THE WILLIAM DAVIDSON INSTITUTE
AT THE UNIVERSITY OF MICHIGAN

Exchange Rate Pass-Through in Transition Economies: The Case of the Republic of Macedonia

By: Besnik Fetai

William Davidson Institute Working Paper Number 1014
April 2011

Exchange Rate Pass-Through in Transition Economies: The Case of Republic of Macedonia

Besnik Fetai*
South East European University

Abstract

This paper investigates the relative costs and benefits associated with introducing a different exchange rate regime in the Republic of Macedonia. In this finding, all econometrics results, using different methodologies (SVAR and VECM), show that introducing a different strategy of the exchange rate targeting in order to promote rapid economic growth could easy disturb macroeconomic stability (after having achieved it at a substantial cost) without any significant economic benefits. In the long term, the coefficient of exchange rate reveals that a one percent change in the exchange rate will generate an increase in the prices level of 0.52 percent, indicating that 52 percent of changes in the exchange rate feed into the prices level. The investigation suggests that introducing a different strategy of the exchange rate regime is likely to incur more costs than benefits.

Keywords: exchange rate, pass-through effect, SVAR and VECM.
JEL Classification Codes: E44, E55, E62, E77

*Southeast European University, Faculty of Business and Economics, Ilindenska bb, 1200, Tetovo, Macedonia, email: b.fetai@seeu.edu.mk and telephone +38971915463.

1. Introduction

The main objective in this paper is to analyze empirically the short and long term effect of the exchange rate on real GDP and prices in the Republic of Macedonia. The small open economy model exchange rate pass through is estimated. Two econometrics methodologies such as Structural Vector Autoregressive (SVAR-henceforth) and Vector Error Correction Methodology (VECM henceforth) are used in order to identify the short and long term effect of the exchange rate on real GDP and prices.

The question of the optimal monetary regime for small open economies is still unanswered. There is no optimal monetary regime; it depends on the circumstances of the country. Economists have not been able to determine whether these countries should use floating or fixed exchange rates. As to, the countries in transition, the exchange rate has often played a fundamental role in macroeconomic stabilization. From 1992 to the end of 1995, the government of the Republic of Macedonia did not have a clear platform regarding macroeconomic stability, which often led to conflict between monetary and fiscal authority. For example, the National Bank of Republic of Macedonia (NBRM henceforth) attempted to stabilize the economy via stabilization of exchange rate, which necessary required a higher interest rate, thus affected the budget adversely and the NBRM was pressured to the lower interest rate. Since 1995, the NBRM is applying monetary strategy of targeting the exchange rate, i.e. the stabilization of exchange rate, has proven very successful at reducing the rate of inflation. From 1996 to the 2008, the rate of inflation has been single digital number. The Republic of Macedonia, in particular, has faced many systemic changes, such as the liberalization of the capital account in 2003, becoming a member of the World Trade Organization in 2002, and gaining candidacy status for joining the European Union in 2004. Under such circumstances, any investigation of monetary policy and exchange rate regime must address a seemingly incompatible trinity: the liberalization of capital movement, fixed exchange rates, and independent monetary policy (Obstfeld 1998; Mishkin 2003). Moreover, Levy-Yeyati and Sturzenegger (2001) claims that for non-industrial economies, a "long" peg (lasting five or more years) is associated with a lower rate of inflation than floats, but at the cost of a slower rate of growth. Recently, the issue of exchange rate regime has become more pronounced since the liberalization of the capital account took place. Therefore, the monetary strategy of targeting the exchange rate could easily become a target of speculative attack (sudden large capital inflows), which in turn could lead to negative impacts on real economic activity due to increases in and fluctuation of the interest rate and fluctuation of foreign exchange reserve – foreign exchange reserve being important for international liquidity. On the other hand, the solution of simply shifting the exchange rate from a fixed exchange rate to a more flexible one, depreciating the domestic currency in order to settle the problem of deficit in the current account, and thereby promoting fast economic growth, could easily disturb macroeconomic stability without any real short-term economic benefits. This suggests a need for ongoing analyses of the effects of exchange rate policy on real GDP and prices in order to assess the relative costs and benefits associated with introducing a different exchange rate regime.

Although the role of the exchange rate regime is limited in influencing economic growth, the role of such regimes in affecting economic growth – especially the costs and benefits of introducing a different exchange rate regime (one using inflation targeting) – has received growing attention in the Republic of Macedonia.

Therefore, in this paper, I focus on identifying the effect that exchange rate regime on real GDP and prices in the Republic of Macedonia. Based on the data from 1997 to 2008, our empirical research is supported by empirical testing using the most-used

methodologies, such as SVAR and VECM. I am limited to using data from 1997 to 2008, because the data for 2008 are not yet available. If I were to use data before 1996, I believe my research would be of lesser quality due to the high rate of inflation experienced from 1992-1996. The theoretical and empirical literature concerning SVAR and VECM, both in the developed countries and the countries in transition, provides the foundation of my empirical research on the Republic of Macedonia.

The reminder paper is organized as a follows. Section 2 explains the reviews the literature on the effect of the exchange rate. Section 3 econometrics model for testing the short term effect of exchange rate on real GDP and prices. Section 4 econometrics model for testing the long term effect of exchange rate regime on real GDP and prices. Section 5 conclusions.

2. Review of literature on the effect of the exchange rate

2.1. Theoretical and empirical evidence of the effect of exchange rate regime

2.1.1. Theoretical aspect of exchange rate regime

Applying a fixed or flexible exchange rate regime depends on the structure and circumstances of each country in question: no universal law applies to all. *The early literature* on the choice of exchange rate regimes proposes that the smaller and more "open" an economy is (i.e. the more dependent it is upon exports and imports) the better it will be served by the adoption of a fixed exchange rate regime. *A later approach* to the choice of exchange rate regimes looks at the effects of various random disturbances on the domestic economy.

In general, a fixed exchange rate regime is preferable if the disturbance in the economy is predominantly monetary, for example in the form of changes in the demand for money which affect the general level of prices. Rapid inflation due to an excess money supply and excess demand in the economy would generate a depreciation of currencies in the foreign exchange markets, which in turn would add to aggregate demand in the economy and generate further inflationary pressure. An increase in prices would cause a rise in money wages, which in turn would induce more inflation, and so on. If inflation is generated by such monetary factors, it is better to use a fixed exchange rate than a flexible one.

The main reason why the Republic of Macedonia and other similar small countries in transition have pegged their currencies to their leading trading partner's currency is the unstable demand for money. The central banks in those countries were experienced difficulties in achieving their final goals of maintaining price stability through monetary strategy targeting the growth rate of money; thus, the Republic of Macedonia abandoned this strategy in 1995 and adopted a monetary strategy targeting the exchange rate.

A flexible exchange rate is preferable if disturbances are predominantly real factors or factors that originate abroad and affect the relative prices of domestic goods.In addition, *the literature in general indicates that a small open economy is better served by a fixed exchange rate than by a flexible exchange rate regime.* Most economists claim that the best exchange rate regime is one that stabilizes macroeconomic performance, i.e. one that minimizes fluctuations in output, domestic prices and other macroeconomic variables.

However, the question of the optimal monetary regime for small open economies has yet to be definitively answered, however.

2.1.2 Empirical evidence from the evaluation of macroeconomic performance under alternative exchange rate arrangements

Concerning the empirical evidence, economists do not offer clearly convincing answers to the question of whether a country should allow its currencies to float or should fix its currencies to other currencies. The experience of many countries suggests that neither of these two main types of exchange rate regime can be unambiguously ranked above the other in terms of macroeconomic experience. *While countries with a pegged-fixed exchange rate have experienced a relatively lower and more stable rate of inflation and a relatively less volatile real exchange rate regime, output growth does not appear to differ significantly between countries with fixed and flexible exchange rate regimes.* Thus, there are pros and cons to different exchange rate regimes. After the experience of floating exchange rate regimes, it is difficult to determine the correct choice of exchange rate regime.

A number of studies explore the effect of exchange rate arrangements on economic performance. I can divide this empirical research into two groups. The first group includes those studies that involve before/after case studies with regard to countries that changed their arrangements; comparative case studies; narrative explanations; and econometric analyses of the pooled experiences of a cross-section of countries. Studies that use SVAR methodology make up the second group.

2.1.2.1. Empirical research of the exchange rate regime according to a variety of macroeconomic models

Ghosh et al. (1997) examine 140 countries over thirty years under nine types of exchange rate arrangements. They find that both levels and variability of inflation are clearly lower under fixed exchange rate regimes than under floating exchange rate regimes. In contrast to inflation, the level of growth does not seem to be greatly influenced by the exchange rate arrangement, perhaps because investment ratios are higher under fixed exchange rate regimes. On reviewing previous empirical literature, Quirk (1994) reaches a contrary conclusion, finding that there is little linkage between exchange rate arrangements and inflation. Jazbec Boštjan (2001) makes a model of real exchange rate determination in countries in transition. He finds that the exchange rate does not seem to play a direct role in explaining output performance in different countries in transition. However, he claims that the fixed exchange rate regime serves better to keep up inflationary pressure and therefore has an indirect effect on real output growth via better inflation performance. On the other hand, Levy-Yeyati and Sturzenegger (2001) find that for non-industrial economies, “long” pegs (lasting five years or more) are associated with lower inflation than floats, but at the cost of slower economic growth. A similar trade-off between inflation and economic growth is observed in the case of the “hard” peg, whose growth performance does not differ significantly from that of conventional pegs. In contrast, “short” pegs under-perform floats, as they grow slower without any gains in terms of reducing the rate of inflation.

The IMF (1997) reports that inflation rates under fixed exchange rate regimes are, on average, lower than those of floating exchange rate regimes. For de facto classification, pegged regimes continue to exhibit a significantly lower rate of inflation than freely floating regimes, at 4.5 percent lower. The intermediate exchange rate regimes exhibit 2.9 percent lower inflation rates than those of freely floating exchange rate regimes. Regarding economic performance, the pegged and floating exchange rate regimes of both de jure and de facto classification show that economic growth does not exhibit a

relationship with exchange rate flexibility. For developing economies, economic growth appears to decline with increased flexibility. Thus, the association observed above of lower rate of inflation with greater rigidity clearly does not come at the expense of economic growth. For emerging markets, the relationship between economic growth and regimes is noisy as well as for rate of inflation. Ghosh et al. (2000) compare the economic performance of countries with currency boards, other pegs, and floating exchange rate regimes, to countries placed into regimes by the IMF de jure classification. Countries with currency boards grow the most rapidly, on average, by a considerable margin. No differences in economic performance are found between floating and fixed exchange rate regimes. Levy-Yeyati and Sturzenegger (2003) report an interesting finding: when they use the IMF classification system, the intermediate regime performs best, but when they use their own de facto system (LYS), the ranking is precisely reversed, in that more floaters perform better. According to the IMF classification, intermediate regimes do perform best; while according to the LYS classification, the intermediate regimes do the worst, and those with floating exchange rate regimes perform the best. Reinhart and Rogoff (2002) suggest treating countries with dual or multiple exchange rate regimes as a separate category. They claim that countries with limited flexibility perform the best, while floaters come in last. But as far as average growth rate is concerned, the different regimes do not seem to make very much difference.

It can be seen from the empirical research that there is no clear answer as to which exchange rate regime is optimal for the different countries. Not surprisingly, therefore, the results are inconclusive and sometimes contradictory; varying with the countries covered, the period, the detailed specification of the econometrics model used, and subjectivity on the part of the authors. Nevertheless, theory suggests – and most of the empirical evidence proves – that the best regime is one that will stabilize fluctuating macroeconomic variables.

2.1.2.2. Empirical research of the effect of exchange rate regime according to SVAR and VECM-methodology

Following the path of most literature regarding U.S. and Western Europe countries, the few VAR studies which have been carried out on Central Eastern European and South Eastern European countries use the same identification in their models regarding the effect of exchange rate regimes on real GDP and inflation.

Regarding the effect of exchange rate in developed countries, it will be seen that in the big and developed countries the exchange rate does not play a significant role of the effect of exchange rate on inflation, while it does play such a role in smaller developed countries. McCarthy (2000) analyzes the effect of exchange rate changes and import price fluctuation on producer and consumer prices in six industrialized OECD countries from 1976:1 to 1998:4. The impulse response function and variance decomposition show that the exchange rate has had a modest effect on domestic prices throughout the post-Bretton Woods era. He also finds that pass-through is somewhat stronger in countries with larger import shares. Campa and Goldberg (2004) provide empirical evidence on the exchange rate pass-through for twenty-three OECD countries. Using quarterly data from 1975 through 2003, they estimate pass-through elasticity. They find that countries with less exchange rate and inflation variability are likely to have lower pass-through of exchange rate via import prices. Cushman and Zha (1997) analyze monetary policy in Canada and find that the dynamic responses to identified monetary policy shocks are consistent with standard theory and highlight the exchange rate as a transmission channel of monetary policy. Also Kim and Rubini (2000) and Maćkowiak (2003, 2005) analyze small

developed countries and find that the exchange rate channel did play an important role in transmitting the dynamic effect of monetary policy. Cîtu (2003) examines New Zealand and finds that exchange rate channels play an important role in the transmission of the dynamic effect of monetary policy.

By this empirical evidence, it can be seen that in the big and developed countries the exchange rate does not play a significant role in transmitting the dynamic effect of monetary shock on real economic activity, while it does play such a role in smaller developed countries. Recently, exchange rate channels have been examined in two ways in the small economies in transition: firstly, in terms of the pass-through effect of nominal exchange rate changes, via import prices, on prices in small and open economies, whereby a depreciation of domestic currency causes price level to rise; secondly, in terms of the possible implications of different exchange rate regimes on monetary strategy[1].

As for the effect of the exchange rate in transition countries most of the studies conclude higher pass-through effect of the exchange rate on inflation. Billmeier and Bonato (2002) examine Croatia using SVAR and VECM with the model including manufacturing and retail indices, the exchange rate nominal anchor, monetary aggregate, and output gap. They find a significant role for the exchange rate in the level of prices. Coricelli, Jazbec, and Masten (2004) examine the exchange rate pass-through effect for acceding countries to the European Union, such as the Czech Republic, Hungary, Poland, and Slovenia. They find a strong pass-through from nominal exchange rates to domestic inflation. In this context, countries with accommodative exchange rate policies show a high and fast pass-through effect, as is demonstrated in the case of Hungary and Slovenia. According to the authors, a different choice of exchange rate policy can achieve disinflation at low costs in terms of output decline and with potential benefits in social welfare. Jarociński (2004), Maćkowiak (2003), and Maliszewski (2002). Dovciak (1999) and Kuijs (2002) analyze Slovakia, and both authors find that the exchange rate channel plays an important role in the monetary transmission mechanism. In their view, the exchange rate can affect inflation, and they find a strong pass-through effect of the exchange rate in Slovakia. In addition, Kuijs claims that the degree and direction of the exchange rate depends on many factors, such as the elasticity of demand for exports and imports, the openness of the economy, and the exchange rate pass-through. Ganev et al. (2002) analyze the dynamic effect of monetary policy on real GDP and inflation in 10 CEE countries. The evaluation of the pass-through effect of monetary policy on real GDP and inflation is examined by two indicators: the interest rate and the exchange rate. Positive exchange rate shocks (deprecation) seem to boost real GDP in most countries, though this effect dies out after a short-period. In Latvia, the exchange rate shock does not have any effect on real GDP. Depreciation shocks fuel core inflation in most countries. The effect is greatest in Slovakia, Latvia, the Czech Republic, Bulgaria, Romania and Poland, and it seems to persist after 36 months. Core inflation does not seem to be significantly influenced by depreciation in Hungary, Slovenia and Lithuania. It can be seen that the exchange rate has played a significant role in these countries, showing a strong pass-through of the dynamic effect of monetary policy; whilst interest rates had a lower effect on the monetary transmission mechanism. The weakness of these traditional channels is explained by the lower degree of competition in the banking sector, the shallowness of financial intermediation, currencies substitutions, etc. Horváth and Maino

[1] Clark (1999), Kuijs (2002), Ganev, Molnar, Rybinski and Wozniak (2002), Leigh and Ross (2002), Billmeier and Bonato (2002), Juks (2004), Golinelli and Rovelli (2004), Hyder and Shah (2004), Vonnák (2005) Horváth and Maino (2006) e.g.

(2006) examine the dynamic effect of monetary policy on real GDP and prices in Belarus. The model they employ incorporates four variables: price, money stock, exchange rate peg, and real GDP. They find that exchange rates have a strong effect on prices – i.e. a strong pass-through effect – but do not affect real GDP. In addition, money causes inflation but does not have an effect on real GDP.

My research somehow share the feature of the above mentioned author, but I differ from them (expect Coricelli at all. and Billmiller and Bonato) since I use both SVAR and VECM in order to identify the transitory and permanent shock of the exchange rate. They have attempted to measure the pass-through effect only with SVAR methodology, i.e. where the conclusion about magnitude of the pass-through, measured as an impulse response function should be considered with caution (see more Corsetti and Dedola, 2003). Therefore, I try with this research to justify that using only SVAR to assess pass-through without employing VECM method can not consistently measure the pass through effect of the exchange rate.

3. Econometric model for testing short-term effect exchange rate on real GDP and prices in the Republic of Macedonia

In this empirical research, *two channels of the effect of exchange rate can be identified. First, the direct channel of the exchange rate*: that it affects inflation via the import prices pass-through effect. That is, changes in the nominal exchange rates directly affect import prices, which in turn cause domestic prices to rise. *Second, the indirect channel of the exchange rate*: that it affects real GDP through the balance of payments. It is important to recognize these possible implications of different exchange rate regimes, i.e. the costs and benefits of introducing a different exchange rate regime. The issue at hand is whether the exchange rate still plays a significant role in maintaining macroeconomic stability in the Republic of Macedonia.

For this purposes, we perform several tests: diagnostic tests (JB-test, LB-test and ARCH-test); a test for VAR order; a test for reaction of the real GDP and prices to exchange rate disturbances, i.e. the effect of exchange rate disturbances on real GDP and prices; and forecast error variance decomposition test of exchange rate disturbance on real GDP and prices.

3.1. Data in empirical research

We are limited to using data from the period of 1997:01-2008:12, in our work, because if we were to use time series before 1997, we think that our research would be of lesser quality due to high rate of inflation experience in the period 1992-1995. Because of the narrow time series in countries in transition, we use monthly data rather than quarterly in order to perform a more observation points. Almost all empirical research involving countries in transition follows this approach, owing to the short time periods inherent to such evaluation. Furthermore, Bernanke and Mihov (1998); and Christiano, Eichenbaum and Evans (1996 and 1999) show that inferences drawn from quarterly data are congruent with inferences gathered from monthly data.

The variables used in our model are: manufacturing prices index (MPI), retail prices index (RPI), money stock (M1), exchange rate (EXCH.R), and real gross domestic product (real GDP). All data is expressed in logarithmic form (denoted ln). Hence, coefficients on the logged levels measure constants of elasticity. The short-term interest

rate has been excluded from the model since it does not reflect the market type behavior in the Republic of Macedonia. The short term interest rate has no means to be included in the model (see more from Ganev et al., 2002; and Billmeier and Bonato 2002) when countries use currency boards or employ the exchange rate as a nominal anchor.

The sources of data are mainly from the NBRM, the Ministry of Finance, and the Official State Statistics Bureau of the Republic of Macedonia.

3.2. Econometrics model and result

3.2.1. Testing the short-term effect of exchange rate on real GDP and prices: SVAR Sims-approach

The empirical research has some features in common with previous empirical research regarding both developed countries and countries in transition.

The specification of the model is:

$$x_t = v + A_1 x_{t-1} + \ldots + A_p x_{t-p} + \psi D_t + \varepsilon_t$$

We start with identifying our model as a five-dimensional vector. In the equation above, the vector x_t includes five variables: the exchange rate (EURO), the manufacturing prices index (MPI), the retail prices index (RPI), the money stock (M1), and the real gross domestic product (real GDP). The v is the vector of the constant. All variables are expressed in logarithmic form to satisfy the theoretical assumptions of constant elasticity models. During the period of investigation, there are notable structural monetary shocks and episodes of internal and external political turbulence. In order to eliminate the negative impact of internal and external shocks, we include several vector D_t dummy variables, such as: the devaluation of the denar by 16.1 percent, the war between Serbia and Kosovo, the value-added tax, and ethnic conflict in the Republic of Macedonia.

The structural model is composed of five equations. Moreover, the series are estimated consistently in levels with OLS (ordinary least square). The variables in the model are divided into two blocks: the *non-policy vectors,* including the log of MPI, the log of RPI, and the log of real GDP; and the *policy vectors,* including the log of M1 and the log of EXCH.E. Vector e_t is the vector of structural disturbance. MPI and RPI are included in the model for two reasons:

First, we expect a strong link to emerge between the exchange rate and RPI and MPI. Second, the final goal of the NBRM is price stability; therefore, introducing these variables contributes to eliminating the so-called "price puzzle".

In our empirical research we use two decomposition as such the Choleski and Brnanke –Sims decomposition. The Choleski decomposition model is just identified, and the number of coefficients of the matrix B_0 is 10 (lower triangular), which casn be estimated in the monetary VAR (M-VAR henceforth) with unity on the main diagonal. Thereby, the covariance of the matrix will be a diagonal matrix. On the other hand, in the Bernanke-Sims decomposition we must identify the model by means of the restriction on the B_0 matrix. We assume that the vector of non-policy variables cannot respond simultaneously to monetary shocks. This is a standard assumption in the literature regarding both monthly and quarterly data (Christiano et al., 1999). In addition, an important issue in estimating structural VAR-s (Bernanke-Sims decomposition), as in all system of equations, is the question of normalizing the coefficient of the dependent variable (Waggoner and Zha,

1997; and Stock and Watson, 2001). Thereby, first we must make a restriction in the matrix B_0, and then we need to reestimate the model by normalizing these coefficients to one. Before examining impulse response function and variance decomposition of monetary disturbance, we must select *VAR order, perform diagnostic tests, and test for Granger-Causality.*

To begin, we make a visual inspection of the time series. All of the time series show trends, with the exception of exchange rate, which is fixed with the exception of devaluation in 1997. Whether they are trend-stationary or difference-stationary is examined in the section with VECM. However, we are interested in performing tests for seasonality, i.e. whether or not the time series exhibit seasonality. The model is explained in detail in Appendix I.

In Appendix I, we show the model proposed by Gardner (1985) in order to reveal which time series shows seasonality. As we can see from the visual inspection of the time series, ***only real GDP displays seasonality.*** This conclusion leads also to the result of Gardner's methodology. Hence, we make a seasonal adjustment of real GDP, and in my further research, I use seasonally adjusted real GDP. On the other hand, MPI, RPI, M1, and EXCH.E do not display seasonality, and therefore I use these time series without seasonal adjustments.

To continue, we include these time series only in VAR level (Sims-approach) – estimated by OLS. In Appendix II, we show the result of the routine tests of VAR: *tests for selection of VAR order and for checking the "quality" of the VAR based on its residuals, such as: JB-test for normality distribution, LB-test and LM-test for autocorrelation, and ARCH test for the presence of heteroscedasticity in the VAR's residuals*

We test VAR-order according to criteria such as FPE, AIC, HQ and SC. Using these criteria, we select appropriate models that best fit the data. The tests show that by all criteria the optimal order is **VAR (2).** Therefore, we use VAR of order **2** in my further research. Concerning the matrix of residual correlation of diagonal elements, they are rather close to zero, such that no contemporaneous correlation is being ignored by the VAR. Therefore, we can conclude that: there are contemporaneous correlations residual between MPI`, RPI, M1, IR and real GDP or contemporaneous and intertemporal correlation between the residuals of the variables.

Upon visual inspection, the residuals of almost all series exhibit a number of statistical outliers, such that we do expect significant non-normality. On the other hand, the result of the *JB-test for normality* distribution of residuals shows that the H_0 hypothesis of normality distribution cannot be rejected for MPI, RPI and real GDP at a significance level of 5%, while it is rejected for EXCH.E and M1. There are problems with the EXCH. E. and M1 equations; however, the time series in the short term is quite sure to have this kind of problem since it includes monthly data with a great deal of noise. Furthermore, in models with many points of observation, there are often instances of non-normality of distribution of the residuals. According to Johansen and Juselius (1992), non-normality is not such a problem in the short term if, in the long term, the variables prove to be weakly exogenous. As can be seen in the last section, EXCH.E and M1 is a weak exogenous variable (see Brooks 2004). Concerning the LB-test for non-significant residual autocorrelation, there are no statistically significant autocorrelated residuals and no visible patterns (see appendix II and III). The ARCH-test strongly rejects the assumption of heteroscedacity of VARs residuals.

Finally, we can conclude that, despite an unstable VAR due to the inclusion of non-stationary time series in the model, *the diagnostic test is satisfactory and consistent with the assumption of white noise process with constant variance over time.*

(i). The effect of exchange rate disturbance on real GDP and prices

(a)- Choleski decomposition

We employ a recursive VAR approach in order to analyze the effect of exchange rate on real GDP and prices. In addition, we use both *Choleski and Bernanke-Sims decomposition* in order to compare the outcomes between the first and second decomposition. This is consistent with the methods used by McCarthy (2000), Campa and Goldberg (2004), and Cîtu (2003) in their research on developed countries, and also with the methods used by Billmeier and Bonato (2002), Ganev et al. (2002), and Horváth and Maino (2006) in examining small countries in transition via the recursive VAR approach or Choleski decomposition.

In order to identify shocks or their respective impulse-response functions via Choleski decomposition, the variables need to be given a plausible ordering. Following McCarthy (2000) and Campa and Goldberg (2004), we assume a recursive ordering with some small modifications, mostly due to the different characteristics of the national economy. The aforementioned authors assume that international supply shocks are exogenous shocks to the exchange rate by way of import prices. Shocks in the exchange rate will instantly affect the manufacturing prices index and retail prices index, whereas the central bank reaction function with money stock is ranked at the end of the ordering of the variables (Cîtu, 2003). Some research regarding countries in transition has employed shocks in the oil price index or exchange rate as the first variable (Billmeier and Bonato 2002). Therefore, with respect to the aforementioned paper, our own methodology differs in that we do not include a measure of import prices due to a lack of relevant data in the Republic of Macedonia. Billmeier and Bonato (2002) have the same problem, and they also omit import prices (in the case of Croatia). Given that Macedonia is a small open economy, and an insignificant power in the world market, we expect the transmission of import prices to be complete over a rather short time horizon.

In contrast to the work of McCarthy (2000), which analyzes only the effect of the exchange rate on prices, we follow Horváth and Maino (2006) and other authors who focus on countries in transition, and we include real GDP and prices. That is, the direct channel of the effect of exchange rate on prices and the indirect channel of the effect of exchange rate on real GDP through the balance of payments. We are *interested in analyzing both channels of the dynamic effect of exchange rate on real economic activity in the Republic of Macedonia.*

It is assumed that an unexpected change in the exchange rate instantly affects the manufacturing prices index, while MPI instantly affects RPI. Since the central bank in Republic of Macedonia addresses its final goal of price stability through the exchange rate, it reacts instantly to changes in the exchange rate and price indices with its operative targets: the base money and through it on the money stock M1. Moreover, according to McCarthy (2000), Campa and Goldberg (2004), and Cîtu (2003), central banks react to changes in the exchange rate and prices indices. Based on the theoretical assumption and following Sims we assume that M1 instantly affects real GDP (Sims, 1980). Therefore, real GDP could be affected by both channels: exchange rate and money stock. Also, the new Keynesian approach claims that money stock instantly affects real GDP, while prices are rigid in the short term. we must emphasize that the new Keynesian approach regarding the rigidity of prices in the short term points to the possible impact of monetary policy on real GDP. Therefore, the Wald ordering of the variables is as follows: $EXCH.EURO \rightarrow MPI \rightarrow RPI \rightarrow M1 \rightarrow realGDP$.

For the reasons mentioned above, I think that such ordering of the variables in the model is completely valid – both from a theoretical point of view and when considering the behavior of the Central Bank in the Republic of Macedonia.

The recursive approach (Choleski decomposition) is constructed like this:

$$x_t = \begin{bmatrix} EURO \\ MPI \\ RPI \\ M1 \\ realGDP \end{bmatrix} \qquad B_0 = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ b_{12} & 1 & 0 & 0 & 0 \\ b_{31} & b_{32} & 1 & 0 & 0 \\ b_{41} & b_{42} & b_{43} & 1 & 0 \\ b_{51} & b_{52} & b_{53} & b_{54} & 1 \end{bmatrix}$$

The first period of the matrix shows that any unexpected change in the exchange rate will instantly affect the two prices indices, then the central bank responds by the operational target M1 in order to maintain exchange rate stability as an intermediate target. Hence, by stabilizing the exchange rate, the central bank achieves the main goal of monetary policy i.e. price stability. Thus, we can assume that the other variables do not react instantly to M1, but that M1 can instantly affect real GDP. In addition, real GDP can be affected by both channels – the exchange rate and money stock.

In addition, it can be seen from the matrix that the Choleski decomposition model is just identified and that the number of coefficients of matrix B_0 are 10 (lower triangle), which can be estimated in the VAR with unity on the main diagonal. Therefore, the covariance of the matrix is a diagonal matrix. All variables are logarithmic and are estimated by the OLS, which produces residuals that are uncorrelated across the equations. The error bands (interval of confidence) corresponding to 95 percent probability intervals are computed by a Monte-Carlo simulation, following the methodology suggested by Sims and Zha (1999).

Interpretation of the result

The effects of exchange rate shock or disturbances are displayed in Figure 1. The *vertical axis denotes* the response of log MPI, log RPI, log M1, and log real GDP to a one percent shock in the exchange rates by the initial period. The *horizontal axis* denotes time in months.

The dynamic effect of a one percent shock in the exchange rate generates a permanent increase in manufacturing and retail prices and money stock, whereas the response of real GDP is insignificant. *The shock in the exchange rate triggers: (i) a depreciation of the exchange rate; (ii) a sharp and rapid increase of the manufacturing prices index; (iii) an increase of the retail prices index; (iv) an insignificant effect on real GDP; and (v) an increase of money stock.* The manufacturing prices index responds in the first month, and thereafter it shows a permanent increase after twenty-four months of around 0.52 percent. The retail prices index shows a significant response, and it continues to show a permanent increase after twenty-four months of around 0.59 percent. Money stock shows a significant effect in the first month and a permanent increase after twenty-four months of around 0.32 percent.

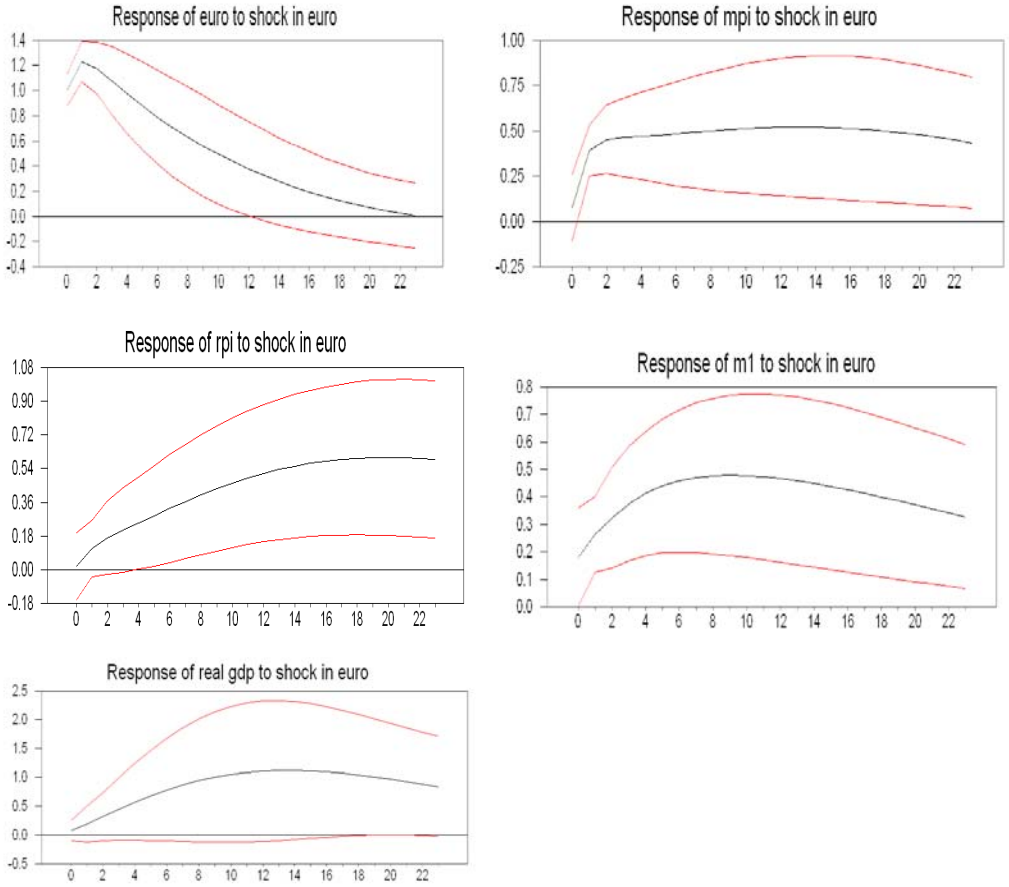
The results of the empirical research suggest that the direct channel of the exchange rate has a strong pass-through effect on prices, but that the indirect channel of the exchange rate does not have an effect on real GDP. Figure 1 highlights this potentially strong pass-through exchange rate effect on prices in the Republic of Macedonia. There is

strong transmission of the effect of changes in the nominal exchange rate *via import prices* to prices in the economy; therefore, a deprecation of domestic currency causes price levels to rise approximately 0.59 percent. Even within the first month, manufacturing prices react to changes in the nominal exchange rate, which reflects a strong pass-through effect of exchange rate changes into domestic prices via import prices. On the other hand, a depreciation of the domestic currency does not show a significant effect on real GDP in Republic of Macedonia.

In addition, the findings are consistent with those from other empirical studies in that the monetary transmission mechanisms are different between developed and small countries in transition. Due to relatively high dollarization of the domestic economy (asset substitution), we see a large pass-through effect from the exchange rate to prices. In contrast to the results of McCarthy (2000), which show that changes in the exchange rate have a modest effect on domestic prices in developed countries, the empirical evidence regarding countries in transition does not seem to suggest the same is true for them, possibly due to a lack of credibility of the monetary authorities, higher dollarization levels and/or the structural element of the price-taking nature of the firms in the international market. Our result is therefore consistent with most other findings regarding small countries in transition, such as those from: Billmeier and Bonato (2002), Kuijs (2002), Jazbec et al.(2004), Ganev et al. (2002), and Horváth and Maino (2006). Results from the empirical research of these authors is covered in the review of the literature on exchange rate regime type, where we mention that they find that exchange rate channels play a more significant role than do other channels in transmitting the dynamic effect of monetary policy to real GDP and prices.

The result reflects the NBRM's monetary strategy of targeting the exchange rate. Figure 1 shows that the prices level cannot be returned back to its baseline trend by endogenous exchange rate adjustments. Thus, this suggests that the exchange rate has been directly determined more by the NBRM than by the prices or real GDP – for example devaluation of the denar against the deutschmark in 1997. Also, this finding is consistent with the deficiency of short-term economic determinants of the exchange rate. Hence, in the absence of changes in the other variables, the prices level can be returned to its baseline trend gradually through changes in the rate of inflation and more rapidly by money supply adjustment. As an alternative, the prices level has to be brought into line with the exchange rate target. The result is consistent with the evidence that the base money and through it the money stock during the period of investigation is a predetermined endogenous variable, so employing rapid endogenous adjustments of money supply in order to return the prices level to its equilibrium is also consistent with endogenety of money supply to exchange rate targeting. Therefore, the money supply is a predetermined endogenous variable to inflation and exchange rate movement through the NBRM's intervention in the foreign exchange market.

Figure 1: The effect of exchange rate on real GDP and prices: Choleski Decomposition EXCH.E-VAR-level



Source: Author's calculations

In addition, we expected a potentially strong pass-through effect of exchange rate on prices in the Republic of Macedonia. This is made clear when assessing the characteristics of the Republic of Macedonia's economy, such as: small open economy, high degree of dollarization at around 51.50 percent, a large imports share (particularly of raw materials), and the lack of influence of the Republic of Macedonia in the world economy. Moreover, many prices, mainly of property and consumer durable goods, are to some extent indexed to the exchange rate. Wages are even indexed to the exchange rate in some economic sectors. Therefore, my result is consistent with the features of the national economy in the Republic of Macedonia. *Hence, these results suggest that monetary policymakers in the Republic of Macedonia must take into account these features concerning the effects of the monetary policy transmission mechanism on the economy.*

Finally, the result shows that any change in the current monetary strategy of exchange rate targeting carries a likely risk of financial instability, due to higher dollarization in Republic of Macedonia, and such changes would adversely affect the NBRM's ability to control inflation due to the higher pass-through effect of the exchange rate regime change on prices.

(b) Bernanke-Sims decomposition

In order to compare the result obtain with the Choleski decomposition, we use Bernanke–Sims decomposition. In Bernanke-Sims decomposition, the plausible ordering of variables is not important, however, we must perform the LR-test proposed by Sims. As such, both channels of the effect of exchange rates on economy are analyzed by Sims and Zha (1998) , Brischeto and Voss (1999), Kim and Rubini (2000), and Uhling (2005) using Bernanke-Sims decomposition.

The variables in the model are divided into two groups: the non-policy vectors, which include the log of GDP, the log of MPI, and the log of RPI; and the policy vectors, which include the log of the exchange rate and the log of M1. *In order to identify the policy shock in the structural VAR, we assume that the non-policy vector-variables cannot respond instantly to the policy vector-variables.* This is a standard assumption in the literature both with quarterly and monthly data (Christiano et al., 1996). Furthermore, as shown by Sims and Zha (1998), a non-recursive identification scheme allows for simultaneous interaction between exchange rates and money stock. The work of Christiano et al. also allows simultaneous interaction between policy vector-variables. In addition, an important issue in estimating structural VAR-s (Bernanke-Sims decomposition), as is true in all systems of equations, is the question of normalizing the coefficients of the dependent variable (Waggoner and Zha, 1997; and Stock and Watson, 2001). Therefore, we must first make restrictions on the matrix B_0, and then we will re-estimate the model by normalizing these coefficients to one.

We propose the following restriction on the B_0 matrix:

$$x_t = \begin{bmatrix} EURO \\ MPI \\ RPI \\ M1 \\ realGDP \end{bmatrix} \qquad B_0 = \begin{bmatrix} 1 & b_{12} & b_{22} & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & b_{32} & 1 & 0 & 0 \\ b_{41} & 0 & 0 & 1 & b_{42} \\ 0 & b_{52} & b_{53} & 0 & 1 \end{bmatrix}$$

The fourth row can be interpreted as the monetary policy reaction to changes in the exchange rate regime; therefore, we allow an instantaneous response of money stock shock to exchange rate shock. On the other hand, the non-policy variables in the *second, third and fifth rows* do not respond instantly to policy variables. *Finally*, the exchange rate responds instantly to innovations in the manufacturing and retail prices indices, whereas manufacturing and retail prices and real GDP do not respond instantly to innovations in either the exchange rate or the money stock.

In order to examine the significance of identification restriction, it is necessary to perform the likelihood ratio test. The LR-test returns significant results, so our identification restriction is accepted.

The LR TEST is:

χ^2 (2) =3.88052; p= 0.17031.

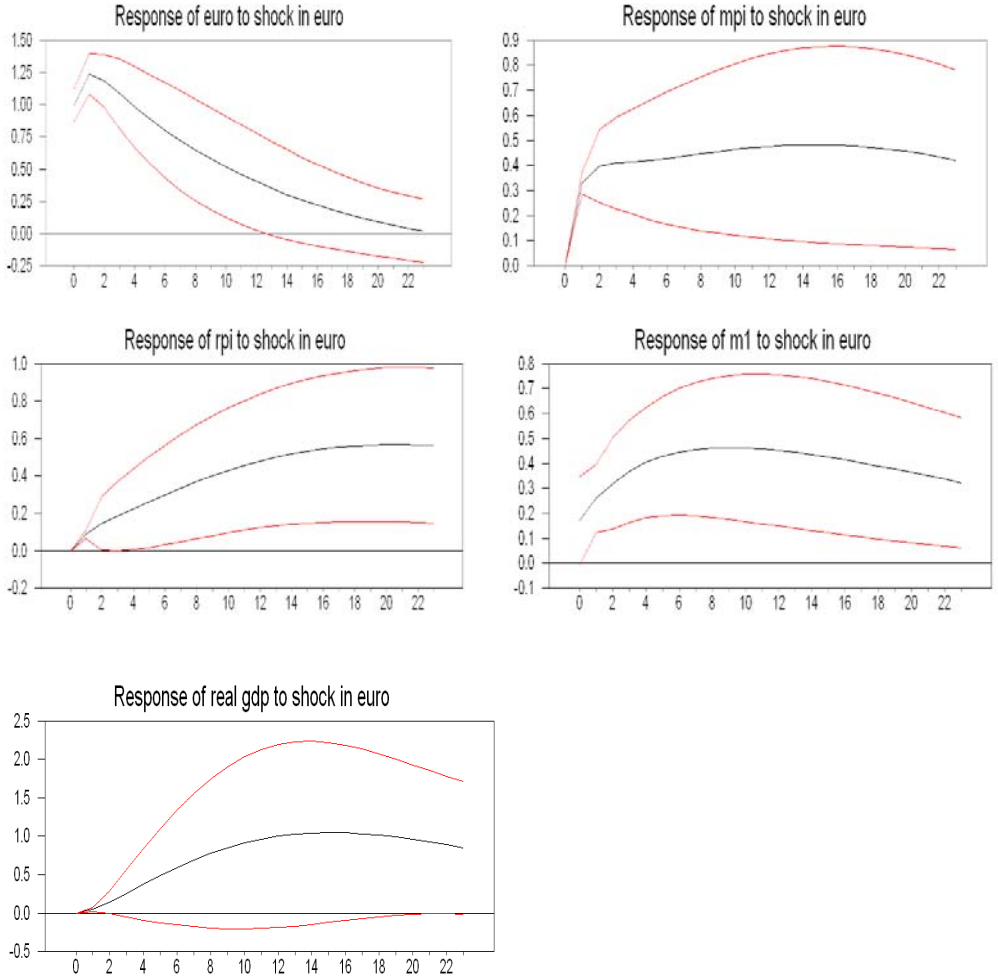
It can be seen that the significance level p>0.05 is greater than 0.05, so we cannot reject the hypothesis *that the restrictions are not binding*. Therefore we can accept the imposed identification restrictions within matrix B_0.

To continue, the result obtained by the Bernanke-Sims decomposition is rather similar to the result obtained by the Choleski decomposition. This similarity between the decompositions suggests that the model is robust.

Interpretation of result

The dynamic effect of the exchange rate on prices and real GDP is displayed in Figure 2 below. Figure 2 shows that the exchange rate has the same pattern in its impulse response function as is seen in the previous Choleski decomposition. Again, this similarity between the results confirms that the model is robust.

Figure 2: The effect of the exchange rate on real GDP and prices: Bernanke-Sims decomposition EXCH.E-VAR-level.



Source: Author's calculations

This decomposition also shows that the exchange rate plays a significant role in the Republic of Macedonia, which is in line with almost all findings regarding small countries in transition. Figure 2 shows that Bernanke-Sims decomposition highlights a potentially strong exchange rate pass-through effect on prices; whereas it does not generate a significant effect on real GDP. Since the results found by this Bernanke-Sims

decomposition are close to the results from the earlier Choleski decomposition, the interpretation of these results is the same as is noted for that previous decomposition.

(ii). Forecast error variance decomposition of exchange rate disturbance on real GDP and prices

Table 1 reports the contribution of exchange rate and money stock disturbances to fluctuations of the MPI, RPI and real GDP. This information is obtained by the forecasts error variance decomposition of endogenous variables generated by the exchange rate and money stock disturbances.

The real variables are accounted for by the median value and 95 percent probability intervals of h-steps-ahead forecasts error decomposition. The result of this test is consistent with the determination of the impulse response functions. Table 1 shows that the contributions of the exchange rate to the fluctuation in the manufacturing and retail prices indices is 47 and 48 percent, respectively. Regarding the forecasts error variance decomposition of real GDP, the contribution of exchange rate to the fluctuation of real GDP is insignificant (around 5 percent).

As for the money stock, Table 1 shows that the contributions of money stock to the fluctuation in the manufacturing and retail prices indices are 9 and 18 percent, respectively. Regarding the forecasts error variance decomposition of real GDP, the contribution of money stock to the fluctuation of real GDP is 10 percent.

These results are consistent with those obtained in the impulse response function by two decompositions. Table 1 shows that exchange rate changes play a more significant role in the fluctuation of prices than do money stock changes. Both channels of the monetary transmission mechanism do not have any significant effect on the fluctuation of real GDP.

Table 1: Forecast error variance decomposition, h periods ahead, accounted for by innovations in EXCH.E and exchange rates-VAR

Forecast error in	Forecast horizon *h* (months)	Innovation in Exchange rate	Innovation in M1
MPI	1 12 24 48	0.09 0.33 0.37 0.47	0.01 0.05 0.09 0.09
RPI	1 12 24 48	0.01 0.19 0.36 0.47	0.01 0.15 0.17 0.18
Real GDP	1 12 24 48	0.01 0.02 0.04 0.05	0.01 0.08 0.09 0.10

Source: Author's calculations

In addition, the results suggest the exchange rate highlights a strong exchange rate pass-through effect on domestic prices. On the other hand, the money supply channel is weak as an independent instrument of monetary policy

4. Econometric model for testing long-term dynamic effect exchange rate on real GDP and prices in the Republic of Macedonia: Vector Error Correction Model (VECM)

In this part of our empirical research, we use a Vector Error Correction Model (VECM) in order to examine long-term dynamic effect of exchange rate shocks on real GDP and prices in the Republic of Macedonia.

4.1. Econometric model and result

4.1.1. Testing long-term dynamic effect of exchange rate disturbances on real GDP and prices in Republic of Macedonia: VECM-method

Initially, we test for integrated properties of the variables – i.e. an augmented Dickey Fuller test (henceforth-ADF test) – in order to check whether the time series are difference-stationary or trend-stationary, as well as to check whether the time series are integrated in the first or second order. Subsequent to the Dickey Fuller test, we perform tests for cointegration of the properties of the variables and for the presence of long-term links between exchange rates, money stock, real gross domestic product, and manufacturing and retail prices indices. In doing so, we follow the methods used by Johansen (1995), Mosconi (1999), Enders (2004), and Lütkepohl (2005).

(i). Test for Integrated Properties of the Variables-A Testing for Trends and Unit Roots Test - Augmented Dickey-Fuller-Test

By visual inspection of the univariate time series, it can be seen that all of the time series exhibit trend patterns, with the exception of the exchange rate. However, we cannot differentiate between those that are trend-stationary and those that are difference-stationary by visual inspection alone. Moreover, if the time series exhibit difference-stationarity (henceforth DS), they can be transformed into a stationary time series by differencing, whereas if the time series exhibits trend-stationarity (henceforth TS), they can be transformed into a stationary model by removing the deterministic trend.

To examine the integration properties of the time series – i.e. whether they are DS or TS series – we use an Augmented Dickey-Fuller test (henceforth ADF). *The null hypothesis of the ADF test is that the process has a unit root, i.e. the process is nonstationary.* Therefore, if the calculated value τ (tau) is higher than the value reported by the Dickey-Fuller table, the null hypothesis can be rejected; hence, the time series does not have a unit root and it is stationary. Conversely, if τ is smaller than the critical value, the null hypothesis cannot be rejected, so we can conclude that the time series does have a unit root and therefore it is nonstationary. As in the previous models, we use monthly data ranging from 1997:1 to 2008:12, so there are 120 observations. The choice of the number of lags is based on Schwartz's Bayesian Information Criterion.

Table 2: Tests for integration properties of the variables in levels with linear trend (t) and constant term(c): level

LEVELS			
Variables	**Test Statistic**	**Deterministic**	**k**
LNECXH.E	-3.9326	t,c	0
LNMPI	-2.1446	t,c	0
LNRPI	-2.1236	t,c	0
LNM1	-2.5226	t,c	0
LNADJGDP	-1.9425	t,c	2

Critical value for 93 observations:

ADF; -4. 04 (1% significance); -3.45 (5% significance.); -3.15 (10% significance).

The critical values for the ADF test are taken from Hamilton (1994) and Enders (2004)

Source: Author's calculations

The first column in Table 2 reports the variables that will be estimated by the ADF test: log of the Exchange rate, log of MPI, log of RPI, log of M1 and log of the seasonally adjusted real GDP. All variables are in levels. The second column shows the Dickey–Fuller statistics. The third column shows the deterministic components that are used for testing. The last column shows the number of lags selected by the Schwartz Bayesian Criterion (SBC), (Enders, RATS, 2004; and Mosconi, MALCOM, 1999 and 2007). The critical values of the ADF test are denoted in the button of Table 2.

This test includes real GDP seasonality because the variable used in the model is seasonally adjusted real GDP. Using trend and constant as a deterministic component for the variables in levels, Table 2 shows that all variables have a unit root and are therefore non-stationary, because we cannot reject the null hypothesis of a unit root against the alternative of stationary for any of the variables. The null hypothesis for exchange rates is rejected at the five percent and ten percent significance level, while it is not rejected at the one percent significance level. The result for the exchange rate is inconclusive, but upon taking the first difference it became stationary, so therefore the exchange rate is integrated in the first order I(1) process (see Table 3). Therefore, I can conclude that the variables are difference-stationary (DS) and not trend-stationary (TD).

Table 3: Tests for Integration Properties of the variables in first difference with constant: in differences

FIRST/SECOND DIFFERENCE			
Variables	**Test Statistic**	**Deterministic**	**k**
LNECXH.E	-7.0998	c	1
LNMPI	-11.1527	c	1
LNRPI	-10.098	c	0
LNM1	-6.9505	c	3
LNADJGDP	-11.8327	c	10

Critical value for 93 observations:

ADF; -3. 51 (1% significance); -2.89 (5% significance.); -2.58 (10% significance.)

Source: Author's calculations

We continue the analysis by taking the first difference, so that we may determine in which order the properties of the variables are integrated. Table 3 shows that when taking the first difference with deterministic component constant across all variables (excepting

real GDP), the null hypothesis is strongly rejected at all significance levels. Therefore, we can conclude that the time series are stationary and are integrated in the first order I(1). With respect to real GDP, the null hypothesis can not be rejected in the first difference at any level, so it does not become stationary and integrated in the first order. Further, in the second difference, real GDP can reject strongly the null hypothesis at all levels of significance and thus becomes a stationary process, but it is integrated in the second order I(2). Therefore, we can conclude that real GDP becomes stationary once it is calculated in the second difference. According to Johansen (1995), having this one variable as I(2) should not cause significant problems because all of the other variables are integrated in I(1), and therefore we are allowed to establish the VECM model (see Mosconi, 1999 and 2007; and Enders, 2004).

Finally, we can conclude that the time series are not trend-stationary (TS) processes; whereas instead they proved to be difference-stationary (DS) and integrated in the first order I(1).

(ii) Test for cointegration of the properties of the variables and long-term links between exchange rates, money stock, real GDP, and prices

According to the Augmented Dickey-Fuller test, the cointegration link among the variables can be investigated only if the variables are difference-stationary (DS) and integrated in the first order. Aside from the fact that the time series have to be integrated in the first order, we must also include error correction terms into the standard VAR in order to examine the cointegration of time series, i.e. to analyze issues in the VECM. We must then attempt to determine if there is any linear combination among the variables in the long-term equilibrium. Using Johansen methodology, the linear combination between the variables in the long term is then analyzed.

Therefore, based on Johansen methodology and the data from 1997:1 to 2008:12, the VECM specification is given as:

$$\Delta x_t = \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-1} + \mu_0 + \Psi D_t + \Theta w_t + e_t$$

Here, $\Gamma_i \Delta x_{t-i}$ is the matrix of parameters relating to *the short-term dynamics* of the model, while $\prod = \alpha\beta'$ contains information relating to the *long-term relationships* of the variables in the model. With regard to α and β are $p \times r$ matrices, and r is the number of cointegrating relation. The colum of β is a cointegrating vector, whereas α is the *loadings matrix* of the cointegrating vector and shows the speed of adjustment towards the long-term equilibrium, μ_0 is a *vector of the constant,* D_t is a *vector of intervention dummy,* and e_t is a *vector of disturbance.* The linear combination expresses $\beta' x_{t-1} = ECT_{t-1}$ the cointegration relationships (error correction terms) between the variables.

I start with specification of the tests, such as: *the maximum lags, the trend polynomial, the cointegration ranks, the stability of parameters, and the testing hypothesis for the I(1) model.*

The maximum lags are based on AIC, HQ, and SC criterion. All of the criteria have shown that *two lags* are the optimal number of lags, and therefore we use two lags in my model.

The test for the trend polynomial clearly supports the model with a *constant in the short-term matrix*, whereas it does not support the alternative model with a trend in the cointegration space (see Appendix I). In this model, the restriction that the trend coefficient is zero in the cointegration space cannot be rejected against the model with a trend in the cointegration space. In continuing, *I establish a model with a constant in the short-term matrix and no trend in the cointegration space.*

In the next step, we examine the trace test statistics for cointegration rank, as reported in Table 4, which is estimated using *Johansen's maximum likelihood procedure.*

In the trace statistic tests, the null hypothesis that the number of cointegration vectors rank $(\mathbf{\Pi})$ is less than or equal to r will be evaluated against a general alternative hypothesis. We use Johansen and Nielsen's (1993) critical value of the λ_{trace} statistics for dummy variables included in the system. These should be appropriate since the impact of impulse dummies on the asymptotic distribution of the rank test is usually negligible (Hubrich 2001).

Table 4: Test for cointegration rank (r)

Null Hypothesis	Alternative Hypothesis	λ -trace	90% critical value	95% critical value	97.50 critical value
$r = 0$	$r > 0$	77.20	64.84	68.52	71.50
$r \leq 1$	$r > 1$	46.55	43.95	47.21	50.35
$r \leq 2$	$r > 2$	29.87	26.79	29.68	32.56
$r \leq 3$	$r > 3$	16.02	13.33	15.41	17.52
$r \leq 4$	$r > 4$	3.48	2.69	3.76	4.95

Note: The hypothesis is accepted when the calculated value < table value
Source: Author's calculations

The null hypothesis is rejected if the trace statistic is larger than the critical value. It can be seen in Table 4 that under the null hypothesis r =0 is rejected because the trace statistic is higher than the critical value at the 95 and 97.5 percent significance levels. On the other hand, the alternative hypothesis of the presence of one or more cointegrating vectors is accepted. Since, *46.55 is less than the 95 and 97.5 percent critical values (47.21 and 50.35 percent respectively),* we cannot reject the null hypothesis at these significance levels. Based on the results of the trace test, we accept a rank r = 1, which implies that we need to find one cointegration vector of long-term relationship among the variables.

In addition, the parameter's stability has been evaluated using tests such as stability of cointegration vectors and cointegration space (see Appendix I). The test shows that both cointegration vectors and the cointegration space are stable in all periods of observation. In the interpretation, a value of more than one means that the hypothesis is rejected, whereas a value of less than one means that the hypothesis cannot be rejected. The cointegration rank r is stable if rank r-1 is rejected for any sample size and if rank r is not rejected for any sample size. As seen in Appendix I, the uppermost line represents the test for hypothesis r = 0, which in this case is clearly rejected for any sample size since the ratio of the test value to the critical value is more than one. The second line shows that r = 1 is selected for any sample size and therefore it cannot be rejected since the ratio of the test value to the critical value is less than one. Actually, this choice corresponds to the true rank in the Data Generation Process.

With respect to cointegration space Sp(B*), the figure in Appendix I shows that the normalized test results are well below one for the Z-model and the R-model for any sample size, which is evidence in favor of the stability of Sp(B*). Also, in this case, a value greater than one means that the hypothesis is rejected, whereas a value less than one means that the hypothesis cannot be rejected. Here, *both models are less than one and converge to long-term equilibrium.*

Next, we examine the I(1) model by employing tests such as: the *test for stationary, the weak exogenity test of variables , and the test for exclusion of variables from the model.* We also examine the identification of the B matrix and test for linear restrictions on loading in matrix A and matrix B.

The likelihood ratio test (LR-test) for each of these hypotheses is that they are asymptotically X^2 distributed with r degrees of freedom under the null hypothesis, with a significance level of 5 percent. The first row of each table in Appendix I shows the variables of the model; the second row shows degrees of freedom; and the third and fourth row show LR TEST statistics and significance level *p*.

The evidence as to whether or not the series are stationary, as reported in Appendix I, shows that the hypothesis of stationarity is rejected for all variables. This confirms the Dickey-Fuller test that the time series have a unit root and are non-stationary. The results of analyses of weak exogenity are also reported in Appendix I. The exchange rate, money stock, and real GDP all show weak exogenity variables, i.e. these variables are not affected by the cointegration of long-term relationships of the variables – they are affected only by the short-term relationships. *Since money stock has this characteristic, we may conclude that the NBRM does not apply monetary rules, but that instead the monetary policy is being lead by discretionary measures.* In addition, during the investigated period, the base money and through it the money stock has been endogenous to inflation and exchange movement via central bank intervention in the foreign exchange market. *This is consistent with my finding that money supply is endogenous to the exchange rate target, whereby money supply is highly determined by developments in the foreign exchange market.*

Finally, the result of the exclusion of the variables from the cointegration vector is reported in Appendix I. According to this analysis, only real GDP is excluded from the cointegration vector, whereas exchange rate, manufacturing prices, retail prices, and M1 are not. *Thus, there is only one long-term stable linear combination: between exchange rate, manufacturing prices, retail prices, and money stock.* Furthermore, the manufacturing prices and retail prices react to long-term equilibrium between exchange rate, manufacturing prices, retail prices, and money stock, whereas exchange rate and money stock do not react to such equilibrium due to their characteristic of weak exogenity.

The result is consistent with the evidence that the exchange rate is endogenous to Macedonian monetary policy, i.e. part of the managed exchange rate regime.

In the next section, we examine the linear restriction on the loadings matrix and the matrix of the cointegration vector, and therefore we normalize with one RPI. For this purpose, we employ the likelihood ratio test for this hypothesis, where chi squared with 1 degrees of freedom is 1.64251, whereas the level of significance is 0.64979*. Thus, the linear restrictions on α and β are accepted because the significance level is 0.64979, which is higher than 0.05. In other words, the LR-test shows that overidentifying restrictions on both matrices are accepted[2]. We also compute the "standard error" for both matrices in order to calculate the *t* value, i.e. the significance of the estimated coefficient. The "standard error" in the loadings matrix are MPI = 0.06 and RPI = 0.0647, and the "standard error" in the matrix of cointegration vector are EXCH.E= 0.2329, MPI=0.2363 and M1=0.0557. We can now estimate the *t* value: (MPI = (*t*) 2.60 and RPI = (*t*) 2.72, while EXCH.E 0.5212/0.2329 = (*t)* 2.23, MPI 0.5622/0.2363=.(*t*) 2.37 and M1 0.17/0.0557= (*t*) 3.15

Table 5: Linear restriction on loading and cointegration vector matrices

Variables	β	α
EXCH.E	-0.5212	-0.06
MPI(exog.)	-0.5622	0
RPI(exog.)	1	0
M1	-0.17	-0.13

Note: α adjustment coefficient, β cointegration vector, coefficient is normalized on the RPI.

Source: Author's calculations

Finally, we may conclude that all estimated coefficients are statistically significant and have the expected signs. In continuing, we can rewrite the long-term equilibrium relation as follows for easier interpretation of the cointegration vector:

RPI = 0.5212 EXCH.E+0.5622MPI+0.17M1
(see) (0.2329) (0.2363) (0.0557)
(*t*) (2.23) (2.37) (3.15)

The long-term relationship between exchange rate, manufacturing prices, retail prices, and money stock is statistically significant due to the high value of the t statistic (EXCH.E=2.23, MPI=2.37 and M1=3.15).

The cointegration vector can be interpreted as a causal model with the price level as the dependent variable. Therefore, the cointegration vector shows that retail prices are positively correlated with exchange rate, manufacturing prices, and money stock.

Table 5 shows that the retail prices index moves positively according to changes in the exchange rate. A depreciation of the domestic currency of one percent against the euro will generate an increase in the price level of 0.5212 percent. Therefore, the coefficient *of EXCH.E (in the above equation) shows a strong pass-through effect of nominal exchange rate changes to prices level in Republic of Macedonia.* Moreover, the coefficient of the exchange rate could be interpreted as a long-term coefficient of elasticity (due to logs), *indicating that a 10 percent devaluation (depreciation) of domestic currency results in a*

[2] ***Note: Overidentifying restriction is accepted when the significance level is larger than 005.***

5.2 percent rise of the retail prices level in the long term in the Republic of Macedonia. In other words, the exchange rate has a long-term coefficient of 0.52, indicating that 52 percent of changes in the EXCH.E are fed into the prices level.

It can be seen that the exchange rate is a potential source of inflation both in the short and long term in the Republic of Macedonia. Hence, we can conclude that the direct channel of exchange rate has a strong effect on inflation in the long term, whereas the indirect channel of exchange rate has no effect on real GDP. These results lend solid support in favour of the NBRM's monetary strategy of exchange rate targeting, since a strong link between exchange rate and prices in the Republic of Macedonia is present.

In comparing these results with the findings of other research on small open countries in transition, e.g. Kuijs (2002) for Slovakia, Billmeier and Bonato (2002) for Croatia, and Ganev et al. (2002) for CEES countries, it can be determined that the Republic of Macedonia has a higher long-term pass-through coefficient. Kuijs finds that the long-term pass-through coefficient is 0.2 for Slovakia, whereas Billmeier and Bonato find it to be 0.33 in Croatia. Ganev et al. finds that in most countries in transition the coefficient is close to the value (1.0) that economic theory suggests (e.g. Latvia, Slovakia, Romania, Bulgaria, Czech Republic, and Poland). However, core inflation does not seem to be significantly influenced by depreciation in Hungary, Slovenia, or Lithuania. My result is consistent with the conclusions of McCarthy (2000), who claims that pass-through is stronger in countries with larger import shares.

The coefficient of the money stock (in the above equation) shows that changes in the money stock will generate an increase in the price level by 0.17 percent. This is in accordance with the monetarist view that an increase of the nominal quantity of money will cause the price level to rise, i.e. rate of inflation.

The result is close the result of Belullo (1999), who finds that an increase of money stock will cause inflation (in Croatia). In addition, the result shows a persistent effect of money stock on retail price level that is statistically significant and which confirms the importance of money stock as a source of inflation in the Republic of Macedonia.

Regarding α the coefficient of adjustment, RPI will adjust to its long-term equilibrium after 18 months by endogenous exchange rate adjustment. This supports the evidence that exchange rate is endogenous to Macedonian monetary policy, i.e. part of managed exchange rate regime. Because of exchange rate targeting by the NBRM, relatively rapid endogenous exchange rate adjustments can "catch up" to a price level above equilibrium via the nominal depreciation of the exchange rate after 18 months. *This reflects a relative degree of exchange rate stability after the devaluation in 1997.* On the other hand, the mechanism of adjustment implies that the prices level can be brought into line with the exchange rate target more rapidly. This can be achieved via rapid money supply adjustment to return the prices level to long-term equilibrium. This is consistent with the endogeneity of money supply to exchange rate targeting, whereby money supply has been made endogenous to inflation and exchange rate movement through central bank intervention in the foreign exchange market.

5. Conclusions

The main objective of this paper is to examine the effect of exchange rate regime type on real GDP and prices in the Republic of Macedonia over the period from 1997 to 2008. Based on the available theoretical and empirical evidence, we employ SVAR and VECM methodologies in order to investigate the short and long term effect of exchange rate on real GDP and prices.

For countries in transition with short spans of data (which are sometimes of questionable quality), empirical results are to be indicative rather than definitive. With that caveat in mind, my main findings and their implications are as follows:

The short and long term effects of exchange rate on real GDP and prices in the Republic of Macedonia are tested using SVAR and VECM methodologies and Choleski and Bernanke-Sims decomposition (Enders, 2004; and Lütkepohl, 2005). The result of the empirical research reveals that the direct channel of the exchange rate has a strong *pass-through effect on prices*, whereas the indirect channel of the exchange rate does not have an effect on real GDP. This highlights the potentially strong pass-through effect of exchange rate on prices in the Republic of Macedonia. Namely, it shows the strong transmission effect of nominal exchange rate changes via import prices on the domestic prices, i.e. a deprecation of domestic currency generates a rise in prices level in the Republic of Macedonia. Even within the first month, the manufacturing price level reacts to nominal exchange rate changes, which indicates the strong pass-through effect of exchange rate changes into domestic prices via import prices. On the other hand, a depreciation of the domestic currency does not show any significant effect on real GDP in the Republic of Macedonia. The exchange rate changes may have a weak effect on real GDP, but this only occurs for two months before the effect died out. This result is consistent with other empirical studies, which find that the effects of the transmission mechanism of monetary policy are different between developed countries and small countries in transition, purportedly due to relatively high dollarization of the domestic economy (currency and asset substitution) in transitional countries, which results in a high pass-through effect from exchange rate changes into prices. In contrast to the conclusion of McCarthy (2000) regarding developed countries, our own conclusion is consistent with most findings regarding small countries in transition, such as those in Bonato and Billmeier (2002), Kuijs (2002), Ganev et al. (2002), and Horváth and Maino (2006) – all of which find that the exchange rate channels play a more significant role than do other channels in the monetary transmission mechanism. A strong pass-thorough effect of exchange rate changes on prices in the Republic of Macedonia is to be expected, bearing in mind the characteristics of the national economy: small open economy, higher dollarization, , and a larger import share (particularly of raw materials). *The long-term effect* of exchange rate regime type is tested with VECM methodology. *The statistical test for stationarity* shows that the hypothesis for stationarity can be rejected for all variables. This test is consistent with the Dickey-Fuller test, in which all time series have unit roots and are non-stationarity. *The results of analyses for weak exogenity* show that exchange rate, real GDP, and money stock are all weak exogenous variables, meaning that these variables are not affected by the cointegration of long-term relationships between the variables, but that they are instead affected only by short-term relationships. As the money stock has this characteristic, we conclude that the NBRM does not base its monetary strategy on monetary rules, but rather that monetary policy is run according to discretionary measures. As a final point, the result of the *test for the exclusion of variables* from the cointegration vector shows that only real GDP is excluded, while the exchange

rate, manufacturing price, retail price, and money stock are not excluded from the cointegration vector. Thus, we conclude that there is only *one long-term stable linear combination between the exchange rate, manufacturing price, retail price, and money stock.* Furthermore, the manufacturing price and retail price react to the long-term equilibrium between exchange rate, manufacturing prices, retail prices, and money stock, while the exchange rate and money stock do not react to such equilibrium due to their characteristic of weak exogenity. This finding is consistent with the fact that the exchange rate and money stock are endogenous to Macedonian monetary policy, whereas exchange rate is part of the managed exchange rate regime. Therefore, the VECM finds only one long-term cointegration vector between exchange rate, manufacturing and retail prices, and money stock. In this context, *the coefficient EXCH.E (exchange rate euro) shows a greater pass-through effect of nominal exchange rate changes to prices in the Republic of Macedonia.* Hence, the exchange rate is a potential source of inflation in both the short and the long term in the Republic of Macedonia. In the long term, the direct channel of exchange rate changes has a strong effect on the rate of inflation, while the indirect channel of exchange rate changes shows no effect on real GDP. The result also lends support to the NBRM's monetary strategy of targeting the exchange rate due to the strong pass-through effect of nominal exchange rate changes to prices in the Republic of Macedonia. For the sake of easier interpretation, the results reveal that the exchange rate has a *long-term coefficient of 0.5212, indicating that 52 percent of changes in the EXCH.E feed into the prices level.* For comparative purposes, I report the results of other findings from small open countries in transition: e.g., Kuijs (2002) finds that the long-term pass-through coefficient is 0.2 for Slovakia, and Bonato and Billmeier (2002) finds that the coefficient is 0.33 in Croatia. As we can see, Macedonia has a higher pass-through than those countries in transition. However, my result is almost consistent with the finding reported in Ganev et al. (2002), which claims that the coefficient is close to 1.0 (in keeping with economic theory) for most countries in transition (e.g. Latvia, Slovakia, Romania, Bulgaria, Czech Republic and Poland). However, depreciation does not seem to significantly influence core inflation in Hungary, Slovenia and Lithuania. *In the long term, the coefficient of money stock shows that a one percent change in the money stock will generate an increase in the prices level of 0.17 percent,* which is in accordance with the monetarist view that an increase in the nominal quantity of money will cause the prices level to rise, i.e. inflation. The result shows that the persistent effect of money stock on retail price level is statistically significant, confirming the importance of money stock as a source of inflation, both in the short and the long term in the Republic of Macedonia.

Finally, assessing the relative costs and benefits associated with introducing a different exchange rate regime in the Republic of Macedonia, all econometrics results, using different methodologies (SVAR and VECM), show that introducing such policies in order to promote rapid economic growth could easy disturb macroeconomic stability (after having achieved it at a substantial cost) without any significant economic benefits. Therefore, introducing a different exchange rate regime is likely to incur more costs than benefits, since changes of exchange rate regime type does not show a persistent effect on real GDP, while changes of exchange rate regime does show a strong and persistent effect on prices level. In this context, all results show that changes in the exchange rate exhibit a potentially strong pass-through effect on domestic prices via import prices. A depreciation of the domestic currency against the Euro causes a sharp and rapid increase in manufacturing prices, an increase in the retail prices index and an insignificant effect on real GDP. Since the Republic of Macedonia achieved macroeconomic stability at a substantial cost, the empirical result suggests that the stability of the exchange rate is very important for macroeconomic stability because it highlights a potentially strong pass-

through effect on the domestic prices level. Without a doubt, changing the type of the exchange rate regime carries a likely risk of financial instability due to higher dollarization. Such changes also adversely affect the NBRM's ability to control inflation, due to the strong pass-through effect of the exchange rate changes on domestic prices. It is probably not worthwhile to do anything that may return Republic of Macedonia to inflation, which the flexible exchange rate regime may do, since the high cost of stabilization will once more be born by the people. Since the exchange rate reveals a strong potential effect on prices level, the results suggest that abandoning the exchange rate regime or depreciating the domestic currency would not be a wise strategy for promoting economic growth, since it would not create any economic benefit, while macroeconomic instability would follow with well-known negative consequences for economic growth.

Appendix I

A. Data sources

All data come from the NBRM, the, and the Macedonian Bureau of Statistics.

"GDP": gross domestic product, provided by the Macedonian Bureau of Statistics.
"MPI": manufacturing prices index, provided by the Macedonian Bureau of Statistics.
"RPI": retail prices index, provided by the Macedonian Bureau of Statistics.
"M1": money stock consists of the base money and balances held in chequing accounts (personal and current accounts), provided by the National Bank of the Republic of Macedonia (NBRM);
"EXCH.EURO": monthly average exchange rate of Macedonian Denar (MKD) per EURO, provided by the NBRM.

B. The method and parameters for seasonality adjusting

The seasonality of the variables will be tested by the method of exponential smoothing. The following table shows the model proposed by E.S.Gardener (1985) for different combinations of the season and trend.

	No seasonality deviation (bais)	Additive seasonality	Multiplicative seasonality
No trend	$S_t = S_{t-1} + \alpha e_t$	$S_t = S_{t-1} + \alpha e_t$ $I_t = I_{t-\gamma} + \delta(1-\alpha)e_t$	$S_t = S_{t-1} + \alpha e_t / I_{t-\gamma}$ $I_t = I_{t-\gamma} + \delta(1-\alpha)e_t / S_t$
Linear trend	$S_t = S_{t-1} + T_{t-1} + \alpha e_t$ $T_t = T_{t-1} + \alpha\gamma e_t$	$S_t = S_{t-1} + T_{t-1} + \alpha e_t$ $T_t = T_{t-1} + \alpha\gamma e_t$ $I_t = I_{t-\gamma} + \delta(1-\alpha)e_t$	$S_t = S_{t-1} + T_{t-1} + \alpha e_t / I_{t-\gamma}$ $T_t = T_{t-1} + \alpha\gamma e_t / I_{t-\gamma}$ $I_t = I_{t-\gamma} + \delta(1-\alpha)e_t / S_t$
Exponential trend	$S_t = S_{t-1}T_{t-1} + \alpha e_t$ $T_t = T_{t-1} + \alpha\gamma e_t / S_{t-1}$	$S_t = S_{t-1}T_{t-1} + \alpha e_t$ $T_t = T_{t-1} + \alpha\gamma e_t / S_{t-1}$ $I_t = I_{t-\gamma} + \delta(1-\alpha)e_t$	$S_t = S_{t-1}T_{t-1} + \alpha e_t / I_{t-\gamma}$ $T_t = T_{t-1} + \alpha\gamma e_t / (I_{t-\gamma}S_{t-1})$ $I_t = I_{t-\gamma} + \delta(1-\alpha)e_t / S_t$

S_t smoothing the level of time series;
T_t trend;
I_t seasonal index
e_t error in period t;
α parameter of smoothing level;
γ seasonal period;
δ parameter of smoothing seasonal.

The estimation of parameters has utilized the simplex method, which minimizes the squares error e_t^2.

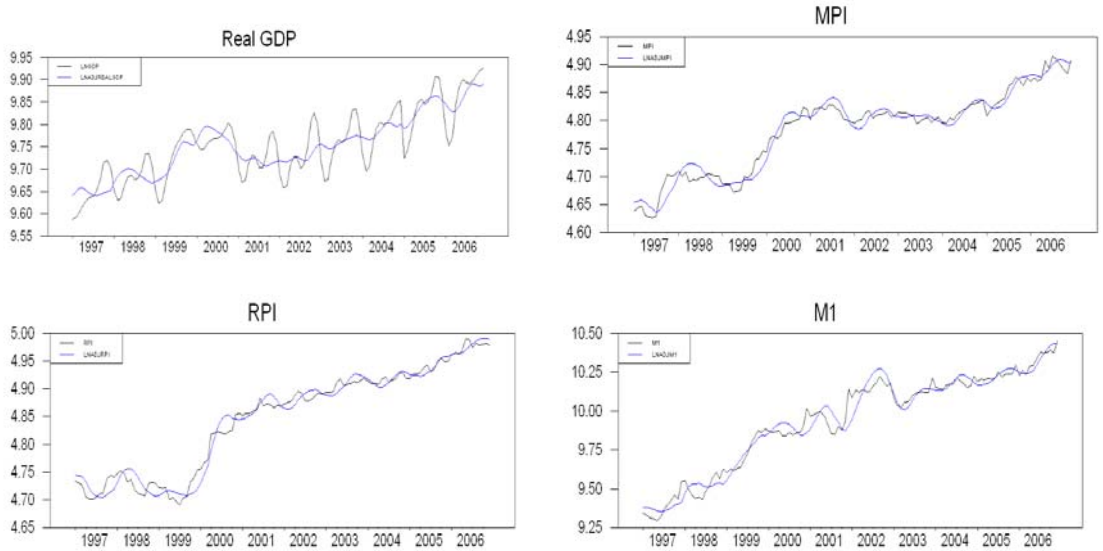
The value of the parameters α γ δ for GDP

Model with TREND=Linear, SEASONAL=Multiplicative

Estimated coefficients: alpha = 1.458067, gamma = -0.012734, and delta = -0.295535

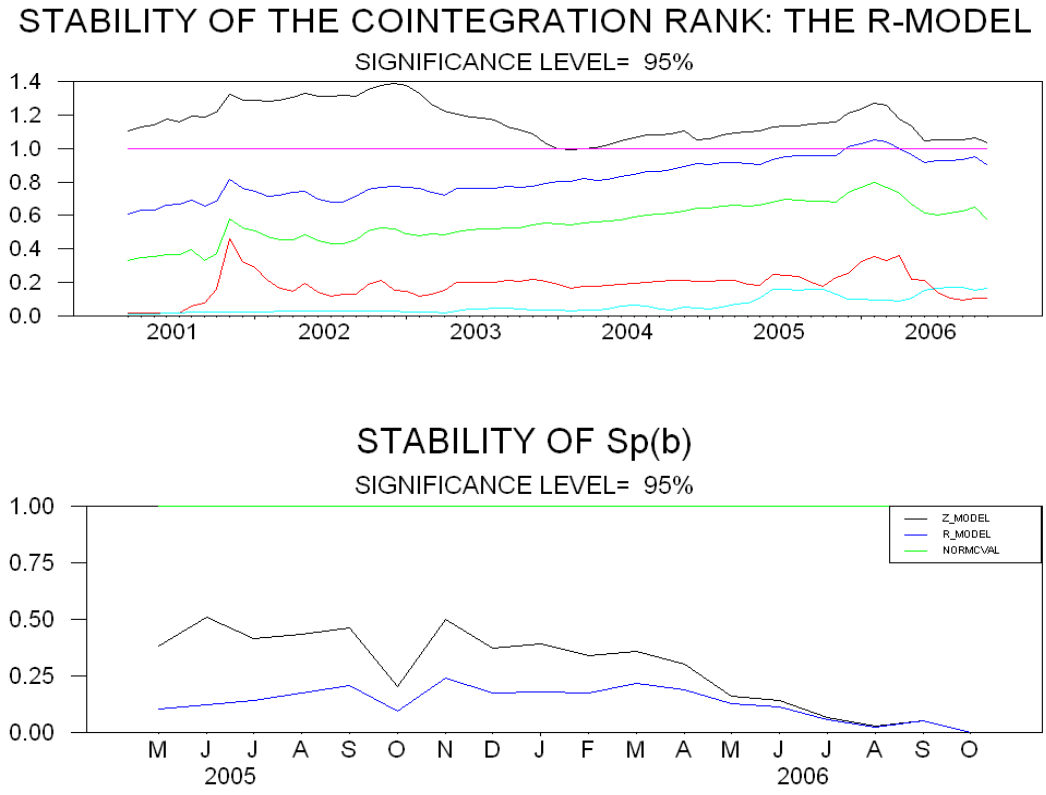
C. Figures

Figure C1: Logarithms of time series MPI, RPI, M1 and GDP, except IR.



Source: Author's calculations

Figure C2. Parameter of stability



D. Tables

D1. Test for the trend polynomial

****

TESTS FOR THE TREND POLYNOMIAL (r GIVEN):

****

H0	HA	\ TEST	DGF	SIG.LEV.
m0 = m0; m1 = 0	**m0 = m0; m1 = ab1 |**	**6.610**	**1**	**0.158**

****

NOTE: THE HYPOTHESIS IS ACCEPTED WHEN SIG.LEV > 0.05. The mo=mo;m1=0 is
a model with constant in the short-run against the model with constant and trend in the cointegration space.
It can be seen that model without trend in the cointegration space is better than the model with trend.

D2. Tests for stationarity, weak exogeneity and exclusion

TESTS FOR STATIONARY					
VARIABLES	EXCH.E	MPI	RPI	M1	REAL-GDP
D.F	4	4	4	4	4
X^2	31.41597	38.13822	27.18662	34.01207	27.91391
Sig.level	2.52E-06	1.05E-07	1.82E-05	7.41E-07	1.30E-05

TESTS FOR WEAK EXOGENEITY					
VARIABLE	EXCH.E	MPI	RPI	M1	REAL-GDP
D.F	1	1	1	1	1
X^2	3.086	5.56521	6.79681	0.11	0.02
Sig.level	0.11	0.01	0.02	0.74	0.86

TESTS FOR EXCLUSION					
VARIABLE	EXCH.E	MPI	RPI	M1	REAL-GDP
D.F	1	1	1	1	1
X^2	9.118	8.74	9.04	7.94	1.55
Sig. level	0.001	0.03	0.001	0.03	0.212

Note: Stationarity, weak exogeneity and exclusion is accepted when the significance level is larger than 0.05.

Author's calculations.

Appendix II

Endogenous variable: EXCH.EURO, MPI, RPI, M1, GDP
Deterministic component: constant and dummy

Criteria for VAR Order Selection

	FPE	AIC	HQ	SC
1	2.55219e-020	-45.19921	-44.96213	-44.61536
2	1.15089e-020	-45.99863	-45.52194	-44.82461
3	1.24219e-020	-45.92892	-45.21007	-44.15830
4	1.33478e-020	-45.86932	-44.90570	-43.49554
5	1.59554e-020	-45.71120	-44.50016	-42.72757

VAR Residual Correlation

EURO	MPI	RPI	M1	GDP
1.0000	0.5764	0.1772	0.0853	-0.1319
0.5764	1.0000	0.1636	0.0277	-0.0191
0.1772	0.1636	1.0000	-0.0524	-0.0210
0.0853	0.0277	-0.0524	1.0000	-0.0358
-0.1319	-0.0791	-0.0210	-0.0358	1.0000

VAR Residual Analysis

	Skewness	Kurtosis	JB (2)	LB (16)	LM (16)	ARCH (16)
MPI	-0.0148	3.3293	0.4236	21.1956	32.8244	14.5937
			0.8091	0.0691	0.0078	0.5546
RPI	0.4247	3.3826	3.3630	21.3262	34.9456	7.3163
			0.1861	0.0667	0.0040	0.9667
EURO	0.6025	21.9501	1397.1654	30.4409	42.4985	30.9899
			0.0000	0.0041	0.0003	0.0635
M1	1.4352	8.4074	145.2319	39.6502	45.2594	8.3360
			0.0000	0.0002	0.0001	0.9382
GDP	1.0178	5.0301	32.0263	30.0941	48.1023	12.2267
			0.0000	0.0046	0.0000	0.7282

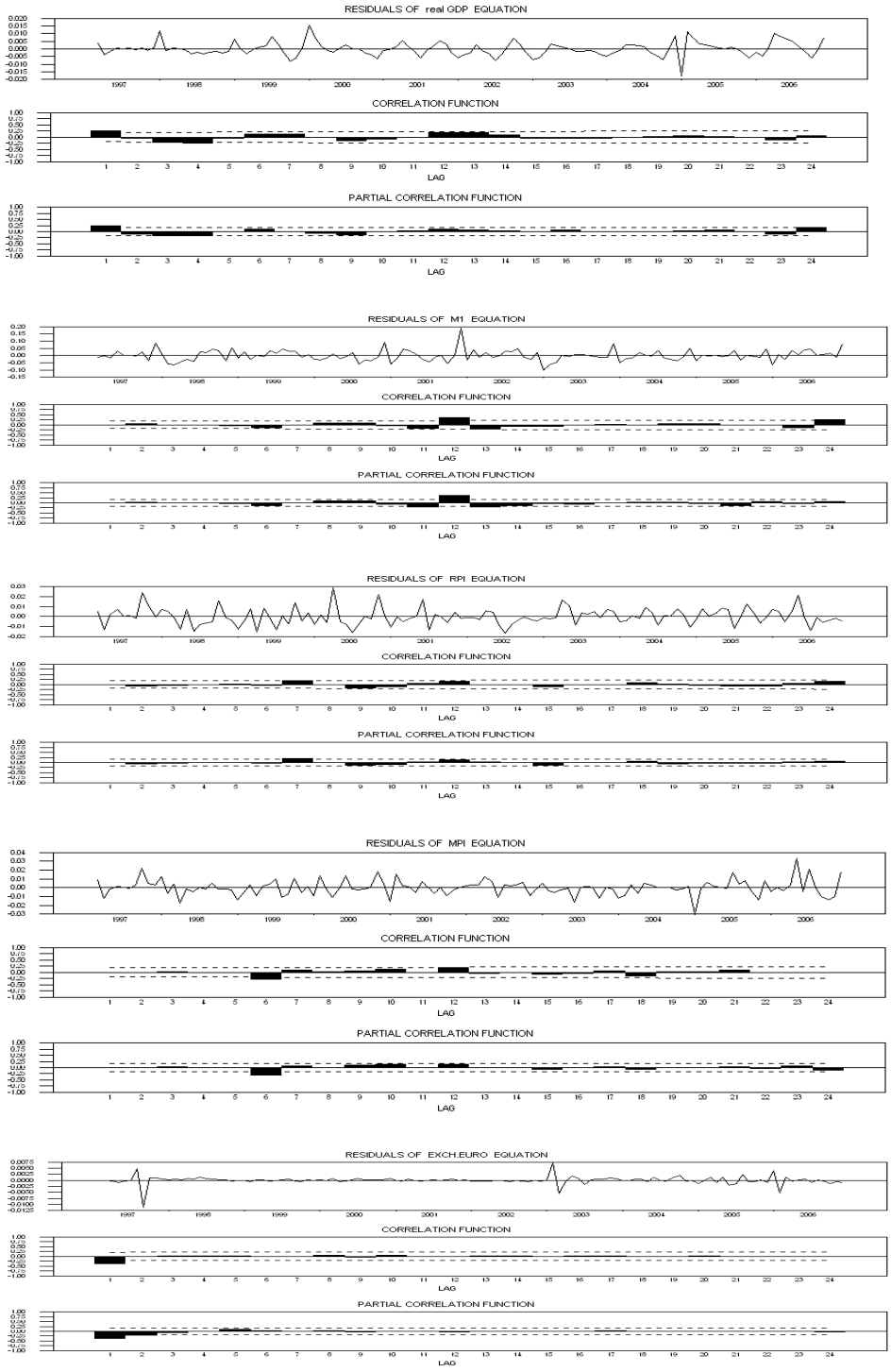
Appendix III

EXCH.E-VECM
Endogenous variable: EXCH.E, MPI, RPI, M1, GDP
Deterministic component: constant and dummy -VECM

Maximum Lag Analyses

LAG	AKAIKE	HANNAN-QUINN	SCHWARZ
1	-44.919	-44.386	-43.606
2	-45.666	-44.891	-43.757
3	-45.607	-44.590	-43.101
4	-45.485	-44.226	-42.382
5	-45.199	-43.697	-41.499

Residual Analyses



References

Bernanke, B., and I. Mihov,: Measuring Monetary Policy. Quarterly Journal of Economics, 113(1998)3, pp. 869-902.

Billmeier, A., and L. Bonato,: *Exchange Rate Pass-Through and Monetary Policy in Croatia.* International Monetary Fund, Working Paper 02/109, 2002. pp. 1-34

Brooks, C: *Introductory Econometrics for Finance.* Cambridge, MA: MIT Press, (2004), p. 209.

Campa, J. M., and L. S. Goldberg,: Exchange Rate Pass-Through into Import Prices. CPER, Discussion Paper, No. 4391, (2004).

Coricelli, F., B. Jazbec, and I. Masten,: *Exchange Rate Pass-Through in Acceding Countries: The Role of Exchange Rate Regimes.* European University Institute, Working Paper, No. 2004/16, (2004), pp. 1-32.

Christiano, L. J., M. Eichenbaum, and Ch. L. Evans,: *The Effect of Monetary Policy Shocks: Evidence from the Flow Founds.* Review of Economics and Statistics, No.78 (1996a), 1, pp.16-34.

Cîto, F.: *A VAR Investigation of the Transmission Mechanism in New Zealand.* Reserve Bank of New Zealand, (2003), pp. 1-28

Clark, T. E.: *The Responses of Prices at Different Stages of Production to Monetary Policy Shocks.* Review of Economic and Statistics, Vol. 81 No. 3, (1999), pp 420-433.

Cushman, D. O., and Tao Zha: *Identifying Monetary in a Small Open Economy Under Flexible Exchange Rate*. Elsevier, Journal of Monetary Economics, Vol. 39, (1997), pp. 433-438.

Corsetti, R., Dedola, L. Macroeconomics of international price discrimination. European Institute, Mimeo (2003).

Dovciak, P.: *Transmission Mechanism Channels in Monetary Policy*. National Bank of Slovakia, Institute of Monetary and Financial Studies, DOV/0008, (1999).

Enders, W.: *Applied Econometric Time Series.* Second Edition, ISBN, 0-471-23065-0, USA, (2004). pp. 1-452.

Ganev, G., K. Molnar, K. Rybinski, and P. Wozniak,: *Transmission Mechanisms of Monetary Policy in Central and Eastern Europe.* Central for Social and Economic Research, Case Reports No. 52., Warsaw, (2002), pp. 1-28.

Gardner, E. S.: *Exponential Smoothing: The State of the Art.* Journal of Forecasting, Vol. 4, (1985), pp.1-28.
Golinelli, R., and R. Rovelli,: *Monetary Policy Transmission, Interest rate Rules and Inflation Targeting in Three countries in transition.* University of Bologna. Available at: http://amscta.cib.unibo.it/archive/00000656/.2004.

Ghosh, A. R., Ane-Marie. Gulde, J. D. Ostry, and H. C. Wolf,: *Does the Nominal Exchange Rate Regime Metter?* NBER, Working Paper, No 5874, (January 1997).

Ghosh, A. R., Anne-Marie. Gulde, and H. C. Wolf,: *Currency Boards: The Ultimate Fix?* Economic Policy, No. 31, (2000), pp 270-335.

Horváth, B., and R. Maino,: *Monetary Transmission Mechanism in Belarus*. IMF Working Paper 06 (2006)246. pp. 1-21.

Hubrich, K.: *A Review of Systems Cointegration Tests.* Econometrics Review, Vol. 20, Issue , (2001), pp. 247-318.

Hyder, Z., and S. Shah,: *Exchange Rate Pass-Through to Domestic Prices in Pakistan.* Working Paper No 5, State Bank of Pakistan, (2004), pp. 1-19.

IMF: *Exchange Rate Arrangement and Economic Performance in Developing Countries*. Washington D.C.: International Monetary Fund, Outlook Report, (1997), pp. 1-20.

Jarociński, M.: *Response to Monetary Policy in the East and the West of Europe: A Comparison.* Center for Social and Economic Research, Working Paper 9667, (2004).

Jazbec, B.: *Model of Real Exchange Rate Determination in Transition Economies.* Faculty of Economic, Ljubljana, Working Paper No.118, (2001), pp.1-45.

Johansen, S., and B. Nielsen,: *Asymptotic for Cointegration Rank Tests in Presence of the Intervention Dummy.* Manuel of Simulation Program DISCO. Manuscript, Institute of Mathematical Statistics, University of Copenhagen, (1993).

Johansen, S.: *Likelihood-Based Inference in Cointegrated Vector Auto-Regression Models.* Oxford Bulletin of Economics and Statistics, No. 92, (1995), pp. 1-24.

Johansen, S., and K. Juselius,: Maximum Likelihood Estimation and Inference on Cointegration-with Application to the Demand for Money. Oxford Bulletin of Economic and Statistics, Vol. 52, (1990), pp. 169-209.

Juks, R.: *Monetary Policy Transmission Mechanism a Theoretical and Empirical Overview. In: The Monetary Transmission Mechanism in the Baltic States.* Tallinn, (2004), pp. 39-59.

Kim, S., and N. Roubini,: *Exchange Rate Anomalies in Industrial Countries: A Solution with a Structural VAR Approach.* Journal of Monetary Economy, No.45, (2000), pp. 561-860.

Kujis, L.*:"Monetary Policy Transmission Mechanism and Inflation in the Slovak Republic.* IMF, Working Paper No 02/80, (2002), pp. 1-24.

Leigh, D., and M. Rossi,: *Exchange Rate Pass-Through in Turkey.* IMF, Working Paper, No. 02/204, Internationally Monetary Fund, (2002), pp. 1-25.

Levy-Yeyati, E., and F. Sturzenegger,: *Exchange Rates Regimes and Economic Performance*, Special Issue, Vol. 47, IMF, (2001), pp. 62-98.

Levy-Yeyati, E., and F. Sturzenegger,: *To Float or To Fix: Evidence on the Impact of Exchange Rate Regimes on Growth.* American Economic Review Vo. 93, (2003), pp. 1173-1193.

Lütkepohl, H.: *New-Introduction to Multiple Time Series Analyses.* ISBN: 978-3-540-26239-8, Berlin, (2005), p. 283.

Maćkowiak, W. S.: *External Shocks, U.S. Monetary Policy and Macroeconomic Fluctuations in Emerging Markets.* Working Paper, Berlin: Humboldt University, (2003).

Maćkowiak, W. S.: *How Much of the Macroeconomic Variation in Eastern Europe is Attributable to External Shocks?.* Working Paper, Berlin: Humboldt University, (2005).

Maliszewski, W. S.: *Monetary Policy in Transition. Structural Econometric Modeling and Policy Simulation.* Central for Social and Economic Research CASE, Studies and Analyses, No. 52, Warsaw, (2002), pp. 1-26.

McCarthy, J.: *Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economics*" Federal Reserve Bank of New York, Staff Reports, No. 11, (2000).

Mishkin, F. S.: *Inflation Targeting in Emerging Countries*. NBER, Working paper, No. 7618, (2003).

Mosconi, R.: *Maximum likelihood Cointegration Analyses of Linear Models"-(MALCOM)-The Theory and Practice of Cointegration Analyses in RATS*. Department of Economics and Production Politecnico di Milano, Milano, (1999), pp 5-131 and *Maximum Likelihood Cointegration Analyses of Linear Models,* 2007, version 2.9, Greta Regional Econometrics Models, Italy.

Obstfeld, M.: *The Global Capital Market: Benefactor or Menace?* Journal of Economic Perspectives, Vol.12, No. 4. (1998), pp 9-30.

Reinhart, C., and K. Rogoff,: *The Modern History of Exchange Rate Arrangement*: A Reinterpretation , Washington, DC: International Monetary Fund, (2002).

Sims, Ch. A., and Tao Zha,: *Does Monetary Policy Generate Recessions?*. Working Paper, No. 12, Federal Bank of Atlanta, (1998), pp. 98-12.

Sims, Ch. A. and Tao ZHA: *Error Bands for Impulse Response.* Econometrica, Vol. 67(5), (1999), pp 1113-1155.

Sims, Ch. A.: Macroeconomics and Reality. Econometrica 48, (January 1980), pp. 1-49.

Stock, J. H., and M. W. Watson,: *Vector Autoregressions.* NBER, (March 2001), pp 3-27.

Uhling, H.: *What are the Effects of Monetary Policy.* Journal of Monetary Economics, (2005), p. 17.

Vonnák, B.: *Estimating the effect of Hungarian Monetary Policy within a Structural VAR Framework.* Magyar Nemzeti Bank, Working Papers No. 2005/1, February (2005), pp.1-26.

Voss, G., and A. Brischetto,: *A Structural Vector Autoregression Model of Monetary Policy in Australia.* Research Discussion Paper 1999-11, Reserve Bank of Australia, (1999), pp. 1-51.

Waggoner, D. F., and Tao Zha,: *Normalization, Probability Distribution, and Impulse Response*. Federal Reserve Bank of Atlanta, Working Paper, No. 11; (1997), p.34.

DAVIDSON INSTITUTE WORKING PAPER SERIES - Most Recent Papers

The entire Working Paper Series may be downloaded free of charge at: www.wdi.umich.edu

CURRENT AS OF 4/21/11

Publication	Authors	Date
No. 1014: Exchange Rate Pass-Through in Transition Economies: The Case of Republic of Macedonia	Besnik Fetai	April 2011
No. 1013: Establishing Data Collection Procedures Equivalence in International Business Research	Agnieszka Chidlow & Pervez N. Ghauri	March 2011
No. 1012: The Link between Innovation and Productivity in Estonia's Service Sectors	Priit Vahter & Jaan Masso	March 2011
No. 1011: Learning by exporting: evidence based on data of knowledge flows from innovation surveys in Estonia	Priit Vahter	Feb 2011
No. 1010: Firm Investment & Credit Constraints in India, 1997 – 2006: A stochastic frontier approach	Sumon Bhaumik, Pranab Kumar Das and Subal C. Kumbhakar	Jan 2011
No. 1009: Industrial Enlargement And Competitiveness Index	Art Kovacic	Jan 2011
No. 1008: SUPPORTING AFRICA'S POST-CRISIS GROWTH: THE ROLE OF MACROECONOMIC POLICIES	Zuzana Brixiova, Leonce Ndikumana & Kaouther Abderrahim	Jan 2011
No. 1007: The Funding & Efficiency of Higher Education in Croatia & Slovenia: A Non-Parametric Comparison w/ the EU & OECD Countries.	Aleksander Aristovnik and Alka Obadic	Jan 2011
No. 1006: Public Investment and Fiscal Performance in New EU Member States	Jan Hanousek and Evžen Kočenda	Dec 2010
No. 1005: Is Monetary Policy in New Member States Asymmetric?	Bořek Vašíček	Dec. 2010
No. 1004: Inflation Targeting in Brazil, Chile & South Africa: An Empirical Investigation of Their Monetary Policy Framework	Mona Kamal	Nov. 2010
No. 1003: Assessing Mondragon: Stability and Managed Change in the Face of Globalization	Saioa Arando, Fred Freundlich, Monica Gago, Derek C. Jones and Takao Kato	Nov. 2010
No. 1002: Money Market Integration and Sovereign CDS Spreads Dynamics in the New EU States	Peter Chobanov, Amine Lahiani and Nikolay Nenovsky	Oct 2010
No. 1001: Modeling transition in Central Asia: the Case of Kazakhstan	Gilles DUFRENOT, Adelya OSPANOVA, Alain SAND-Zantman	Oct 2010
No.1000*: Unlocking Productive Entrepreneurship in Ethiopia: Which Incentives Matter?*	Zuzana Brixiova & Emerta Asaminew	Oct 2010
No.999: Price convergence and market integration in Russia	Konstantin Gluschenko	Sept 2010
No. 998: Bank Efficiency in Transitional Countries: Sensitivity to Stochastic Frontier Design	Zuzana Irsova	Sept 2010
No. 997: EU Enlargement and Monetary Regimes from the Insurance Model Perspectives	Nikolay Nenovsky	June 2010
No. 996: Which Foreigners are Worth Wooing? A Meta-Analysis of Vertical Spillovers from FDI	Tomas Havranek and Zuzana Irsova	June 2010
No. 995: Environmental Regulation and Competitiveness: Evidence from Romania	Guglielmo M. Caporale, Christophe Rault, Robert Sova & Anamaria Sova	June 2010
No. 994: Pollution Abatement And Control Expenditure In Romania: A Multilevel Analysis	Guglielmo M. Caporale, Christophe Rault, Robert Sova & Anamaria Sova	June 2010
No. 993: Do Innovative Workplace Practices Foster Mutual Gains? Evidence From Croatia	Derek Jones and Srecko Goic	May 2010