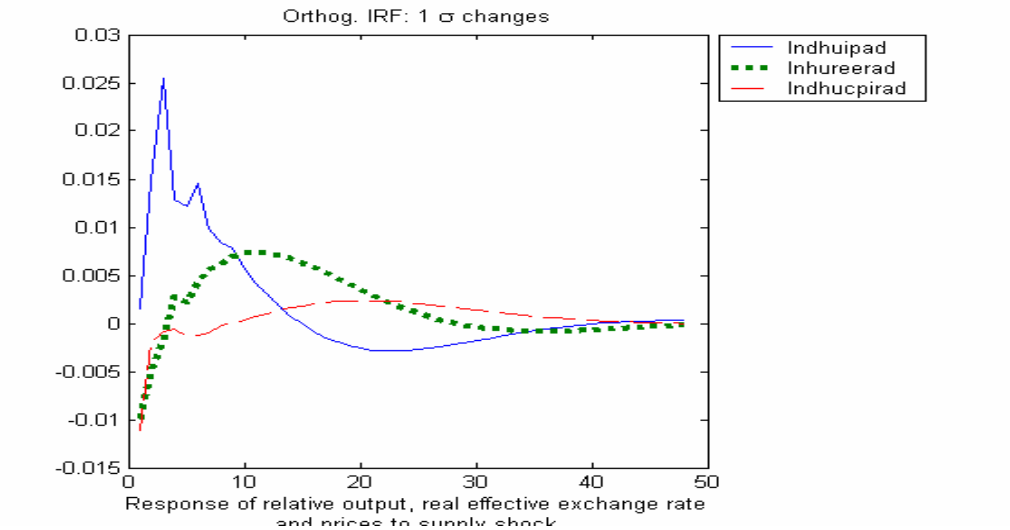
a) Czech Republic

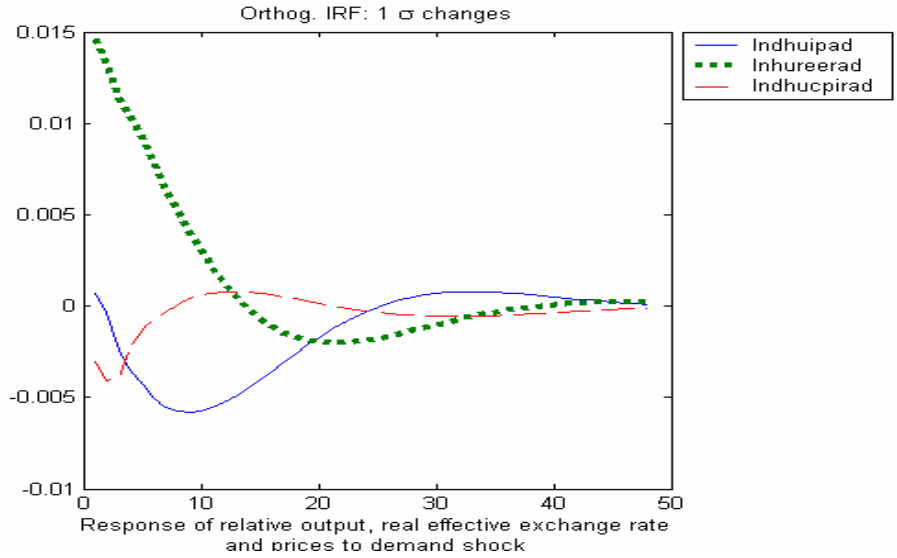


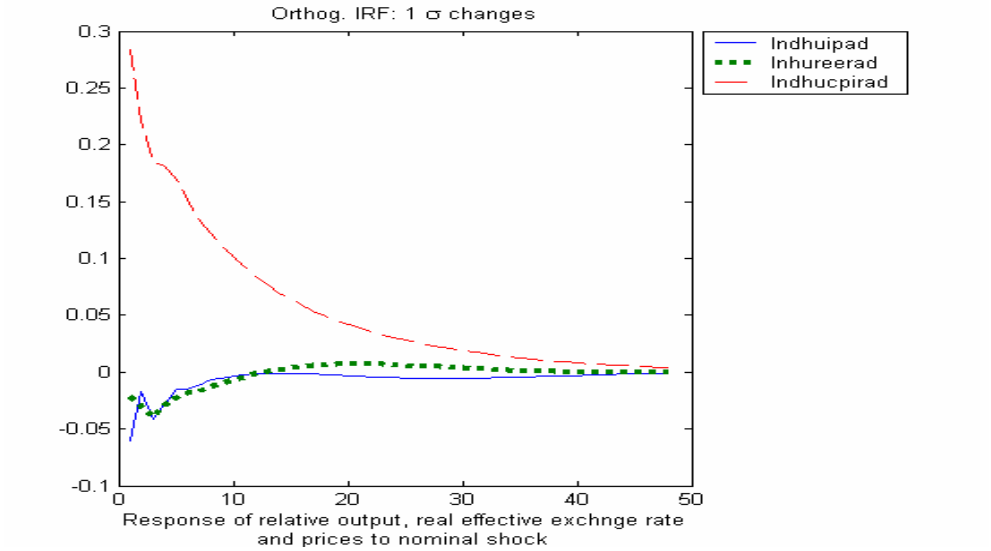




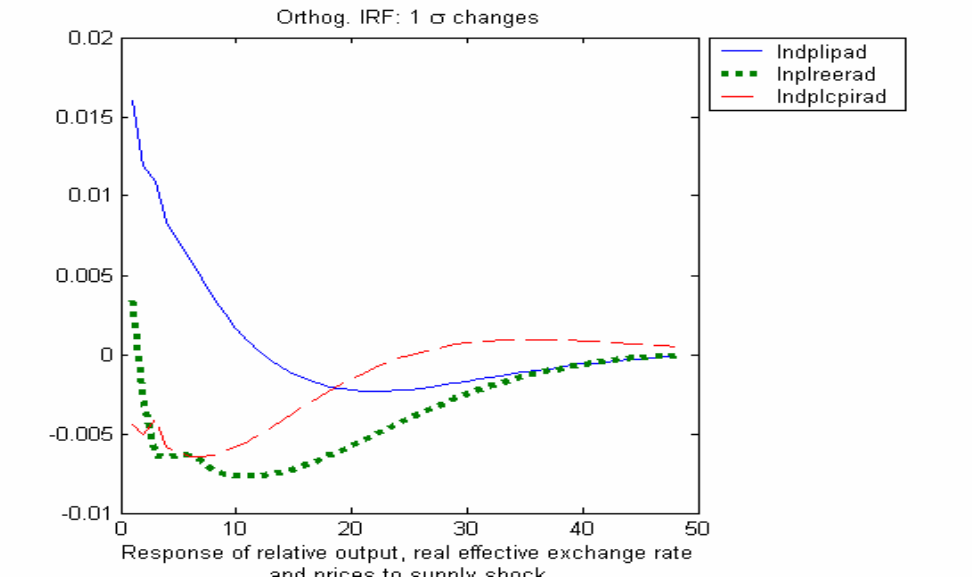
b) Hungary- Bayesian VAR

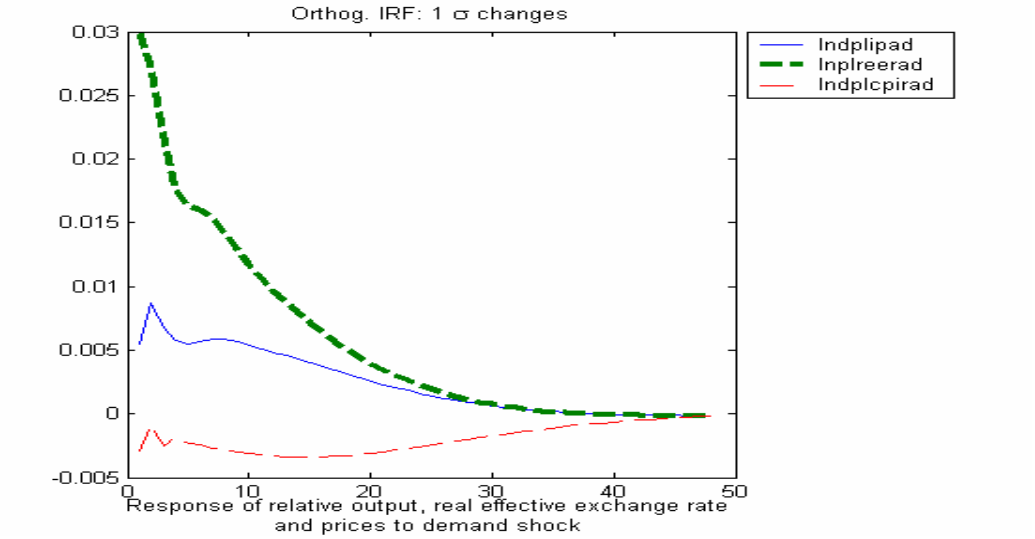


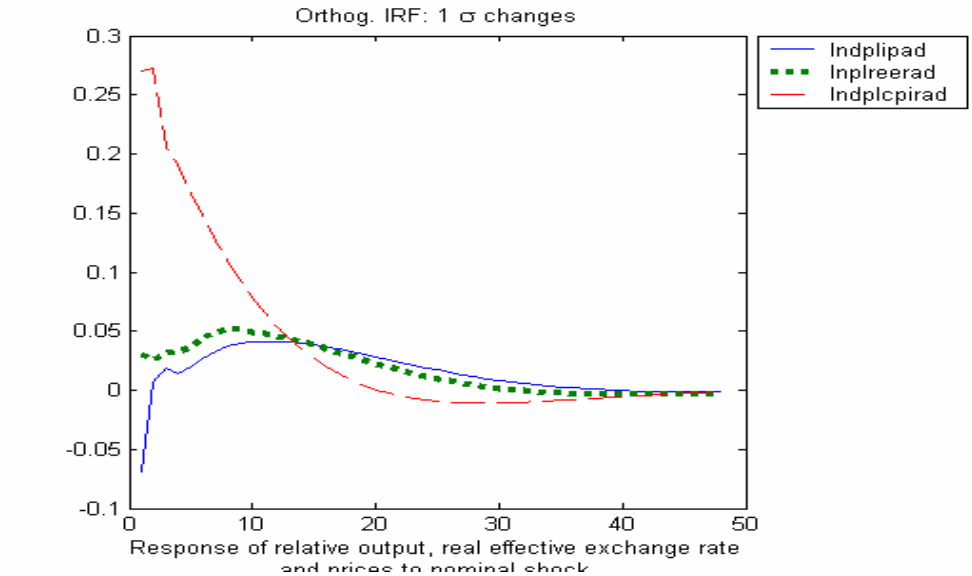




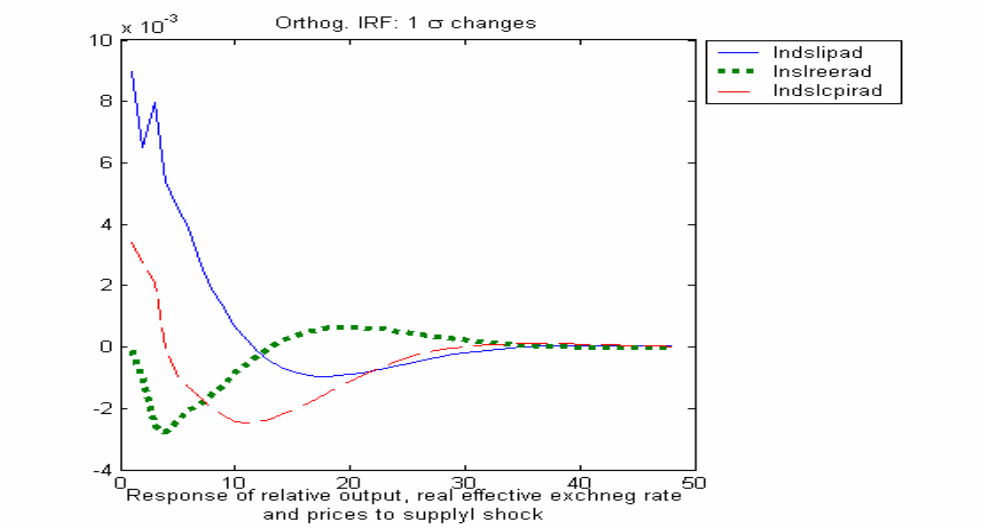
c) Poland - Bayesian VAR

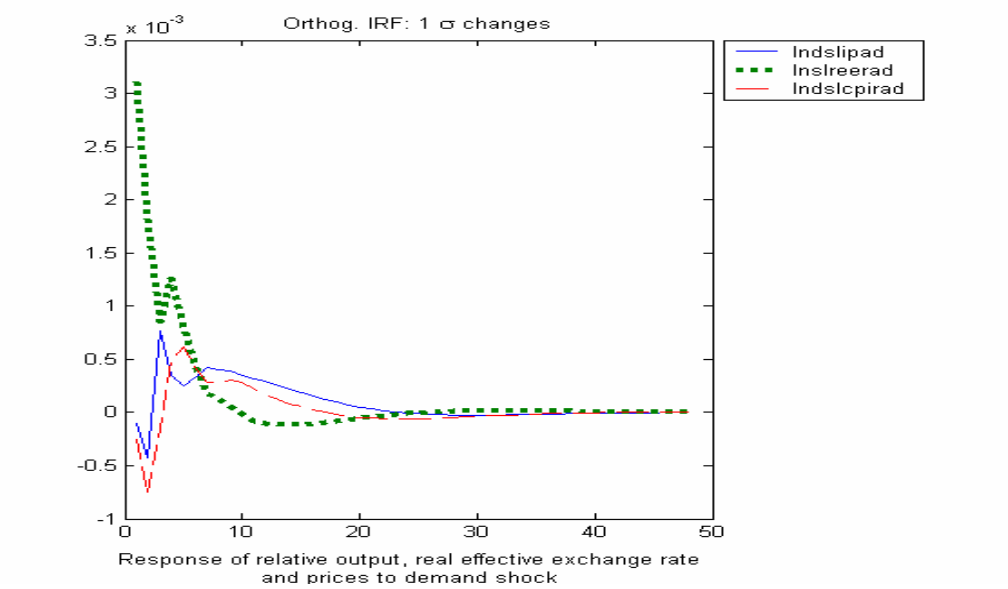


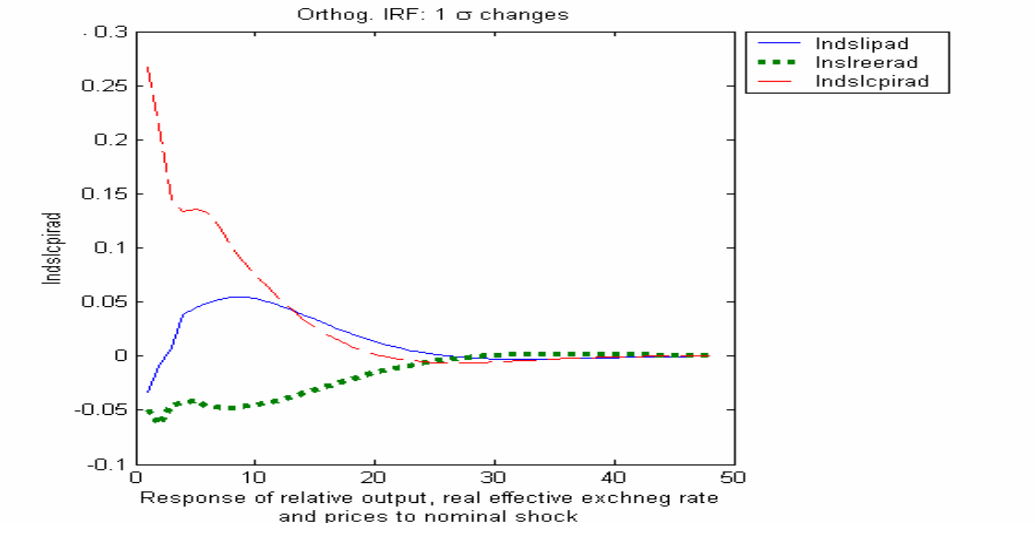




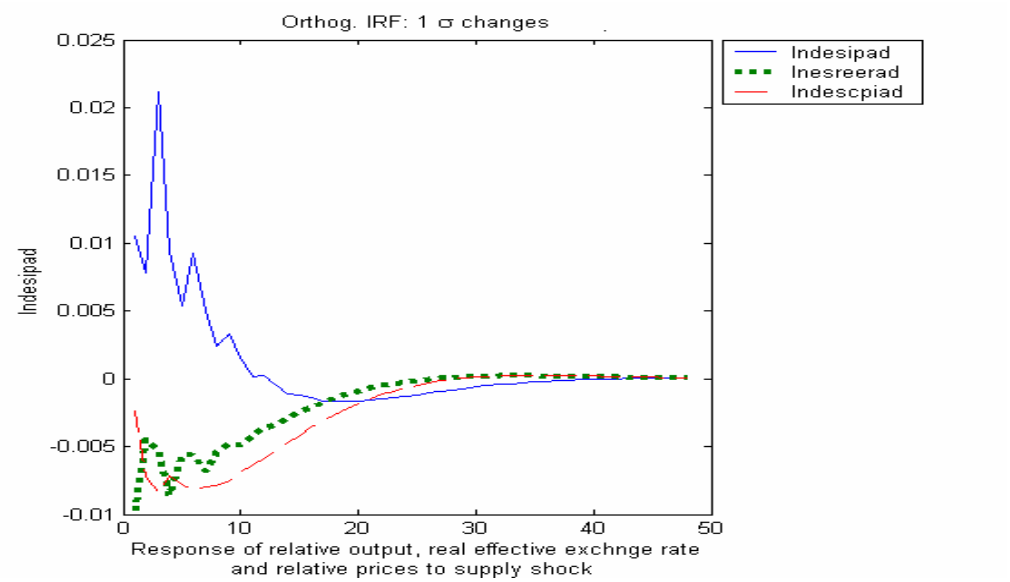
d) Slovenia- Bayesian VAR

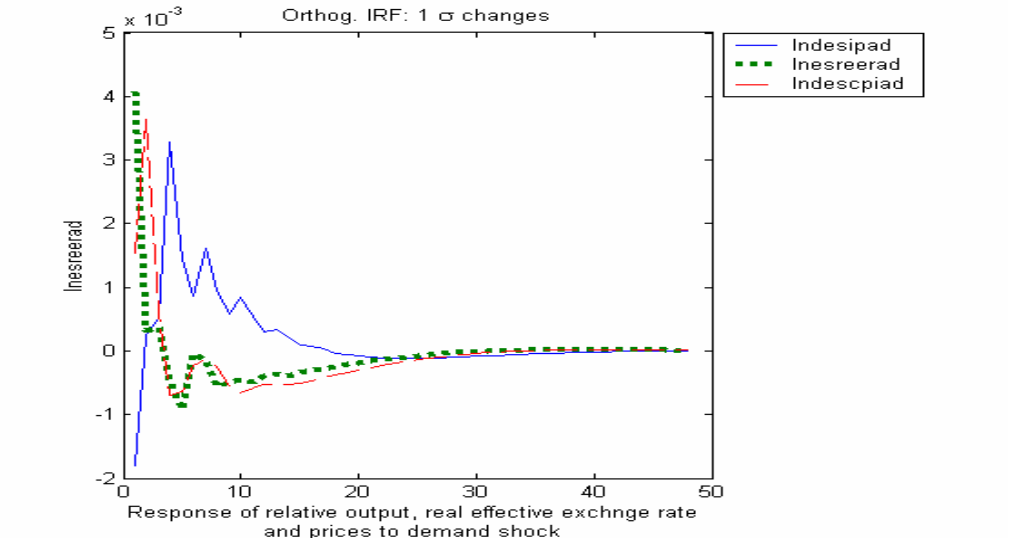


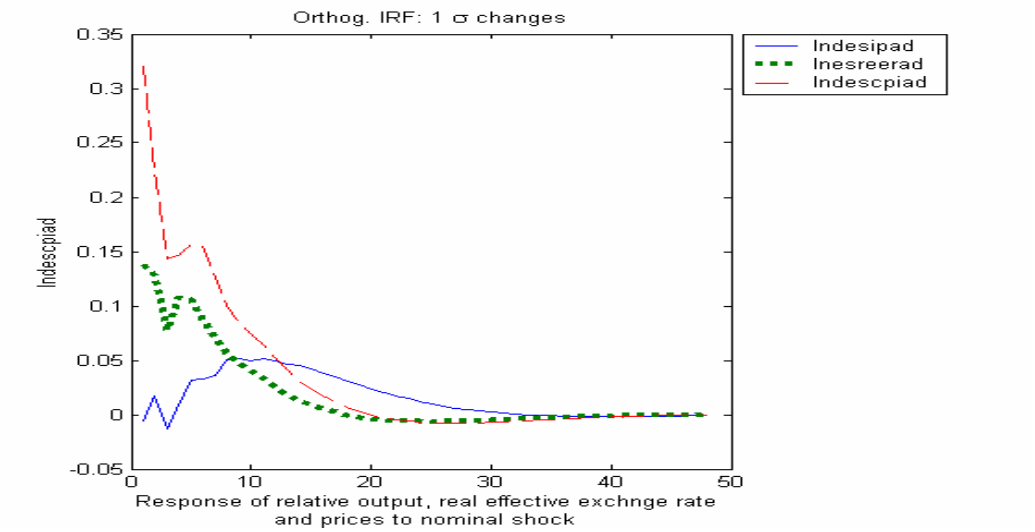




e) Estonia - Bayesian VAR







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