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3rd Research Conference "Towards Recovery and Sustainable Growth in the Altered Global Environment"

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Foreword

On 28-29 April 2014, the National Bank of the Republic of Macedonia organized the 3rd Annual Research Conference entitled: "Towards Recovery and Sustainable Growth in the Altered Global Environment". This conference was organized on the occasion of the anniversary of the monetary independence of the Republic of Macedonia. Several distinguished speakers made presentations on the main conference topic. In addition, high quality papers were presented, received upon Call for Papers sent to the central banks in the region. This booklet incorporates the papers presented at the conference, as well as the official speech of the Governor of the National Bank of the Republic of Macedonia.

Launching this booklet, we would like to express our gratitude to all presenters, the esteemed keynote speakers, the discussants, the moderators of the conference sessions, as well as to all other participants, all of them adding value to the success of the conference.

National Bank of the Republic of Macedonia

Ladies and Gentlemen,

Your Excellences,

Dear guests,

It is indeed with great pleasure that I welcome you all to our third Research Conference! Just like in the previous years, we hope to have a fruitful discussion on the main topics from the current surrounding and the economic prospects of the region and the global economy.

This year's conference will be focused on the recovery process in the wake of the long lasting global financial and debt crisis and making a floor for sustainable growth in the altered global environment. Today, we would like to talk with you about consequences from the crisis, the lessons learnt and the impact of the regulatory and institutional changes on the recovery process. To touch upon the issues: Why did it take so long to come to this point and how sound this recovery is? How close are we to the normalization of policies setup and the desirable growth rates? How successful the fiscal consolidation will be and is the financial system more resilient to shocks now? It is still difficult to judge on many of these issues, but we are here to identify the strengths and weaknesses, to express the pros and cons, to present our estimates and results that will certainly extend our mutual knowledge and wisdom for better guidance through the recovery process and beyond.

Changes in the global environment

Many changes in the regulatory framework, policy implementation, even in the way of reasoning and perceiving the actual developments, have taken place in the last seven years. The developed economies, besides zero bound lowered rates, also needed additional monetary policy accommodation through the quantitative easing. They also turned into using a kind of forward guidance framework as a tool for announcing monetary policy stance in a longer horizon than the usual one. Central banks around the globe, depending on the circumstances, were using a range of non-standard measures designed in a way to tackle specific drawbacks of the crisis. Exceptional conditions called upon exceptional measures, including "whatever it takes" approach in the euro zone in the peak of the debt crisis, which in total, mostly gave a positive feedback towards economic recovery.

Considering the fact that this crisis originated from the financial system, a comprehensive reform of the financial regulatory framework has been launched during the crisis through Basel III - new capital and liquidity requirements are waiting to be implemented in practice. In addition, the euro zone has undergone tremendous changes in the institutional settings by the establishment of the Single Supervisory Mechanism by the ECB, along with the Single Resolution Mechanism and other accompanied ongoing or upcoming reforms.

Another area of reforms in the European Union was the strengthening of fiscal and macroeconomic policy through the Fiscal Compact and accompanying macroeconomic surveillance mechanism, aiming at sound public finances and preventing from macroeconomic imbalances. What urgently came to our knowledge during the last crisis was the importance of the financial stability for the overall macroeconomic stability, but also the so-called "doom loop" between banks and sovereign that emerged from this crisis, adding yet another specific experience that we should all be aware of in the future.

On the recovery process and sustainable growth

The data since mid of the last year and the forecast for this year are pointing to an upturn of the global economy, although it is still fragile and surrounded by risks. The economic recovery of the European Union is crucial for stronger revival of the region, considering the trade relations, although due to specific factors, countries in the region differ in terms of their position in the economic cycle.

In 2013, the Macedonian economy grew by 3.1%, mainly driven by the strong net export and the strengthening of private consumption in line with curbing down of the unemployment. In this view, it is worth mentioning the positive contribution of the new FDI inflows in tradable sector, which contributed to both higher and more diversified net export and higher employment. In addition, economic recovery was supported by the fiscal stimulus as well as the accommodative monetary policy stance. Since July last year, the main policy rate is at the historical lowest level of 3.25%. Moreover, during the crisis period, a combination of standard and non-standard measures have been undertaken by the central bank aimed to give additional support specifically to the credit growth and accordingly, to the economic growth, while still preserving the price and financial stability in the economy. The outlook for this year is also positive. We expect GDP growth of close to 4%, and therefore we see economy going up on the cycle. What one can learn from our experience is the fact that the implementation of sound structural reforms can definitely move the economy upward - even during the crisis - that is an important message for the macroeconomic policy afterwards.

When discussing the recovery from the crisis, we need to point out some related issues that are dealing with the exit of non-standard policy measures and turning towards fiscal consolidation, currently being the topical issues between the policy makers worldwide. The tapering decision by the FED by the end of the last year somehow announced the need of this reversal that will eventually be recognized in other countries, too. We already acknowledged the benefits from all specific measures implemented during the crisis, but we should be aware of their transitory role and the need to get back to the standard policy tools. Of course, the signs of current recovery are pointing to different stages of the normalization path and therefore, this reversal in the policy settings will differ from country to country. The new threat of deflation in the advanced economies is yet another potential obstacle in this reversal.

From this point, that is already a challenging one, the next big challenge will be to return to a solid and sustainable growth. During this crisis, we experienced a lot and we learnt a lot. A number of weaknesses, mainly in the financial and fiscal areas, have been detected and addressed. Anyway, with the first signs of economic recovery, not everything has been fixed yet. There is still a need to repair banks' balance sheets, to squeeze central banks' balance sheets, to restore market confidence and to strengthen public debt management. The prolonged period of low interest rates has created a room for fiscal expansion and public debt increase, but the fiscal authorities must be aware that the end of this period is just about to come. The regulatory and institutional reforms undertaken in the last years should contribute to the soundness and stability of the financial systems. What has been done in this field in the last years should be fruitful on a longer horizon.

* * *

To sum up, the global economy is on the recovery path although there is still a long way to go towards sound and sustainable growth. Reshaping of the banking and financial sector will definitely contribute in this regard and the contribution in the same direction is expected from the fiscal sector, too. The central banks worldwide have proven their flexibility, but the monetary policy must not be overburdened in the long run and should get back to its primary function. A sustainable growth needs sound policies and accelerating reforms towards building more competitive and more flexible economies.

Ladies and gentlemen,

I hope I have already triggered many issues to be discussed in details later on, during this conference. Considering the eminent keynote speakers that we have in the first session and the high quality research papers to be presented in the next sessions, I have no doubt that all together we will enlighten this complex "package" of issues related to the recovery in the aftermath of the crisis.

Thank you so much for attending our conference and thank you for your attention!

Dimitar Bogov, Governor of the National Bank of the Republic of Macedonia

Skopje, 28 April 2014

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338.23:336.74]:338.012(497.7)

THE EFFECT OF LOAN SUPPLY SHOCKS ON BANK LENDING AND THE REAL ECONOMY: EVIDENCE FROM SLOVENIA[1]

Matija Lozej, Bank of Slovenia and Uroš Herman, Bank of Slovenia

Abstract

This paper investigates the monetary policy transmission, focusing on the bank lending channel and foreign debt capital inflow. The responses of the Slovenian economy to a monetary policy shock closely correspond to standard textbook responses. There are only weak indications that bank lending channel exists and has significant effects on nonfinancial corporations and real activity. There is more support that bank lending channel operates for long-term loans than for short-term loans. Applying the same identification scheme to banks shows that a wholesale funding supply shock to banks has strong, significant and persistent effects both on bank lending to firms and real activity.

JEL classification: E32, E51, G21

Keywords: Monetary policy, Bank lending channel, Capital flows, Business cycles

May 19, 2014

1 This draft was prepared for 3rd Research Conference of the National Bank of the Republic of Macedonia. Please do not cite without permission. The views contained here are those of the authors, and not necessarily those of the Bank of Slovenia.

1. Introduction

Monetary policy transmission through various forms of credit channels has long been a puzzling issue. One of the main puzzles researchers and policymakers were concerned with was the question how small and relatively short-lived changes in monetary policy rates lead to a relatively large and delayed responses of real variables. The views on how precisely the amplification mechanism works are varied and very difficult to distinguish. Three views have been proposed.

The money view. The standard textbook money view of the monetary policy transmission is that there are only two assets, deposits (money) and bonds. When a central bank reduces the amount of reserves available to banks, banks reduce their holdings of bonds, which increases interest rates and reduces the amount of deposits (money). If prices of goods and services do not respond immediately to a monetary policy action, real interest rates increase, which reduces investment and aggregate economic activity.[2] According to this view, bank loans are not special and are just a form of bonds.

The balance sheet view. The balance sheet view is related to the money view in the sense that it is the increase in the cost of financing that plays a major role. The balance sheet view emphasises that an increase in the central bank policy rate causes a deterioration in firms' balance sheets (either directly through higher interest payments on external debt tied to a variable interest rate or indirectly through the decrease in asset values and hence collateral), which amplifies problems due to information imperfections and leads to an increase in external finance premium. Higher external finance premium increases firms' costs of capital and leads to a reduction in investment. As argued by Bernanke and Gertler (1995), this should be viewed as an amplification mechanism on top of the textbook money view.

The lending view. The lending view distinguishes between deposits (money), bonds, and bank loans. According to this view, monetary policy not only affects market interest rates as in the standard money view, but also affects the supply of bank loans, in addition to the effect it has on market interest rates. The implicaton is that even if bonds and deposits are very close substitutes, so that monetary policy tightening will have only a minor effect on market interest rates, it will still reduce the quantity of bank lending. Bank-dependent firms will face a reduction in the supply of loans and will have to reduce investment.

There are three conditions that have to be satisfied for the separate lending channel of monetary policy transmission to exist (Kashyap and Stein, 1994). First, at least for some firms, bank loans should not be perfect substitutes with market debt. Firms should not be able to offset a drop in bank loans by raising funds directly in financial markets. Second, the central bank should be able to affect the supply of bank loans. Traditionally, this has been explained as the ability of central banks to reduce bank reserves, which leads to a reduction in reservable deposits, which in turn forces banks to reduce loans. Banks should not be able to offset the reduction in deposits by resorting to other sources of financing or by reducing their holdings of bonds. While the notion that central banks can affect banks' reserves, deposits, and loan supply in an environment where banks have free access to wholesale money markets has been challenged, there are explanations why this may nevertheless be the case. For instance, this may be the case if there exists a balance sheet channel at the bank level (Disyatat, 2010).[3] Finally, prices of goods should adjust slowly to monetary policy actions, which ensures that a change in nominal interest rates also causes a change in real rates that matter for economic decisions. The last condition has to hold for any monetary policy transmission channel mentioned above.

As Kashyap and Stein (1994) point out, quantity rationing for loans is not a necessary condition for the bank lending channel to exist. However, it is also not necessary that the bank lending channel operates only when there are changes in monetary policy. Any factor that affects bank loan supply can in principle have real consequences, as long as there are bank-dependent firms.

2 See, for instance, Bernanke (1988) or Kashyap and Stein (1994).

3 Disyatat (2010) argues that in monetary policy frameworks where central banks target interest rates, banks' reserve holdings are typically determined by structural characteristics of the payments system and reserve requirements (if binding). When reserves are not remunerated or remunerated at below-market rates, central banks simply supply the amount of reserves demanded by the banking system. When reserves are remunerated at market rates, they are a very close substitute for other short-term liquid assets and the central bank can choose the amount of reserves. The implication is that the same amount of reserves can coexist with different levels of interest rates.

Bank lending channel is a potentially very relevant transmission channel in Slovenia, where nonfinancial corporations rely almost exclusively on bank loans (for instance, the outstanding amount of securities issued by nonfinancial corporations has never exceeded 3% of outstanding bank loans). Non-bank financial intermediaries that would invest in firm debt are almost non-existent. This indicates that bank lending channel should be stronger in Slovenia and that shocks to bank loan supply should have a strong effect on the real economy. Moreover, practically all firms in Slovenia can be considered small firms in the sense that they do not fund themselves using funds from financial markets. For instance, commercial paper has only been issued recently and that by only a handful of very large firms.[4]

While firms depend on banks for financing, these in turn depend to some extent on wholesale financing, including financing from abroad. The access of banks to wholesale funding has varied considerably over the recent decade, which has affected bank lending. During the Euro accession, capital controls have been abolished and the exchange rate risk has diminished and finally disappeared with the adoption of the Euro. Considerable amounts of foreign funds have been entering the country until the crisis. At the beginning of the crisis, these flows have first stopped, and then reversed sharply. This indicates that bank lending is not driven only by monetary policy actions, but also by the availability of predominantly foreign wholesale funding. The effect of foreign wholesale funds supply shocks on bank lending should operate along the same lines as the bank lending channel, i.e., a reduction in foreign funds supply leads to the reduction in bank loans, provided that banks are not able to offset this reduction by selling their security holdings or by borrowing elsewhere. We call the effect of foreign wholesale funds' supply on bank loans the bank funding channel. One of the aims of this paper is to assess the effect of foreign wholesale funds' supply fluctuations on bank lending and the real economy.

We investigate these issues by estimating a standard textbook monetary VAR, and then augment it with an indicator of bank loan supply of the type suggested by Kashyap, Stein, and Wilcox (1993). We first focus on nonfinancial corporations (firms). The responses of firm debt to a monetary policy shock are in line with the standard predictions - following a monetary tightening, output, inflation and firm debt tend to decrease. Short-term loans briefly increase, which is in line with the hypothesis that firms use short-term debt to finance a temporary increase in inventories. Next we augment the VAR with the Mix variable that under a set of assumptions measures the changes in bank loan supply. While responses to a monetary policy shock are consistent with the hypothesis that there is a bank lending channel, the shock to the Mix gives less favourable results. Data limitations prevent us to efficiently control for potential composition effects, so we are not able to give firm conclusions. Given our assumptions and definitions, the results indicate that if there is a bank lending channel, it is not particularly strong.

The second part of the paper focuses on banks. The same reasoning as for firms is used for bank liabilities, i.e., an increase in one type of otherwise similar funding instruments indicates that the relative supply of this type of financing has increased. If there are bank-dependent borrowers, shocks to bank funding are expected to have real effects. Here the results are more clear cut. The results indicate that banks substitute the relative reduction in deposits after a monetary contraction with an increase in wholesale funds. Moreover, the effect on an increase in the relative supply of wholesale funds is strong and has a sign that is consistent with the view that an increase in the foreign funds supply to banks increases bank lending and has a positive impact on the real economy.

The paper begins with a brief description in Section 2 of the data used and in Section 3 with a set of unconditional stylised facts at business cycle frequencies. Section 4 conditions the analysis on shocks and presents the results for the standard interest rate channel, bank lending channel, and bank funding channel. The section ends with a counterfactual analysis of the influence of firm debt on real activity. Section 5 concludes.

4 We use terms 'firms' and 'nonfinancial corporations' interchangeably.

2. Data

For the empirical analysis we use a sample of quarterly data spanning the period from 2004Q1 to 2013Q3. The reason for using this relatively short sample is that the key data used for the identification of the bank lending channel come from the flow of funds statistics, which is available at quarterly frequency only since 2004.

For the identification of loan supply shocks, we construct various loan supply (Mix) indicators by using financial accounts data. In addition to different measures of loan supply indicators, we also include standard macroeconomic variables such as aggregate output, prices, bank loans to firms and the monetary policy rate. Output is measured by real GDP, developments in prices are proxied by the GDP deflator, bank loans to firms are in nominal terms and are collected from the financial accounts statistics. The policy rate is measured by the main refinancing operations (MRO) rate set by the ECB. For the period before 2007, we use the interest rate on 60-day Tolar bills as the relevant policy rate. The data in our sample are not seasonally adjusted and are mostly in log-levels. Loan supply indicators and the central bank interest rate are in levels.

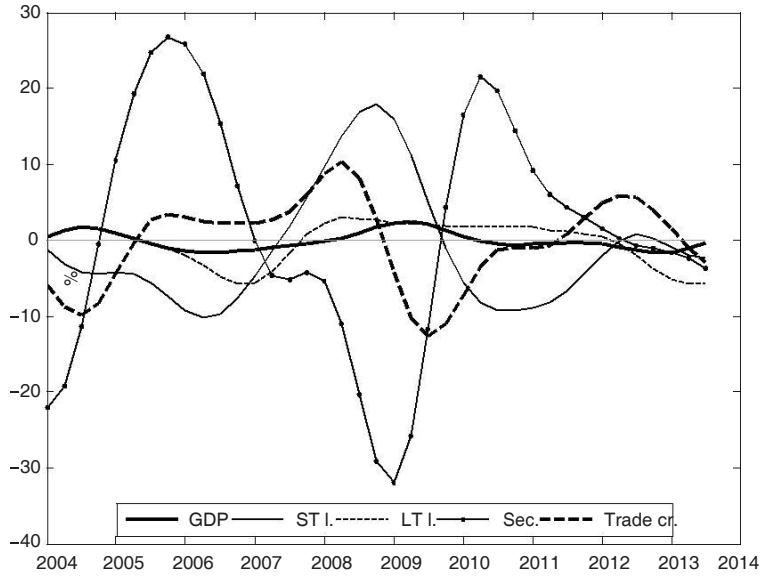
3. Stylised facts

We first report some typical stylised facts about the behaviour of financial variables investigated in this paper over the business cycle.[5] Figures 1 and 2 show the cyclical components of real GDP (thick line) and various components of nominal firm debt, all as percentage deviations from trend. Table 1 reports contemporary correlations of cyclical components of firm debt variables with the cyclical component of real GDP.

Cyclical components of firm debt types are by an order of magnitude more volatile than the cyclical component of real output. This is quite typical for financial data. What is interesting is that out of all debt types, only cyclical components of loans are strongly positively correlated with the cyclical component of real output. The highest correlation is for foreign loans. Trade credit is negatively correlated with real output at cyclical frequencies and there is almost no difference whether this is trade credit from abroad or domestic trade credit.

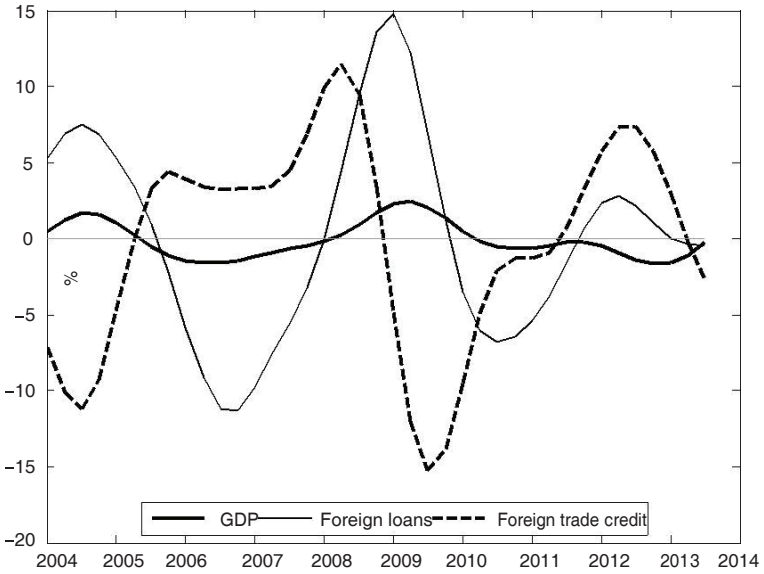
5 To obtain the cyclical components we use the Christiano-Fitzgerald filter in order to avoid putting too much emphasis on the most recent observations, as is typically the case when using the Hodrick-Prescott (HP) filter. Results do not differ materially if the HP filter is used instead.

Figure 1. Cyclical components of firm debt and real GDP



Notes: Cyclical components are extracted using the Christiano-Fitzgerald filter (extracting fluctuations at frequencies from 6 - 32 quarters). All variables are in log-levels, GDP is real, debt components are in nominal terms. The lines in the figure can be interpreted as percentage deviations from trend.

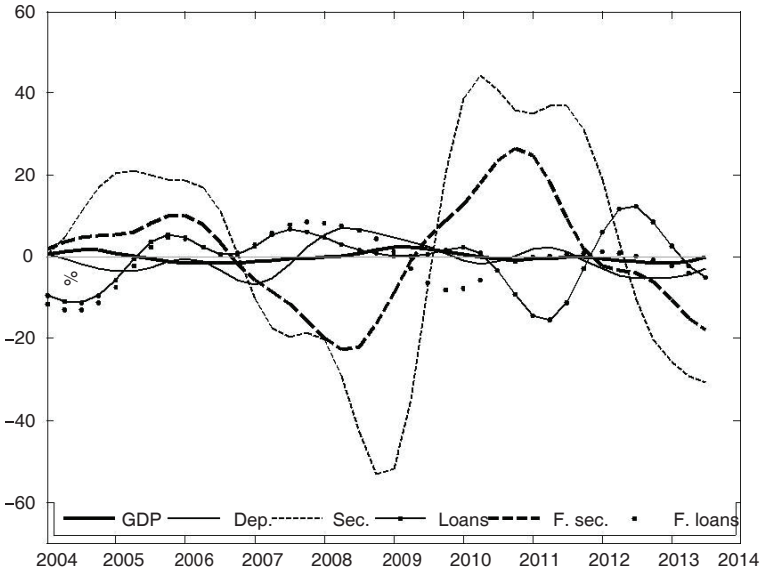
Figure 2. Cyclical components of foreign firm debt and real GDP



Notes: Cyclical components are extracted using the Christiano-Fitzgerald filter (extracting fluctuations at frequencies from 6 - 32 quarters). All variables are in log-levels, GDP is real, debt components are in nominal terms. The lines in the figure can be interpreted as percentage deviations from trend.

Similarly as for firms, Figure 3 shows correlations of various forms of bank debt with real GDP at cyclical frequencies. Debt components of banks are even more volatile than those of firms at cyclical frequencies. Moreover, as Table 1 shows, all bank liabilities except deposits are negatively correlated with real output at cyclical frequencies.

Figure 3. Cyclical components of bank debt and real GDP



Notes: Cyclical components are extracted using the Christiano-Fitzgerald filter (extracting fluctuations at frequencies from 6 - 32 quarters). All variables are in log-levels, GDP is real, debt components are in nominal terms. The lines in the figure can be interpreted as percentage deviations from trend.

Table 1. Correlations and standard deviations at cyclical frequencies

	Relative stdev.	**Corr. with GDP**
Real GDP	1	1
Firms:		
Trade credit	4.85	-0.63
Securities	12.94	-0.61
ST loans	6.56	0.54
LT loans	2.37	0.70
Foreign loans	5.63	0.80
Foreign trade credit	5.79	-0.65
Banks:		
Deposits	3.09	0.56
Securities	23.11	-0.22
Loans	5.76	-0.33
Foreign securities	10.79	-0.07
Foreign loans	4.92	-0.43

Positive correlation of bank loans to firms and real output can be caused by many factors. This positive comovement should not be taken as a sign that there is something like a bank lending channel or that an increase in bank loans to firms stimulates output (Kashyap and Stein, 1994). While this finding is consistent with the existence of the bank lending channel, there are many plausible alternative explanations that can explain such positive comovement. One would obtain the same positive comovement if an increase in bank loans was driven by demand for bank loans. A similar case can be made for the absence of a positive correlation of most bank debt components with the cyclical component of real output.

Stylised facts presented in this section are all unconditional - correlations and volatilities are driven by all shocks that have affected the economy during the sample period. These stylised facts

therefore depend both on the frequency of each particular shock, relative sizes of shocks, and the strength of reaction of each variable to a shock. Without the identification of shocks, one cannot explain what drives these statistics. The remaining sections attempt to condition the analysis on shocks and attempt to provide a more structural explanation.

4. Evidence conditional on shocks

A structural VAR model is used to condition the analysis on shocks. The estimated reduced-form model takes the following form:

$$Y_t = c + t + A + {}_0 D_t + \sum_{i=1}^{q} A_i Y_{ti} + u_t;$$

where c is a constant, t is a linear trend, D_t is a vector of quarterly dummies, Y_t is a vector of endogenous variables that include a policy instrument, and u_t is a reduced-form error term. q is the number of lags and A_i are coefficient matrices. Vector Y_t contains variables whose current values are in the central bank's information set, $Y_{1,t}$, policy instrument, r_t, and variables whose current values are not in the central bank's information set, $Y_{2,t}$, so that $Y_t = [Y_{1,t}; r_t; Y_{2,t}]$.[6] The benchmark VAR uses a constant, linear trend, quarterly dummies and three lags of endogenous variables. The VAR is estimated using ordinary least squares, with all variables in levels or log-levels.[7]

4.1. Identification

The identification assumption used to identify a monetary policy shock relies on timing assumptions. Short-term interest rate is taken as the monetary policy instrument and the identifying assumption is that inflation, real activity, and the volume of loans react to an exogenous innovation in the monetary policy rate with a lag. To strengthen this identification assumption, the monetary policy rate used is the average monetary policy rate over the last month of the quarter.[8] The only variable we allow to respond contemporaneously to a monetary policy innovation is the variable that measures changes in bank loan supply.

While the identification of the monetary policy shock is fairly standard, the identification of changes in bank loan supply is much more controversial. This paper relies on the identification proposed by Kashyap, Stein, and Wilcox (1993). They propose a variable called the Mix, which is a ratio of short-term bank loans to the sum of short-term bank loans and commercial paper issued by nonfinancial corporations, as a measure of bank loan supply. Their reasoning was that if short-term bank loans and commercial paper are close substitutes and if a monetary contraction reduces the supply of bank loans, then the Mix should decline. When firms reduce their demand for financing after a monetary contraction, they will reduce it equally for all types of debt forms that are close substitutes. If the reduction in bank loans is more than proportional, then this must be due to the contraction in the supply of bank loans.

During the subsequent discussion regarding this identification assumption (Oliner and Rudebusch (1996), Kashyap, Stein, and Wilcox (1996)), Oliner and Rudebusch pointed out that the decline in the Mix following a monetary contraction is due to the shift of all forms of financing from small firms to

6 All lagged values of all variables included are in the central bank's information set.

7 For most specifications used in this paper, lag length criteria typically indicate three lags or less. Note that the VAR is estimated in levels, which yields consistent estimates even when variables used are (co)integrated, as long as sufficient number of lags is used to make residuals stationary. For this reason we opt for three lags in all specifications. While it is common in empirical work to include four lags when quarterly data is used, this leads to low degrees of freedom in the relatively short sample that is available.

8 Using the average policy rate over the entire quarter makes no material difference.

large firms. Because the latter rely less on bank debt (and more on commercial paper), this results in the decline in the Mix.

This paper exploits the fact that firms in Slovenia are essentially all small firms and that commercial paper was either not used during the sample period or that its use was negligible. Oliner and Rudebusch's argument of the shift in bank loans to the type of firms that is more reliant on commercial paper or other securities does not apply. There may, however, be other distributional shifts.

Data on firm balance sheets by firm size, industry, etc. are unfortunately not available at quarterly frequencies and at the level of breakdown by instruments and sectors that is available in the flow of funds statistics. This prevents a for-mal investigation of potential distributional shifts of firm finance based on firms' characteristics. A plausible hypothesis could be that large firms and in particular large exporting firms have more access to foreign financing and are therefore less dependent on domestic bank loans. If after a monetary contraction all forms of finance shift to large exporting firms that are less reliant on domestic bank loans, then this could potentially explain the decrease in the Mix. Unfortunately, while the breakdown of the data on foreign financing based on the type of instrument is available, the breakdown based on the type of intermediary is not. This does not allow making conclusions regarding the bank lending channel, as it is impossible to define the Mix based on the type of intermediary (e.g., an increase in foreign finance after a monetary contraction may come from exporting firm's foreign part-ners or customers or from foreign banks).

4.2. Monetary policy and the interest rate channel

First we investigate the effect of a monetary policy shock using the approach of Christiano, Eichenbaum, and Evans (1999). We estimate a simple reduced-form VAR with GDP deflator, real output, bank loans to domestic firms, and the central bank interest rate, in this order. In order to identify the exogenous monetary policy shock, we use the standard Cholesky decomposition, which enables us to disentangle structural shocks from the reduced-form errors. The idea behind this recursive identification scheme is that the central bank responds using the central bank interest rate endogenously to contemporaneous movements in real output, GDP deflator and bank loans to domestic firms, while changes in the central bank interest rate do not have contemporaneous effect on these variables. That is, all variables in the VAR respond to changes in monetary policy with a lag. Note that this model is only partially identified, meaning that we identify only one structural shock, which is the monetary policy shock. Other shocks in the model are not identified.

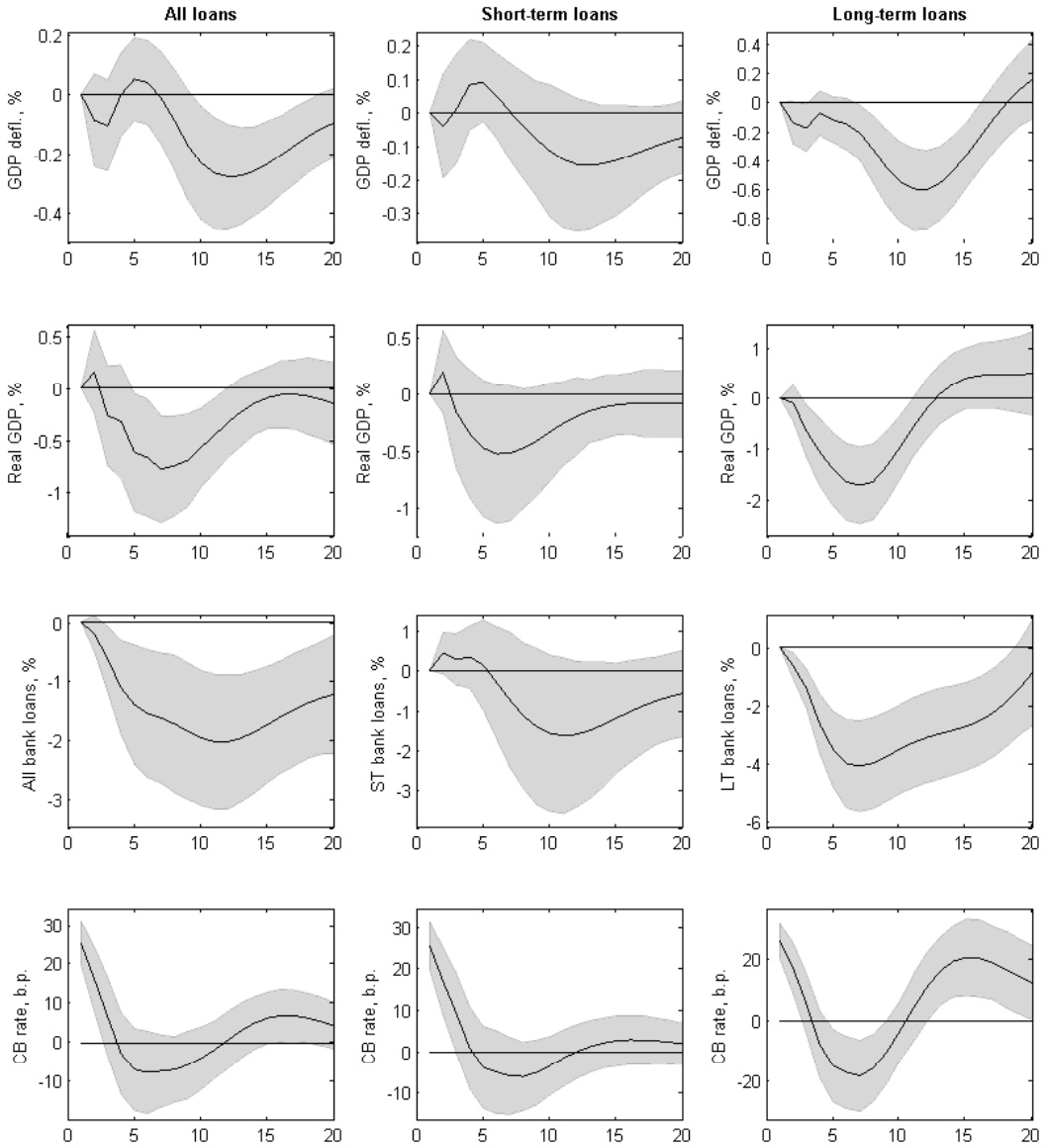
Results are presented in Figure 4. Each column of the figure corresponds to one VAR model. The models are very similar, the only difference is that we include bank loans to domestic firms with different maturities, while all other variables are the same. The leftmost column shows the effect of a contractionary monetary policy shock on all (short- and long-term) bank loans to firms and other variables of interest. Results are fairly standard; the price level falls only after several quarters, but then the effect becomes highly significant and persistent. The increase in the central bank's interest rate reduces real output after two quarters, with the effect becoming significant after one year. The economy starts to recover within a year and a half. All (short-term and long-term) loans fall immediately after a monetary tightening, while the effect becomes significant after three quarters.

Next we include short-term bank loans in the model. As can be seen from the middle column of Figure 4, an increase in the policy rate leads to similar results as before; i.e. output drops, the price level falls with a lag, while short-term bank loans first increase and only after a year start to decrease. This tendency of short-term loans to decrease only with a lag after a monetary tightening, is well known (see e.g. Bernanke and Gertler (1995), Gertler and Gilchrist (1993, 1994)). Following their reasoning, this may be due to the need to finance inventories in an environment of declining cash flows, or that firms just shorten the maturity of their loans as a reaction to increases in lending rates.

Finally, the right-hand-side of the Figure 4 presents impulse responses from a VAR with long-term bank loans. Results are qualitatively in line with previous findings, but the responses are stronger and more significant than before. The effect on real output is immediate and reaches a peak after six quarters. The same is true also for long-term loans, but the effect of the shock is much more persistent than for short-term loans. The response of prices is again very sluggish.

A possible objection tot the analysis above could be that the monetary policy shock is not properly identified and that the model is misspecified,[9] because Slove-nia entered in the ERM II in 2005, which implies that the monetary policy is since then conducted by the European Central Bank (ECB). Therefore, one should also include Euro area variables that are relevenat from the ECB's perspective (are in the information set of the ECB) in the model. For that reason, we augment the model with the Euro area output and replace the GDP deflator for Slovenia with that of the Euro area. All the other variables remain the same. Results are presented in Figure 15 in appendix A.

Figure 4. Interest rate channel



Notes: Impulse responses to a 1 standard deviation shock in the central bank rate. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate, which is in basis points). Shaded areas are 90 percent confidence bands (corresponding to 5 percent significance level for one-sided test), generated using bootstrap with 1000 draws.

9 This would mean that our monetary policy shock is not measured correctly.

4.2. Monetary policy and the bank lending channel

As outlined in the introduction, the bank lending channel is an additional channel of monetary policy transmission. It is operational under the assumption that monetary policy can affect bank lending and that firms cannot replace bank loans by other forms of financing. The existence and the strength of this channel have been a contentious issue since the early 1990s. The problem is that by simply looking at the response of bank loans to a monetary policy shock one cannot attribute the direction of the response to either demand or supply of loans.

The typical procedure to identify the bank lending channel, i.e., the change in the supply of bank loans, is to examine the behaviour of the ratio of bank loans to a sum of bank loans and all their close substitutes (this is the Kashyap, Stein and Wilcox's (1993) Mix variable). If the Mix decreases after a monetary contraction, this indicates that there has been a disproportionally large reduction in bank loans, which is considered as evidence consistent with the existence of the bank lending channel. We follow this line of reasoning. There are two characteristics of the Slovenian economy that lead us to expect a priori that the bank lending channel exists and that it is strong. First, in highly bank-dependent economies bank lending channel should be strong (Iacoviello and Minetti, 2007). Slovenia is such an economy. Second, if firms are more homogeneous regarding the choice of financing alternatives, identification of bank lending channel should in principle be more straightforward, as there is less scope for a particular group of firms with special characteristics to drive the aggregate results.

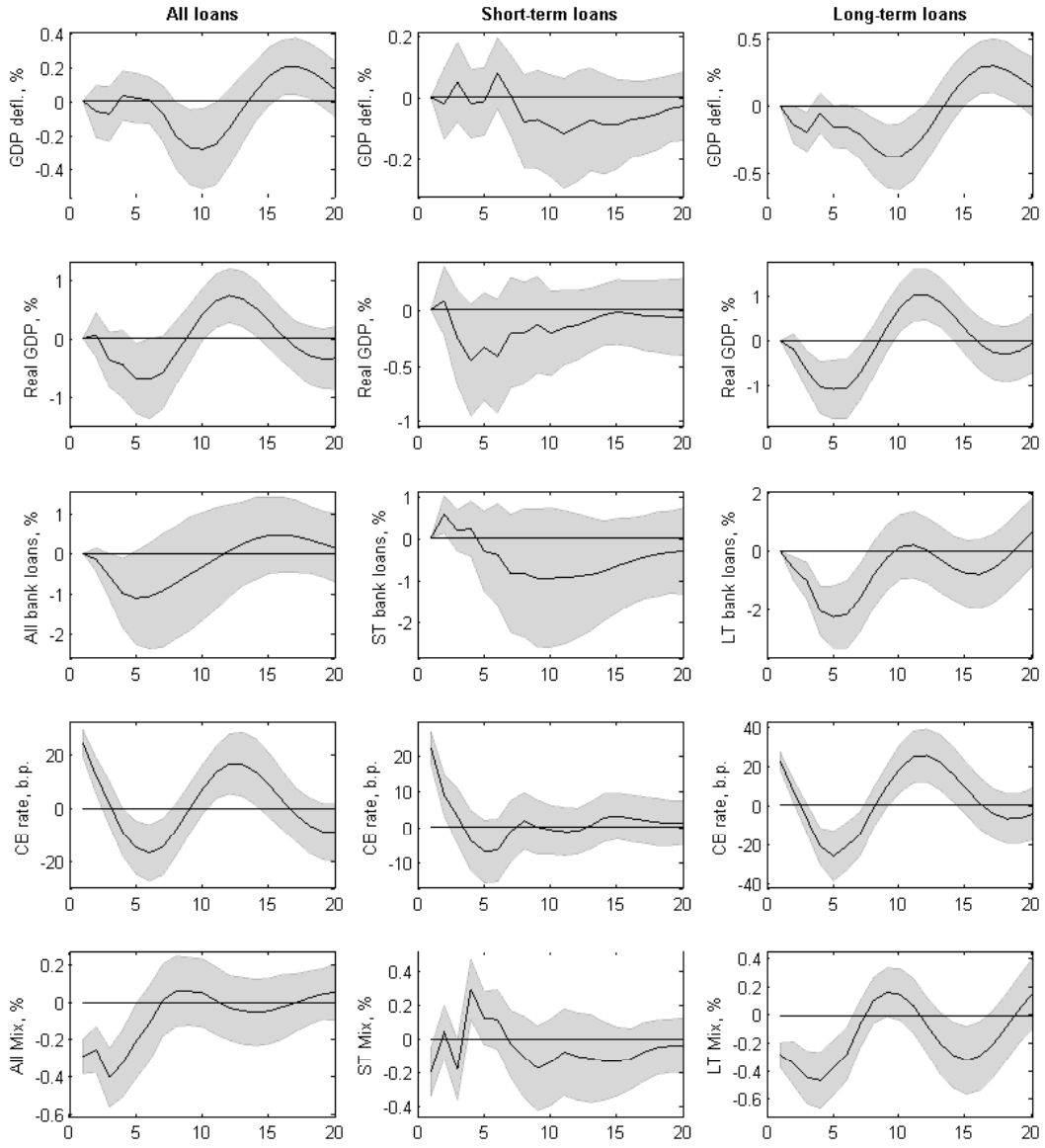
To investigate the effect of monetary policy on bank lending, it is first necessary to define the Mix variable. In principle, the Mix is the ratio between bank loans and other sources of financing that are close substitutes for bank loans (Kashyap, Stein, and Wilcox, 1993, Oliner and Rudebusch, 1996). Moreover, substitutes for bank loans should be economically relevant, which is why it is difficult to take only securities as a relevant alternative. In Slovenia, the only quantitatively important source of nonbank financing is trade credit. While there are some securities issued by nonfinancial corporations, the amounts outstanding are tiny. We follow the argument of Oliner and Rudebusch (1996) and include a broad range of substitutes for bank loans. These are trade credit, outstanding securities, and loans from nonbank intermediaries. We use these quantities on a consolidated basis (e.g., excluding securities issued by a firm that are held by another firm), because we wish to measure the amount of funds that are provided to the whole sector of nonfinancial corporations (firms). Bank loans are loans from resident banks.[10]

While all these forms of debt are substitutes to some degree, some may be closer substitutes than others. It is reasonable to assume that various types of finance with the same maturity are closer substitutes than types of finance across different maturities. Because of this, we examine three groups. First, we define the Mix as a sum of all bank loans (short-term and long-term) to firms, divided by the sum of all (short-term and long-term) alternatives. Second, we define the short-term Mix as short-term bank loans to firms, divided by all short-term alternatives. Finally, we define the long-term Mix as long-term bank loans to firms, divided by all long-term alternatives. The results for each definition of the Mix are reported in columns of Figure 5.[11]

10 Loans to firms from abroad are quantitatively less important and limited to only a handful of firms. The data do not allow us to distinguish foreign loans by type of intermediary.

11 Bank loans are nominal bank loans. Using real loans does not alter the results qualitatively.

Figure 5. Bank lending channel



Notes: Impulse responses to a 1 standard deviation shock in the central bank rate. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the mix, which are in basis points). Shaded areas are 90 percent confidence bands (corresponding to 5 percent significance level for one-sided test), generated using bootstrap with 1000 draws.

The left column of Figure 5 shows the impulse responses after a monetary tightening for a VAR with all bank loans. The results are standard - price level decreases (after a delay), real output and bank loans to firms decrease. Notably, the Mix also decreases and stays at a decreased level for about two years. These results are, under the identification assumptions used and under the assumptions underlying the Mix, consistent with the hypothesis that the monetary policy shock causes a reduction in the supply of bank loans, relative to the supply of other forms of financing. Note that the definition of the Mix in the first column assumes that all other forms of financing are close substitutes for all bank loans to firms.

What is interesting are the results in the middle and the right columns of Figure 5, which use definitions of the Mix that distinguish between short-term and long-term forms of debt. The middle column shows the responses to a monetary tightening from a VAR that includes only short-term bank loans and the Mix defined using only short-term forms of financing. While the Mix still decreases on impact, this decrease is barely significant and the initial decrease is quickly reversed. Moreover, short-term bank loans to firms increase initially. These results are not entirely consistent with the bank lending channel hypothesis. While the initial increase in short-term loans to firms may be the result of the increased demand for such loans (e.g., because real GDP does not decrease initially), the brief decrease in the Mix that is quickly reversed seems to indicate that banks also tend to increase the supply of short-term loans.

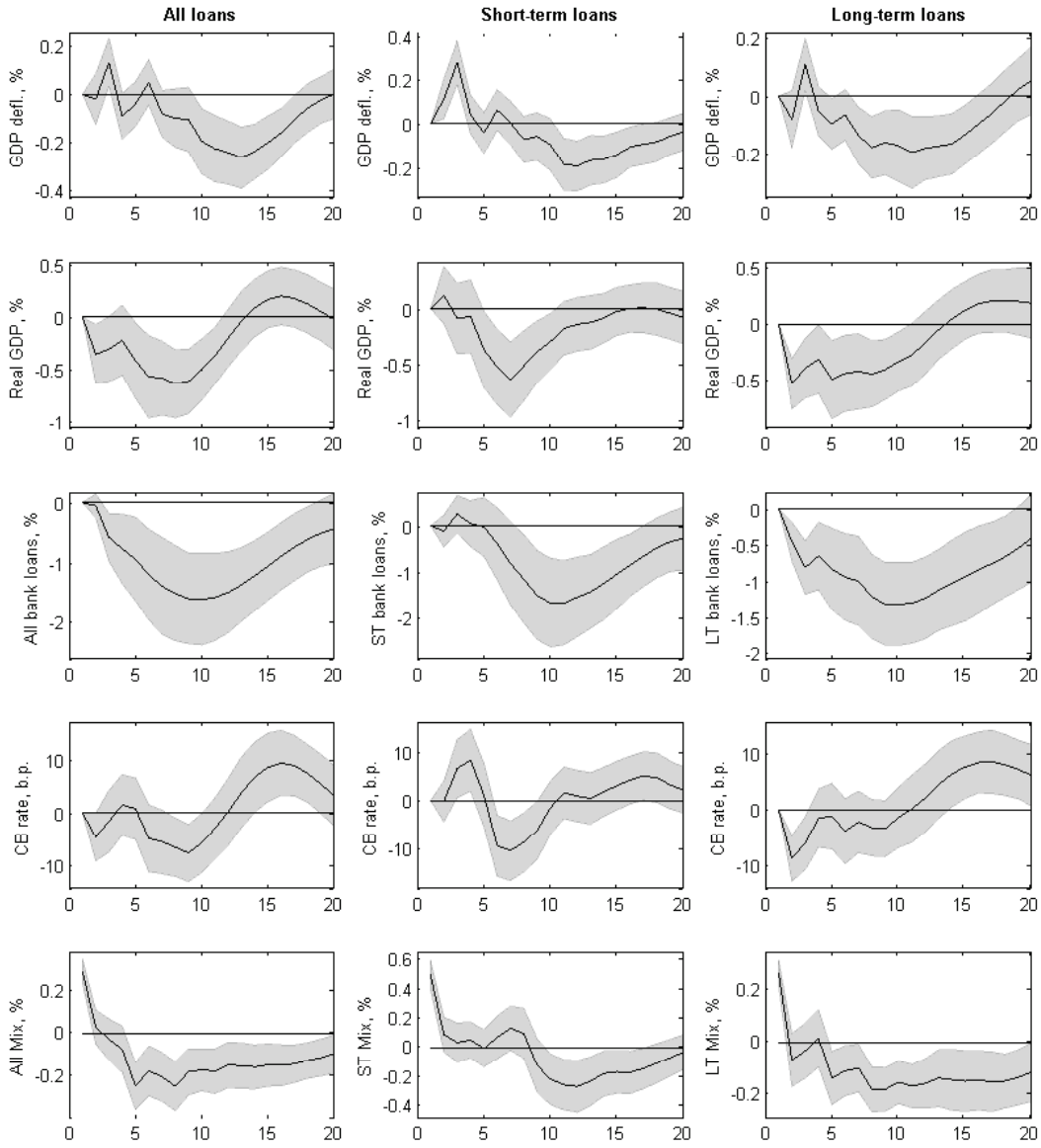
The reduction in bank loan supply that is indicated by all bank loans to firms (left column of Figure 5) therefore cannot be explained based on short-term loans. What does explain it is the reduction in the supply of long-term loans, shown in the right column of Figure 5. This column displays the responses to a monetary tightening from a VAR that includes long term bank loans to firms and the Mix that is defined using only long-term forms of finance. While the responses of the price level and real GDP are qualitatively the same as in the other two VARs, long-term bank loans decrease significantly and more sharply than short-term bank loans. At the same time, the Mix also decreases strongly and significantly, and it remains depressed for about two years. These results are consistent with the hypothesis that the bank lending channel exists.

Overall, the results from Figure 5 are consistent with the hypothesis that there is a bank lending channel for domestic banks, but that it is stronger for the long-term loans. Long-term loans seem to be the main driver of the overall response of firm debt and the Mix defined using long-term forms of finance seems to drive the response of the aggregate Mix. Taken together, the results are also consistent with hte hypothesis that after a monetary tightening, banks tend to tighten the supply of long-term loans by more than they tighten the supply of short-term loans (if they tighten it at all).[12]

Finally, we follow Iacoviello and Minetti (2007) and examine responses to a shock to the Mix. Under our identification assumption, the shock to the Mix is a shock to the bank loan supply. If the bank lending channel has a bite, the exogenous increase in the Mix should lead to an increase in bank loans and an increase in output. Results are displayed in Figure 6.

12 The above results are remarkably robust to the choice of alternatives for bank loans. Results are not materially different if only trade credit is used as the alternative, if trade credit and loans from nonbank intermediaries are used, if securities are added to either, if consolidated or nonconsolidated series are used, etc.

Figure 6. Effects of the shock to bank lending



Notes: Impulse responses to a 1 standard deviation shock to the Mix. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the mix, which are in basis points). Shaded areas are 90 percent confidence bands (corresponding to 5 percent significance level for one-sided test), generated using bootstrap with 1000 draws.

As Figure 6 shows, after an increase in the Mix, both loans and output decline. There is a (statistically insignificant) increase in short-term loans accompanied by a brief increase in GDP, which could be consistent with the hypothesis that there is a bank lending channel (note that in Figure 5, the Mix for short-term loans does decrease on impact, but this decrease is very short-lived and later reversed).[13] Overall, the responses to a shock to bank lending in the benchmark VAR specification used here do not seem to be consistent with the hypothesis that there is a bank lending channel.

13 Iacoviello and Minetti (2007) exclude the central bank rate from the VAR where they shock the mix, stating that they wish to exclude the effect of the interest rate. If we do this, the results are not qualitatively different fromt hose reported here.

While it is possible to find VAR specifications where firm debt and output increase after a shock to the mix (for instance, by ordering the mix above the central bank rate), we report the benchmark VAR results, which are unfavourable for the hypothesis that there is a bank lending channel. In appendix B we report the responses to a bank lending shock in the VAR where the Mix is ordered above the central bank rate, i.e., the central bank is allowed to respond to the Mix during the same period. In this case, there seems to be more evidence in favour of the bank lending channel, especially at the long-term segment of bank lending.

Given these findings, we cannot claim that we find robust evidence for the bank lending channel. A possible reason is that the identification of this channel is not correct. Recall that the Mix is defined using trade credit in the denominator. If trade credit tends to be more tightly linked to the real activity (though this is not corroborated by unconditional correlation at cyclical frequencies), then an increase in the Mix may also contain a negative shock to real activity. Given the lack of other economically meaningful firm funding alternatives, we cannot investigate whether this is indeed the case.

4.3.1. Composition effects

The typical argument against the bank lending channel is that one type of agents behaves differently than the other, which drives the results in the aggregate. In the context of Kashyap, Stein and Wilcox (1993), the problem is that the decrease in bank loans is associated with small firms and the increase in commercial paper with large firms. When this is the case, then the Mix is not a valid measure of changes in the bank loan supply (Eichenbaum, 1994).

In an economy that is highly dependent on bank finance, such differential behaviour is less likely. The only economically meaningful alternative to bank loans is trade credit and it is difficult to see why some type of firms would behave differently than the other with respect to the use of trade credit.

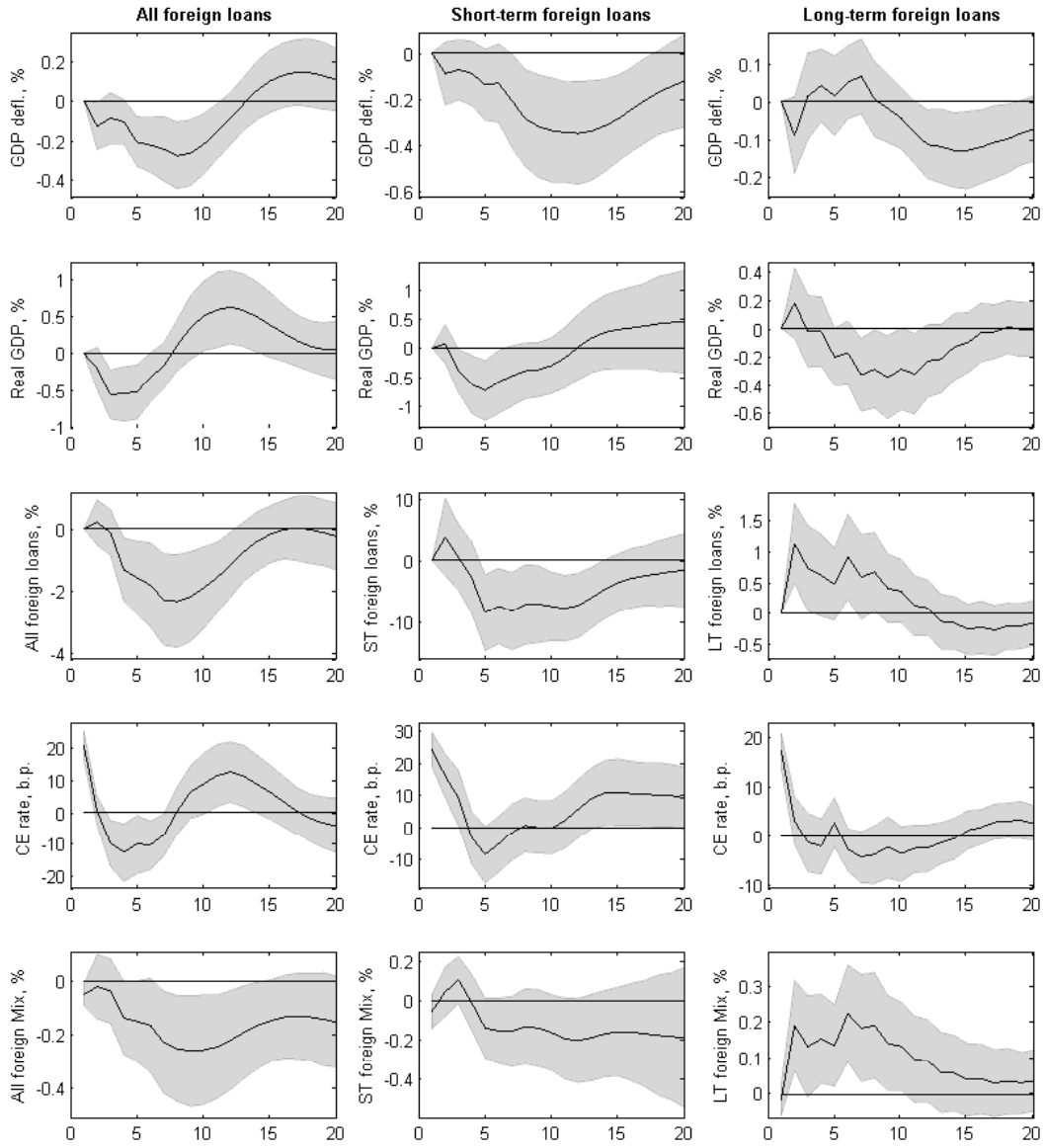
One alternative hypothesis that could be caused by differential behaviour of different types of firms and is consistent with the decrease in the Mix reported above is that after a monetary contraction foreign banks replace domestic banks in firms that have access to foreign banks. However, this is not necessarily the evidence against the bank lending channel, as it can merely indicate that the bank lending channel for foreign banks is weaker than for domestic banks. This would hardly be surprising, as foreign banks are much larger than domestic banks and have easier access to wholesale funding, which violates one of the conditions for the existence of the bank lending channel.

While not necessarily providing evidence against the bank lending channel, we nevertheless examine compositional effects with respect to foreign loans to see if the hypothesis about the weaker bank lending channel for foreign debt is valid.

Effect of foreign loans. To investigate the effect of monetary policy on foreign loans to firms, we examine the behaviour of the Mix that is defined as a ratio of foreign loans to domestic firms to all alternatives (all loans, all securities, all trade credit). As above, the Mixes are defined for all foreign loans, short-term foreign loans (compared to short-term alternatives), and long-term loans (compared to long-term alternatives). Unfortunately, the data does not permit us to distinguish foreign bank loans from foreign nonbank loans. The Mix used here therefore includes foreign nonbank loans in the numerator, so that the evidence is biased in favour of showing that foreign bank lending channel is weaker than domestic.

We can consider two extreme cases. If foreign loans are entirely foreign bank loans, then an increase in the Mix is caused by an increase in foreign bank loans. As explained above, this is not the evidence against the bank lending channel, but is consistent with the hypothesis that the bank lending channel is stronger for domestic banks. At the other extreme, if foreign loans are entirely foreign nonbank loans, then the increase in the Mix is consistent with the existence of the bank lending channel.

Figure 7. Foreign lending after a monetary contraction



Notes: Impulse responses to a 1 standard deviation shock in the central bank rate. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the mix, which are in basis points). Shaded areas are 90 percent confidence bands (corresponding to 5 percent significance level for one-sided test), generated using bootstrap with 1000 draws.

The leftmost column of Figure 7 shows that after a monetary contraction the foreign Mix decreases for all foreign loans (although insignificantly in the beginning), and that aggregate foreign loans decrease after a brief and statistically insignificant initial increase. Results for short-term loans in the middle column of Figure 7 are broadly in line with the results for the aggregate foreign loans.

If one is willing to assume that foreign loans are bank loans, then the outcome is consistent with the notion that the bank lending channel also exists for foreign bank lending. If foreign loans are mainly nonbank loans, then the results for all foreign loans and short-term foreign loans do not support the bank lending channel hypothesis (or support the hypothesis that the bank lending channel for foreign

banks is stronger than for domestic banks, which is not very plausible). The results for long-term loans, depicted in the rightmost column of Figure 7, are the opposite of those for all foreign loans and for short-term foreign loans. Both the Mix of long-term foreign loans and long-term foreign loans increase. If long-term foreign loans are nonbank loans, then this is still consistent with the existence of the bank lending channel. If long-term foreign loans are mostly bank loans, then this is consistent with the view that bank lending channel is weaker for foreign banks.

To obtain an estimate of the extent of foreign bank loans among foreign loans we used firm-level balance sheet data. Since firms so not report separately foreign bank loans, we proxy them as the sum of long- and short-term loans and financial leasing from unrelated firms (we assume that foreign banks are not owners of domestic firms). The share of foreign bank loans (both short- and long-term) in total foreign loans (estimated as the sum of long- and short-term loans and financial leasing from the rest of the world, related and unrelated) is about 74% for nonfinancial corporations and about 55% for manufacturing firms. While this does indicate that the majority of foreign loans are bank loans, the proportion of bank loans is not overwhealming. Moreover, there are considerable differences across sectors, which does not permit us to make stronger conclusions regarding the behaviour of foreign bank loans.

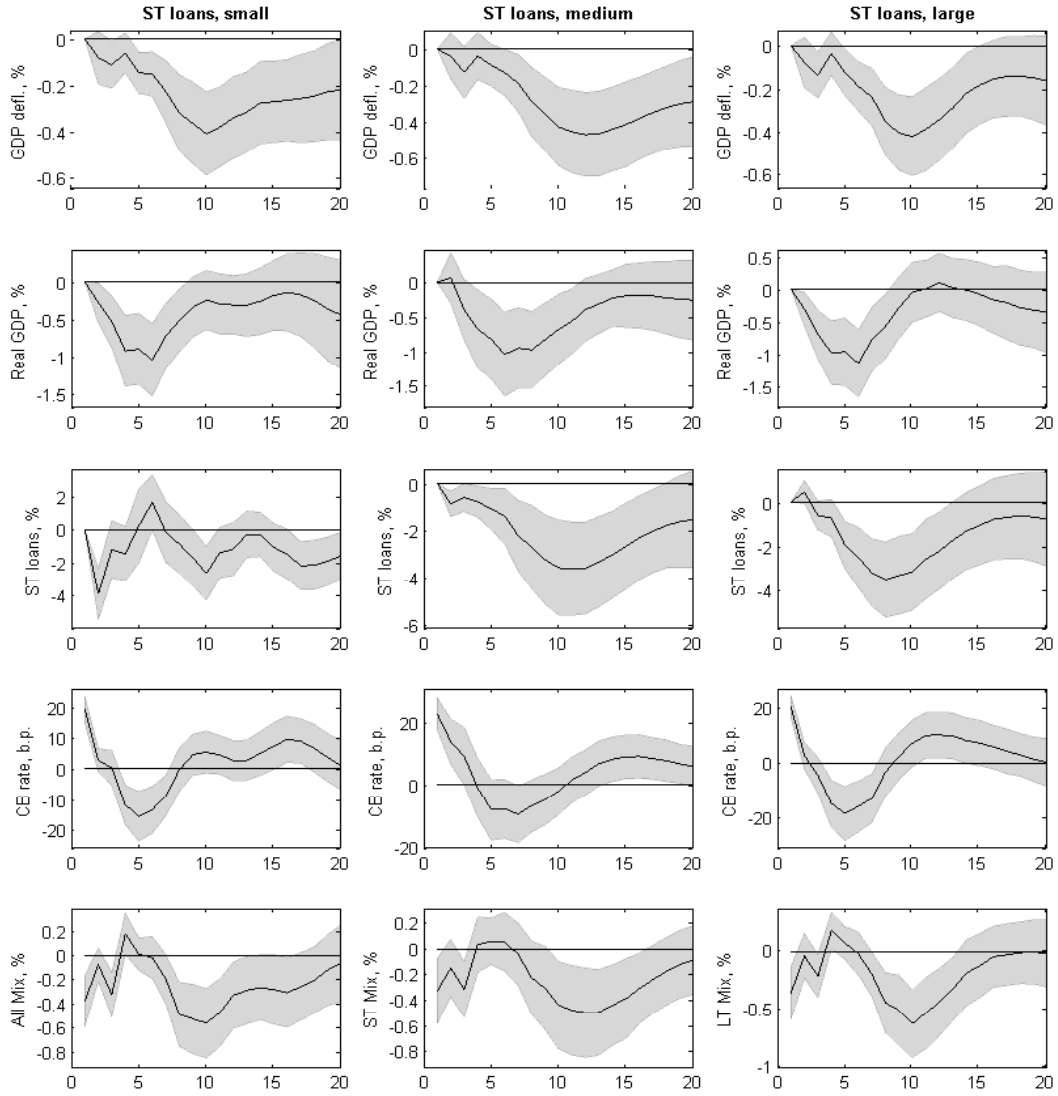
Effects of firm size. The increase in the Mix for foreign long-term loans and in foreign long-term loans themselves after a monetary contraction is still puzzling. There are hypotheses that could explain such behaviour without resorting to the bank lending channel. One such interpretation is that only the best borrowers have access to foreign loans (typically, large exporting firms). The increase in the Mix for long-term foreign loans after a monetary contraction may therefore reflect the reduction in lending to all non-prime borrowers, while the best firms (who rely more on foreign funding) are less constrained and are still able to borrow. This would explain the increase in the proportion of foreign funds among firms' liabilities in the aggregate, even if there is no bank lending channel.[14]

To investigate these hypotheses one would require detailed disaggregated time series by different types of borrowers. Such data are unfortunately not available. Given data limitations, the most we can do is to examine the behaviour of loans by firm size. While this will not provide a definitive answer to the problem outlined above, it could at least give an indication whether the behaviour of bank loans is very different depending on firm size (for instance, if long-term loans for large firms increase after a monetary contraction and decrease for small firms). This would clearly indicate that there are compositional shifts of bank loans from one type of firms to the other.

The breakdown of data on firm loans by firm size is not available at quarterly frequency. We therefore had to construct quarterly data based on annual data (the procedure is described in appendix B). The constructed loan series are for total loans of nonfinancial corporations, broken down by maturity and firm size. Sales were used as a proxy for firm size and firms were grouped into three groups. Small firms are those with sales in the lower five percentiles of the sales distribution. Large firms are those with sales larger than the 95th percentile of the sales distribution, while medium-sized firms are those in between. The reason for choosing relatively high (low) percentiles is that the size distribution is skewed and that we wanted to isolate very large firms, which are typically those that have access to foreign loans. At the same time, these firms also tend to be mainly exporters and have a relatively good credit standing. Figures 8 and 9 display the results of this exercise for short-term and long-term loans, respectively. Obviously, findings based on constructed data should be interpreted with extreme caution, but given data limitations, this is the only way one can look at the behaviour of bank loans at a more disaggregated level.

14 Another interpretation could be that domestic lenders may react more sharply to an increase in information asymmetries than foreign lenders (e.g., because foreign lenders may have less information about the local environment). This would imply differences in the strength of the balance sheet channel, not in the bank lending channel.

Figure 8. Bank lending channel by firm size: Short-term loans

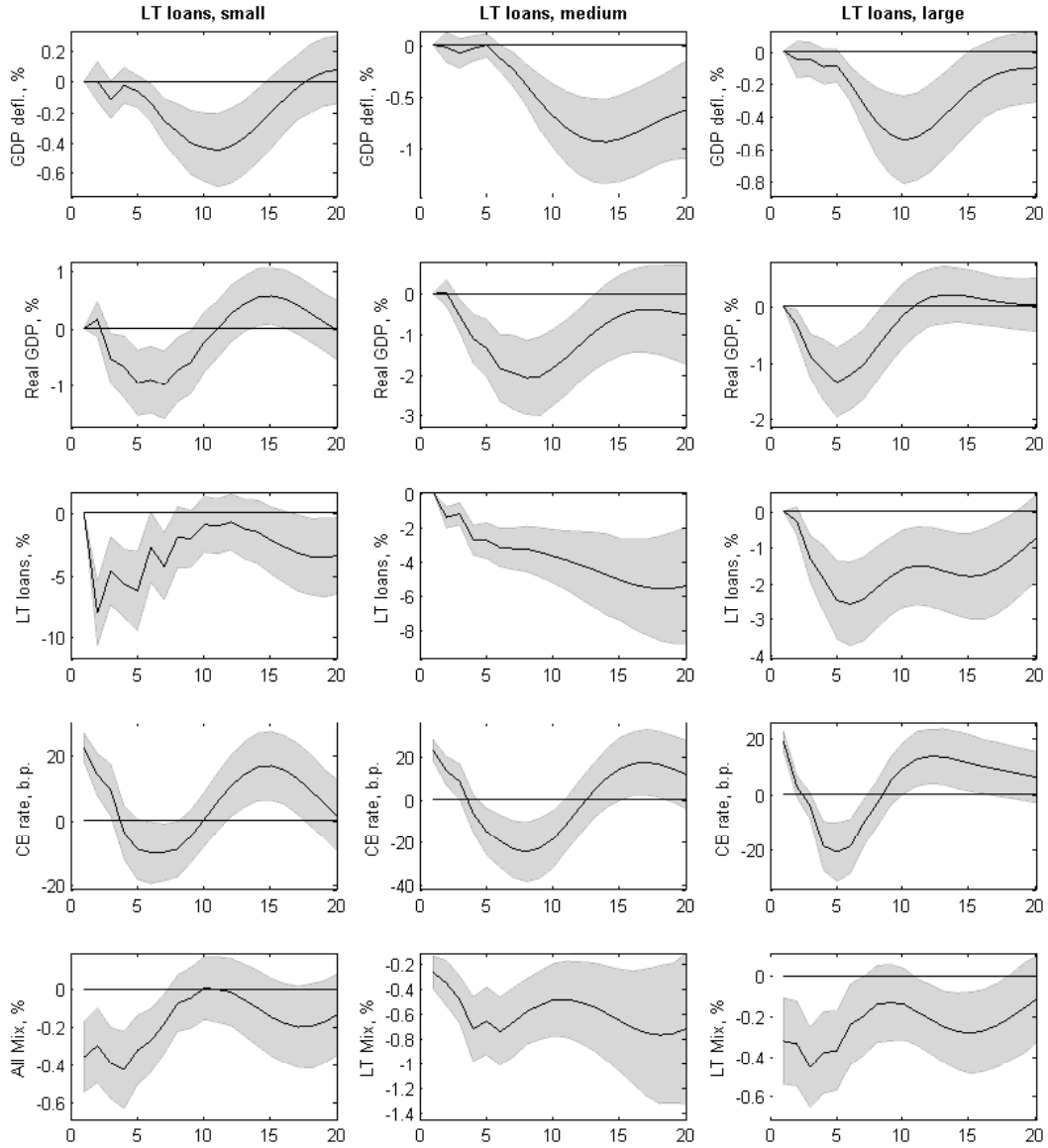


Notes: Impulse responses to a 1 standard deviation shock in the central bank rate. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the mix, which are in basis points). Shaded areas are 90 percent confidence bands (corresponding to 5 percent significance level for one-sided test), generated using bootstrap with 1000 draws.

The comparison of impulse responses to a monetary tightening by firm size for short-term loans (and short-term Mix indicators) with those of the aggregate in Figure 5 show some differences across size groups, but are generally in line with the findings for the aggregate. It seems that large companies are responsible for the brief initial increase in the aggregate short-term loans. The aggregate dynamics is mostly dominated by large and medium-sized firms, as small firms represent only a very small proportion of all short-term loans (a little more than 1% in the sample average, the rest is almost equally divided between large and medium-sized firms). Unfortunately, the magnitudes of the decrease in loans are very different and occur at different times, which does not rule out changes in the distribution of short-term loans.

The reaction of long-term loans to a monetary contraction by firm sizes is somewhat more unified, as Figure 9 shows. Long-term loans decrease in absolute terms across all firm sizes and the Mix decreases significantly. However, even here the magnitudes and timings differ, so that distributional effects cannot be ruled out.

Figure 9. Bank lending channel by firm size: Long-term loans



Notes: Impulse responses to a 1 standard deviation shock in the central bank rate. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the mix, which are in basis points). Shaded areas are 90 percent confidence bands (corresponding to 5 percent significance level for one-sided test), generated using bootstrap with 1000 draws.

Based on the results above for different firm sizes, it is difficult to exclude distributional effects. What is possible to conclude is that long-term loans do decrease after a monetary contraction, and that this decrease is accompanied by the decrease of the (aggregate) Mix. It is therefore not the case that debt for large firms increases and for small firms decreases (which is sometimes found in the U.S. data and taken as the indication that there are distributional effects present). However, even if the direction of the loan reaction is the same, the magnitude and timing differ across firm sizes, so that there may still be distributional effects present.

4.4. The bank funding channel

The same ideas that were used for the analysis of firm liabilities can also be applied to banks. In the same way as firms, banks have access to different types of liabilities. The menu of liability types for a financial intermediary is typically much larger than even for a very large nonfinancial company. Moreover, different liability types are likely to be even closer substitutes for banks than for nonfinancial firms.

Applying the same reasoning as for firms, a reduction in the proportion of one bank liability type in the sum of all liability types that are its close substitutes indicates that the relative supply of this particular liability type has decreased. Put differently, given its funding need and a set of substitutable funding options, a bank will pick the funding option whose supply is the most readily available among the funding options it has.

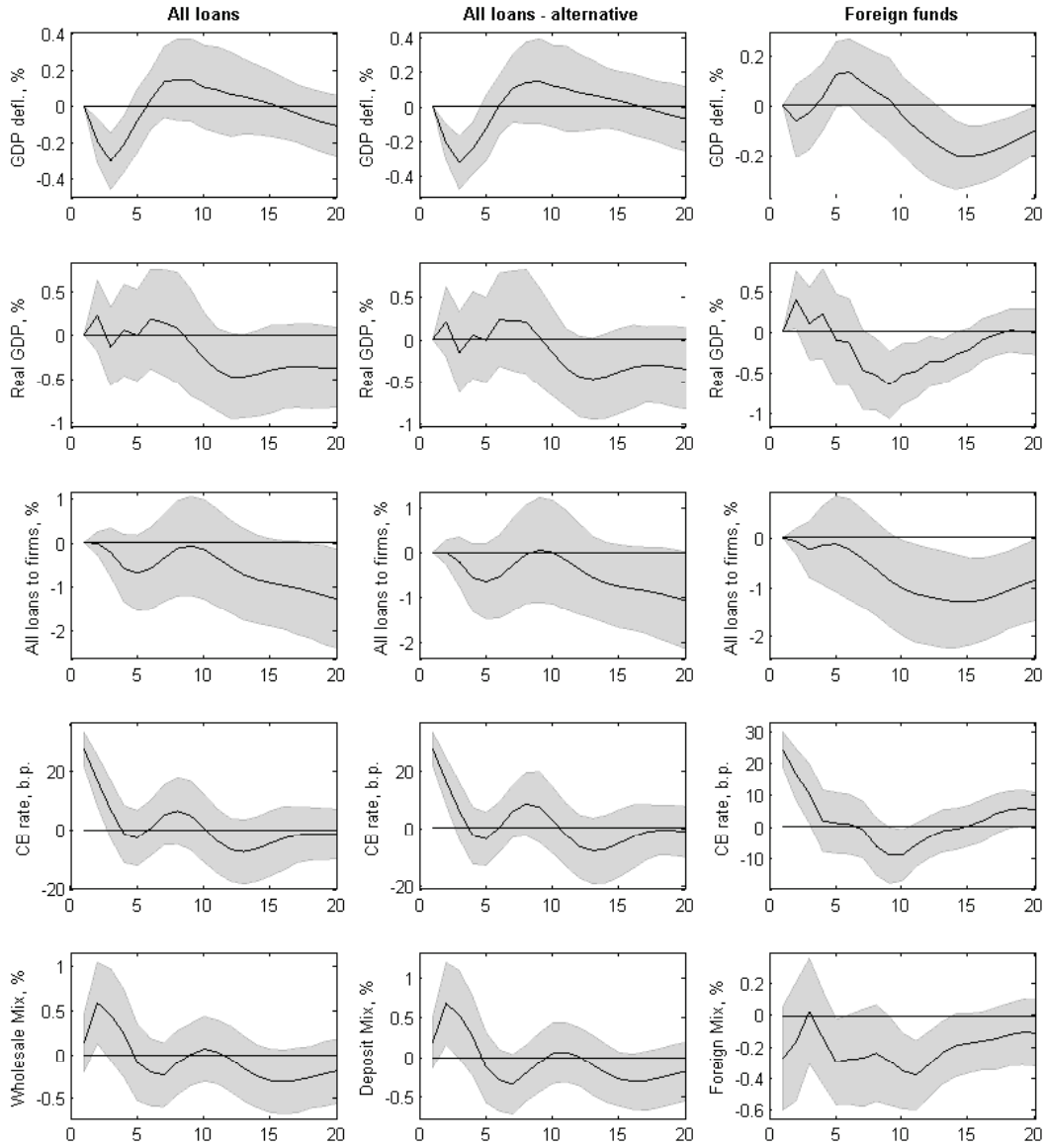
We follow the line of reasoning outlined above and use a variant of the mix to examine the behaviour of bank funding supply after a monetary contraction. This has several benefits. First, it helps to explain the role of wholesale funding of domestic banks. Banks in Slovenia have been by far the most important entry point for foreign capital, which entered the country primarily as debt (mostly as long-term loans to banks). Second, the reaction of wholesale funding to a monetary contraction may shed more light on the functioning of the bank lending channel. If banks are able to replace deposits by wholesale sources of finance, then this implies that the bank lending channel is weaker. Finally, if there exists a balance sheet channel at the bank level (Disyatat, 2010), then a relative change in the proportion of foreign wholesale funds could indicate different perception of bank creditworthiness by foreign and domestic agents.

To examine the behaviour of bank funding after a monetary policy shock, we define three types of mix. The wholesale Mix is the proportion of all loans obtained by banks to the sum of all loans, securities, and deposits (all on a consolidated basis).[15] The reason is that loans are by far the most important source of wholesale finance for Slovenian banks. Moreover, because banks can relatively easily switch between different types of financing, this suggests using a broad set of alternatives. The second definition is the Deposit Mix, which is defined as the ratio of loans obtained by banks to the sum of loans and deposits. The reason is that the issuance of securities is lumpy and limited to a handful of largest banks, which may blur the results. The final definition of the mix is the Foreign Mix, which is the ratio of all foreign loans and securities to all loans, securities, and deposits. This mix measures the potentially different behaviour of foreign creditors.

The effects of a monetary contraction are presented in Figure 10. What is particularly interesting is the behaviour of the mixes in the bottom row of the figure. The leftmost and the middle column indicate that wholesale loans increase significantly relative to other alternative sources of bank financing after a monetary contraction. Moreover, while Foreign Mix decreases initially, the decrease becomes weakly significant only after about a year. These results seem to indicate that after a monetary contraction banks tend to partly offset the (relative) decrease in deposits by resorting to wholesale funds, which may not necessarily be foreign wholesale funds.

15 The results carry through if we exclude government deposits from the anaysis.

Figure 10. Effects of monetary policy shock on bank funding



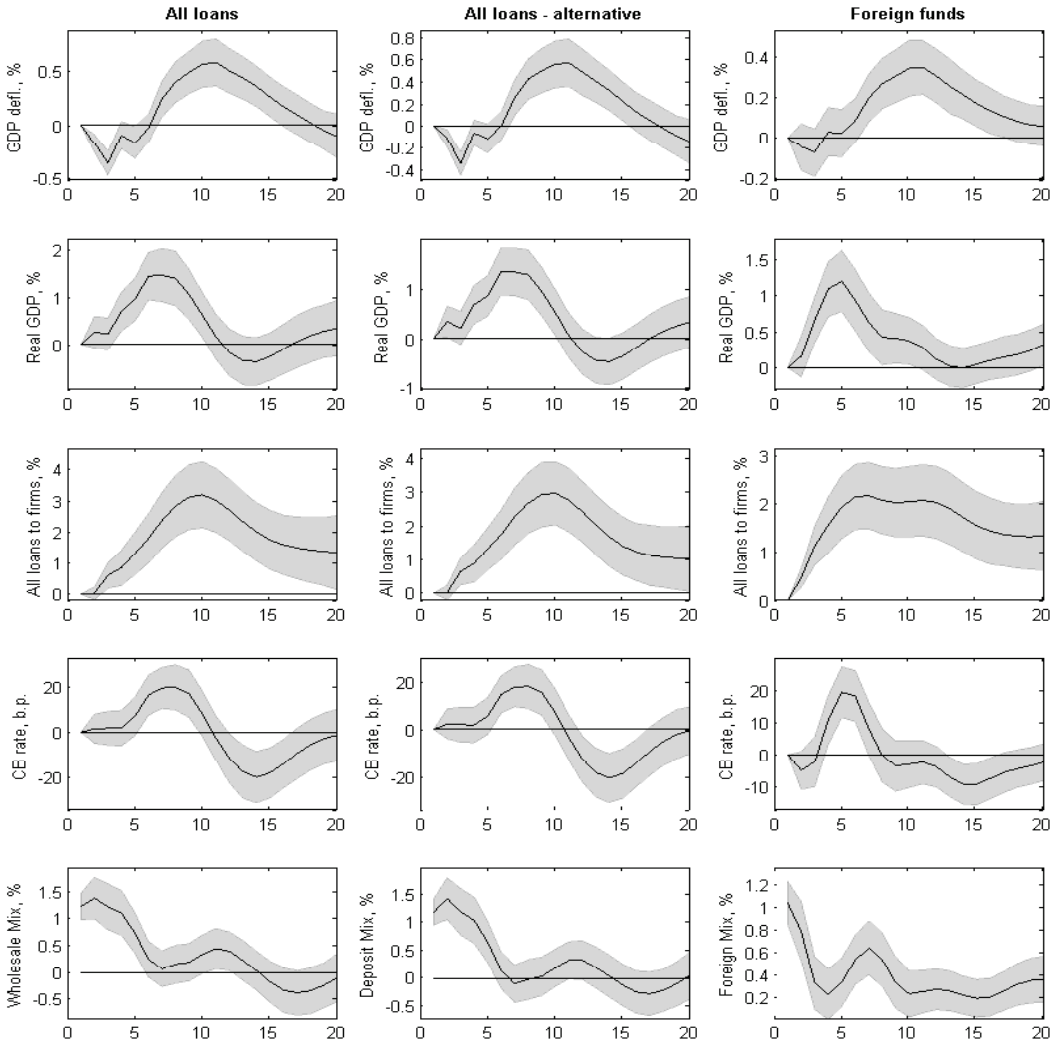
Notes: Impulse responses to a 1 standard deviation shock in the central bank rate. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the mix, which are in basis points). Shaded areas are 90 percent confidence bands (corresponding to 5 percent significance level for one-sided test), generated using bootstrap with 1000 draws.

The finding that banks use wholesale funds is not necessarily inconsistent with the evidence from section 4.3 that there may be an indication that a bank lending channel exists. If banks do use wholesale funds and if there still is some evidence for a bank lending channel, then this would suggest that the channel would be stronger if wholesale funds were not available.

Given that banks use wholesale funds, it is interesting to examine the effect of a change in the (relative) supply of these funds. This is done in Figure 11, which shows the effect of an increase in a particular Mix on the other variables.[16] We label this a 'bank funding shock' and order it last (so that all other variables react with a lag to an innovation in the mix). Note that this bank funding shock represents a relative increase in the supply of wholesale funds to banks.

16 A similar exercise, but without the central bank rate, has been used by Iacoviello and Minetti (2007). We keep the central bank rate in the VAR because it is more likely that the central bank will react to an innovation in the European wholesale market. The results are not materially affected if the central bank rate is left out.

Figure 11. Effects of a bank funding shock



Notes: Impulse responses to a 1 standard deviation shock in the mix. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the mix, which are in basis points). Shaded areas are 90 percent confidence bands (corresponding to 5 percent significance level for one-sided test), generated using bootstrap with 1000 draws.

The striking result in Figure 11 are the strength and the uniformity of the effect of the increase in the relative supply of wholesale funds to banks on domestic lending and GDP. Bank lending to firms and GDP increase immediately and significantly. The magnitude of the increase is also remarkable. The increase in any mix by about one percentage point results in about 3% increase in bank loans to firms and about 1.2% increase in real GDP after approximately two years. These findings are very robust and similar results are obtained for various measures of bank loans and mix definitions.

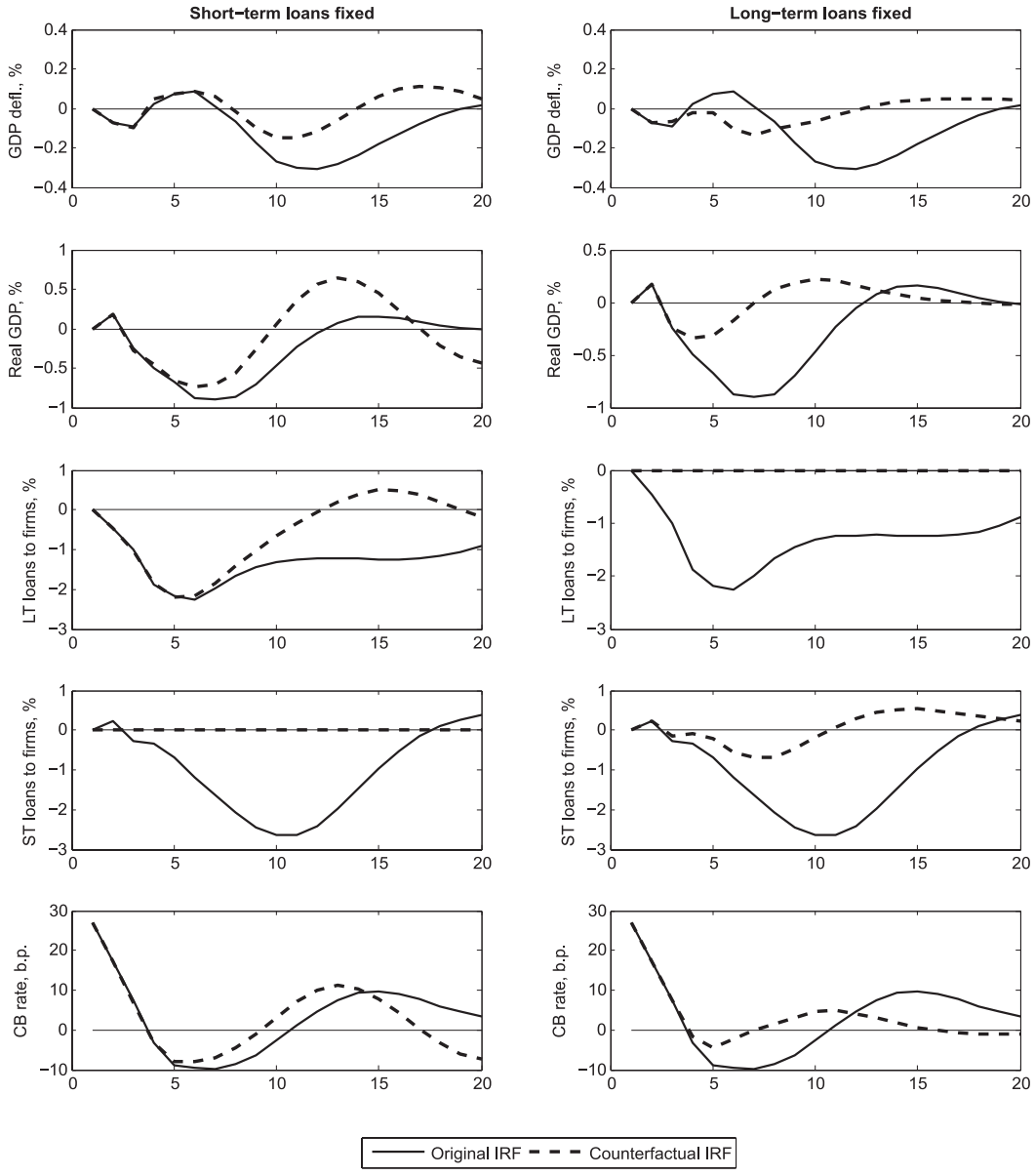
The findings reported above are consistent with the bank funding view. More-over, they suggest that shocks to bank funding play an important role in the domestic economy. While one should be careful and not make policy conclusions based on such analysis, the results nevertheless suggest that policymakers should perhaps be more attentive to developments in bank funding.

4.5. The link between bank loans and real activity

From a policy perspective it is also interesting to see what is the effect of loans of different maturities on the real activity, in other words, what is their relative importance for output after a monetary policy shock. Just by looking at the magnitude of different responses, it is impossible to assess the relative importance of long-term and short-term loans on GDP. One way to get more insight is to perform a counterfactual exercise.

To do so, we estimate a standard monetary VAR that includes both short-term and long-term loans. Again, we shock the central bank's interest rate and look at the impulse responses, while keeping the responses of one loan type at a time fixed.[17] For instance, a counterfactual experiment that artificially increases long-term loans by about two percentage points increases real GDP by about one percentage point. An artificial increase of short-term loans by a similar magnitude increases real GDP by only about half of a percentage point.

Figure 12. Counterfactual analysis holding bank loans constant



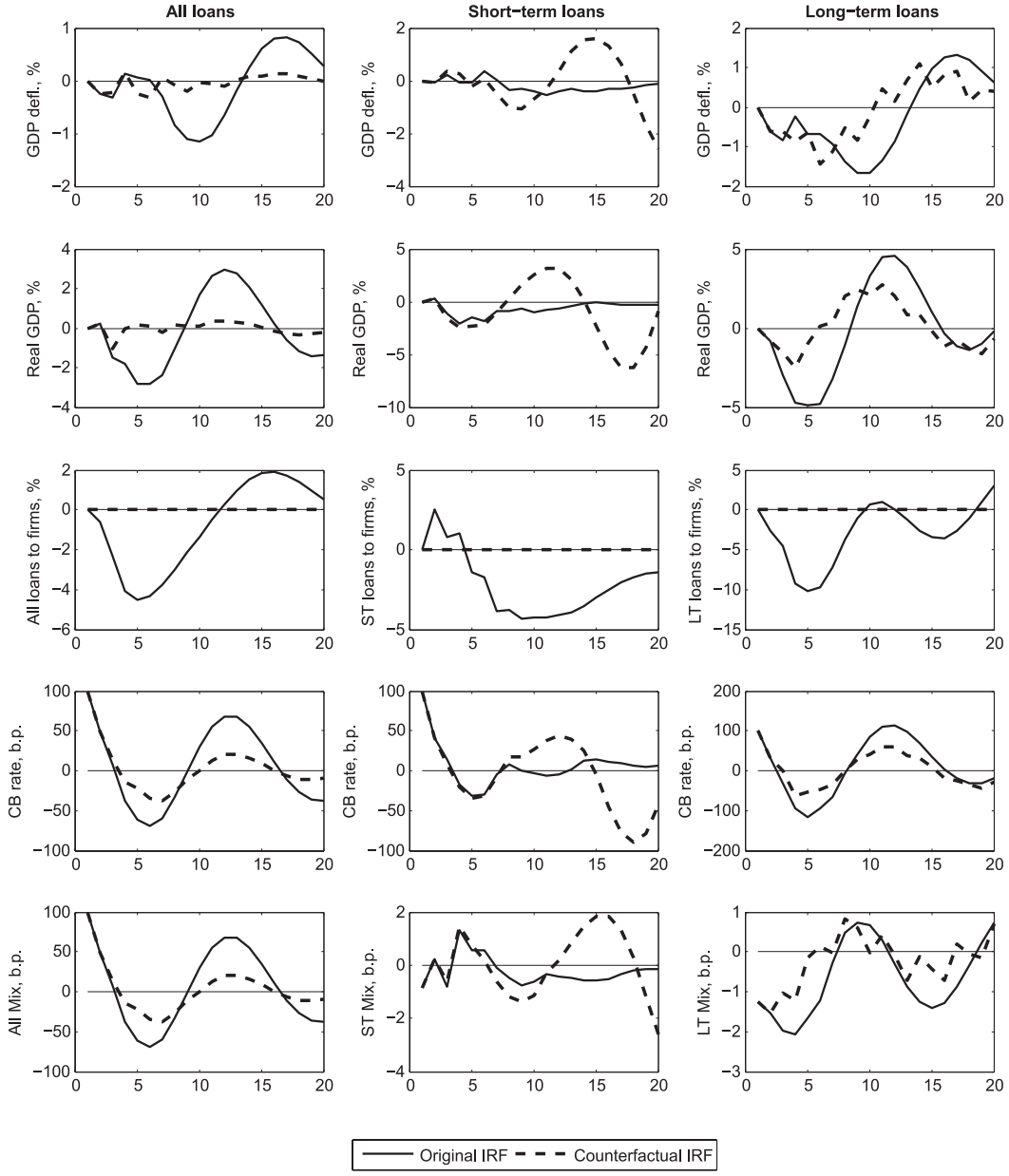
Notes: Impulse responses to a standardised 100 basis points shock in the central bank rate. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the Mix, which are both in basis points).

17 This is equivalent to the idea that this variable does not respond to the shock

To assess the importance of bank loans for real activity and bank loan supply, we also perform a series of counterfactual experiments. We take the impulse responses to a monetary tightening reported in Figure 5 and force firm debt to remain constant after the shock.[18] In all three cases, this implies, at least during some time interval, artificially increasing firm debt. If firm debt has some influence over the real variables and the indicator of the bank loan supply, then this should be reflected in the changed responses of these variables.

Figure 13 shows the result of such experiment. Except for short-term loans, fixing the response of loans to a monetary shock also stabilises output. Moreover, wherever there is a counterfactual increase (decrease) in loans relative to the original responses, output tends to increase (decrease). Consistent with the idea that a bank loan supply increase to some extent increases bank loans, the bank loan supply indicator also increases.

Figure 13. Counterfactual analysis holding firm debt constant

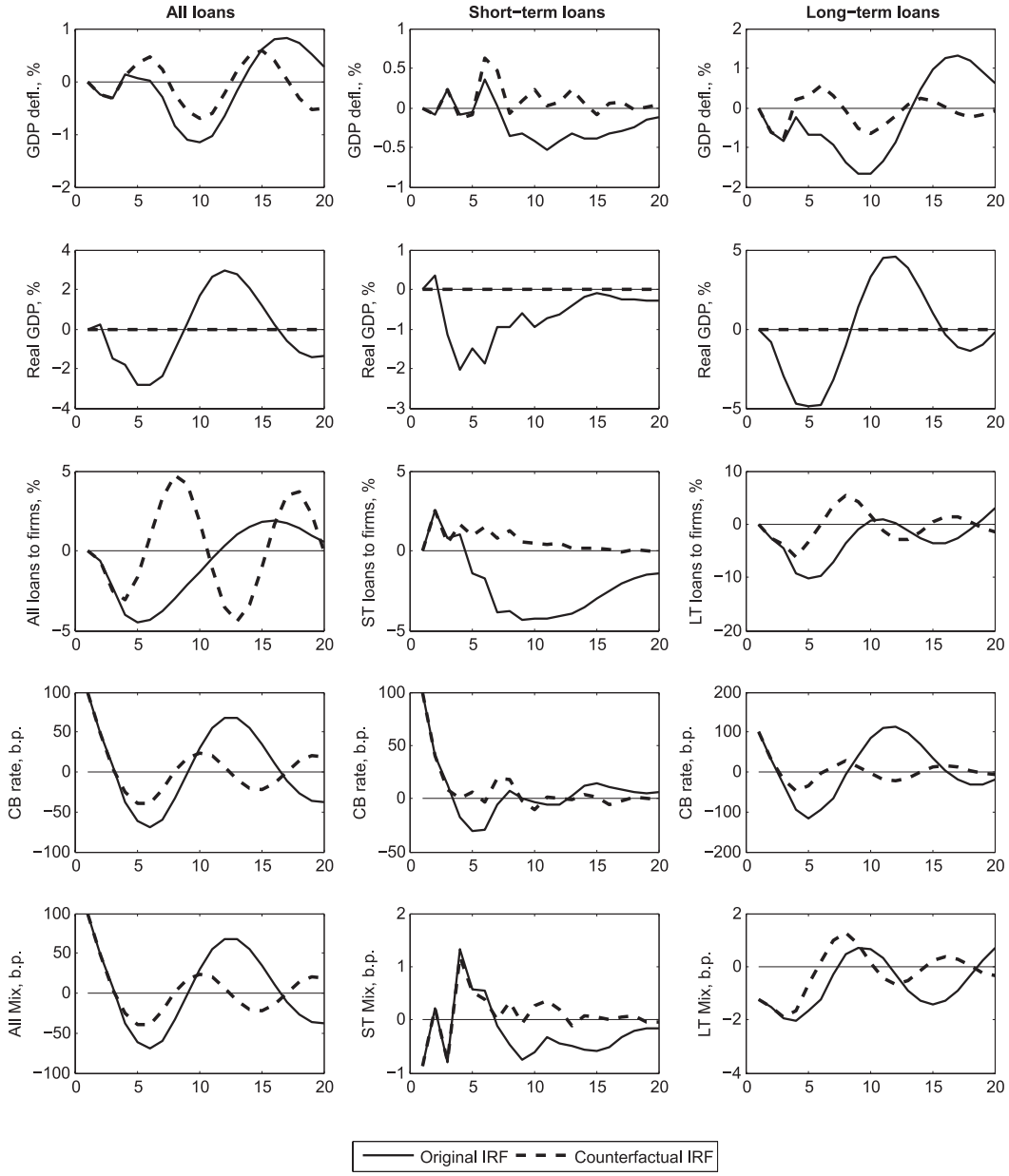


Notes: Impulse responses to a standardised 100 basis points shock in the central bank rate. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the Mix, which are both in basis points).

18 This is equivalent to feeding the estimated model with a series of (reduced-form) shocks to firm debt that would set the level of debt to its initial value in every period following the monetary policy shock.

However, it may also be the case that most of the decline in firm debt after a monetary contraction is driven by the decline in output. To test this, we perform another counterfactual, where we keep output fixed and examine the difference in responses of firm debt and the Mix. Figure 14 shows the results. The relation from real output to firm debt and bank loan supply indicator is also positive (wherever real output response is artificially increased in the counterfactual experiment, firm debt increases and so does the bank loan suppy indicator). Unfortunately this indicates that the influence goes in both directions.

Figure 14. Counterfactual analysis holding real output constant



Notes: Impulse responses to a standardised 100 basis points shock in the central bank rate. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the Mix, which are both in basis points).

The counterfactual experiments indicate that the relation between bank loans, output, and bank loan supply indicators is positive. The direction of influence, however, remains ambiguous. It should be emphasised that the findings of such counterfactual experiments should be taken with caution. Fixing the response of either firm debt or output is equivalend to a series of reduced-form shocks that do not have a structural interpretation.

5. Conclusions

While it would be natural to expect that the bank lending channel is relatively stron in Slovenia and that it would be a simple exercise to identify it, it turns out that this is not exactly the case. The empirical evidence that would support the existence of the bank lending channel for firms is mixed. On the other hand, there seems to be a strong support for the existence of the bank funding channel (a lending channel for banks' wholesale funds). This channel seems to be both strong, significant, and robust.

Given such results, both channels of monetary transmission would warrant further investigation. Exploiting firm heterogeneity could provide new sources of identification. More detailed data on firm debt structure could in principle be constructed, which would enable the examination of potential distribution effects.

6. References

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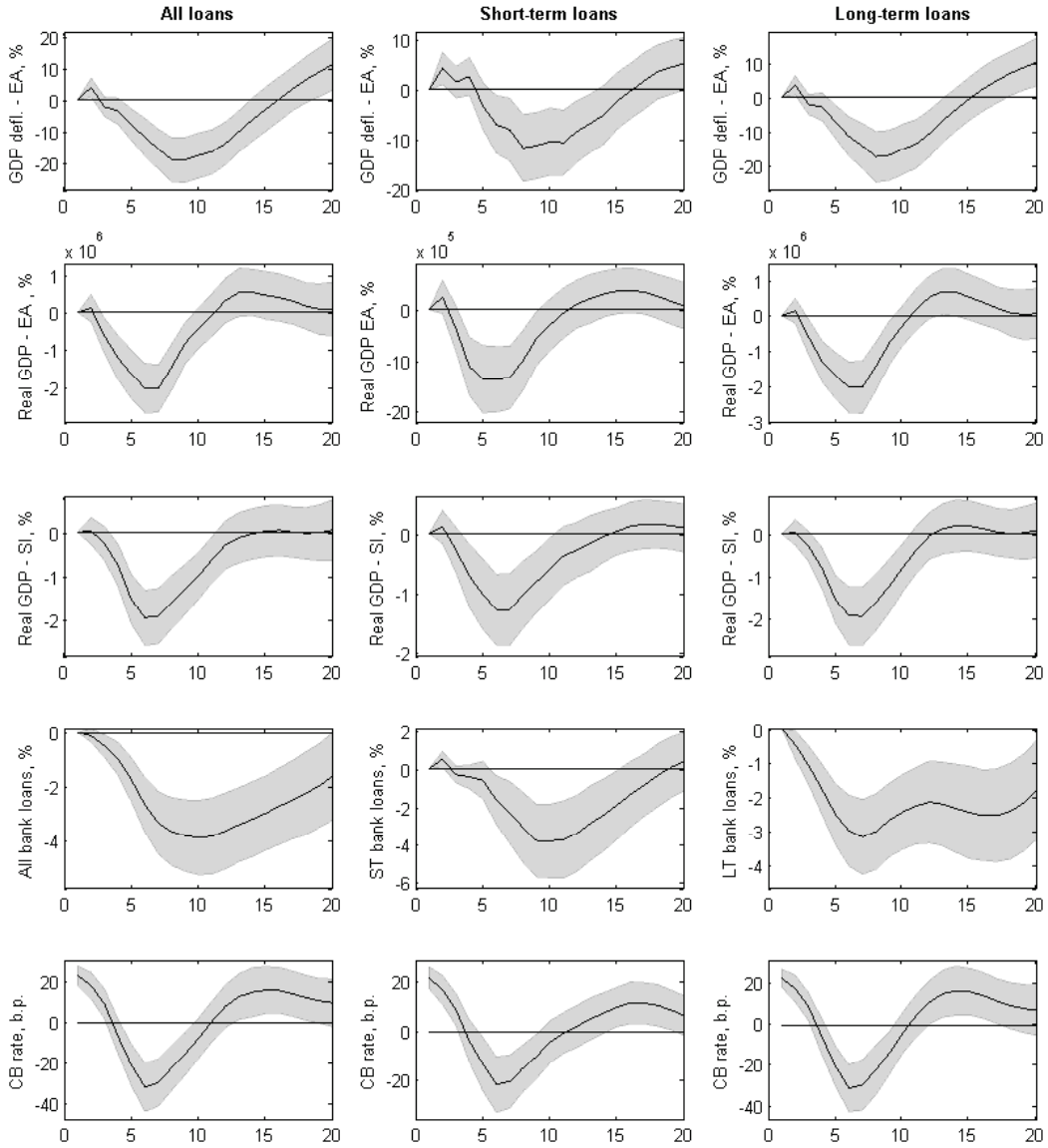
A. Effects of bank lending shock using different VAR specification

Figure 15. Monetary policy shock with the EA data



Notes: Impulse responses to a 1 standard deviation shock in the central bank rate. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the mix, which are in basis points). Shaded areas are 90 percent confidence bands (corresponding to 5 percent significance level for one-sided test), generated using bootstrap with 1000 draws.

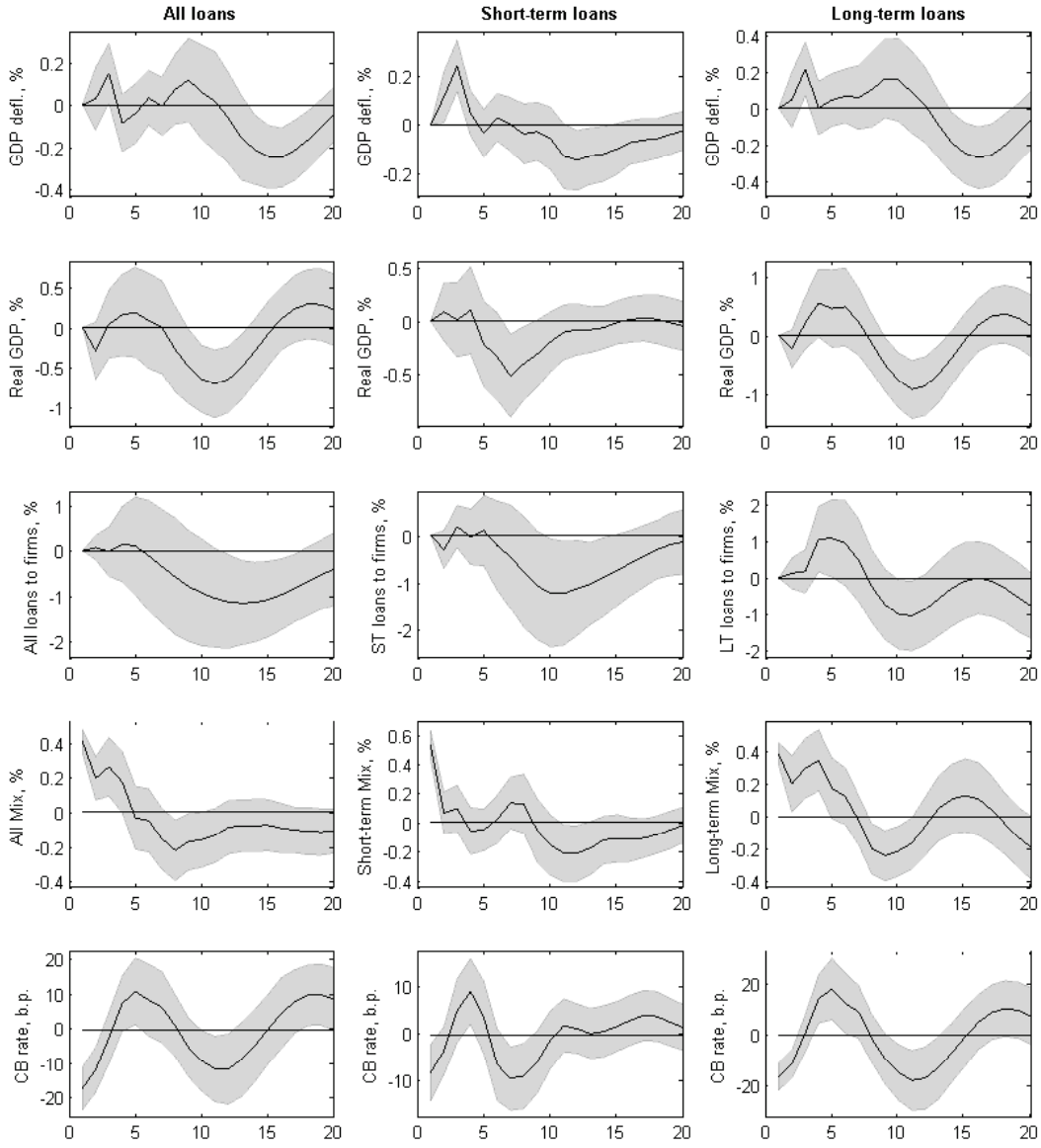
B. Data construction

To construct quarterly data on firm loans broken down by firm sizes we use annual data from firms' balance sheets and quarterly data from the flow of funds statistics. In particular, we use annual balance sheet data to group firms into different size groups and compute end-of-year amounts outstanding of loans from banks for each size group. We then use the intra-year dynamics of flow-of-funds data for aggregate short-term and long-term loans and for each size group adjust the quarterly

dynamics so that it gives the amounts outstanding at the end of each year. The data constructed in this way are available only until Q3 2012.

Figure 16 reports responses to a bank lending shock (an increase in the Mix) in the VAR that is identical to that in the main text, with the exception that the Mix is ordered above the central bank rate. This implies that the central bank is allowed to respond contemporaneously to the innovation in the Mix. The results for all loans and short-term loans are statistically insignificant in the short run, but the results for the innovation in the long-term Mix are both statistically significant and consistent with the hypothesis that there is a bank lending channel (especially because the response of the long-term Mix to a monetary policy shock in this VAR - not reported here - is negative and significant).

Figure 16. Effects of the shock to bank lending



Notes: Impulse responses to a 1 standard deviation shock to the Mix. The responses should be interpreted as percentage deviations from initial values, except for the central bank rate and the mix, which are in basis points). Shaded areas are 90 percent confidence bands (corresponding to 5 percent significance level for one-sided test), generated using bootstrap with 1000 draws.

UDC 339.727.3.025(496.5)

FOREIGN CURRENCY LENDING IN ALBANIA

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Abstract

The increase in foreign currency lending in many countries of Central and South Eastern Europe (CESEE) has resulted in a surge of research on this area. Similar to other countries of CESEE, in Albania it is highly important to study the main determinants of the behaviour of foreign currency, given that 65% of total loans to private sector are denominated in foreign currency. This material employs means of the bound test to Autoregressive Distributed Lag approach including demand and supply side indicators such as: interest rate differential, foreign currency deposits, and volatility of inflation and exchange rate.

JEL Classification: C32, C51, E44, E51, F31, G11, G21, O57

Keywords: Foreign currency lending, dollarization, minimum variance portfolio, ARDL approach

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The views expressed herein are of the authors and do not necessarily reflect the views of the Bank of Albania.

I. Introduction

The presence of a sizeable share of foreign currency (FX) lending in the Central, Eastern and South Eastern European (CESEE) countries has recently attracted a keen interest of economic policy and research. Although, as in the CESEE countries, in Albania this phenomenon started as a feature of private firms, it quickly expanded to individuals. Nowadays, although diminishing over the years, more than 65 per cent of all private sector loans in Albania is currently denominated in (or linked to) a FX lending. This type of lending is dominated by retail loans, household mortgages and large entrepreneur's loans. In line of thinking, FX lending is largely demand driven, or the demand factors are not important, they are just relatively more important than supply factors mainly due to less extend of asset substitution [Beckmann, Scheiber and Stix, (2011)].

FX lending to firms could be explained by currency hedging of exporting firms [Fidrmuc, Hake and Stix (2011)], the existence of positive spreads[2] and the assumption that the euro is a very stable and trustworthy currency than the domestic one [OeNB Euro Survey, (2012)]. But, unhedged FX lending is seen as a major threat to financial stability and risk of systemic crises in SEE, in case of exchange deprecations and interest rate changes [Brown and De Haas (2010)][3]. Unhedged FX lending is as high as 60% of total FX lending in the case of Albania. Currently, the FX loan portfolio appears somewhat more problematic in terms of its quality compared to the portfolio in local currency, at 71% versus 29% of all non-performing loan (NPL) and at 17% versus 7% of all lending to private sector. Recently, pace of deterioration of the NPL in foreign currency has risen at higher level than that in domestic currency. Hence, considering the significantly higher burden of FX lending, the situation appears particularly disturbing since the risk and consequences associated with this portfolio are materially of greater importance[4] as the system would be exposed to exchange rate credit risk indirectly. Moreover, FX lending potentially constrain the effectiveness of monetary policy and complicates macroeconomic policy; in particular, it can limit the central bank's ability to influence output and inflation by forcing it to prioritise exchange rate stabilization [Beckmann, et. al., (2011)].

Under such circumstances, the appropriate well-targeted regulatory and supervisory measures to these challenges crucially depend on the knowledge about the sources of the driving forces behind the developments of FX lending dominance and the impact the crisis had on it, even though the implications of FX lending for macroeconomic and financial stability have been debated already prior to the global economic and financial crisis [Streiner, (2011)]. After the crisis had hit the CESEE region, triggering exchange rate fluctuations and straining the financial situation of both firms and individuals, the issue of FX lending has increasingly caught the attention of policymakers. The Governing Council of the Bank of Albania, by late 2008 and early 2009, decided to raise the demand for capital expenditure for the unhedged bank's loan portfolio[5] and placed a higher constraint weighted level of for the foreign bank branches[6]. These macro-prudential measures aimed to de-motivate FX lending. However, the widespread view that FX lending in Albania is driven by interest rate differentiations, exchange rate and inflation risk or funding of banks in FX has not yet been empirically analysis[7]. Moreover, although the literature on the causes and consequences of FX lending is growing, many questions in the case of Albania remain unanswered, in particular in connection with the factors driving and their effects on FX lending by private sector. Therefore, the main purpose of this material is to provide new evidence on the various dimensions effects thriving FX lending by private sector in the case of Albania.

2 See: Bank of Albania Annual reports, mainly Bank of Albania, (2004a) and Bank of Albania, (2004b).

3 Beckmann, et. al. (2011) finds that the majority of respondents in a survey answered that FX lending has become riskier because of exchange rate depreciations. The number of responders is 10 percentage points higher than in countries where no depreciation took place.

4 Stress test scenarios that take into consideration currency devaluation by 20% results in the collapse of the banking system capital adequacy level, with only at relatively small portion. See also Bank of Albania Annual Report.

5 These macro-prudential measures consisted of 50% higher limit for portfolio related to the calculations of capital adequacy level, a ceiling limit level of 400% of FX lending to the regulatory capital.

6 The limit was placed at 6.25% of total system assets and 6.25% of total system liabilities;

7 See: Bank of Albania Annual Reports and Supervision Reports. Also, in the Supervision Department's (Bank of Albania) report on the project over some changes in the regulation on "The management of loan risks" and the regulation on "The capital adequacy ratio" and the regulation on "The management of the activity of foreign bank branches" these were listed as some of the motives for FX lending.

To our best knowledge, credit channel has only recently been studied in the case of Albania, both on individual and a panel sample and by means of empirically and non-empirically techniques[8]. In a recent discussion material, Shijaku and Kalluci (2013) studied the long-run determinants of bank credit to the private sector in the case of Albania. The model is estimated by employing a Vector Error Correction Mechanism (VECM) approach and considers both the demand and supply indicators. The main findings of this paper concluded that credit behavior is positively linked to economic growth and has a countercyclical behaviour. Bank credit would be stimulated by a higher banking and financial intermediation, as well as further financial liberalisation lower cost of lending, diminishing government domestic borrowing and a more qualitative bank lending would create further lending incentives. The exchange rate is found to pick up some demand valuation and consumption smoothing effects. The authors find also an adjustment mechanism that brings bank lending back to equilibrium, but the coefficient is relatively low.

Against this background, this material contributes to the empirical research on this topic by explicitly disaggregating bank lending and concentrating only on the FX lending. The material provides additional evidence of supply-side and demand-side factors related to the popularity of this type of loan in the years leading up prior and post to the financial crisis at the macroeconomic level. The model is based on the meta-analysis of Cuaresma, Fidrmuc and Hake (2011) for CESEE countries. It is estimated through the bound test to the Autoregressive Distributed Lag (ARDL) approach as explained by Pesaran, Shin and Smith (2001). This provides an advantage prior to the relatively short sample time-span. We also incorporate the concept of a minimum variance portfolio (MVP) as explained by Ize and Levy-Yeyati (2003) on the determination of the optimal share of the portfolio of foreign assets considering both inflation and foreign exchange risk. The material support findings by previous empirical work in the case of Albania. The study identifies a stable long run cointegrated vector and the speed of adjustment is relative higher comparable to earlier studies on credit behaviour and money demand utility function.

The results provide evidence that FX lending is mainly driven by the availability of bank FX funding deposits and a MVP share. The findings confirm the theoretical assumption that FX lending will be influenced by risks perception conditions and it reflects more the tendency towards stable currency patterns. Firms and households will be more likely to request FX loans when interest differentials are higher, even though the impact was found relatively small. Lending euroisation was found to be slidely effected by the inflation and exchange rate patterns due to the lower inflationary pressure and stable exchange rate regime through the sample time. Bank of Albania macroprudential policies have provided positive incentives, but probably more efforts might be needed to de-motivate further lending euroisation.

This paper consists of four sections. Section 2 focus on some stylised facts on FX lending patterns. Section 3 presents the mechanisms underlying the estimating equation as described in the literature and indicates the data and the estimation method used. Section 4 presents summarizes the results. The material concludes in section 5.

II. Stylised facts

The past decade placed Albania among the regional countries with a fast growing financial intermediation. This is not surprising, given the initial low level of bank credit-to-GDP ratio compared to Europe Union countries and other regional countries. However, the bank lending boost was not gradual and seems to have gathered more momentum during 2004 – 2008. The progress in financial intermediation began after the privatisation of the largest bank in the country, Saving Bank. This was facilitated by the entry and the re-dimension of some foreign and emerged banks that stepped up the lending process and increased competition in this aspect[9]. In fact, much of the increase is attributed to the prevalence of the private sector, particularly private firms and households, and lending in FX currency unit. The prevalence of FX lending shows different patterns. Although diminishing over the years, it composes more than 65 per cent of all private sector loans in Albania. The share of FX lending is among the highest in the region, despite that total loan to GDP ratio remains among the lowest.

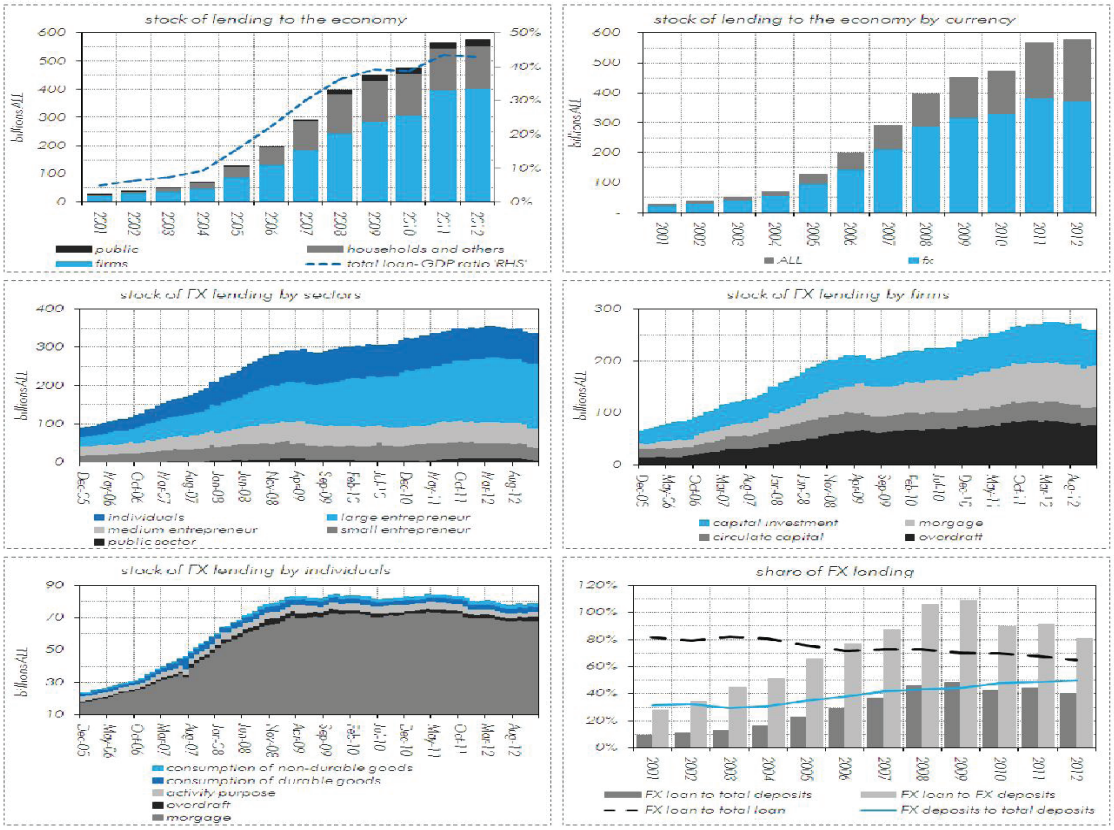
8 See: Kalluci, (2011), Dushku, Dushku and Kota, (2012), Note and Suljoti (2012), Suljoti and Hashorva (2012), Note and Suljoti (2013), Suljoti, Note and Manjani, (2013).

9 Shijaku and Kalluci (2012).

FX lending is mainly provided to private firms, particularly large entrepreneurs, but over the years it has quickly been attractive to individuals. Firms require more FX lending to improve technology through capital investment and expand their activity by raising circulated capital and overdraft, but slidely less for mortgages purposes. Individuals use most of FX lending for mortgages, which constitutes nearly 86% of all FX lending. Borrowing in foreign currency is more attractive to a number of factors related to the existence of the lowest rates for U.S. dollar and euro interest compared with those in domestic lending, as well as a lasting period of domestic exchange rate appreciation against the foreign currencies[10]. It is worth mentioning that the main foreign currencies, in which the FX lending is provided, are euro and U.S. dollar (USD). Euro has gained a greater foothold over U.S. Dollar (USD) as a result of the gradual strengthening on the international markets and the strengthening of trade relations between Albania and the European Union. However, they both are considered as strong currencies, with a particularly notable stability in the medium term. Menawhile, the exchange rate against them has been generally stable, following the long period of time progress in international markets[11].

Over the years, the structure of FX loan shows gradual shifts of short and medium towards long-term FX lending. This trend shows a better perception of the investment environment by the banking system, as well as optimizing the use of resources towards longer term assets, which may also generate more income. However, the growth of short term FX loan signals the need of firms for circulated capital and that of individuals for consumption of non-durable goods, which is verified more after 2008. In return, deposits by firms and individuals constrain the main sustainable source of lending. Traditionally, local currency deposits make up the majority of funds invested by clients in the banking system, while already FX deposits occupies nearly 47 percentage of total deposits, compared with 30 percentage in the early 2000s'. However, the share of FX lending to FX deposits remains high, at 85% in 2012 versus 120% in 2008.

Graph 1: Portfolio of categorised lending to the economy

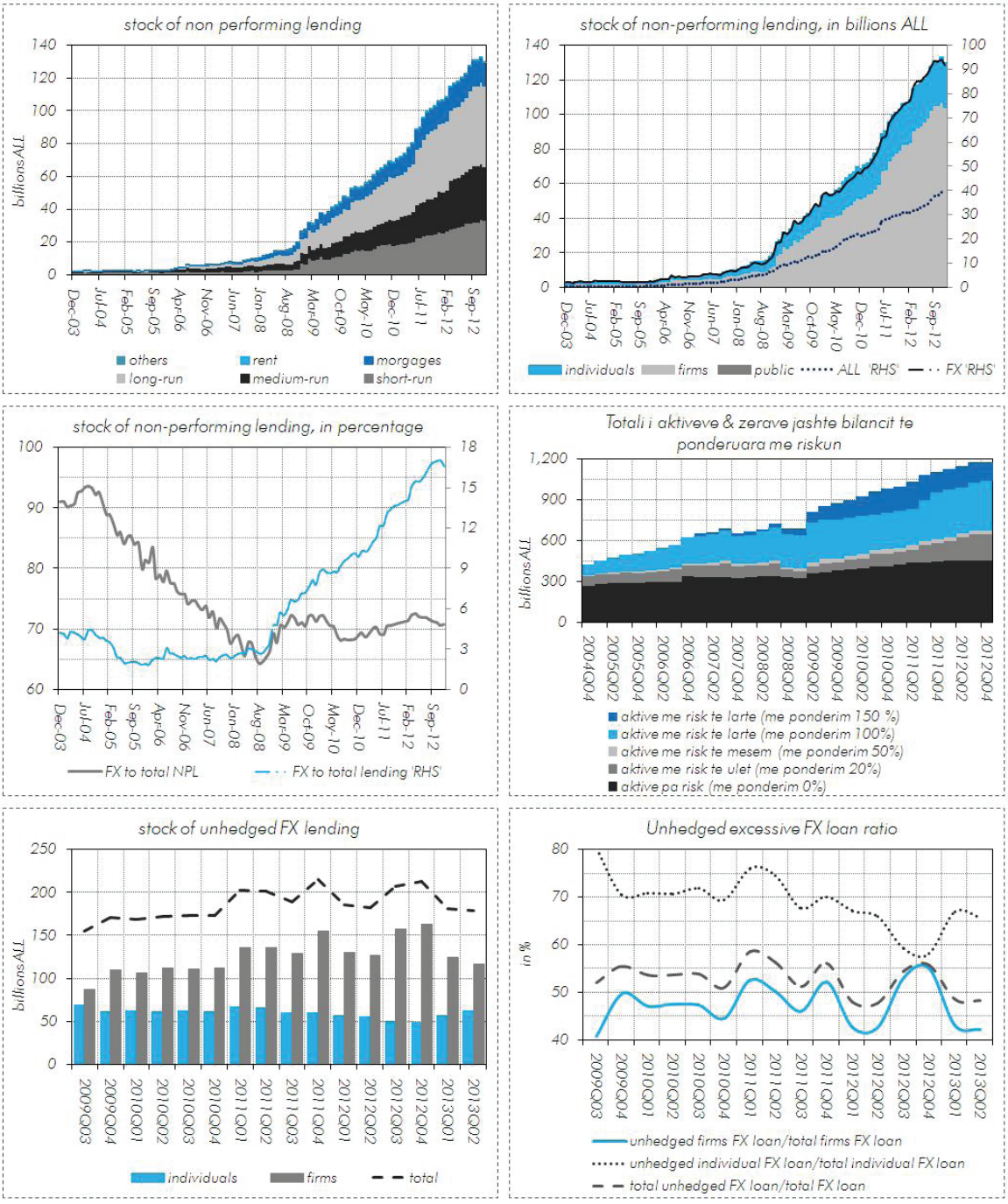


Source: Bank of Albania

10 See: Bank of Albania Annual reports, mainly Bank of Albania, (2004a) and Bank of Albania, (2004b).

11 See: Bank of Albania, (2005a) and Bank of Albania, (2005b).

Graph 2: Portfolio of categorised lending to the economy



Source: Bank of Albania

The events of international financial markets in late 2008, which were manifested in the domestic financial system through the lack of public confidence in the system and the withdraw deposits, led to the need for intensified the monitoring of the situation in a timely reaction by Bank of Albania. After the crises, banking activity was characterized by a cautious approach to enterprise risk exposures. Lending grow at moderated levels, reflecting the perception of banking and economic agents to general economic developments domestically and that of the region and worldwide. The FX loan portfolio appears somewhat more problematic in terms of its quality compared to the portfolio in local currency, at 71% versus 29% of all non-performing loan (NPL) and at 17% versus 7% of all lending to private sector. The quality of the hedged portfolio appears more problematic than the quality of unhedged portfolio. Overall unhedged FX lending remains as high and has generally been above 50%. The unhedged FX lending is higher for individual than for firms, at 80% versus 40%. Although, credit risk in the system appears to

be increasing, maintaining a satisfactory level of capital adequacy by banks provide a safeguard pattern for controlling the overall level of risk. This indicator has been significantly higher compared to the regulatory minimum level of 12%[12]. The level of capitalisation is supported mainly by injecting liquidity to the banking system in response of the growing NPL, which resulted in lower financial result of the banking system.

III. The methodology and data

The empirical studies on the determinants of FX lending process consider both the supply and the demand factors. As explained by Cuaresma, *et. al.* (2011), they tend to build upon linear regression models of the following type:

$$\phi_t = \alpha + X_t\beta + \varepsilon_t \quad (1)$$

Where, depending on the study, ϕ stands as an indicator of FX lending; X is a matrix of explanatory variables and $\varepsilon \sim iid\ (0, \sigma^2)$ is the stochastic error term. In our paper, we address this issue by employing data used by Cuaresma, *et. al.* (2011) focusing only on interest rate differential, inflation and exchange rate volatilities of these determinants, the supply side of deposit euroisation as well as on a indicator based on the MVP approach.

The concept of the MVP was first introduced by Ize and Levy-Yeyati (2003) and thereafter has received substantial attention in empirical analyses of both deposit and loan dollarization. Thus they developed a simple portfolio model where the risk averse depositors and borrowers choose the currency composition of their deposits and loans in a bi-monetary economy. The approach assumes that the menu of assets available to depositors includes home currency deposits and foreign currency deposits (at home and abroad). Borrowers, on the other hand, can borrow either in the home or in the foreign currency directly from domestic banks. The equilibrium in the market for loanable funds allows us to characterize the interaction between depositors and borrowers, its implications in terms of interest rate differentials, and the dollar portfolio share on both sides of domestic banks' balance sheets. In other words, this approach implies that the optimal share of the portfolio of foreign assets or liabilities is determined by both sides of a bank's balance sheet by hedging against inflation and foreign exchange risk, while the choice of location depends only on country risk[13].

12 In response of the crisis, Bank of Albania approved a new regulation on liquidity, which set certain standards mandatory for banks to manage liquidity, as well as a new definition and realistic composition of liquid assets. Also, it was determined for the first time a regulatory norm for liquidity on a monthly basis, which states that the ratio of liquid assets to short term liabilities should not be lower than 20%.

13 While nominal interest rates are pre-determined over the maturity of assets and loans, the real returns are subject to different risk sources. On the one hand, the real returns to domestic assets are subject to an inflation shock, μ_ρ,

$$r = \bar{r} - \mu_\rho \quad (a)$$

On the other hand, real returns to assets issued in the foreign currency are influenced by changes of the real exchange rate, μ_π,

$$r^f = \bar{r}^f - \mu_\pi \quad (b)$$

For simplicity the minimum variance portfolio (MVP) approach assumes that inflation and real exchange rate shocks have zero means and a variance-covariance matrix $\Sigma_{\pi\rho} = [\sigma_{ij}]$. The risk-averse households minimize the variance of the expected real return from their portfolio structure,

$$E(R) = \lambda\ (r^f) + (1 - \lambda\ )\ E(r) \quad (c)$$

by choosing the optimal share of foreign currency assets or liabilities, λ. The MVP share of foreign currency assets or liabilities is determined as,

$$\lambda_{MVP} = \frac{\sigma^2_{\rho\rho} + \sigma_{\rho\pi}}{\sigma^2_{\rho\rho} + \sigma^2_{\pi\pi} + 2\sigma_{\rho\pi}} \quad (d)$$

Where, σ is the variance or covariance of inflation and changes of real exchange rate.

Our empirical estimation strategy follows the ARDL approach proposed by Pesaran, *et. al.* (2001). Such intention considers also Shijaku (2012) for the case of Albania and the advantage is threefold. First, the pursuit of this approach provides more degrees of freedom compared to the Vector Autoregressive (VAR) and VECM approach developed by Johansen and Juselius (1990) due to single equation estimation mechanism. Therefore, it is more efficient over a sample with relatively limited number of observations. Second, this approach specifies a long run cointegration relationship by bringing together both the long run and the short run effects. Third, the method hypothesis the existence in the long run of a cointegration relationship among the variables of interest regardless of their different order of integration I(0) or I(1). The estimated regression can be specified by:

$$\Delta\phi_t = \beta_0 + \beta_1\phi_{t-1} + \beta_2\rho_{t-1} + \beta_3\pi_{t-1} + \beta_4\boldsymbol{\lambda}_{MVP_{t-1}} + \beta_5\iota_{t-1} + \beta_6\omega_{t-1}$$

$$+\sum_{i=1}^{p}\delta_{1i}\,\Delta\phi_{t-i} + \sum_{i=0}^{q}\delta_{2i}\,\Delta\rho_{t-i} + \sum_{i=0}^{q}\delta_{3i}\,\Delta\pi_{t-i} + \sum_{i=0}^{q}\delta_{4i}\,\Delta\boldsymbol{\lambda}_{MVP_{t-i}} + \sum_{i=0}^{q}\delta_{5i}\,\Delta\iota_{t-i} + \sum_{i=0}^{q}\delta_{6i}\,\Delta\omega_{t-i} \quad (2)$$

$$+\beta_7\tau_{t-1} + \varepsilon_t$$

Where, ϕ is the FX lending; and π are the volatility of inflation and exchange rate; λ_{MVP} is the minimum variance portfolio; ι is the interest rate differential; ω is the FX deposits; τ is a dummy variable; β_0 is a vector of constant term; β_i and δ_i are the long and short-run coefficients to be estimated; Δ is the difference operator; $\varepsilon \sim iid\ (0, \sigma^2)$ is the stochastic error term[14].

Accordingly, our intended ARDL specified model, went through a four step protocol mechanism. First, equation 2 is estimated by means of Ordinary Least Square (OLS) techniques. Second, an F-test (Wald test) over the hypothesis[15] on the joint significance of the coefficients of the lagged levels of the variables[16] is conducted according to the bounds test to co-integration and Granger causality approach to investigate the long run equilibrium relationship between variables of interest[17]. Third, based on the SIC lag length criterion for our ARDL model[18], the long-run magnitude between variables of interest is evaluated as follows:

$$\Delta\phi_t = \beta_0 + \beta_1\Delta\phi_{t-i} + \beta_2\Delta\rho_{t-i} + \beta_3\Delta\pi_{t-i} + \beta_4\Delta\boldsymbol{\lambda}_{MVP_{t-i}} + \beta_5\Delta\iota_{t-i} + \beta_6\Delta\omega_{t-i} + \beta_7\tau_t \quad (3)$$

Where, variables are as previously defined. Third, the short run coefficients were obtained by estimating an error correction mechanism (ECM) model convergence to long run equilibrium, specified as follows:

$$\Delta\boldsymbol{\phi}_t = \beta_0 + \sum_{i=1}^{p}\delta_{1i}\,\Delta\boldsymbol{\phi}_{t-i} + \sum_{i=0}^{q}\delta_{2i}\,\Delta\rho_{t-i} + \sum_{i=0}^{q}\delta_{3i}\,\Delta\pi_{t-i} + \sum_{i=0}^{q}\delta_{4i}\,\Delta\boldsymbol{\lambda}_{MVP_{t-i}} + \sum_{i=0}^{q}\delta_{5i}\,\Delta\iota_{t-i}$$

$$+\sum_{i=0}^{q}\delta_{6i}\,\Delta\omega_{t-i} + \alpha_i ECM_{t-1} + \varepsilon_t \quad (4)$$

Where, α_i is the speed of adjustment towards equilibrium; δ is the short-run dynamic coefficient; ECM_{t-1} is the lagged error correction term mechanism estimated through equation 4, specified as follows:

14 In the estimated model by including instead the ratio of FX loan to the total loan, ϕ, and the ratio of FX deposits to the total deposit in the banking system, ω. This in return would be another way to evaluate the determining factors behing loan euroisation in Albania.

15 The null hypothesis of no co-integration is H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$ and the alternative hypothesis of co-integration is H_0: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$.

16 Pesaran et al (2001) suggest that for models with quarterly data there is an up to 8 optimal lags, even though the results of the F-test depend on the number of lags imposed [Bahmani-Oskooee and Rehman (2005)].

17 To fulfill the endogeneity condition, each variable is estimated as a dependent variable on the left-hand side (LHS) of equation 2 and existence of possible other long-run relationships is tested again by means of the F-test.

18 SIC is known for selecting the respective minimum lags, which satisfies our relatively small sample.

$$ECM_t = \boldsymbol{\Phi}_{t-i} - \beta_0 + \beta_1 \Delta \boldsymbol{\Phi}_{t-i} + \beta_2 \Delta \rho_{t-i} + \beta_3 \Delta \pi_{t-i} + \beta_4 \Delta \boldsymbol{\lambda}_{MVP_{t-i}} + \beta_5 \Delta \iota_{t-i} + \beta_6 \Delta \omega_{t-i} + \beta_7 \tau_t \quad (5)$$

The majority of the studies[19] consider the inflation volatility as a proxy for the lack of monetary credibility. Hence, as asserted by the model of Jeanne (2005) and Brown, Kirschenmann and Ongena, (2010), a higher volatility is expected to induce more borrowing in foreign currency as it is associated with more stable real interest rates than borrowing in local currency. However, Cuaresma, *et. al.,* (2011) believes that from the perspective of the borrower, the impact of this factor on FX lending depends on the trade-off between currency risk and real interest rate risk. Credit portfolio in foreign currency is quite sensitive to fluctuations in exchange rate [Shijaku and Kalluci, (2013)] and including π allows capturing the extra cost effects of the volatility in the exchange rate regardless of changes in monetary policy [*Vika (2007)*]. The incentive towards FX lending is weaker when the volatility of the exchange rate is higher, as this boosts the default risk on un-hedged loans [Brown, Ongena and Yesin, (2009) and Brown, et. al., (2010)]. Therefore, local currency earning firms will be less likely to take foreign currency loans when exchange rate volatility is high. Earlier work by Barajas and Morales (2003) on low-income countries and Rosenberg and Tirpák (2009) in a study on CESEE EU Member States and Croatia confirm the hypothesis that higher exchange rate volatility reduces FX lending. However, theoretical impact of exchange rate depreciation may also be ambiguous, as it can have a different impact on lenders' and borrowers' behaviour, depending on whether it represents consumption smoothing or cost effect[20]. The later might be viewed as a tendency toward stable currency and less risk through higher exchange rate volatility.

In early stage of transition there is a low level of financial development and integration. Hence, at this stage, banks basically financed loans through domestic deposits [Weller (2000)], while in Albania there is a higher share of bank liabilities in domestic currency. Therefore, as in the majority of the studies[21], in addition to factors that are related to both supply and demand for FX lending, we also empirically analyse elements that are supposed to be related only to the supply side, such as how banks finance their FX lending. Accordingly, an expansion in deposits provides banks with more funds available for lending, thereby, encouraging credit extension. Thus, a positive dynamics in banking deposits involves a credits evolution in the same direction. The paper tests the role of bank disposable funding as a significant driver of FX lending and whether there is a positive relationship between foreign liabilities of the bank and FX lending. Luca and Petrova (2008) find no robust relation between aggregate lending in FX across transition countries and aggregate foreign liabilities of banks. They do, however, find a strong relation between aggregate levels of deposit "euroisation" and FX lending.

The choice of the cost related indicators is quite straightforward. Calza, *et. al.,* (2003) and Kakes (2000) believe that the interest rate is a potential determinant of credit demand and as an opportunity cost indicator it simultaneously determines both the demand and supply of bank credit. Égert, *et. al.,* (2006) imply that the usage of spread rather than the interest rate is more important since it reflects the relative price and the risk of foreign currency loans. Based on Brown, *et. al.,* (2009) and Brown, et. al., (2010) we expect that a higher interest rate differential is required to motivate firms with higher distress costs to take loans in foreign currency. Hence, it is expected that a higher interest rate differential would induce more FX lending. But, the real interest rate differential is influenced by macroeconomic stability, and its significance could result from the trade-off between currency risk (in the case of a large devaluation of the domestic currency) and real interest rate risk (in the case of a lower-than expected inflation rate).

Finally, our model suggests that FX lending is also determined by the MVP indicator, λ_{MVP}[22]. In a similar vein, Ize and Levy-Yeyati (2003) explain that borrowers consider the relative volatility of real returns issued in domestic and foreign currency and hence trade off inflation volatility and real exchange rate volatility. In their sample of transition countries, Basso, Calvo-Gonzales and Jurgilas (2007) finds

19 See also Jeanne (2005), Luca and Petrova (2008), Cuaresma, *et. al.,* (2011).

20 See also Barajas and Morales (2003), Jeanne, (2005) and Luca and Petrova (2008).

21 See also Luca and Petrova, (2008), Albulescu, (2009), Brown, et. al. (2009), Cuaresma, et. al. (2011) and Streiner (2011).

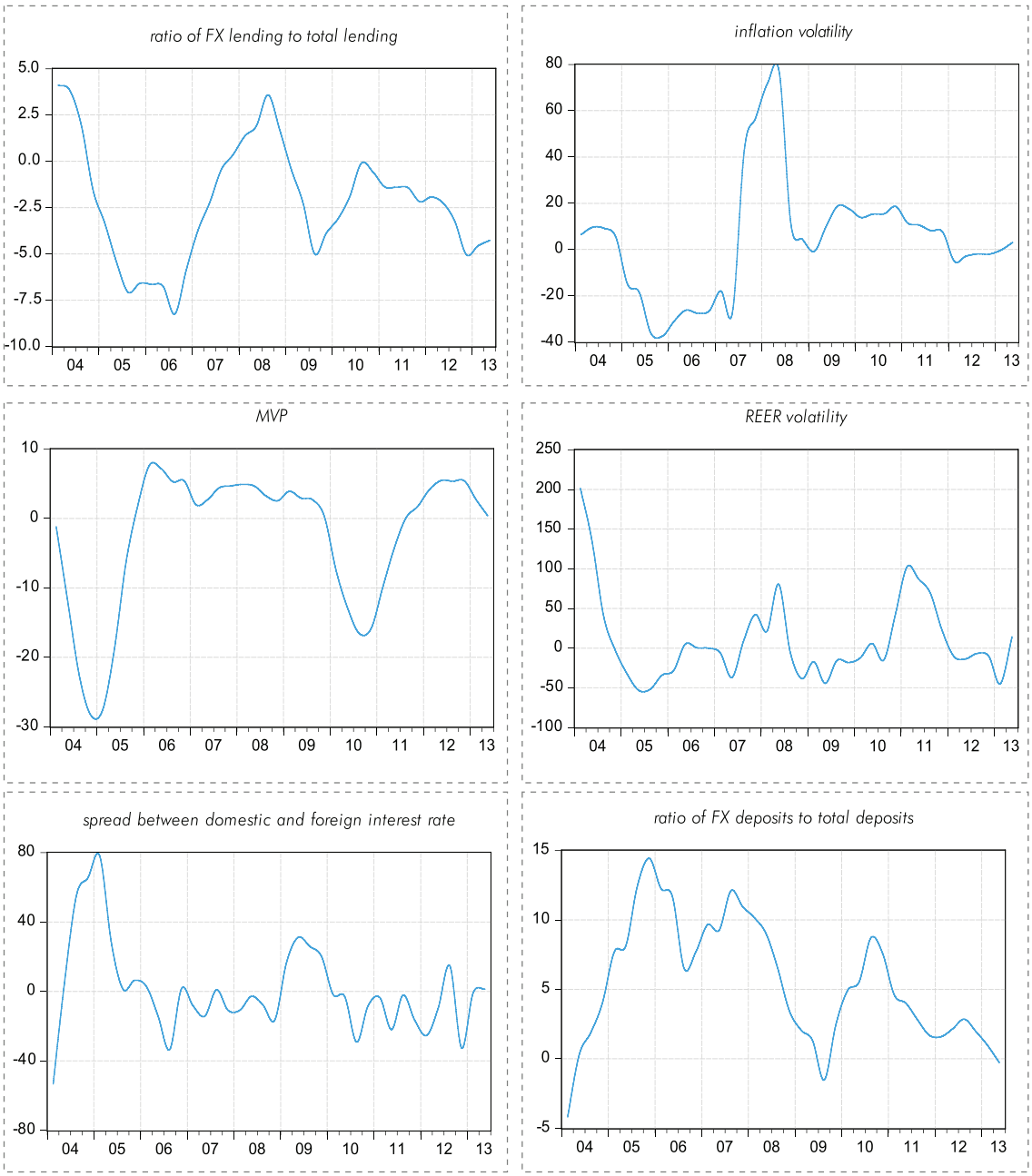
22 Theoritically, from an econometrical point of view, the set of informations used to construct the MVP index might be correlated with both inflation and exchange rate volatility. As such the model might suffer from multicollinearity problems. However, the diagnostic test shows a low level of correlation among these variables. Further, the ARDL approach has an advantage over some other approaches as it solves for the multicollinearity issues by incorporating simultaneously both the long run and the short run effects. Finally, other diagnostic tests do not show evidence of such problems.

that higher MVP dollarization induces a higher degree of both deposit and loan euroisation. On the contrary, Neanidis and Savva (2009) suggests that MVP's effect on FX deposits is materialised only in the long run as agents have the capacity to better assess the differences associated with the volatility of inflation versus that of depreciation. They find no relationship or even a slight negative impact of the MVP indicator on FX lending in the short run.

A. Data

The specified model on the determinants of foreign currency loan lending is based on a framework that distinguishes among macroeconomic determinants, such as volatility of inflation and exchange rate, minimum variance portfolio and two other major aggregate determinants, namely interest rate differential and FX deposits. In our specified models, the dependant variable, ϕ, represents the ratio of FX loans to the total level of loans to the private sector. Both ρ and π are indicators of volatility, namely the inflation and exchange rate estimated through EGARCH technique (Table 1 and 2 in Appendix) as suggested by Rummel, (2010). Data on inflation rate are generated as [dlog(CPI)x400]. As Basso, *et. al.,* (2007) explain, one could estimate variances over the whole sample period, but this would introduce look-ahead bias and make it impossible to account for unobserved heterogeneity in our empirical analysis. In addition, in the absence of forward-looking data on inflation and exchange rate expectations, variance and covariance were obtained from the percentage change in inflation and the real effective exchange rate (REER) over the period of one year starting from January 1998 to June 2013. Therefore, based on their work as a compromise, we estimate λ_{MVP} based on all historical information up to the last observation point according to equation (d) at the footnote. The data on ω consider the ratio of FX deposits to the total level of deposits in the banking sector. The indicator on $\imath$ represents the spread between average-weighted interest rate on domestic and foreign currency lending. Finally, τ represents a dummy variable to account for the effect of macruprudential policy taken by the Bank of Albania by early 2008, taking the value 0 for the period 2004Q01 – 2008Q03, 1 otherwise. All indicators enter the model as annual percentage change. The data are taken from the Bank of Albania.

Graph 3. Annual growth rate of model specification variables.



Source: Bank of Albania and Author's Calculations

IV. Empirical results and discussion

The specified model considers quarterly data from 2004Q01 to 2013Q02 based on eq. (2). This period is considered more reliable given the privatization of some major banks (Saving Bank) and innovation in banking sector. Most importantly this is the period which saw a major launch of bank lending to the private sector. In addition, in line with Shijaku (2012), we implemented a unit root test procedure as it is necessary to understand first, their characteristics and second, to make sure that the ARDL approach is an appropriate method. Therefore, after tracing out the Augmented Dickey Fuller and Philips Peron unit root test, results (Table 3 in appendix) provide conclusive evidence supporting the ARDL approach, while in the estimated equation a constant has been included[23]. Further, FX lending

23 The variables on λ_{MVP}, π and ι are found to I(0), while other indicators are found to be I(1).

and its determinants are found to be bound together on a long-run equilibrium at 10 percentage level of significance. The computed critical values of F-statistics from the Wald tests on the restrictions imposed on the parameters are reported in Table 4[24]. The bound test to ARDL approach for co-integration and the endogeneity condition are satisfy at an optimal 2 lagged specified equation according to the SIC maximization criterion. The results suggest that in the case of Albania, there is a unique cointegration relationship between FX lending and its determinants, which are found to be bound together in the long run. Next, based on the optimal ARDL lag order as suggested by SIC criterion, there is a discussion on the results (Table 5 and 6) on a set of diagnostic tests conducted on the model specification along the comments on the long and short-run estimated coefficients. The statistical values on such tests reveal a high coefficient on regression determination and no problems with respect to model functional formulation, normality, serial correlation and heteroscedasticity in the error term and stability of the coefficient estimated using the cumulative sum (CUSSUM) and cumulative sum of squares (CUSSUMSQ) test (Diagram 1)[25].

The long run coefficients indicate that FX lending is found to be positively related to domestic inflation and exchange rate volatility. The former, is in line with findings by Luca and Petrova (2008) that rising inflation volatility will shore up attitude towards borrowing in foreign currency. The later, as Cuaresma, *et. al.,* (2011) reveals, might merge from the demand side effects of the expected stability of repayment rates given that it represents more a portofolio optimisation model. Lending euroisation will increase by around *0.0654pp* and *0.0178pp* in response of a boost by round 1pp in ρ and π. However, but both coefficients are found to be relatively small, even though statistically significant at conventional level. Accordingly[26], such empirical findings might be due to the lower inflationary pressure and stable exchange rate regime through the sample time and would suggest that the problem of inflation and exchange rate volatility is less dominant in the case of Albania.

The variable on interest rate differential has the expected positive sign. Nevertheless, comparably to Fidrmuc, *et. al.* (2011), the estimated impact is found relatively small and it is even statistically insignificant. By contrast, Brown, *et. al.* (2009) find also a weak impact of interest rate differentials. This is also similar to the small impact of cost relating findings by Shijaku and Kalluci (2012). A preliminary assumption would suggest two particular reasons. First, most of the banking lending is in FX currency and received by private firms and household. This form of borrowing is considered strong, with outstanding stability, mainly in the medium and long term, while the exchange rate against them has been generally stable, following the performance of developments in international markets for longer periods of time. Therefore, there is no substitution effect given that FX lending is considered more risk free in terms of domestic inflation and exchange rate. Second, borrowers might be orientated toward cost reduction, but the needs for fund financing make the demand for loans inelastic.

The relevance of MVP as key explanatory factors of FX lending is further confirmed empirically. Similar to other empirical studies[27], findings confirm the theoretical argumentation of Ize and Levy-Yeyati (2003), incorporated into our model, that λ_{MVP} is positively related to FX lending. This form of lending would rise by round *0.10651pp* in response of a *1pp* in λ_{MVP}. At the same time, considering other empirical studies[28] in the case of Albania, unlike the South East European (SEE) and Central East European (CEE) countries, but similar to Luca and Petrova (2008) and Cuaresma, *et. al.* (2011), FX deposits constitute a statistically key driver of FX lending in the Albanian banking system. The estimated magnitude is found to be the highest among other explanatory variables. Shijaku and Kalluci (2012) found the same results regarding the relation between credit and deposit behaviour. Rising ω by ropund 1pp would boost ϕ by round *0.5427pp*[29]. The dummy variable is found to have a statistically significant negative, but small,

24 The approximate critical values of F-test were obtained from Narayan (2004), which has re-estimated the lower I(0) and upper I(1) bound critical values, in order to estimate the adequate coefficients with a low number of observations. I have also estimated the critical value of F-test using instead the nominal effective exchange rate and the estimated MVP based on the NEER information. The results are relatively the same. The estimated results can be provided upon request.

25 A stable relationship was found even after we omitted the dummy variable or when the NEER and MVP based on the NEER information was used instead. The impact of inflation, exchange rate and spread was found low even when the model was specified in nominal terms.

26 Rosenberg and Tirpák (2009) and Cuaresma, *et. al.* (2011).

27 Basso, *et. al.* (2007), Neanidis and Savva (2009), Cuaresma, *et. al.* (2011) and Fidrmuc, *et. al.* (2011).

28 Note and Suljoti (2012) and Shijaku and Kalluci (2012).

29 Both λ_{MVP} and ω remain the key drivers even when the model was specified in nominal terms. The former was found to have a coeficient of 0.1605 and the later round .49202. this coefficients were found to be statistically significant.

effect on FX lending behaviour. This implies that the macroprudential policy taken by the Bank of Albania have provided positive incentives, but probably more efforts might be needed to de-motivate further lending euroisation.

Furthermore, FX lending is found to be cointegrated with other explanatory variables in the long-run. The coefficient on error term has a negative sign and is statistically significant at 1 percentage point level. There is an error correction mechanism, which brings FX lending back to equilibrium. Thus, the long-run equilibrium of Granger (1986) is achievable. This reconfirms implicitly the remarks on the Wald tests for restrictions imposed on the parameters are reported in Table 4. Results, support also findings by Shijaku and Kalluci (2012) that FX lending is determined by both the demand and supply factors. Meanwhile, the speed of adjustment coefficient is found to be round 0.47, which implies that any deviation from the equilibrium level would be corrected with 3-4 quarters. It will be corrected even faster than what has been observed by previous studies on credit behaviour and money demand utility function[30].

Finally, some additional conclusions can be made regarding the results, reported in Table 6 on the short-run coefficients. Results have the expected sign and are statistically significant. Accordingly, there is a high inertia in FX lending in the short-run. This effect is found to be the highest among other indicators. Interestingly, interest rate differential and the volatility in inflation and exchange rate still exhibits a even smaller impact, impling that interest rates and spread developments in the short run are as much important component as they are in the long run. At the same time, the accumulated lag impact of FX deposits remains a key driver of FX lending even in the short run. But, different to deposit euroisation, the accumulated MVP impact confirms the results by Neanidis and Savva (2009) that the effect of MVP is materialised only in the long run, while in the short run there might be no relationship or even a slight negative impact.

V. Conclusion

The Albanian economy experienced a rapid credit growth, particularly after 2004s. The privatisation of the largest bank and entry of foreign banks stepped up the lending process and promoted competition in this aspect. Accordingly, bank loans, particularly FX lending, has played an important role in the catching-up process and financial integration in Albania, mainly over the last decade. Interestingly, rapid FX lending was a common feature of CESEE countries, but it reversed after the outburst of financial crisis. In particular, the financial crisis intensified the attention to the determinants of FX lending due to the negative impact on financial stability. Likewise, the impact of FX lending on the effectiveness of monetary policy has become an important issue. Therefore, it has gained growing attention from economic researchers in recent years.

This material builds upon previous empirical analyses in the case of Albania. In particularly, it disaggregates lending stock into FX and domestic currency counterpart. The aim is to appraise explicitly the determinants of FX lending (demand or supply side) based on the meta-analysis for CESEE countries and to evaluate how lending euroisation is related to them. The model specification is estimated through means of bound test to ARDL approach. Therefore, the coefficients on short run elasticity were obtained by estimating an ECM model convergence to the long run equilibrium. The study identifies an error correction mechanism, which brings FX lending back to equilibrium. Interestingly, the speed of adjustment is greater than the magnitude observed previously on credit behaviour and money demand utility function studies.

The material support findings by previous empirical work in the case of Albania. The findings confirm the theoretical assumption that FX lending will be influenced by risks perception conditions and it reflects more the tendency towards stable currency patterns. Firms and households will be more likely to request FX loans when interest differentials are higher, even though the impact was found relatively small. Lending euroisation was found to be slidely effected by the inflation and exchange rate

30 See: Shijaku and Kalluci (2012) on credit behaviour and Tanku (2006), Shijaku, (2007) and Shijaku (2012) on money demand adjustment coefficient.

patterns due to the lower inflationary pressure and stable exchange rate regime through the sample time. Other results support the theoretical argumentation of the concept of MVP as explanatory factor of FX lending. Together with FX deposits pattern they constitute a key driver of FX lending in the Albanian banking system. FX lending displays the tendency towards stable currency patterns due to the lower inflationary pressure and stable exchange rate regime through the sample time. The needs for liquidity overcome the substitution and cost reductions effects, making the demand inelastic. Bank of Albania macroprudential policies have provided positive incentives, but probably more efforts might be needed to de-motivate further lending euroisation. Results on the shorter scale imply strong inertia in FX lending behaviour. Findings reinforce the long term observed pattern, besides inflation volatility. The later, might be due to the perception of a rising risk indicator and the unpredictability of monetary policy over the long term horizon.

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Appendix

Table 3 EGARCH (11) – AR(12, 1, 12)-in-variance model for log(π) (errors follows normal distribution)

Dependent Variable: Δlog(*REER*)

Method: ML - ARCH (Marquardt) - Normal distribution
Sample (adjusted): 2001M01 2013M06

Included observations: 150 after adjustments
Convergence achieved after 19 iterations MA
Backcast: 2000M01 2000M12

Presample variance: backcast (parameter = 0.7)

LOG(GARCH) = C(6) + C(7)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(8) *RESID(-1)/@SQRT(GARCH(-1)) + C(9)*LOG(GARCH(-1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
log(GARCH)	1.32E-05	0.000412	0.03207	[.9744]
C	-0.00092	0.008027	-0.11478	[.9086]
AR(12)	0.89566	0.021841	41.00752	[.0000]
MA(1)	0.264216	0.042313	6.244339	[.0000]
MA(12)	-0.73575	0.046673	-15.7638	[.0000]
	Variance Equation			
C(6)	-1.24421	0.58679	-2.12037	[.0340]
C(7)	0.407989	0.186959	2.18224	[.0291]
C(8)	-0.25298	0.110543	-2.28851	[.0221]
C(9)	0.892623	0.057278	15.58403	[.0000]
Diagnostic Tests				
R^2	0.52	Mean dependent var		0.000485
Adjusted R^2	0.51	S.D. dependent var		0.015295
S.E.R.	0.010713	A.I.C.		-6.22717
SSR	0.016525	S.I.C.		-6.04572
Log likelihood	472.9241	H.Q.C.		-6.15345
DW statistic	1.494875			
Inverted AR Roots	0.99	.86+.50i	.86-.50i	.50+.86i
	.50-.86i	-.00-.99i	-.00+.99i	-.50-.86i
	-.50+.86i	-86+.50i	-.86-.50i	-0.99
Inverted MA Roots	0.96	.82-.49i	.82+.49i	.47+.84i
	.47-.84i	-.02-.97i	-.02+.97i	-.51+.84i
	-.51-.84i	-.87-.49i	-.87+.49i	-1

Table 4 EGARCH (13) – AR(1, 1, 1)-in-variance model for log(CPI) (errors follows normal distribution)

Dependent Variable: Δlog(CPI)				
Method: ML - ARCH (Marquardt) - Normal distribution				
Sample: 2001M01 2012M12				
Included observations: 144				
Convergence achieved after 27 iterations				
MA Backcast: 2000M12				
Presample variance: backcast (parameter = 0.7)				
GARCH = C(5) + C(6)*RESID(-1)^2 + C(7)*GARCH(-1) + C(8)*GARCH(-2) + C(9)*GARCH(-3)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	0.034357	0.071683	0.479287	0.6317
C	3.109167	0.333329	9.327620	0.0000
AR(1)	0.754454	0.060989	12.37042	0.0000
MA(1)	0.280435	0.091246	3.073408	0.0021
Variance Equation				
C	0.008099	0.005631	1.438303	0.1503
RESID(-1)^2	-0.089696	0.017781	-5.044376	0.0000
GARCH(-1)	0.182186	0.268219	0.679242	0.4970
GARCH(-2)	0.356906	0.387534	0.920968	0.3571
GARCH(-3)	0.499013	0.311087	1.604093	0.1087
R^2	0.673742	Mean dependent var		2.997265
Adjusted R^2	0.666750	S.D. dependent var		1.221163
S.E.R.	0.704950	A.I.C.		1.887166
SSR	69.57363	S.I.C.		2.072780
Log likelihood	-126.8760	H.Q.C.		1.962589
DW statistic	1.902029			
Inverted AR Roots	.75			
Inverted MA Roots	-.28			

Table 3 Unit Root Test[a], period 2004:1 – 2013:02

Variable	Level			First difference		
	Intercept	Intercept and trend	None	Intercept	Intercept and trend	None
			Augmented Dickey Fuller (ADF) test			
ϕ	[0.0164]	[0.0610]	[0.0054]	[0.0059]	[0.0264]	[0.0003]
λ_{MVP}	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
π	[0.0004]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$\imath$	[0.0153]	[0.0647]	[0.0009]	[0.0000]	[0.0000]	[0.0000]
ω	[0.5698]	[0.4481]	[0.1886]	[0.0025]	[0.0038]	[0.0001]
ρ	[0.2335]	[0.4731]	[0.0290]	[0.0001]	[0.0003]	[0.0000]
			Phillips-Peron (PP) test			
ϕ	[0.1640]	[0.4438]	[0.0533]	[0.0047]	[0.0204]	[0.0002]
λ_{MVP}	[0.0017]	[0.0195]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
π	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$\imath$	[0.0153]	[0.0647]	[0.0009]	[0.0000]	[0.0000]	[0.0000]
ω	[0.3287]	[0.6758]	[0.0961]	[0.0001]	[0.0002]	[0.0000]
ρ	[0.1884]	[0.3726]	[0.0216]	[0.0000]	[0.0000]	[0.0000]

a automatic lag selection based on Schwarz Info Criterion (SIC)

Table 4. ARDL bound test for cointegration analysis based on equation 2b

Dependant Variable[(1)]	AIC-SC lags	F-stat	df	[Prob.]	Results***
$F_{\phi}(\phi \mid \rho, \pi, \lambda_{MVP}, \imath, \omega)$	2	3.838	*(6, 13)*	[0.0301]	Cointegration
$F_{\rho}(\rho \mid \pi, \lambda_{MVP}, \imath, \omega, \phi)$	2	2.808	*(6, 13)*	[0.0560]	No conclusive
$F_{\pi}(\pi \mid \lambda_{MVP}, \imath, \omega, \phi, \rho)$	2	3.121	*(6, 13)*	[0.0302]	No conclusive
$F_{\lambda_{MVP}}(\lambda_{MVP} \mid \imath, \omega, \phi, \rho, \pi)$	2	3.206	*(6, 13)*	[0.0407]	No conclusive
$F_{\imath}(\imath \mid \omega, \phi, \rho, \pi, \lambda_{MVP})$	2	3.198	*(6, 13)*	[0.0454]	No conclusive
$F_{\omega}(\omega \mid \phi, \rho, \pi, \lambda_{MVP}, \imath)$	2	2.423	*(6, 13)*	[0.0809]	No conclusive

**** Based on the critical value suggested by Narayan (2004), for an equation with intercept, where: k= 6 and n = 40*
(1 %) : lower bound I(0) = 3.796 and upper bound I(1) = 5.299
(5 %) : lower bound I(0) = 2.757 and upper bound I(1) = 3.927
(10 %): lower bound I(0) = 2.316 and upper bound I(1) = 3.371

Table 5: Estimating long-run coefficients using ARDL approach

ARDL(2,1,1,1,2,2) selected based on Schwarz Bayesian Criterion *DV isϕ, 37 observations used for estimation from 2004Q2 to 2013Q2*				
Regresses	*Coefficient*	*Standard Error*	*T-Ratio*	*[Prob]*
ρ	0.06540	0.011895	5.4983	[.094]
π	0.01782	0.009010	1.9784	[.001]
λ_{MVP}	0.10651	0.053897	1.9762	[.000]
ι	0.01546	0.021693	.71293	[.484]
ω	0.54274	0.170030	3.1921	[.000]
c	-0.08108	0.016055	-5.0505	[.000]
τ	-0.03720	0.011543	-3.2228	[.036]

Source: Author's Calculations

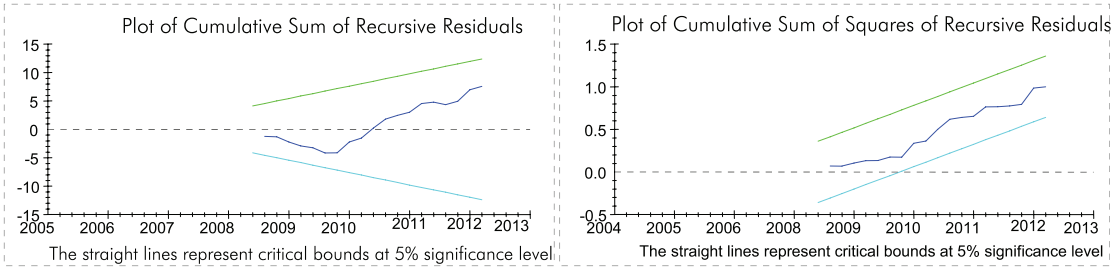
Table 6: Error correction for the selected ARDL model

ARDL(2,1,1,1,2,2) selected based on Schwarz Bayesian Criterion *DV is η, 37 observations used for estimation from 2004Q2 to 2013Q2*				
Regresses	*Coefficient*	*Standard Error*	*T-Ratio*	*[Prob]*
$\phi_{(-1)}$	.44196	.12764	3.4625	[.002]
$\Delta\rho$	-.015480	.0087562	-1.7679	[.089]
π	-.010697	.0051228	-2.0881	[.047]
λ_{MVP}	.12437	.055285	2.2496	[.005]
$\lambda_{MVP(-1)}$	.13143	.048383	2.7165	[.012]
$\Delta\iota$	.024642	.0080449	3.0631	[.005]
ω	.42917	.071359	6.0142	[.000]
$\omega_{(-1)}$	-.085287	.055683	-1.5317	[.138]
$ECM_{(-1)}$	-.46937	.064036	-7.3298	[.000]
Diagnostic Tests				
R^2	.91645	-	1.4022	[.496]
Adj. R^2	.85678	$X^2_{Re\ set}$	.034586	[.852]
F-stat. F(10, 27)	23.0[.000]	X^2_{Auto}	15.1626	[.233]
S.E.R.	.0055932	X^2_{white}	9.2001	[.686]
AIC	133.8672	*Cusum*	*S*	
SIC	120.9798	*Cusumsq*	*S*	

$ecm_t = \phi_{(t-1)}$ -.06540*$\rho_{(t-1)}$ - 0.01782*$\pi_{(t-1)}$ -0.10651*$\lambda_{MVP(t-1)}$ -0.01546*$\iota_{(t-1)}$ -0.54274*$\omega_{(t-1)}$ +0.08108 -0.03720*τ

Source: Author's Calculations

Diagram 1a. Stability test analysis based on CUSUM and CUSUMSQ



Source: Author's Calculations

UDC 334.72:658.153(497.2)

ANALYSIS OF THE DELEVERAGING PROCESS OF NON-FINANCIAL ENTERPRISES IN BULGARIA

Svilen Pachedzhiev[1] and Zornitsa Vladova[1]

Abstract

The deleveraging process, typical for periods of recession, should be analysed with respect to the debt sustainability assessed by liquidity and solvency considerations. The data available at present supports the view that at a macro level a reduction of indebtedness of non-financial enterprises in Bulgaria occurred in 2011, while in 2012 the level of indebtedness remained broadly unchanged. We conclude that the process of corporate sector deleveraging is taking place in a gradual and orderly manner. At present there is no significant evidence that this process has strong negative effects on corporates' business activity as companies preserve high liquidity ratios and restructure their expenditures in order to maintain sound finances.

JEL Classification:

Key Words: Corporate Indebtedness, Financial Crisis, Deleveraging.

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1 Bulgarian National Bank. The paper expresses the views of the authors and not of the Bulgarian National Bank.

2 Not to be cited.

1. Introduction

This paper investigates the behaviour of non-financial corporations (NFC) in Bulgaria in the context of the recent global financial and economic crisis, focusing specifically on the deleveraging process and its impact on firms' adjustment strategies in the period from 2009 to 2013. Although the empirical evidence is mixed about the negative impact of corporate debt reduction and debt level on investment and economic growth, some authors find that significant amounts of debt burden limit firms' economic activity. Faced with high debt burden and subdued demand firms are expected to maximize their profits by scaling back their leverage, reducing their labour costs and limiting their investments. In cases of simultaneous deleveraging in the private sector (NFC and households), the financial corporations and the public sector, the historical evidence analysed in the economic literature generally shows that the negative impact on the economy increases substantially.

Some of the recent studies on the issue of deleveraging focus on the link between business cycles and credit cycles. Schularick and Taylor (2012), who study the development of financial crisis for 14 developed countries over the period 1870–2008, find that asset price booms lead to deeper financial crisis when they occur at high credit-to-GDP levels. Jordá et al. (2013) argue that financial factors play an important role in the modern business cycle. Based on an analysis of 14 advanced countries with data spanning over the period 1870-2008, they show that a stronger increase in financial leverage in the preceding boom period tends to correlate with a deeper subsequent downturn and slower recovery. If the recession coincides with a financial crisis, these effects are compounded and accompanied by pronounced deflationary pressures. There are also a limited number of papers trying to determine the debt thresholds above which debt could become a drag on growth. In a sample of 18 OECD countries analysed over the period 1980–2006, Cecchetti et al. (2011) conclude that corporate debt beyond 90% of GDP and household debt above 85% of GDP can have a significant negative impact on economic growth.

The importance of firms' financial position for corporate capital expenditures decisions is confirmed in many studies. Goretti and Souto (2013) find empirical evidence for a negative relationship between firms' investment-to-capital ratio and their debt burden in selected euro area countries over the period 2000–2011, with significant asymmetric effects beyond certain threshold levels of indebtedness. The estimates show, however, that relatively low leverage levels (below euro area first-quartile levels or debt to equity of around 125%), higher indebtedness exerts a positive influence on firms' investment. In a large sample of non-financial corporations in six major euro area countries over the period 1990–2005, Martínez-Carrascal and Ferrando (2008) find that indebtedness and debt burden have a negative impact on NFC investment with some heterogeneity across countries in the magnitude. Hernando and Martínez-Carrascal (2008) focus on the non-linear nature of the relationship between Spanish firms' financial position and their demand of productive factors over the period 1985–2001. Their results show that corporate financial position affects both fixed investment and employment of NFC and the impact is stronger when financial pressure exceeds a certain threshold. Nickell and Nicolitsas (1999), with a study on UK manufacturing companies over the period 1972–1986, suggest that increases in financial pressure measured by firms' ratio of interest payments to cash flow could have a large negative effect on employment and a small positive effect on productivity. Some authors like Koo (2008) and Wolff and Ruscher (2012) find that the process of corporate balance sheet adjustment is generally long lasting. During this period, the adjustment entails changes in corporate balance sheets with an accumulation of liquid assets and a reduction of leverage.

Another group of research points out that the deleveraging of private sector is not necessarily harmful for growth. Tang and Upper (2010) argue that a financial crisis usually takes place after a period in which a rise in the credit-to-GDP ratio is observed and this tends to be followed by a protracted period of debt reduction in the non-financial private sector. The authors conclude, however, that the period of debt reduction is not necessarily associated with low economic growth once banking sector problems related to recognition of losses and rebuilding of bank capital are addressed. Takáts and Upper (2013) examine data from 39 financial crisis preceded by credit booms in emerging and advanced economic and find no correlation between economic growth and credit growth in the first two years of recovery. Bech and Gambacorta (2012) go even further by finding that in a sample of 24 developed countries private sector deleveraging during a downturn associated with a financial crisis helps to induce a stronger

recovery. Bakker and Zeng (2013) advocate the view that the large employment losses related to firms' profitability and indebtedness in the EU countries witnessed in the period of the recent global financial and economic crisis may contribute to the repair of the NFC financial health in the years after the crisis.

Empirical studies that investigate the relationship between deleveraging and economic activity of Central and Eastern European (CEE) economies are generally scarce. Among these studies, Coricelli et al. (2012), who focus specifically on firm-level panel data from a group of CEE emerging economies and apply a threshold model over the period 1999-2008, confirm the existence of a non-monotonic relationship between leverage and productivity growth. Their estimates show that productivity growth increases with leverage until the latter reaches a critical threshold beyond which leverage lowers productivity growth. An interesting finding of this paper is that the identified critical threshold for the debt ratio varies with profitability of the firms. The estimates of the slope coefficients for the three bands of leverage (low, intermediate and excessive) suggest that the productivity gains (costs) to leverage are substantial for under-levered (over-levered) firms. Leverage is found to have similar non-monotonic effects on return on firms' assets and return on equity.

The brief review of the literature presented above points to the fact that a combination of various factors both at the macro-level and firm-level plays a significant role for the process of NFC deleveraging as well as for its overall macroeconomic effects. At the macro-level of critical importance is whether simultaneous deleveraging is taking place in all sectors of the economy – NFC, households, the financial corporations and the public sector. For example, the occurrence of a banking or financial crisis in a country could aggravate potential adverse macroeconomic effects of NFC deleveraging. In the case of Bulgaria over the period 2009–2013 NFC started to moderately reduce their indebtedness accumulated in the previous period of high economic growth. The very low leverage of the public, financial and household sectors in Bulgaria substantially decreases any probability of negative feedback loops within the economy arising from possible developments in the indebtedness of the NFC sector (see the figures presented in Annex I). Furthermore, the Bulgarian banking sector is stable and strongly supports the macroeconomic stability in the country, preserving its financial health in the period since 2009 and cushioning the economy from the negative effect of international financial market turbulence. It also has to be stressed that there is no clear conclusion in the literature on the acceptable level of debt that may be maintained by economies undergoing real and nominal convergence such as Bulgaria, where real growth in the period prior to 2009 has depended to a large extent on foreign capital inflows. Therefore, the analysis of potential risks to economic activity stemming from NFC indebtedness dynamics and the assessment of NFC capacity to service their debts should take into account the specific situation in the particular country depending on the stage of its development. Apart from country-specific characteristics, firm-specific features such as profitability also appear to have significant influence on the development and sustainability of NFC indebtedness.

Against this background, in the present paper we undertake a detailed investigation of the behaviour of Bulgarian NFC in the wake of the recent global financial and economic crisis, contributing to the relatively scarce literature on debt deleveraging in the EU New Member States in general and in Bulgaria in particular. We collect and analyse a large set of data from a number of different sources including financial accounts, sector accounts, balance of payments and external debt statistics, monetary statistics and corporate balance sheets. We also discuss some data limitations as well as problems with the use of standard leverage ratios which should be necessarily taken into account in any empirical work on this topic.

The rest of the paper is structured as follows. The second section elaborates on the definition of debt as well as on potential data limitations. The third section performs an analysis of the NFC indebtedness and deleveraging process at macro and sectoral level. The fourth section concludes the paper.

2. Definitions and Data Description

In this section we present some statistical data issues that pose potential challenges in the analysis of NFC indebtedness. A number of studies base their empirical work on two types of data – at the macro level and at firm level.

The data in national financial accounts and sector accounts is accepted as the most comprehensive source of data for the NFC sector[3] at the macro level. The data from the national financial accounts is used by the European Commission (EC) to compile the private debt indicator. Based on the European System of Accounts (ESA 95) the data should be broadly comparable across countries. Unfortunately, due to the complex nature of the methodology there are some differences regarding the implementation of ESA95 in national statistical practices. Additionally, the national accounts data is subject to large revisions. The most recent and significant revision of the national accounts data for Bulgaria was implemented in the second half of 2013 and entailed a reclassification for the NFC sector over the period 2008–2011. A certain amount of *loans* [F.4] was transferred to *trade credits and advances payable* [F.71], and the overall level of private sector debt was substantially reduced compared to the data available as of the first half of 2013. As a result of these revisions, the data on *loans* [F.4] and *trade credits and advances payable* [F.71] before 2008 are not fully comparable with the data in the period 2008–2012 which represents a certain limitation to the analysis presented in this paper.

Another important issue is the debate regarding the use of consolidated or non-consolidated financial accounts data in the analysis of indebtedness. Non-consolidated data capture all financial links within the institutional sector and between institutional sectors and should be able to reflect the overall credit risks and debt sustainability both within the sector and between sectors. In practice, this is not the case because the financial accounts statistics does not differentiate between inter-company lending and intra-company which overestimates the indebtedness of the NFC sector.[4] At present, the data for intra-group lending is not available for all EU counties. Furthermore, there are different national practices in data compilation which could mislead any comparison between countries (see EC (2013)). One of the changes implemented by the EC to the existing Macroeconomic Imbalance Procedure (MIP) scoreboard indicators in November 2013 was related to the introduction of the use of consolidated data instead of non-consolidated data. Although this change is supposed to improve the comparability of data between counties, there are some remaining issues as recognized by the EC, e.g. such related to the cross-border consolidation that are not yet taken into account. Despite the advantages of the quality of consolidated data, an important source of information about overall NFC indebtedness could also be obtained from inter-company indebtedness which is reflected in the non-consolidated data. The non-consolidated data could therefore be used as additional indicator in the analysis of NFC indebtedness.

In this study we use the definition of NFC debt as suggested in the latest revision of the European Commission's MIP scoreboard as of November 2013. The total debt of the NFC sector is calculated as the sum of securities other than shares, excluding financial derivatives [F33] and loans [F4] from the financial accounts on a consolidated basis. Another item in the financial accounts which also relates to NFC indebtedness but is excluded from the private debt indicator in the MIP is *other accounts payable* [F7]. Other accounts payable comprises *trade credits* and *other payables excluding trade credits and advances*. This item represents financial claims which are created as a counterpart of a financial or a non-financial transaction in cases where there is a timing difference between this transaction and the corresponding payment. The total *other accounts payable* item could potentially be considered as an important source of information about intercompany indebtedness[5]. However, since the statistics of this item is not fully comparable across counties due to factors reflecting the structure and functioning of the different economies as well as due to possible statistical reporting specificities, we decide to focus only on trade credits as an additional debt indicator based on the assumption of somewhat better comparability of this indicator across countries. In the analysis of the trade credits indicator we use non-consolidated data in addition to consolidated data.

3 The NFC sector comprises both private and public companies (classified outside the general government sector).

4 See European Commission (2013).

5 See Burkart and Ellingsen (2004).

In this paper we analyse NFC indebtedness at macro level, based on financial accounts data and sector accounts data, and then augment the empirical analysis with a detailed investigation of firms' indebtedness at sectoral level (i.e. at sectors of economic activity). For the latter part of the analysis, we use data from a number of different sources including national accounts data at A10 level, monetary statistics, balance of payments statistics, external debt statistics as well as corporate balance sheets (at an aggregated basis by economic activity). The data from monetary statistics, balance of payments and external debt statistics is with higher frequency compared to national accounts and allows us to get a more recent insight into the dynamics of NFC indebtedness as well as on the distribution of firms' indebtedness by sectors of economic activity. The data on corporate balance sheets by economic activity is annual and is provided by the National Statistical Institute. This data can be used to evaluate differences related to sector-specific characteristics which cannot be directly observed when macro-level data is considered. Although corporate balance sheet data is not as detailed as firm-level data, this source of data can be useful for analysing the heterogeneity of indebtedness dynamics across economic sectors.

In our analysis on indebtedness, as a measurement of debt we prefer to use ratios relevant to the economic activity of firms. We therefore estimate debt as a ratio to NFC gross value added, gross operating surplus, output, etc., instead of relying only on the widely used in the economic literature GDP as a denominator in the debt ratio indicator.

Our empirical analysis covers the period 2000–2012 for which we have national financial accounts and national sector accounts data. Corporate balance sheet data is available from 2003 to 2012. Monetary statistics, balance of payments and external debt statistics data is available until 2013.

3. Analysis of the indebtedness and the deleveraging of NFC in Bulgaria

3.1. Macro level

The most typical indicator used when evaluating the indebtedness of NFC is the debt to gross domestic product (GDP) ratio. As can be seen from the data presented in Table 1 and Figure 34, there has been a strong upward trend in this ratio from 2002 to 2008. The accumulated change of NFC debt-to-GDP ratio over the period 2000–2008 was about 86 p.p. which was the third highest among the EU member states after Ireland and Malta. Comparatively fast growth of NFC indebtedness in Bulgaria in the period before the global financial and economic crisis was driven by fundamental factors for the economy related to real and nominal convergence processes, high return on capital, favourable macroeconomic situation, increase in FDI inflows, deepening of financial intermediation as well as the low base. Macroeconomic stabilisation after the introduction of the currency board arrangements in 1997, structural reforms, the simplified tax regime, the intensified entrance of multinational companies and legislative harmonisation to prepare the country for EU membership created favourable conditions for investments as an instrument to increase the potential for economic growth in the country.

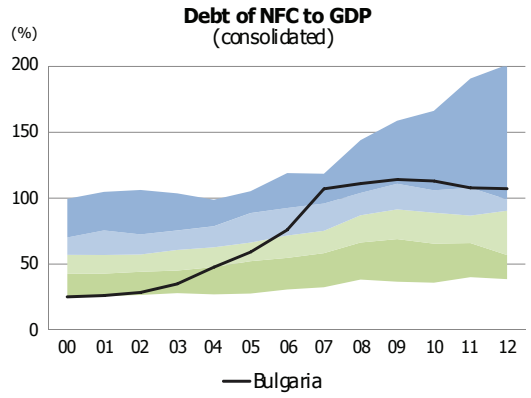
Table 1 Debt as a per cent of GDP

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
						Stocks							
Total economy [S1]	103.5	101.2	93.3	96.1	108.4	115.6	128.5	167.2	173.3	179.2	175.7	166.2	168.1
Non-financial corporations [S11]	25.1	26.1	28.5	34.9	47.7	59.2	76	107.2	111.3	114.4	113.1	108	107.4
Financial corporations [S12]	13.6	9.7	7.9	7.1	8.9	10.6	11.9	18.5	21.1	20.8	17.8	15.8	16.4
General government [S13]	62.5	62.2	52.6	46.9	40.7	30.5	22.7	18.5	14.1	15.3	17.1	17	19.8
Households and NPISH [S14, S15]	2.3	3.2	4.3	7.1	11.1	15.3	17.9	23	26.7	28.7	27.5	25.5	24.5
						Financial transactions							
Total economy [S1]		2	5.6	12.5	19.9	14.5	29.6	51.1	38.8	5.6	2.8	2.1	6.7
Non-financial corporations [S11]		4.5	6.4	8.5	14.3	13.2	24.4	35.8	28.2	3.6	3.6	2.1	2.8
Financial corporations [S12]		-2	-0.6	0	2.6	2.7	2.6	8.5	5.2	-0.5	-2.3	-0.9	1.1
General government [S13]		-1.7	-1.7	0.8	-1.8	-7.1	-1.8	-0.8	-1.4	0.8	1.7	1.2	3.1
Households and NPISH [S14, S15]		1.1	1.4	3.1	4.7	5.7	4.4	7.7	6.7	1.6	-0.3	-0.3	-0.2

Source: Eurostat.

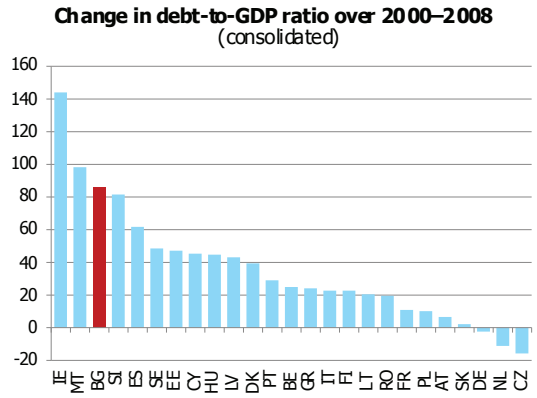
In 2009 right after the start of the global financial and economic crisis, NFC' debt as per cent of GDP continued the upward trend observed over the period 2002–2008. According to the national financial accounts data a process of gradual reduction of accumulated debt has been taking place starting from 2010. As of 2012, when the latest data is available, the NFC debt amounted to 107.4% of GDP. The most significant reduction of debt occurred in 2011, while in 2012 there was a much weaker decrease in the debt level. In 2012 NFC debt-to-GDP remained somewhat higher than EU-average levels. In cumulative terms, in the period from 2010 to 2012 NFC debt in per cent of GDP decreased by about 7 p.p. which is an indication of a gradual and orderly process of deleveraging. Financial transactions data allow an analysis of credit flows as a component of the change in the stock of credit by institutional sector. Over the period 2009-2012 there are small but positive net credit flows for the NFC sector which is an indication that new credit flows exceed repayments of credit.

Figure 1[6]



Source: ECB, authors' calculations.

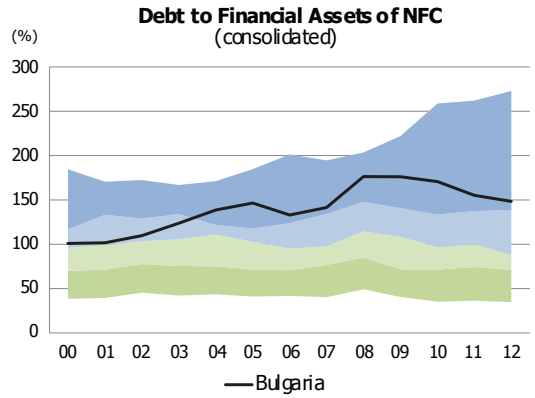
Figure 2



Source: ECB, authors' calculations.

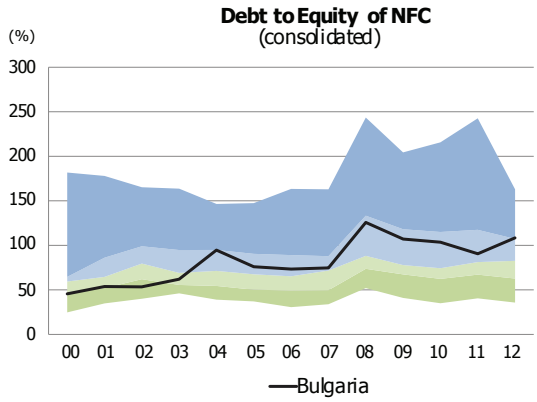
6 Some of the charts in this paper (Figures: 1, 3, 4, 7, 8, 9, 12, 13, 14, 15, 16, 18, 19, *Error! Reference source not found.*) as well as Annex I show a quartile distribution of the respective indicators for EU member states excluding Luxemburg. Each segment contains 25 per cent of the member states: the one at the lowest end presents the first 25 per cent with the lowest values of the indicator; the second segment presents the next 25 per cent of countries with higher values of the indicator and the top 25 per cent segment covers the countries with the highest values. The values for Bulgaria are presented with a line.

Figure 3



Source: ECB, authors' calculations.

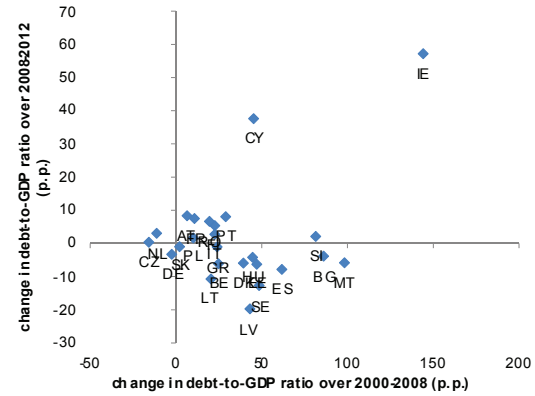
Figure 4



Source: ECB, authors' calculations.

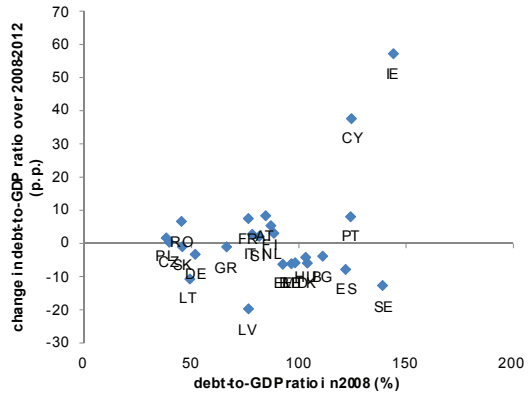
An analysis of the data for all EU countries does not suggest any definitive link between the change in the debt-to-GDP ratio in the period 2008-2012 and the level of indebtedness of NFC in the pre-crisis year of 2008 or to the change in the debt-to-GDP ratio over the period 2000-2008 (see Figure 5 and Figure 6). The lack of association between the level and dynamics of NFC indebtedness in the pre-crisis period and the developments in NFC indebtedness in the period since 2008 may be attributed to various country-specific characteristics.

Figure 5



Source: ECB, authors' calculations.

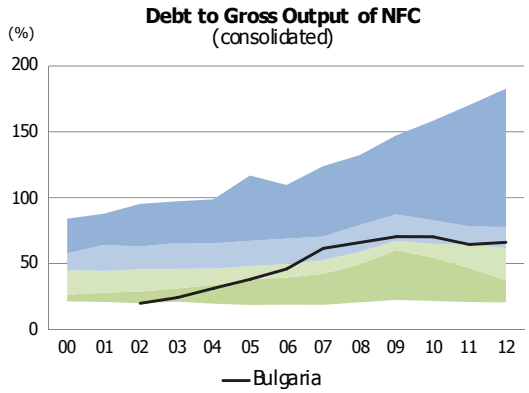
Figure 6



Source: ECB, authors' calculations.

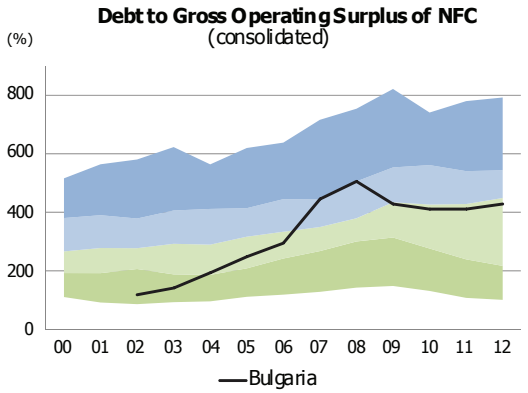
Considering debt-to-financial-assets and debt-to-equity ratios for the NFC sector, it can be seen that like the debt-to-GDP ratio in the period since 2009 these two ratios for Bulgaria have remained above EU average levels despite the moderation observed over the period. Nevertheless, the latest data reveal that the debt-to-equity ratio discontinues its downward trend and shows an increase already in 2012. Although indicators such as debt-to-GDP ratio, debt-to-financial assets ratio and debt-to-equity ratio are widely used in a number of studies we do not consider them as fully comparable across countries because they implicitly reflect the differences in the structure of the economies. If indicators like debt-to-gross operating surplus of NFC and debt-to-gross output of NFC, which represent more relevant denominators regarding the institutional sector of NFC, are applied Bulgaria stands relatively close to the average EU levels both before 2008 and after 2008. This can be interpreted as an indication of comparable developments with EU countries. Furthermore, unlike the former indicators that relate NFC debt to GDP or financial assets, the latter two ratios for Bulgarian NFC slightly increase in 2012 compared to 2011 (Figure 7 and 8).

Figure 7



Source: ECB, authors' calculations.

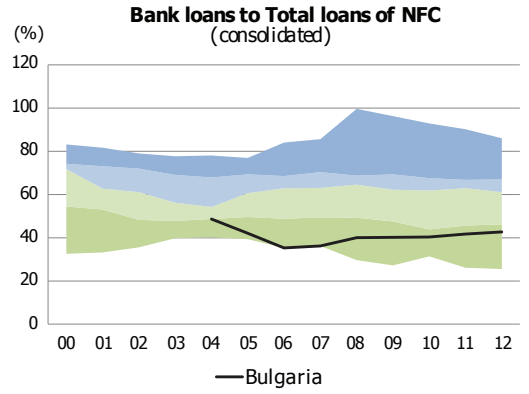
Figure 8



Source: ECB, authors' calculations.

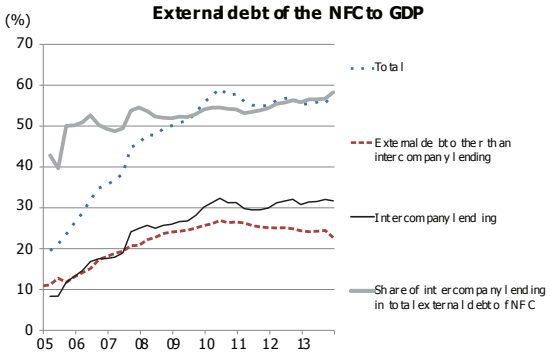
In the composition of *loans* liabilities of Bulgarian NFC the share of domestic bank loans is relatively small compared to other EU member states over the whole period before and after 2008 (Figure 9). We can therefore conclude that cross-border financing flows have a more important role compared to domestic bank credit as a source of financing for Bulgarian companies. Specifically, during the pre-crisis period strong FDI inflows played an important role for the financing of Bulgarian firms. Thus the share of intercompany lending in total external debt of NFC reached a level of above 50 per cent (Figure 10). After 2008 this share has further increased which supports the view that parent companies find it profitable to maintain and further expand their business activities in the country. It can also be seen from the data that after 2010 NFC retain their level of external intercompany financing as a per cent of GDP, while decreasing other external debt which leads to a slight moderation in overall NFC external debt (relative to the overall GDP of the economy) as of 2013 compared to 2010.

Figure 9



Source: ECB, authors' calculations.

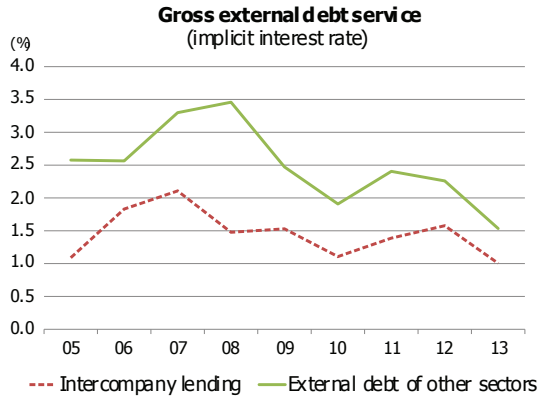
Figure 10



Source: ECB, authors' calculations.

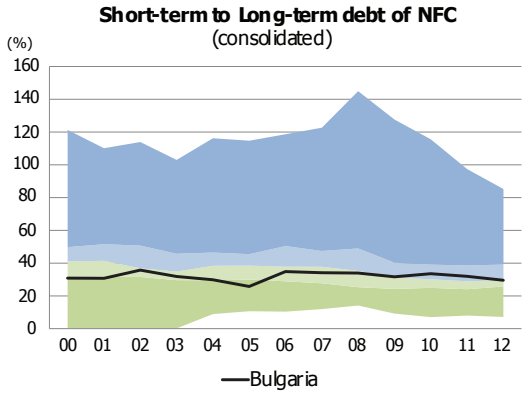
Due to the high share of intercompany lending of Bulgarian corporations from foreign parent companies in their total external liabilities, we support the view that countries like Bulgaria with large FDI inflows may sustain relatively higher levels of indebtedness compared to countries with lower FDI inflows. Countries undergoing processes of real and nominal convergence usually develop faster than advanced economies with a higher rate of return on capital. FDI inflows are indicative of the long-term investor interest in the Bulgarian economy which supports the development of local firms and provides a stable source of financing compared to borrowing in international financial markets characterized by high volatility in setting the cost of financing. Attracted foreign direct investment in the period prior to 2008 has contributed to acceleration of the economy's restructuring and entailed modernisation and build-up of production capacities in all major sectors, as well as development of the infrastructure. Since 2009 external intercompany lending continues to have beneficial effects for the development of the NFC sector and the overall economy.

Figure 11



Source: ECB, authors' calculations.

Figure 12

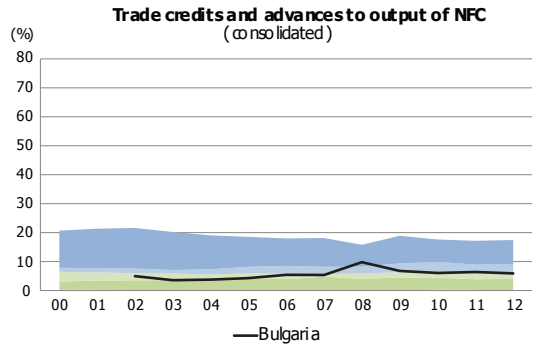


Source: ECB, authors' calculations.

For an assessment of the risks related to NFC debt servicing it is important to consider the maturity of the debt and interest payments. The ratio of short-term debt to long-term debt for the overall NFC sector has been rather table over the period 2000-2012 and as of 2012 amounted to only around one-third. During both the pre-crisis period and after 2009 long-term sources of funding for NFC were dominant and this characteristic is similar to the maturity structure developments observed in the euro area countries. In addition, the ratio of short-term to long-term NFC debt slightly declined to below 30% as of 2012 which is an indication of reduced vulnerabilities of NFC to debt repayments. The ratio of interest paid to gross operating surplus of NFC reached a maximum of 24.6% in 2008, then gradually declined and in 2012 it amounted to 3.9%. The same dynamics is observed in the implicit interest rate related to gross external debt service. It can therefore be concluded that debt repayment has not been a significant burden for Bulgarian firms in the period after the start of the global financial and economic crisis.

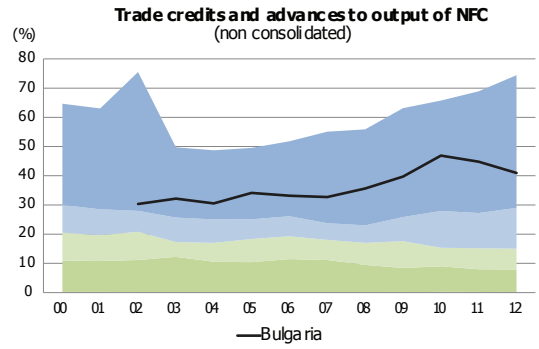
Trade credit and advances may be viewed as another important source of NFC funding. In the economic literature they are often used when making estimates of the total indebtedness of the companies and for this reason they will be considered in this paper too. The empirical evidence in the literature shows that trade credits tend to be procyclical[7] and that there are significant differences across countries in the use of trade credit. The data for Bulgaria on a consolidated basis show an increase of this indicator as a ratio to gross output of NFC only in 2008. Over 2009–2012 the ratio dropped to levels before the crisis that stand close to the EU average. Similar conclusions can be drawn from a comparison of trade credit and advances to GDP or operating surplus of NFC.

Figure 13



Source: ECB, authors' calculations.

Figure 14



Source: ECB, authors' calculations.

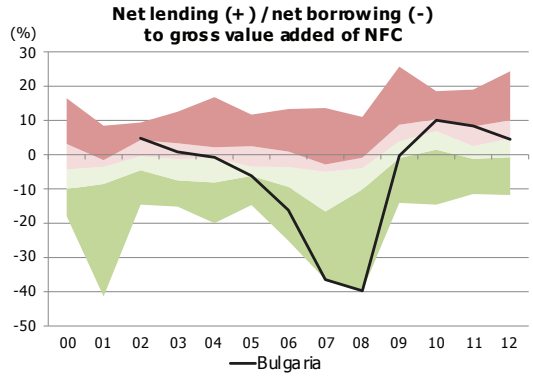
It may be argued that more relevant information for the importance of trade credit as a source of financing for NFC can be obtained when considering non-consolidated financial accounts data as the latter, unlike consolidated data, include the transactions within the NFC sector. Over the period 2002–2012 indebtedness of Bulgarian firms related to trade credits based on non-consolidated data was

7 See for example Ferrando and Mulier (2013).

relatively higher compared to the average for the EU countries. However, it has to be stressed that, as mentioned in Section 2, there may be differences in national statistical practices in recording trade credits which may produce erroneous conclusions when making comparisons across countries. For example, the Bulgarian National Statistical Institute compiles financial accounts data based on the level of legal entities and on non-consolidated basis, whereas other statistical institutes apply the concept of enterprise which can group several legal entities on a consolidated basis. The importance of trade credits relative to NFC output (based on non-consolidated data) increased over the period 2009- 2011 which may be accounted for by the reported increase of bank lending standards and the likely search for alternative sources for firms' financing. As of 2012, we observe some moderation in the dynamics of trade credits-to-NFC gross output, though levels reached remain somewhat higher compared to the pre-crisis period.

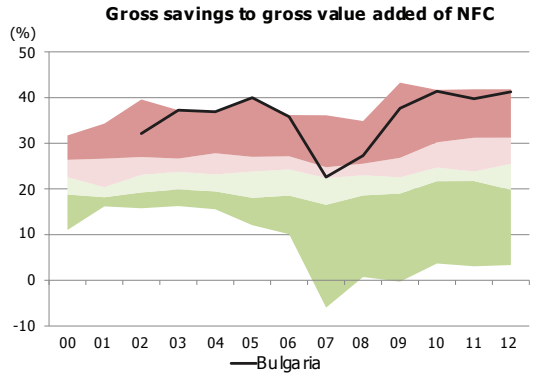
The empirical evidence in the literature[8] generally shows that corporate balance sheet adjustments have implications on firms' investment, employment, wages and savings. It is expected that when NFC are faced with a decrease in demand and have high leverage, they will be reducing their debt while limiting investment and optimizing labour costs in order to be able to service their debt. In the case of Bulgaria no-clear cut conclusion can be made about the effects of NFC debt reduction since 2010 for investment and employment developments. As we have shown, since 2010 the decrease of the NFC leverage observed through various ratios is rather limited, which does not support the view of deleveraging pressures being experienced by Bulgarian companies. At the same time, the dynamics of companies' net lending/borrowing position which moved to positive levels shortly after 2008 is a sign of significant change in the NFC balance sheets compared to the previous period of high economic growth. However, it should be noted that this change does not necessarily reflect pressures coming from the level of pre-crisis indebtedness of NFC (i.e. deleveraging pressures). The increased overall uncertainty in the economic environment, both externally and domestically, could be considered as the most significant driving factor of the dynamics of the net lending position of Bulgarian NFC over the period since 2009. As of 2012, the net lending position of NFC is already showing some signs of moderation.

Figure 15



Source: ECB, authors' calculations.

Figure 16



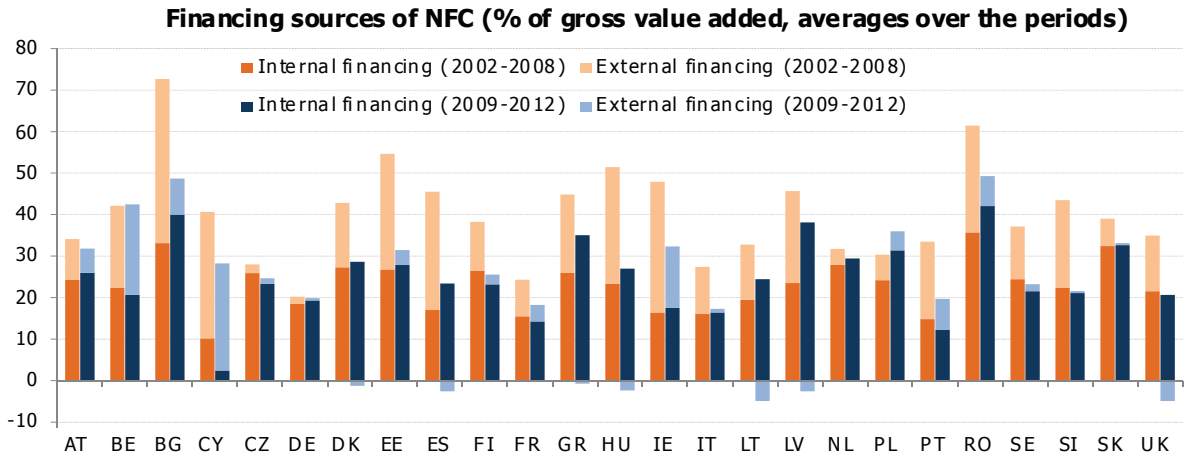
Source: ECB, authors' calculations.

The net lending/borrowing position of NFC in essence represents the net resources that the sector receives from the other institutional sectors, including the external sector (i.e. the rest of the world). The balance may be negative when the sector's sources of finance include substantial external funds used to finance the sector's fixed investment. The period of a substantial increase in the net borrowing position of NFC in the period 2006-2008 can be directly linked to the large FDI inflows that were also reflected in a sizable increase of fixed investment. The latter estimated as a ratio to the gross value added of NFC reached around 60% in 2008 and this represented the highest level in the EU. While firms' dependence on external finance increased before the crisis, their reliance on internal funding sources was lower compared to external financing in this period (Figure 15). Similarly to European Central Bank (2013) we use the gross saving of NFC as a broad proxy for retained earnings, which is considered as the main internal source of financing for firms. In the period 2009-2012 gross savings as a ratio to NFC gross value added retained a level close to that observed from 2002 to 2006.

8 See for example Wolff and Ruscher (2012).

As can be seen in Figure 17, internal financing played an important role in total corporate funding before the crisis and even increased over the period since 2009. Compared to other EU countries, Figure 17 also reveals that Bulgaria is among the countries in which NFC reliance on internal funding is relatively higher. Similarly to other countries, companies' dependence on external sources was reduced in the period since the start of the global crisis. Nevertheless, unlike other counties such as Denmark, Spain, Greece, Hungary, Latvia, Lithuania and UK it did not contract.

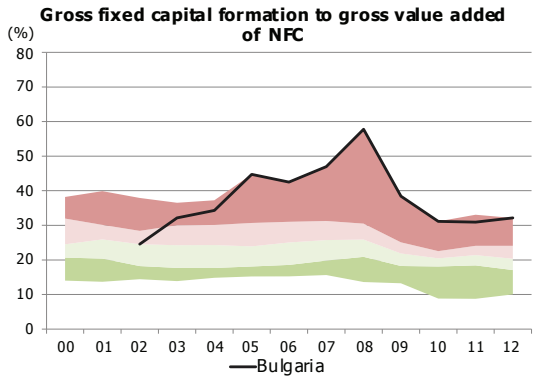
Figure 17



Notes: As a proxy for internal financing we use gross savings based on national sectoral accounts. The total debt of NFC comprising loans and securities other than shares is used as a proxy for external financing flows. Source: Eurostat, ECB, authors' calculations.

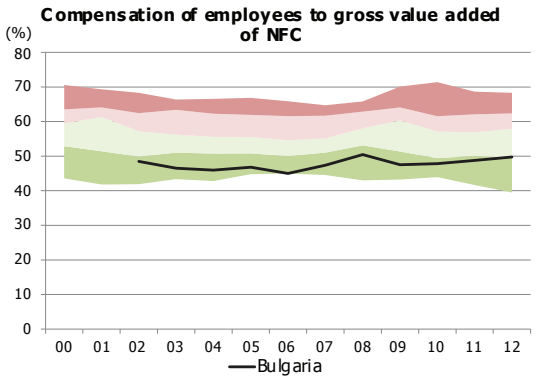
Turning to the development of NFC investment and employment, we observe the following trends. The adjustment of NFC investment, which took place most substantially in 2009-2010 when overall gross fixed capital formation in the economy contracted in real terms by around 18% in both years and NFC investment to value added ratio dropped from 58% in 2008 to 31% in 2010, was broadly in line with the developments observed in Europe (Figure 18). At the same time, as of 2012 when the investment rate of Bulgarian NFC was broadly unchanged at about 32% of gross value added, it still remained the highest among all EU countries measured both as a ratio to value added and to output. While NFC reduced their investment rate, they did not lower the share of compensation of employees in gross value added as this share has remained broadly unchanged over the whole period 2002–2012 (Figure 19). By contrast to the investment rate, the ratio of compensation of employees to gross value added has continued to be among the lowest in the EU. In terms of employment for the overall economy, however, in the period 2009-2013 there was a reduction by about 10%, with the strongest decreases observed in the construction sector, the industry sector (excluding construction) and the agricultural sector by 40%, 20% and 11% respectively. The share of NFC gross operating surplus to valued added has seen almost insignificant change since 2008, standing in 2012 at the relatively high level of 49% (Figure 20).

Figure 18



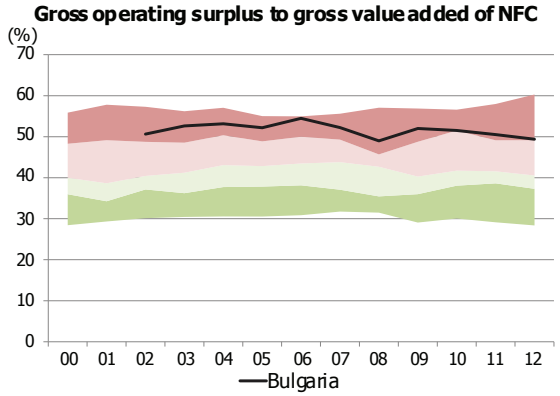
Source: Eurostat, authors' calculations.

Figure 19



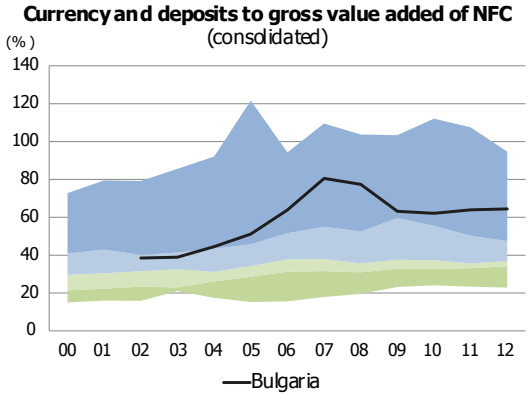
Source: Eurostat, authors' calculations.

Figure 20



Source: Eurostat, authors' calculations.

Figure 21



Source: ECB, authors' calculations.

Bulgarian companies' balance sheets were also adjusted over the period since the start of the global crisis with respect to reduction of liquid assets measured as the ratio of currency and deposits to gross value added (Figure 21). Nevertheless, in 2012 firms' liquid asset position remained stronger than the average for the EU.

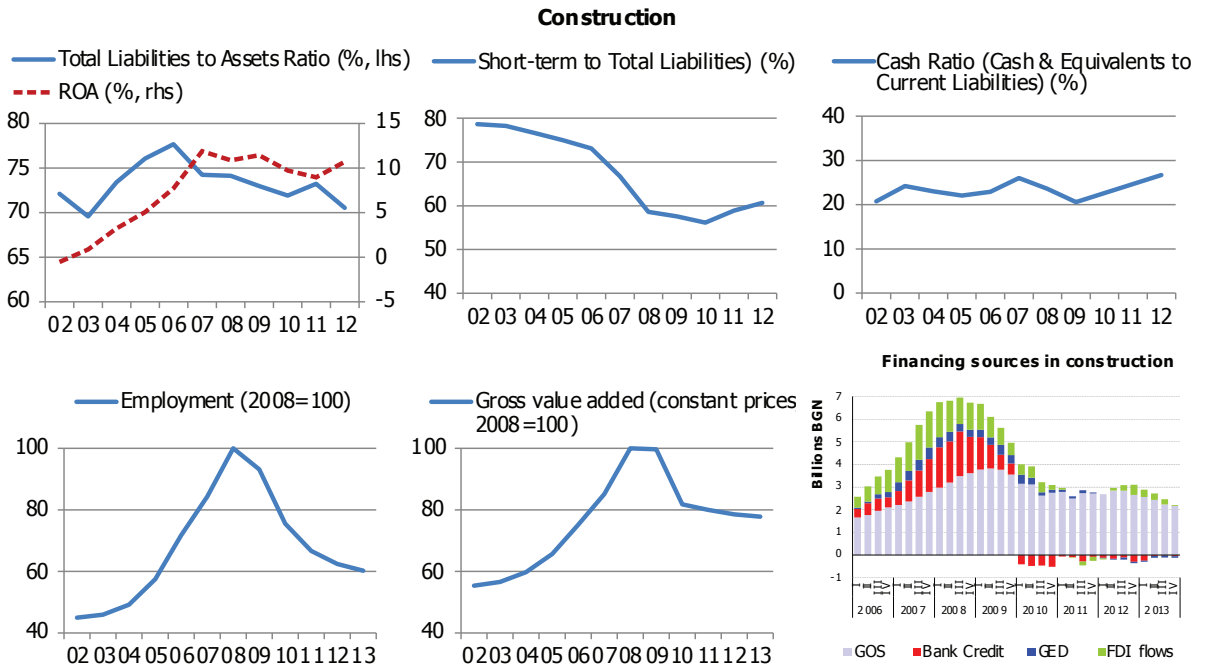
The descriptive analysis, based on macro level data, presented above points to the following conclusions. In the period after the start of the global crisis, Bulgarian companies responded to the heightened uncertainty about the development of the external and internal environment and the lower demand by adjusting their behaviour. Firms have reduced moderately their overall debt, cut employment and decreased their investment rate. The decline in FDI inflows was also reflected in the dynamics of NFC fixed investment. In the period 2009-2012 internal financing has increased its importance for firms and firms' gross savings have retained a level close to that observed from 2002 to 2006. Firms have also developed a net lending position, with the latter showing some signs of moderation as of 2012. Though weakening since the start of the global crisis, in 2012 firms' liquid asset position remained stronger than the average for the EU. As of 2012, indebtedness indicators such as NFC debt-to-gross output and NFC debt-to-gross operating surplus show some weak signs of "releveraging".

3.2. Sectoral level

In this section we present an analysis of indebtedness and overall adjustment behaviour of firms by sectors of economic activity. We use NFC balance sheet data by economic activity on A17 level of aggregation. Due to differences in the statistical classifications of economic activities used by the Bulgarian NSI before and after 2008, we do an additional aggregation of sectors in order to make data comparable. Thus, in our analysis we use four major sectors: agriculture, industry excluding construction, construction and services. For these four sectors we supplement the analysis based on corporate balance sheet data with national accounts, monetary and BOP data.

In order to analyse the sectors' indebtedness we use the *total liabilities* of the NFC. This indicator differs from the definition of debt that we have used in the previous section because total liabilities comprise not only loans and securities other than shares but also other accounts payable such as trade credit and advances, taxes, social contributions, wages and salaries, rents, guaranties etc.

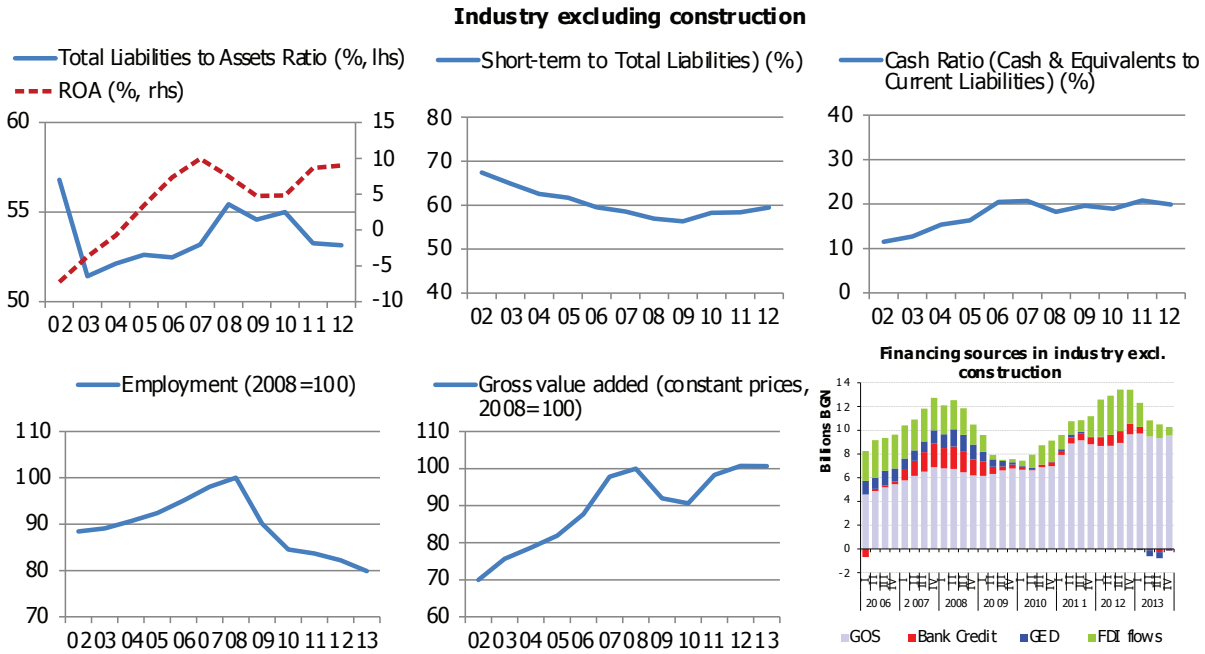
Figure 22



Note: The graph on the financing sources refers to four major sources of corporate financing calculated as four-quarter moving sums: GOS denotes nominal gross operating surplus; Bank Credit denotes banks' claims on NFC; GED denotes gross external debt other than intercompany lending; FDI flows denotes foreign direct investment into the reporting economy by sector. The financial flow data for credit and GED are estimated as changes in the stocks for the sector, while GOS and FDI represent flows. Source: BNSI, BNB, authors' calculations.

Since 2009 the construction sector has undergone significant adjustment. The decrease in the demand for residential and commercial property, partly influenced by the contraction of FDI inflows in real estate, resulted in declining prices. The most severe part of the negative shock for the sector took place in 2010, with gross value added of this sector falling by 18%. As of 2013 the real gross value added of the sector is still more than 20% below the level in 2008. The layoffs in the construction sector were also the most sizable compared to the other sectors of the economy. As of 2013 the employment in the sector was about 40% below 2008 level; however the process of labour shedding has moderated over the last two years. The productivity of the sector increased significantly during the period since 2009, standing at about 30% higher in 2013 compared to 2008. The construction sector is characterised by relatively higher indebtedness and higher share of short-term debt compared to the other sectors both before and after the crisis. The average ratio of liabilities to assets was about 74% over the period 2002–2008, however a moderate downward trend in indebtedness is observed starting from 2007 and continuing until 2012. The external financing flows in construction were the highest among the other sectors in the economy being above 100 percent of gross operating surplus in the period from 2007 Q2 to 2008 Q2. The construction sector also experienced significant outflows from 2010 onwards which were not observed in the other sectors. At the same time, the construction sector retained its profitability and liquidity in the years since 2009. The return on assets followed an upward trend until 2007 and had an insignificant decline from this level as of 2013. In conclusion, the evidence whether the relatively high indebtedness of the construction sector is the main factor behind its observed prolonged contraction is not clear-cut as subdued demand also influences developments in the sector.

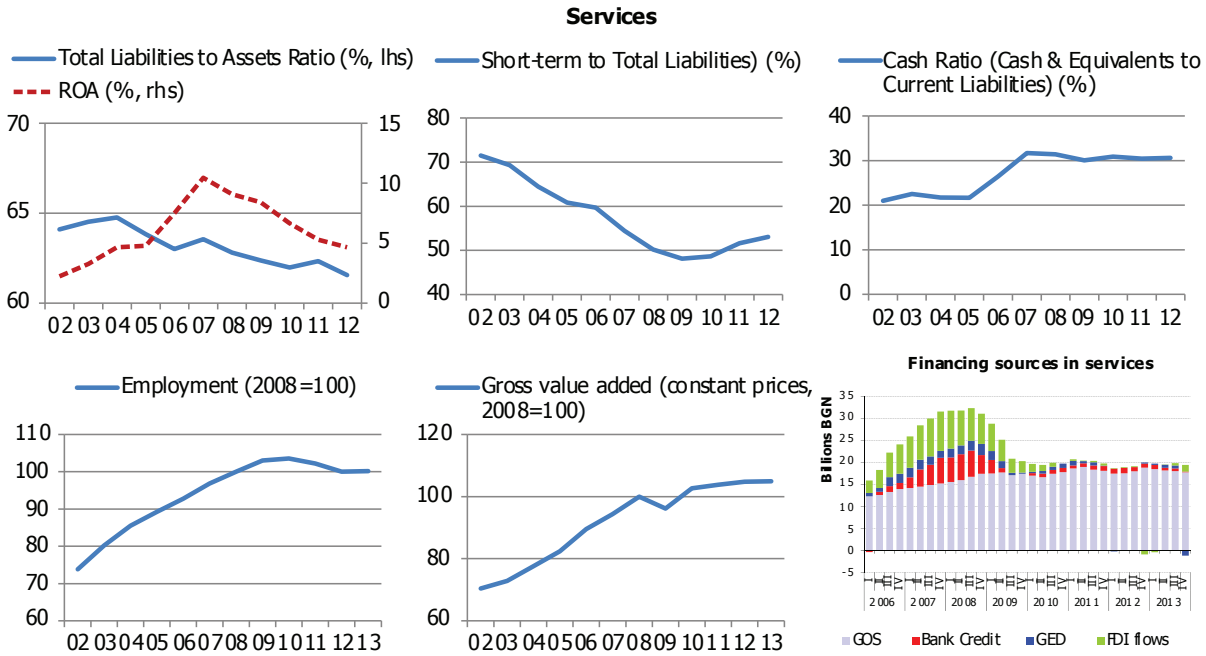
Figure 23



Note: See notes in Figure 22.
Source: BNSI, BNB, authors' calculations.

The adjustment in the industry sector excluding construction was less severe compared to that in the construction sector. Due to worsened external and internal demand the real value added of the sector dropped by about 10% in the first year of the crisis and, in contrast to the construction sector, rebounded afterwards, reaching pre-crisis levels in 2012. The employment fell by 10% in 2009 and dropped another 10% in the period up to 2013. However, it should be noted that this sector appears to be undergoing a long term tendency of employment decrease, which is most likely due to a transition to more technology intensive production processes observed not only in Bulgaria but also in the EU as whole. Over the period from 2009 to 2013 the productivity of the industry sector increased by about 26%. The employment dynamics in this sector throughout the crisis seems to be unrelated to the observed indebtedness indicators. The leverage of the sector is lower compared to construction and services. From 2003 the leverage followed an increasing trend, reaching 55% in 2008. Since 2009 the leverage remained broadly unchanged up to 2011, when some slight downward adjustment took place. After a decline over 2008–2010, in the last two years the return on assets ratio of the sector experienced a noticeable improvement which was also reflected in the dynamics of the gross operating surplus of the sector. The rebound of FDI flows since 2010 is another positive sign of the developments in the industry sector. The cash ratio has remained broadly unchanged since 2006. Overall, the empirical evidence presented above does not point to deleveraging pressures experienced by the industry sector excluding construction.

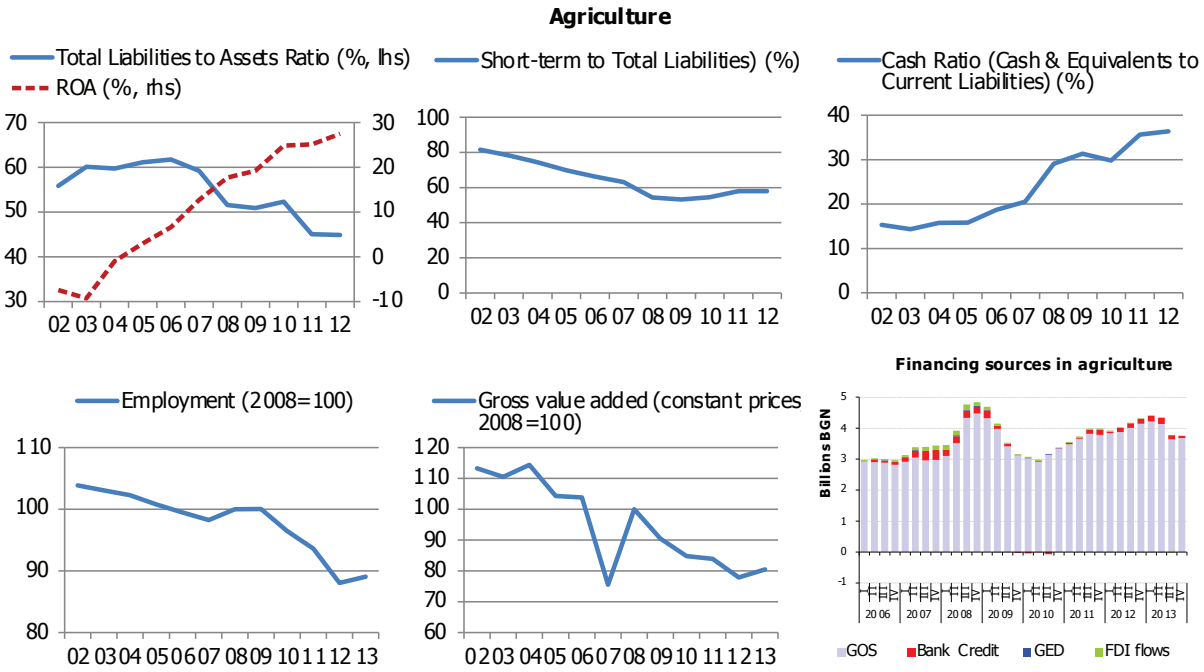
Figure 24



Note: See notes in Figure 22.
Source: BNSI, BNB, authors' calculations.

In contrast to the construction and the industry sector excluding construction, the value added of the services sector followed an increasing trend throughout the crisis and employment did not suffer any significant losses for the overall sector. The cumulative growth of real gross value added of the services sector amounted at about 5% for the period 2009-2013, which represented the highest growth among the other sectors in the economy. Nevertheless, the profitability of the firms in this sector fell from 10% in 2007 to 5% in 2013. The leverage ratio of the NFC in this sector has followed a clear downward trend since 2004 and this trend continues during the crisis period, however with relatively modest downward adjustments in the period from 2009 to 2012. The growth of external financing in the sector declined strongly after 2008 but on an aggregate level for the whole services sector no significant net external financing outflows were observed. The maturity structure of the sector's liabilities moved to somewhat higher share of short-term debt after 2009. The liquidity ratio of the sector remained broadly unchanged after 2007. Overall, the adjustment process in the services sector appears to have had a significant negative impact only on corporate profits of the sector, however with no apparent evidence of negative effects of deleveraging pressures.

Figure 25



Notes: See notes in Figure 22.
Source: BNSI, BNB, authors' calculations.

The agriculture sector's gross value added and employment have experienced a downward trend since 2002. The productivity of the sector also declined in this period. However, the profitability and the liquidity of the NFC in the agriculture sector have been increasing significantly since 2003 which makes this sector the most profitable and liquid sector in the economy. The decline in the leverage ratio after 2007 could be related to the faster growth of firms' assets compared to their debt increase. It should be noted that a specific feature of the sector is that its financing is mostly based on its gross operating surplus and the agricultural subsidies received from EU funds.

In conclusion, the descriptive analysis in this section points towards heterogeneous developments of NFC adjustment across sectors of economic activity. The construction and industry excluding construction sectors were the most severely affected by the global crisis, however while there was a subsequent rebound in the valued added of the industry sector, the adjustment process of the construction sector is still ongoing. The crisis had an adverse impact on employment in most of the sectors. Overall, there is evidence of smooth deleveraging at a sectoral level and in some sectors this seems to be driven by long-term processes which began prior to the start of the global financial and economic crisis. In most of the sectors the observed moderate deleveraging processes during the crisis do not appear to be the main factor behind economic activity and employment developments. A more relevant factor seems to be the gradual shift towards more internally financed growth and the structural changes in employment due to a transition to more technology intensive production processes. Operating in an environment of increased uncertainty, subdued demand and therefore less investment opportunities, Bulgarian enterprises now rely on less external sources of funding. With the exception of the services sector, companies broadly retained their pre-crisis profitability. The crisis did not have an effect on the liquidity position of the four analysed sectors.

4. Conclusions

In the period following the global crisis, the NFC in EU countries started a process of adjustment of their behaviour. In Bulgaria NFC responded to lower demand by reducing their investment rate, shedding labour, improving their efficiency and moderately lowering their overall indebtedness, while

managing to maintain a sound financial position. We find that after the period of rapid debt accumulation prior to 2009, which was mainly related to the large inflow of foreign direct investment, Bulgarian enterprises underwent a process of reduction of indebtedness which as a whole was broadly in line with the trends observed on average for the EU member states and unwound in a gradual and orderly manner.

At present, there is no significant evidence that this process has strong negative effects on corporates' business activity as companies preserve high liquidity ratios and restructure their expenditures in order to maintain sound finances.

At a macro level, the beginning of the deleveraging process can be dated around 2010, with a relatively more significant reduction of indebtedness of non-financial enterprises occurring in 2011. In 2012 the level of indebtedness remained broadly unchanged and according to some indicators such as NFC debt-to-gross operating surplus and NFC debt-to-gross output there are even some weak signs of "releveraging" as of 2012. In the period 2009-2012 internal financing has increased its importance for firms and firms' gross savings have retained a level close to that observed from 2002 to 2006. Firms have also developed a net lending position, with the latter showing some signs of moderation as of 2012.

The external debt statistics does not point to any external deleveraging taking place at the level of the NFC institutional sector as firms' external debt at end-2013 is only slightly lower from the 2010 level. Furthermore, considering a number of indicators for the assessment of the risks related to NFC debt servicing, we find that so far as a whole debt repayment has not been a significant burden for Bulgarian firms.

Our findings point to certain differences of NFC debt adjustment and overall behaviour across sectors of economic activity (construction, industry excluding construction, services and agriculture). The global crisis had a significant negative effect in terms of value added and employment on the construction and industry excluding construction sectors. However, while there was a subsequent rebound in the value added of the industry sector, the adjustment process of the construction sector is still ongoing. Overall, there is evidence of smooth deleveraging at a sectoral level and in some sectors this seems to be driven by long-term processes which began prior to the start of the global financial and economic crisis. In most of the sectors the observed moderate deleveraging processes during the crisis do not seem to be the main factor behind economic activity and employment developments. A more relevant factor appears to be the gradual shift towards more internally financed growth and the structural changes in employment due to a transition to more technology intensive production processes. With the exception of the services sector, the Bulgarian NFC have broadly retained their pre-crisis profitability. The crisis did not have an effect on the liquidity position of the four analysed sectors.

Finally, due to the remaining high uncertainty both in the external and internal environment, at this stage it is also very difficult to give a definitive answer to the question whether corporate deleveraging has run its course in Bulgaria, even though at a macro level the 2012 data give some indication in this direction.

As possible areas of future research, it will be beneficial to expand our analysis at sectors of economic activity with firm level data which has not been so far extensively done for Bulgaria. Analysis with firm level data will enrich the present findings with additional granular firm characteristics which cannot be observed at macro or sectoral level.

Looking ahead, it also has to be stressed that the ongoing process of implementation of European System of Accounts 2010 in EU member states could potentially bring changes to the macro data on which we currently base our findings, and could thus change the conclusions made so far. In relation to this process, improvements in data quality as well as the introduction of greater data comparability across counties, especially when financial accounts data is concerned, will also eventually have a beneficial effect on the future analysis of NFC indebtedness at a macro level.

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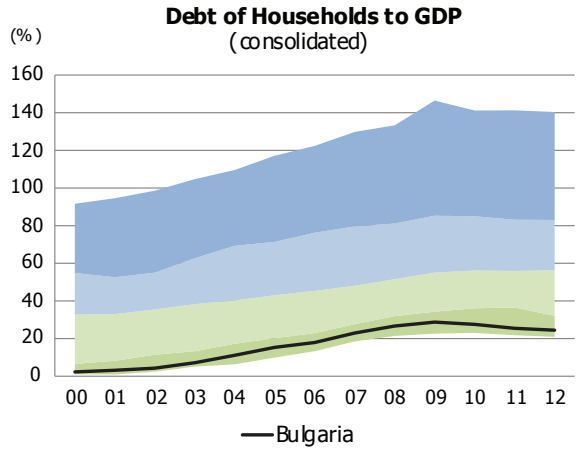
Annex I

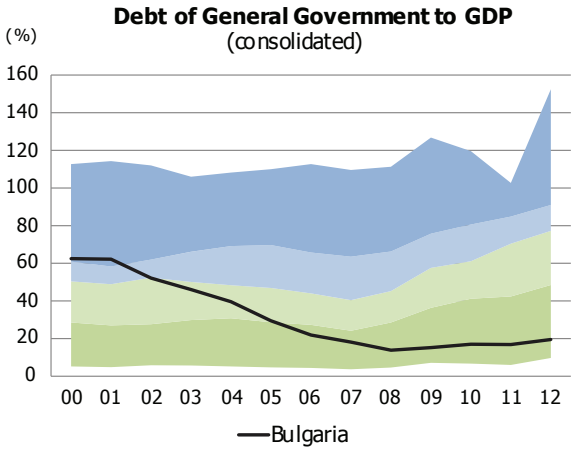
The following figures present the indebtedness of households, general government and financial corporations.

Figure 1



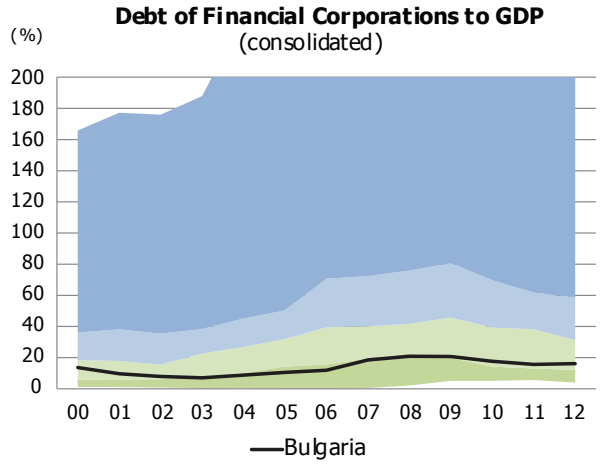
Source: ECB, authors' calculations.

Figure 2



Source: ECB, authors' calculations.

Figure 3



Source: ECB, authors' calculations.

UDC 336.7.055.4.023(497.5)

MEASURING FINANCIAL STABILITY – SYSTEMIC RISK ACCUMULATION AND MATERIALIZATION VS. FINANCIAL SYSTEM RESILIENCE[1]

Mirna Dumičić[2]

Abstract

This paper observes financial stability through the processes of accumulation and materialisation of systemic risks and through the degree of resilience of the overall financial system to potential systemic shocks. To this purpose the method of principal component analysis on the example of Croatia has been used to construct three composite indices – systemic risk accumulation index, systemic risk materialisation index and index of financial system resilience to shocks. Such approach to systemic risk analysis and resilience of the system to shocks could make it easier for both economic policy makers and market participants to monitor and understand the degree of financial stability in the system and enable them to predict possible sources and triggers of crisis episodes more easily.

Key words: financial stability, systemic risk, financial system resilience, principal component analysis

JEL: E44, E50, E58

1 Views presented in this paper are the views of the author and do not necessarily express views of the Croatian National Bank.

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1. Introduction

In the recent years numerous papers have been published dealing with issues related to financial stability and the macroprudential policy focused on its maintenance. This is partly a result of financial crises faced by many countries and regions in the recent decades. Transformation of the recent global financial crisis into an economic crisis that has affected the majority of the world's economies and resulted in enormous costs which are still materialising has motivated national and international institutions and academic community to attach much more attention to the development of macroprudential tools to improve the process of analysing the degree of resilience of the financial system to disturbances related to macroeconomic environment, financial markets or financial institutions and to enable timely recognition of vulnerabilities and potential risks that might jeopardize financial stability.

Financial stability in a wider sense is characterised by the smooth and effective functioning of all financial system segments (financial institutions, financial markets and financial infrastructure) in the resource allocation process, in risk assessment and management, payments execution, as well as in the resilience of the system to sudden shocks (ESB, 2007, Houben et al., 2004). Successful macroprudential policy and identification of financial stability of the system require the capturing of all sources of risks that might threaten such factors that affect the resilience of the financial system in case of shocks. The definition of financial stability itself clearly shows that there is a range of relevant factors that may affect it, particularly when taking into account the increasingly complex relations among financial institutions and financial markets, risks arising from the functioning of financial infrastructure and domestic and international macroeconomic developments. The selection of proper indicators capable of giving timely warning of the appearance or accumulation of systemic risks in the system and reflecting the financial system stability degree is thus one of the biggest challenges of macroprudential policy. The problem of the existence of a very large number of variables that might affect financial stability is often solved by constructing composite indices (Gadanecz and Jayaram, 2009).

This paper observes financial stability through the processes of accumulation and materialisation of systemic risks and through the degree of resilience of the financial system to potential systemic risks. The method of principal component analysis on the example of Croatia has been used to construct three composite indices of financial stability – systemic risk accumulation index, systemic risk materialisation index and index of the financial system resilience to shocks. Risk indicators that might threaten financial stability include those that relate to the quality of the assets of commercial banks, liquidity risk, foreign exchange risk, interest rate variability risk, credit risk, market risk, macroeconomic risks and risks arising from the conduct of individual economic sectors, while the resilience indicator comprises various forms of reserves existing in the banking sector and on the level of the financial system as a whole.

The main contribution of this paper to the existing literature on measuring financial stability is the new approach to financial stability indicators. These indicators reflect the processes affecting financial stability – accumulation and materialisation of systemic risk in the system – rather than reflecting the stability of a sector or system, and identify the developments linked to financial system resilience to systemic risks. Such way of dividing and presenting financial stability indicators should facilitate understanding of the process of creating buffers against shocks on the level of the system as a whole, risk accumulation in the system and the mechanism of materialisation of previously accumulated risks.

Such indices have a high application value because they can be a useful tool in the communications of economic policy makers and the public, particularly in explaining the decisions about the use of measures aimed at strengthening and preserving the risk-resilience of the financial system. Likewise, composite indicators that reflect the state of financial stability or systemic risk can make it easier for economic policy makers and market participants to monitor and understand the degree of financial stability in the system and enable them to predict possible sources and triggers of crisis episodes more easily (Gadanecz and Jayaram, 2009).

Besides, unlike binary methods often used in the literature dealing with crisis early warning system and indicating if a crisis episode is on-going or not, this approach provides continuous measures that may contribute to clearer understanding of the movement of the relation between the system resilience and systemic risks. If it is established that, on the level of the system, the level of risks that

might threaten its smooth functioning is increasing, a set of measures and instruments needs to be identified to affect mitigation of these risks, strengthen the buffers increasing the system resilience and decrease procyclicality in the conducts of financial institutions, especially commercial banks, since the majority of European countries have a bank-centred system (IMF, 2011).

The paper is divided into four main sections. The introduction is followed by a short overview of studies dealing with the measurement of financial stability published so far, with the emphasis on papers calculating composite indicators. In the third section, the systemic risk accumulation index, systemic risk materialisation index and index of financial system resilience to shocks are constructed using the method of principal component analysis on the example of Croatia and their movement and factors having had the greatest impact on them are described. The final section summarises the main results and highlights the benefits of indicators constructed in this manner.

2. Literature review

Although there are numerous papers analysing financial stability and systemic risk, many of which have been published in recent years, there is still no unique model for their comprehensive measurement. Researchers have mainly focused on certain segments of systemic risk or financial stability or analysed data relating to individual sectors or financial institutions. Geršl and Hermanek (2006) point out that in the financial stability analysis process, indicators should be used that reflect trends on financial markets, in financial institutions, and in the real and the public sectors as the main debtors of financial institutions, as well as indicators of financial infrastructure. In this context, due to the importance of banks in the process of financial mediation, the focus was most often on the indicators of their business operations (BIS, 2012). However, even if an initial set of indicators is established that enables an efficient analysis of financial stability in a certain period, such a set should not be static but should always be adjusted to developments in the financial system and macroeconomic environment.

However, although macroprudential indicators covering individual sectors may be very useful in considering individual segments of financial stability, they cannot reveal the state of the system as a whole (Van den End, 2006). For this reason, to solve this problem the literature often uses composite indices capturing numerous data obtained on the basis of individual macroeconomic, financial and other indicators. A set of variables included in the calculation of composite indices must reflect the structure of the financial system and specific macroeconomic characteristics of a country and identify the system resilience to shocks, i.e. the buffers that exist within the system and may be activated if needed.

In their overview of financial stability measures, Gadanecz and Jayaram (2009) have presented the attempts of researchers and central banks to, by use of various indicators and by creating composite indices, contribute to better understanding of financial stability and vulnerabilities that may threaten it. The main conclusions of that paper are that, in spite of the mentioned problems associated with the construction of composite indices, the latter have more power to identify the degree of financial stability than individual indicators. These indicators may be calculated at various levels of complexity and then aggregated into a unique measure of systemic risk by use of simple statistical methods, like arithmetic mean or median (BIS, 2012).

Literature dealing with early warning systems for crisis episodes often assesses multivariate logit or probit models where the dependent variable takes the value of 1 in the period assessed as the crisis period, and zero in other periods (Reinhart et al., 2000). Petrovska and Mucheva (2013) emphasise two most frequently used methods for calculating composite indices – weighted-sum approach where each variable is weighted by its estimated impact on real GDP and the method of principal component analysis. Factor analysis in this form was first used by Stock and Watson (1989, 2002).[3] In this method the data are transformed in such a way that in a small number of constructed series as much information as possible is retained from the initial set of variables (Dumičić and Krznar, 2013).

3 For a summary of factor forecasts and the basic approach of Stock and Watson see Kunovac (2007).

Some of the composite indices commonly used in literature and in practice for monitoring the conditions on financial markets are monetary conditions index and financial conditions index.[4] According to Van den End (2006), monetary and financial conditions can be affected by monetary policy measures, and financial stability indicators by macroprudential policy measures, although they are mutually closely related. Monetary conditions indices usually comprise exchange rate and reference interest rate, while financial conditions indices describing the conditions for borrowing on domestic and international markets include numerous other macroeconomic indicators and indicators of financial markets as well (Mayes and Viren, 2009).

However, although having a wider coverage than similar indicators, financial conditions indices do not include data on the state of financial institutions (Van den End, 2006). Since this state can have a significant influence on the process of financial intermediation, it makes sense to include indicators related to financial institutions in the variables used to calculate financial stability index, beside indicators from financial markets and macroeconomic indicators. Along these lines, in order to construct financial stability index, Van den End (2006) added indicators of business operations of banks, pension funds and insurers to the set of variables used for calculating financial conditions index[5]. Various types of composite indices constructed to monitor financial stability on the system level have been calculated by other researchers as well. Appendix 1 presents indices, their components and calculation methodology from several studies used for this paper.

3. Methodology

In the studies presented above composite indicators of financial stability mostly reflect the degree of stability of an individual sector or segment of financial market and are focused on individual sources of risks. In this paper financial stability indicators for Croatia are divided into those that contain information about the process of the accumulation of systemic risk in the system, those that indicate the materialisation of previously accumulated systemic risk which usually occurs after a financial shock[6] and those reflecting system resilience. Beside the experiences of other researchers, the selection of variables included in the calculation of financial stability indicators has been influenced by specific characteristics of Croatia which as a small open country faces risks which are not necessarily identical to those faced by more developed countries.

In order to avoid the use of arbitrary methods for determining the variables to be included in the systemic risk analysis and to be able to obtain a single indicator or a composite index or factor out of a large number of variables, the principal component analysis method has been used. In this method the interdependence of a large number of variables is analysed by use of a small number of shared factors. Before they are included in an index, individual indicators need to be normalized in order to have the same variance. By statistical normalization indicators are reduced to the same scale, their arithmetic mean being zero and standard deviation equalling one, which enables to avoid distortions arising from different arithmetic means of individual indicators (Cheang and Choy (2011). In this manner indicators which at some point in time report significantly higher values than the average have a stronger influence on the composite indicator. The degree of correlation between individual variables and the index is called "factor loading". The use of this method avoids problems like omitted variables or those related to degrees of freedom occurring when shared trends of risk indicators and macroeconomic indicators are being modelled (BIS, 2012). On the other hand, its disadvantage is that the adding of new observations changes the value of the principal component in preceding periods.

4 Beside the said indicators, we should mention financial stress index aimed at warning regulators about financial system instability based on high-frequency data of securities markets, FX and money markets and data on the banking sector. Illing and Liu (2006) stress that such indices are very useful for analysing developments on highly developed financial markets with numerous financial institutions of importance for the system.

5 Beside real interest rate, real exchange rate, real estate prices and stock prices included in financial conditions index, the financial stability index also includes solvency buffer and volatility of stock index of financial institutions.

6 Financial shocks may be recorded by high-frequency indicators, most commonly those from financial markets.

The composite systemic risk accumulation index (SRAI) is composed of 14 variables (Table 1), and the systemic risk materialisation index (SRMI) and the financial system resilience index (FSRI) consist of eight variables (Tables 1, 2 and 3). Quarterly data for the period from the first quarter of 2002 to the first quarter of 2013 are taken for the computation of the indices. All the three indices are defined as the first principal component obtained by the principal components method analysis:

$$SRAI_t = \mathbf{x}_t\alpha$$

$$SRMI_t = \mathbf{y}_t\alpha,$$

$$FSRI_t = \mathbf{z}_t\alpha,$$

where α is a weight vector having dimension 12 x 1 (or 8 x 1) and $\mathbf{x}_t$ (or $\mathbf{y}_t$ and $\mathbf{z}_t$) is 1 x 12 (or 1 x 8) vector of the value of the indicator on the basis of which the indices are evaluated (Tables 1, 2 and 3). The first principal component explains the greatest part of total variance of a certain set of variables. The loading parameters reflect the contribution of a given variable in the explanation of the common trend of all the indicators included into the calculation of the individual index constructed on the basis of the first principal component.

Apart from that, following Petrovska and Mucheva (2013), all the indices have been calculated by using first five principal components which have been summed up by using their share in the total variability explained by it as weights.

3.1. Systemic risk accumulation

Risk accumulation index describes the process of accumulation of systemic risk in the system. It is calculated on the basis of 12 individual variables which have been assessed as potentially important determinants of that process (Table 1, Figure 1).

A strong loan activity in the pre-crisis period might have considerably exacerbated the effect of the transmission of the crisis from financial mediators to the real sector and vice-versa (GFSR, 2011). Typical pattern of risk accumulation on this basis implies that a strong growth of loans to the private sector stimulates a relatively stronger rise in aggregate demand compared to potential growth, which leads to the economy overheating and the growth of macroeconomic imbalances. In that context, bank loans often result in a growth in spending and imports, causing an enlargement of the deficit (or diminution of the surplus) on the current account balance, inflationary pressures and pressures on the stability of the domestic currency (Hilbers et al., 2005). If the level of savings of a country is too low to finance such credit activity, this involves financing from abroad and an increase in foreign indebtedness.

In cases emerging market countries, this most often involves financing from abroad and an increase in foreign indebtedness. Also it has to be pointed out that a surge in credit activity is often linked with a growth in the financial vulnerability of the system as it implies a rather poor quality of granted loans and an increased acceptance of risk (Evans et al., 2000). It is thus much more difficult to observe a trend of decreased quality of loans in a period of a surge in real estate prices because higher real estate prices make the process of refinancing based on collateral much easier, what hides the problem of potentially bad loans (Turner, 2012).

However, as the dynamics of macroeconomic variables and that of financial variables are similar regardless of the sources of change, one should keep in mind that strong loan activity, which is in the literature often related to the risk accumulation process, is not necessarily linked to increased systemic risk. For example, it may be a consequence of an expected future productivity growth.

Therefore, beside the rates of change of loans to the private sector, SRAI also contains macroeconomic variables that reflect accumulation of macroeconomic imbalances on the system level and in individual sectors, data on the trends in prices of various forms of assets like real estate and shares, and variables identifying risks contained in bank balance sheets. The aim is to differentiate between sound lending growth and a growth accompanied by permanent rise in asset prices and

external imbalances, a rise in risks in bank balance sheets amid the pronounced loosening of lending conditions, etc.

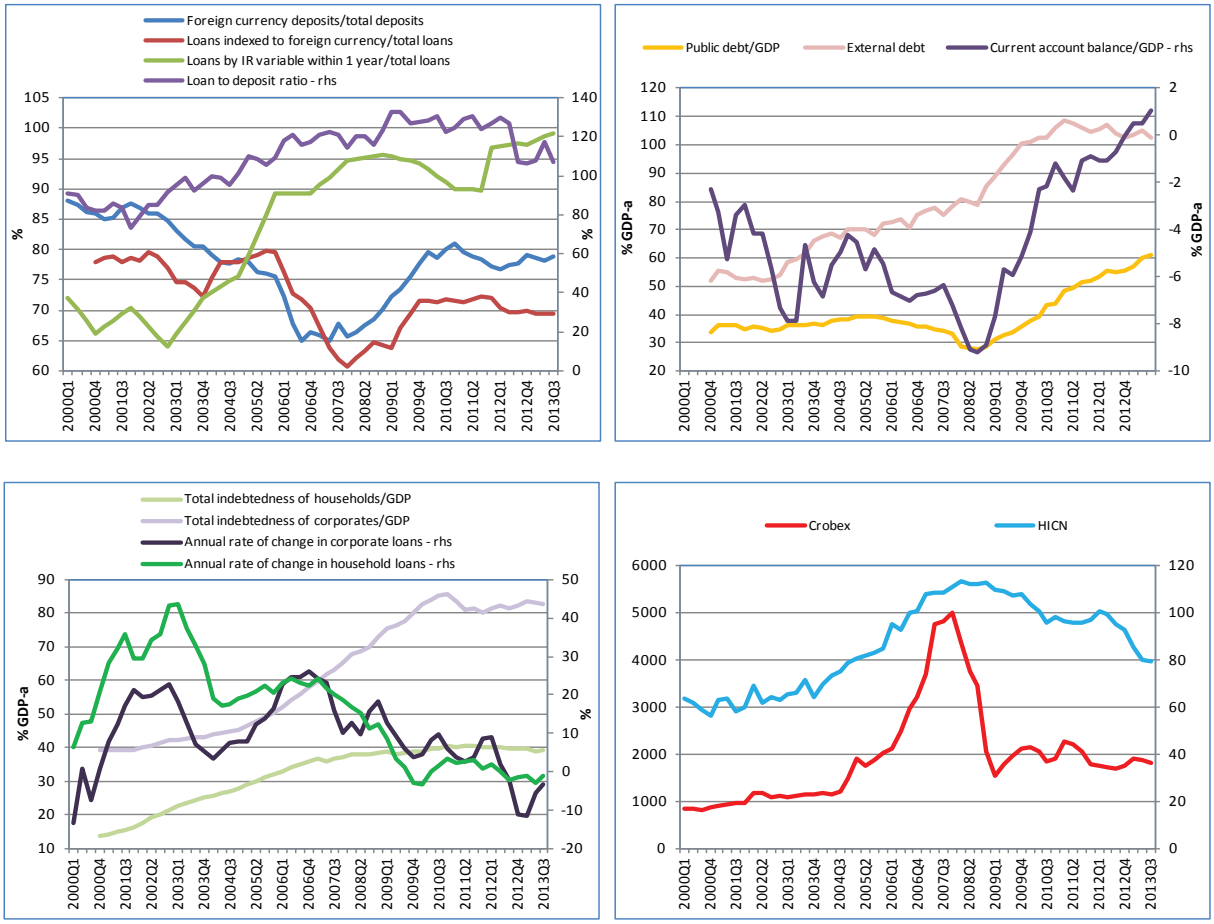
The first principal component of SRAI based on annual data explains 40%, while the first five principal components explain 83% of the total variance of variables included in the index. The percentages of explained variance for the annual data are 24% and 64%, respectively. On the basis of the loading parameters it can be concluded that the most influence was exerted on the process of risk accumulation in Croatia by the trend in real estate prices, the rates of changes of loans to the private sector, the total indebtedness of the household sector, the degree of euroisation and the trend in the public debt and current account balance. SRAI suggests that the most risks were accumulated in the system in the period before the recent financial crisis, which was characterised by low reference interest rates of the leading central banks, a historically low level of global risk premium, a high level of global liquidity and above-average rates of economic growth in European countries with emerging markets attracting foreign capital (Figure 2).

Table 1. Indicators suggesting accumulation or decrease of the systemic risk in the system

Sources of accumulation of systemic risk	**Indicators**	**Loading parameters (annual change)**	**Loading paremeters (quartery change)**
Structure of bank assets and liabilities respect to interest rate variability	Loans by interest rate variable within 1 year/ total loans	0,14	0,07
	Loans indexed to foreign currency/total loans	-0,25	-0,27
	Foreign currency deposits/total deposits	-0,31	-0,30
	Total loans / (total deposits - deposits received from mother banks)	0,23	0,25
Corporates	Indebtedness of corporates/GDP	0,08	0,15
	Rate of change in corporate loans	0,35	0,39
Households	Indebtedness of households/GDP	0,36	0,40
	Rate of change in household loans	0,37	0,43
Government	Public debt / GDP	-0,31	-0,27
	Rate of change in government loans	0,04	0,06
External imbalances	External debt / GDP	0,08	0,09
	Current account balance/GDP	-0,31	-0,29
Asset prices	Hedonic real estate index	0,35	0,27
	CROBEX stock exchange index	0,22	0,13

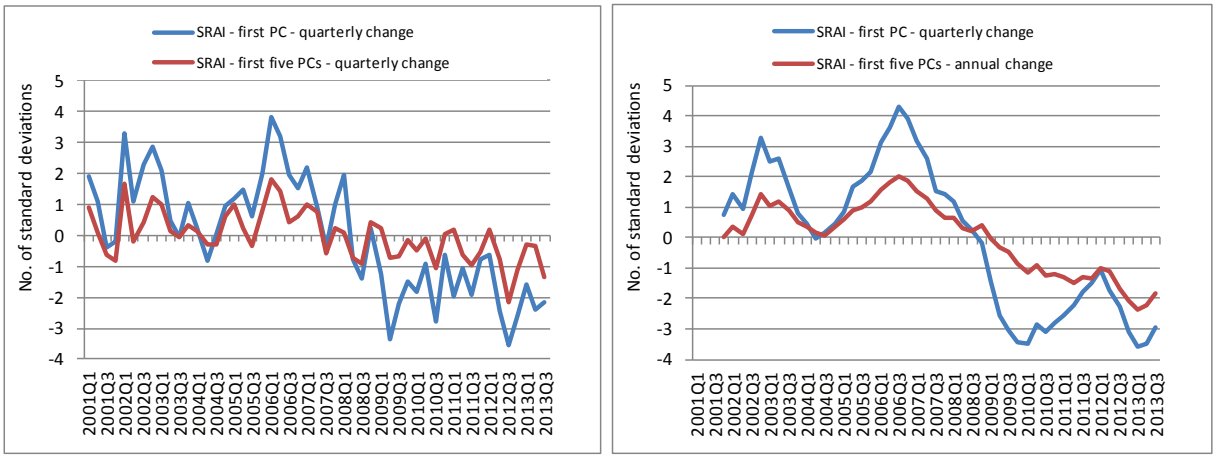
Source: Author's calculation.

Figure 1. Components of systemic risk accumulation index



Source: CNB; CFSSA; MF; CBS7; author's calculations.

Figure 2. Systemic risk accumulation index



Source: Author's calculations

Risk accumulation in the system started as early as 2002. Deceleration of the process in 2003 was primarily related to the then introduced measures of the CNB aimed at discouraging the strong credit expansion and foreign borrowings of banks. In the period from mid-2004 to mid-2006, the main generators of the risk accumulation process in the system were the high rates of growth of loans to the corporate and private sectors and a strong increase of their total indebtedness as measured in terms of

7 CNB – Croatian National Bank; CFSSA – Croatian Financial Services Supervisory Agency; MF – Ministry of Finance; CBS – Croatian Bureau of Statistics

GDP and a surge in real estate prices. A high deficit in current account balances also contributed to the accumulation of risks in the period observed. Reduction of the degree of euroisation measured by the proportion of foreign currency deposits in total deposits and the ratio of foreign currency index loans to total loans that marked a larger part of the pre-crisis period worked in the opposite direction.

The process of risk accumulation started to slow down in the second half of 2006. The trend continued in 2007 as a consequence of the introduction of the highest permissible non-penalised rate of credit growth of 12% per annum in early 2007 and the first signs of the world financial crisis, appearing in mid-2007 and escalating in the third quarter of 2008. In an interpretation of Figure 2, it is important to realise that the low level of risk accumulation index does not necessarily have to mean a reduction of overall level of risk. This becomes clearer when the individual components of the index are considered, on the basis of which it might be possible to conclude that the total achieved level of most of them (total indebtedness of corporate sector and households, public debt, foreign debt) indicated an increased risk, which was reduced slightly only in some segments, while the degree of euroisation actually increased. The only major improvement can be observed in the current account balance.

It has to be pointed out that during the whole of the period the CNB employed various monetary and macroprudential measures and instruments with which, on the one hand, the resilience of the system to shocks was increased and on the other the process of risk accumulation, which would have been still more pronounced without them, was mitigated. This has been described in the part of this paper dealing with the resilience of the domestic financial system.

3.2. Materialisation of systemic risk

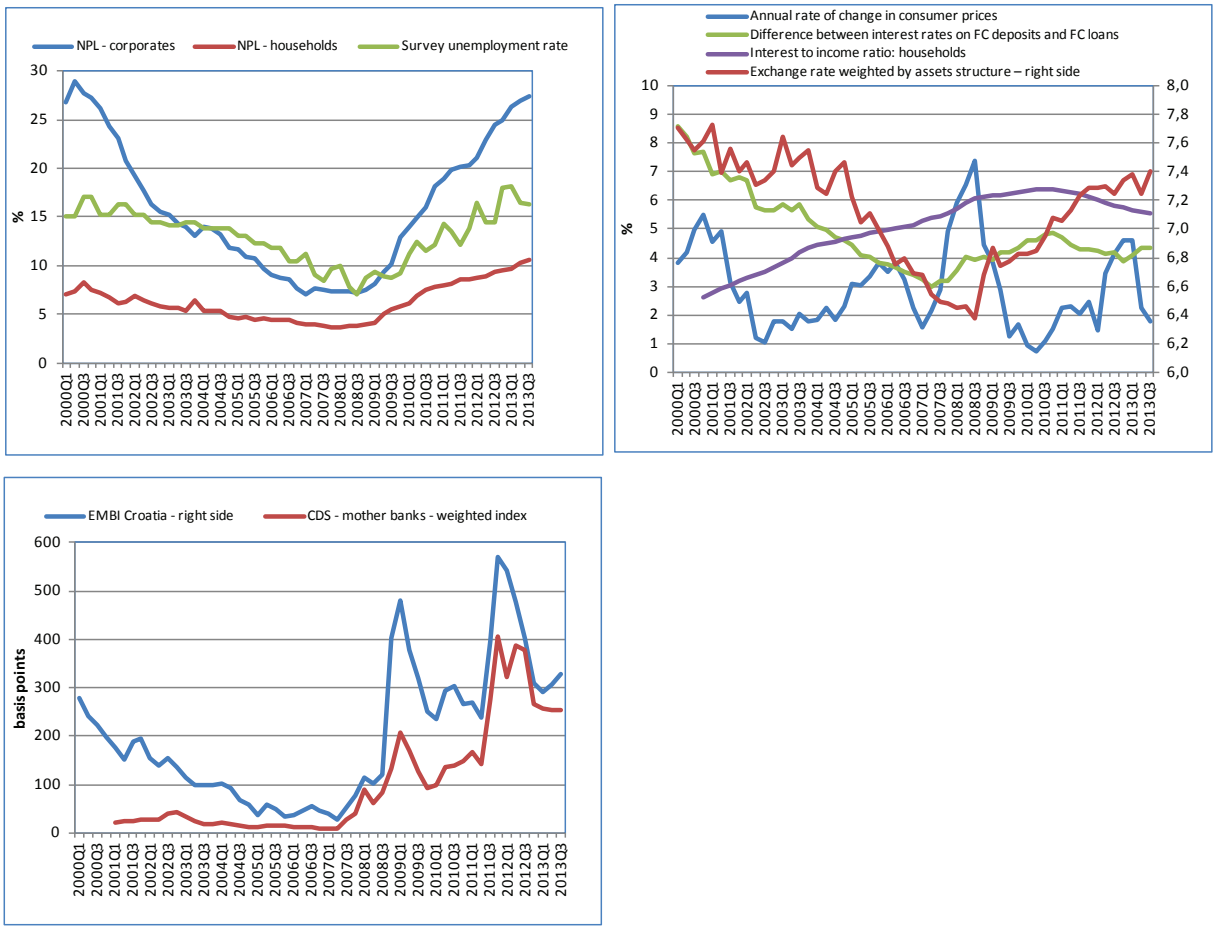
Apart from the process of systemic risk accumulation, for the creation of a more complete view of financial stability it is necessary to observe indicators of risk materialisation, in terms of materialisation of previously accumulated risks in the system and not of shocks on financial markets which are usually measured by financial stress and are usually triggers of gradual materialisation of financial and macroeconomic weaknesses. Index of risk materialisation covers indicators of the quality of the assets of commercial banks, macroeconomic trends and trends on the financial markets (Table 2, Figure 3).

Table 2. Indicators suggesting materialisation of previously accumulated risks

Sources of materialisation of systemic risk	Indicators	Loading parameters (annual change)	Loading paremeters (quartery change)
Corporates	NPL to total loans ratio – corporates	0,47	0,50
Households	NPL to total loans ratio – households	0,46	0,40
	Household interest/income	-0,35	-0,45
Macroeconomic trends	ILO unemployment rate	0,45	0,18
	Annual rate of change in consumer prices	-0,08	-0,19
	Weighted exchange rate according to the structure of the assets of commercial banks	0,37	0,42
Financial markets	Difference between interest rates on foreign currency deposits and foreign currency loans	0,29	0,25
	Risk premium for mother banks of largest domestic foreign owned banks	0,07	0,18
	Risk premium for Croatia – EMBI yield spreads	0,05	0,21

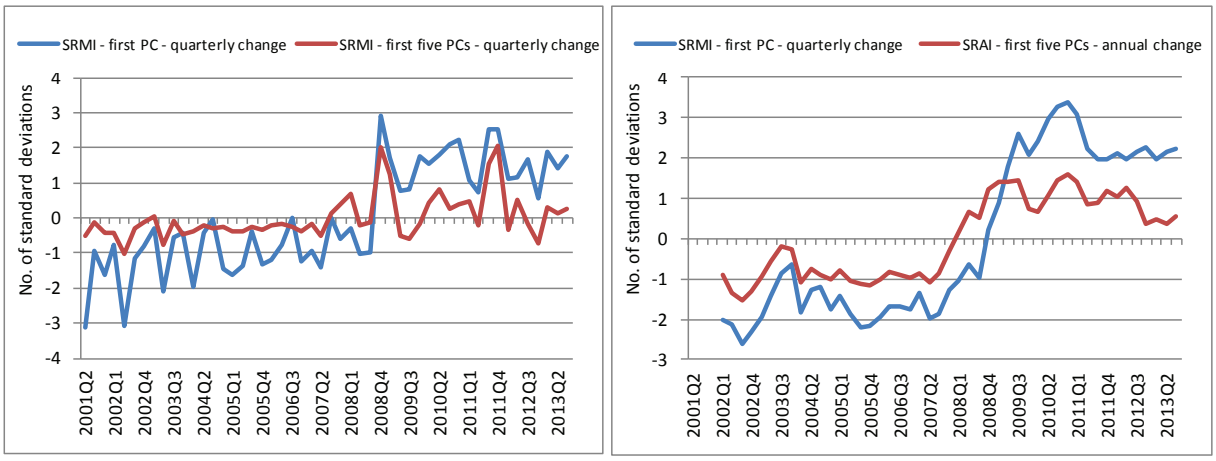
Source: Author's calculation.

Figure 3. Components of risk materialisation index



Source: CNB; CBS; Bloomberg; author's calculations

Figure 4. Systemic risk materialisation index



Source: Author's calculations

The first principal component based on annual data explains 44%, while the first five principal components explain 95% of total variance of data included in SRMI (Figure 4). Percentages of explained variance for quarterly changes are 24% and 85% respectively. Results of the analysis indicate that the major part of the materialised risk is related to balance in bank balance sheets recording a surge in non-performing against total loans to companies and on a slightly smaller scale to the retail sector, along with the trends in the exchange rate weighted by commercial banks' assets structure which depreciated primarily due to the weakening of kuna against the Swiss franc, and with a significant increase in the country risk premium, which resulted in a considerable rise in the costs of borrowing at home and abroad.

In the period up to the escalation of the financial crisis most of the indicators observed had improved considerably. The ratio of non-performing to total loans had reduced for both corporate and household sectors, the ILO unemployment rate was also continually falling, inflation was relatively stable and low and a country risk premium affecting the price of foreign borrowings reached a historically low level. The exchange rate weighted according to the structure of the assets of commercial banks (loans in euros, Swiss francs and US dollars are included) had been in general slightly appreciating as a result of strong capital inflows into the country. Although this was an apparently stable period marked by positive trends and a relatively powerful economic growth, Figure 5 shows that it was then that most of the imbalances and systemic risk was accumulated. This risk started materialising after the strengthening of the world financial crisis.

3.3. Financial system resilience

Index of financial system resilience to systemic risks comprises indicators reflecting the capitalisation of the banking sector, resilience of banks to credit risk, stability of sources of funding, liquidity (with particular emphasis on foreign exchange liquidity), profitability of banks, and bank reserves with the central bank and buffers of the system as a whole measured by the ratio of international reserves to GDP (Table 3, Figure 5).

The first principal component explains 63% of shared variance of data included in FSRI (Figure 6). It should be pointed out that, although decreasing in the largest part of the observed period, the system resilience is still at a very high level, which can be observed when looking at certain components of resilience indicators, especially bank reserves with the central bank and the ratio of international reserves to GDP.

Measures of the central bank had the most significant influence on the strengthening of the system resilience in the period preceding the escalation of the global financial crisis. Croatia is a small and open economy subject to large and volatile capital flows and pervasive informal euroization generating huge currency mismatches in the balance sheets of the non-financial sector (and indirectly credit risk for the financial sector). It is also characterized by a strong link between exchange rate and inflation expectations. Croatian National Bank (CNB) has therefore targeted exchange rate stability as the main way to achieve low inflation and financial stability, which has on the other hand constrained monetary policy to a large extent.

As an environment of rapid financial liberalization and integration into the EU economy with delayed fiscal adjustment fuelled strong capital inflows, fast credit expansion, strong real GDP growth and widening external imbalances - a combination that has in many cases proven conducive to boom-bust cycles with devastating effects on financial stability - monetary policy was tightly intertwined with macro-prudential instruments with the aim of containing rising external imbalances and taming the emerging boom. The close link between monetary and financial stability and the narrowed space for monetary policy therefore encouraged CNB to adopt a series of measures which were called monetary when first introduced but were actually macroprudential in essence.

As early as in 2003 CNB started undertaking a series of measures with the principal aim of reducing systemic risks threatening due to too fast credit growth and increase in external imbalances, and creation of buffers and strengthening of the system resilience to potential shocks.

The most important measures and instruments in this context were the following (Figure 7):

- the high level of general reserve requirements (23.5% in early 2000 and 13.5% in early 2013),
- administrative restriction of loan growth to 16% per annum in 2003,
- the decision on the obligation to maintain coverage of short-term foreign currency liabilities with short-term foreign currency claims at min. 53% was replaced with the decision on the obligation to maintain minimal foreign currency claims at 35% of sources of foreign currency, aimed at ensuring suitable foreign exchange liquidity of banks,

• the decision on the obligation to set aside marginal reserve requirement against increases in the foreign liabilities of banks aimed at making international borrowing more expensive and slowing down the growth of external imbalances and loans; the requirement was gradually increased from 24% to 55%,

• special reserve requirement aimed at making it more expensive for banks to borrow by issuing debt securities on the domestic market which could after that be sold to non-residents, which technically meant that the banks indirectly borrowed abroad and avoided other CNB's measures,

• introduction and increase of capital requirements for currency induced credit risk,

• increase in the capital adequacy requirement to 12%,

• foreign currency interventions that were primarily aimed at alleviating pressures on the appreciation of the domestic currency that resulted in an increase in international reserves,

• the decision on the registration of mandatory treasury bills allowing a non-penalised rate of credit growth of 12% per annum aimed at slowing down credit growth, which was in some periods several times faster than the growth of gross domestic product, and at contributing to the maintenance of macroeconomic and financial stability in the country, and

• increase in capital requirements for banks whose credit growth exceeds 12% per annum, which made it more expensive for banks to grant loans in or indexed to a foreign currency in terms of capital and facilitated gradual reduction of the degree of euroisation, making kuna loans more attractive, while the increase in the risk weight strengthened the stability of the banking system and decreased the systemic risk linked to excessive lending activity due to a strong growth of bank capital.

The majority of these measures were tightened in the observed period and thus increased the system resilience. Continued decrease in the rates of reserve requirements and minimal foreign currency claims aimed at enabling the government to borrow on the domestic instead of the foreign market worked in the opposite direction.

Although the first signs of the crisis on world financial markets started in mid-2007, in Croatia they became prominent only after the collapse of the Lehman Brothers investment bank in September 2008. Pressures on the weakening of the domestic currency were brought about at the end of the 2008 by the spill-over of the global financial and real crisis to the domestic financial system and real economy and the limited net inflow of foreign capital. At that time the CNB began to gradually release the system reserves accumulated by using central bank measures and instruments in the preceding period that were needed for financing domestic sectors. In order to improve foreign exchange liquidity of banks and ensure payment of international liabilities, the marginal reserve requirement was removed in October 2008.

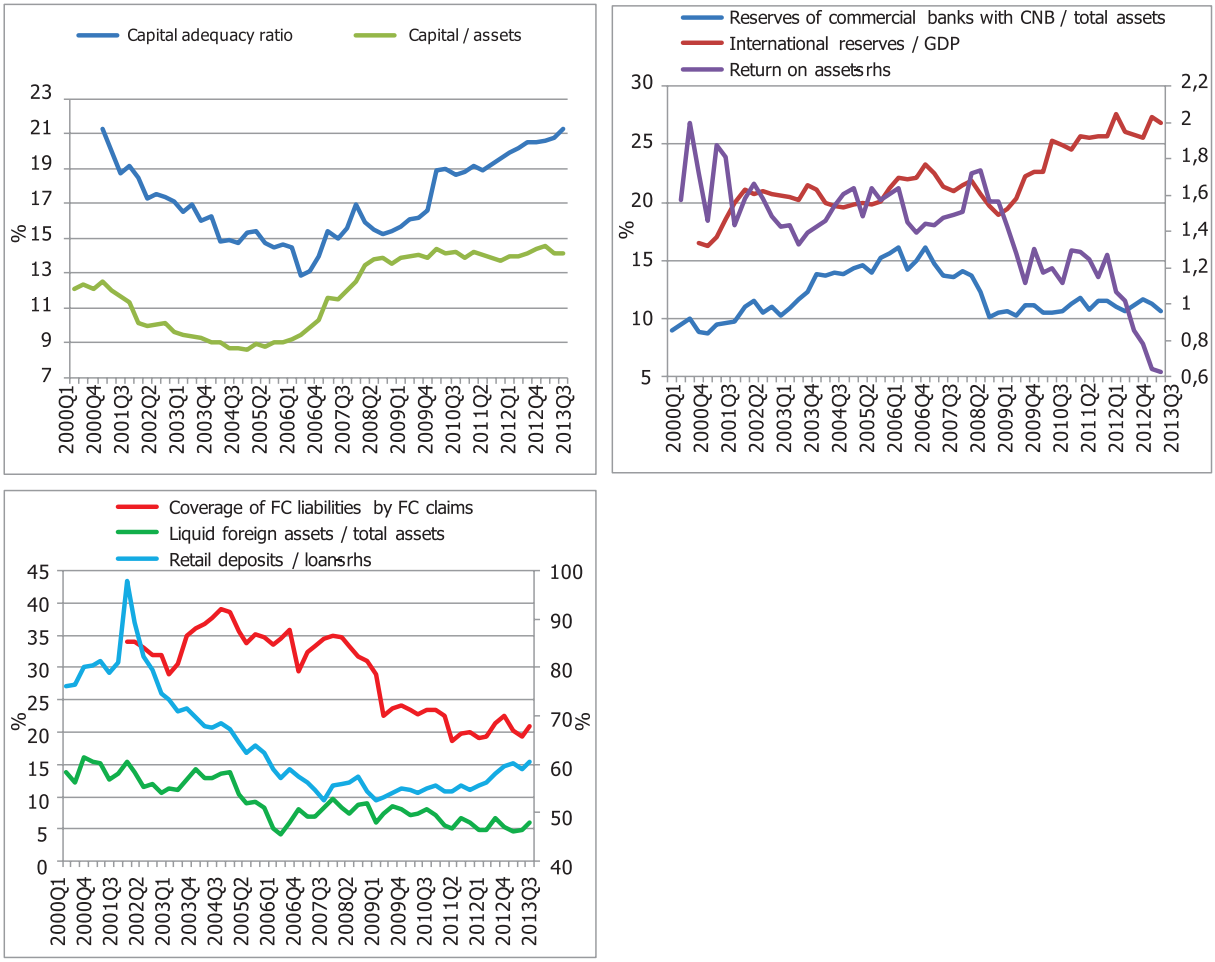
In order to make it easier for the government to borrow on the domestic market, the rate of reserve requirement was reduced from 17% to 14% in December 2008, significantly improving the system liquidity. In order to additionally increase foreign exchange liquidity of the banking system given the freezing of world financial markets, the rate of minimal foreign currency claims was reduced from 28.5% to 25% in February 2009 and then to 20% in mid-February.

These measures enabled the preservation of stable kuna/euro exchange rate and overall financial stability of the system and ensured smooth servicing of the government's liabilities to foreign creditors. It can therefore be concluded that the central bank managed to avoid two mutually linked systemic risks, i.e. ensured international liquidity of the country and stability of the exchange rate of the domestic currency, at the same time preserving the financial stability of the system as a whole and preventing the activation of risks like foreign exchange risk, credit risk, risk of credit rating loss and risk of stopping the inflow of funds from abroad, which at that time could have led to the collapse of the financial system (Rohatinski, 2009).

Table 3. Components of the financial system resilience index

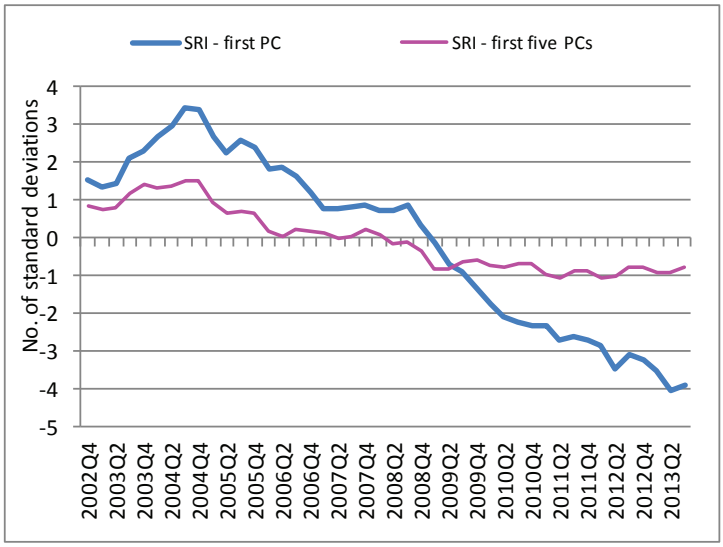
Sources of the system resilience	Indicators	Loading parameters
Capitalisation	capital adequacy ratio	-0,38
	capital / assets	-0,40
Reserves in the system	reserves of banks with CNB / assets of banks	0,24
	international reserves / GDP	0,40
	return on assets	0,38
Resilience to liquidity shocks	retail deposits / loans	0,23
	coverage of foreign currency liabilities	0,43
	liquid foreign assets / total assets	0,32

Figure 5. Components of the financial system resilience index



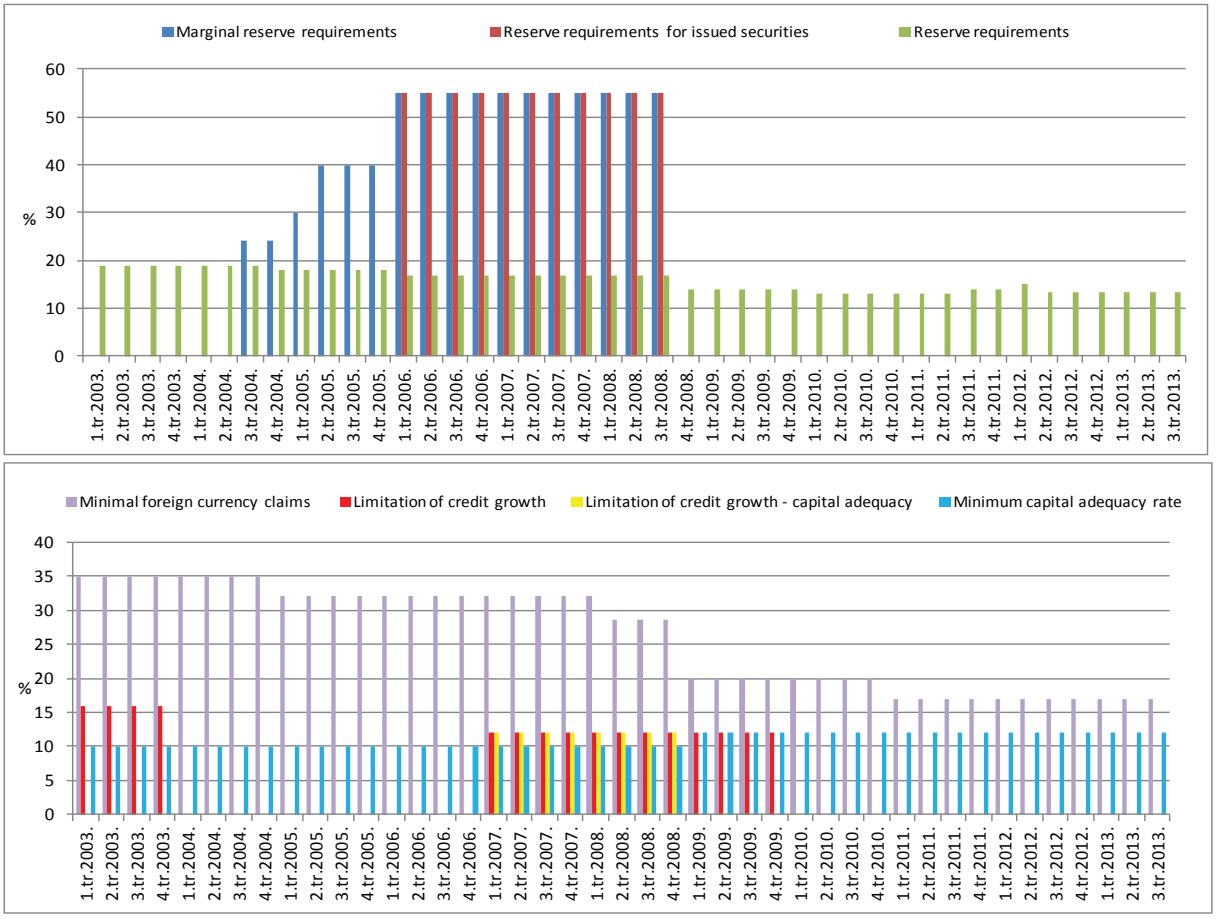
Source: CNB; CBS; author's calculations

Figure 6. Financial system resilience index



Source: Author's calculations

Figure 7. Changes of the most important monetary policy measures in the period from early 2003 to the end of the 1st quarter 2013



Source: CNB annual reports, authors' compilation.

4. Conclusion

Development of methodology for the identification and measurement of risks to financial stability is one of the main challenges in the process of creating an efficient macroprudential framework which would enable prevention and mitigation of systemic risks and contribute to strengthening the financial system resilience to potential shocks. This explains the endeavours of researchers to develop tools for measuring financial stability because it is the analysis of systemic risks that is a basis for making decisions on the use of macroprudential measures and instruments. This paper adds a new approach to the identification of financial stability through the processes of systemic risks accumulation and materialisation and the financial system resilience to systemic risks.

Early observation of an accumulation of systemic risk can be crucial for the prevention of a future crisis episode. Risk accumulation indicators can be very useful as they can provide the macroprudential policy makers and the financial sector enough time to act preventively with adequate measures and instruments on the accumulation of risks and to increase the resilience of the system and provide adequate capital and liquidity buffers capable of being implemented if the shocks should occur and the risks materialise (IMF, 2011).

Analysis of constructed indicators suggests that the process of risk accumulation in Croatia was to the greatest extent related to strong borrowing, which is in line with the findings of most of the authors who deal with crisis episodes. In many research papers identify the excessive credit growth and exaggerated optimism in credit activity as the key characteristics of the financial and banking crises (IMF, 2011, Bank of England, 2011, Kaminsky and Reinhart, 1999). These risks generally materialise only later, and most often after the occurrence of some kind of shock, when as a result it is too late to undertake measures and introduce instruments capable of strengthening the resilience of the system. All together this additionally emphasises the importance of the timely application of macroprudential measures and instruments aimed at preventing and slowing down the process of accumulating risks and at strengthening the resilience of the financial system.

Unlike financial stress indicators that may be temporary and do not necessarily result in systemic events, risk materialisation indicators as calculated in this paper represent a signal to economic policy makers and confirm that measures should be taken and instruments used to mitigate vulnerabilities and strengthen the system resilience to financial shocks. Very often when they occur, these shocks bring up to the surface previously accumulated unsustainable macroeconomic imbalances or risks accumulated in financial institutions and economy. From the central bank perspective, this type of indicators can be used as a signal for loosening previously used measures and instruments of macroprudential policy, for example for releasing capital reserves or liquidity reserves accumulated in the pre-crisis period.

By observing the system resilience indicator in combination with the systemic risk accumulation and materialisation indicators, in can be concluded that CNB's macroprudential policy was pursued in a counter-cyclical manner. This implies action focused on the maintenance of financial stability; CNB used measures and instruments aimed at strengthening the system resilience to potential shocks in periods of risk accumulation. Buffers created in this way were used to stabilise the system if and when the shocks occur and the risks materialise.

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Appendix 1

Composite indicators of financial stability – literature overview

The Central Bank of the Republic of Turkey (2006) calculates a financial strength index as the weighted average of subindices that reflect the stability of the banking sector.

Central Bank of Turkey (2006)	Banking stability index		
Subindices	**Indicators**	**Weight**	**Direction of the imapct**
Capital adequacy	Capital adequacy rate	0,5	+
	Free capital / Total assets	0,5	+
Asset quality	Gross NPLs / gross loans	0,33	-
	Net NPL / equity	0,33	-
	Fixed assets / total assets	0,33	-
Profitability	Net profit / total assets	0,5	+
	Net profit / Equity	0,5	+
Liquidity	Liquid assets / total assets	0,4	+
	Assets with maturity up to 3 months / Liabilities with a maturity up to 3 months	0,6	+
Interest rate risk	(YTL assets with maturity up to 1 month - YTL liabilities with a maturity up to 1 month) / equity	0,5	-
	(Imovina u stranoj valuti s dopsijećem do 1 mjeseca / obveze u stranoj valuti s dospijećem do 1 mjeseca) / kapital	0,5	-
Foreign exchange rate risk	On-balance sheet fx position / own funds	0,5	-
	Fx net general position / own funds	0,5	-

Geršl and Hermanek (2006) have constructed an indicator of stability of the Czech banking sector by weighting the variables for calculating the total index on the basis of professional judgement.

Gersl and Hermanek (2006)	Banking stability index		
Measure	**Indicator**	**Weight**	**Direction of the imapct**
Capital adequacy	Capital adequacy (%)	0,05	+
Asset quality	Nonperforming loans / total loans (%)	0,25	-
Profitability	Return on assets (%)	0,25	+
	Return on equity (%)		
Liquidity	Quick assets / assets (%)	0,25	+
Interest rate risk	Cumulative net balance sheet position to 3 months / assets (%)	0,1	+
Foreign exchange risk	Absolute value of open total position in foreign exchange / Tier 1 capital (%)	0,1	-
	Absolute value of open balance sheet position in foreign exchange / Tier 1 capital (%)		

Albulescu (2010) has created an aggregate indicator of financial stability for Romania which is divided into subindices of financial development, financial vulnerability, financial soundness and global economic climate.

Albulescu (2010.)	Aggregate measures of financial stability		
Subindices	**Indicators**	**Weight**	**Weight**
Financial Development Index (FDI)	Market capitalisation / GDP	0,25	0,2
	Total credit in "lei" / GDP	0,25	
	Interest spread	0,25	
	Banking reform & interest rate liberalisation	0,25	
Financial Vulnerability Index (FVI)	Inflation rate	0,125	0,4
	General budget deficit (% GDP)	0,125	
	Current account deficit (% GDP)	0,125	
	REER excessive depreciation or appreciation	0,125	
	Non governmental credit / Total credit	0,125	
	Loans as a percentage of deposits	0,125	
	Deposits / M2 (variation %)	0,125	
	(Reserves / Deposits) / (Note & coins / M2)	0,125	
Financial Soundness Index (FSI)	Non-performing loans / Total loans	0,2	0,25
	Regulatory capital / Risk weighted assets	0,2	
	Own capital ratio (Own capital / Total assets)	0,2	
	Liquidity ratio (Effective liquidity / Required liquidity)	0,2	
	General risk ratio	0,2	
World Economic Climate Index (WECI)	Economic Climate Index - CESifo	0,33	0,15
	World Inflation	0,33	
	World Economic Growth Rate	0,33	

Cheang and Choy (2011) have created an aggregate index of financial stability for Macao using 19 individual indicators which they, after normalisation, grouped into three categories – financial soundness index, financial vulnerability index and index of regional economic climate. When aggregating each of the indices, variables were assigned equal weights, while, in calculating the total index of financial stability, the subindices were assigned weights in accordance with the assessed importance of each segment for the overall financial sector.

Cheang and Choy (2011)	Aggregate measures of financial stability			
Subindices	**Measures**	**Indicators**	**Weight**	**Weight**
Financial Soudness Index	**Capital adequacy**	Capital adequacy ratio	0,125	0,6
		Ratio of NPL net of provisions to capital	0,125	
	Asset quality	Ratio of NPL to total loans	0,125	
	Liquidity	Ratio of liquid assets to total assets	0,125	
		Loan-to-deposit ratio	0,125	
	Profitability	Return on assets	0,125	
		Interest margin-to-gross income ratio	0,125	
		Non-interest expenses-to-gross income ratio	0,125	
Financial Vulnerability Index	**External sector**	Current account balance-to-GDP ratio	0,11	0,4
		Ratio of M2 to foreign exchange reserves	0,11	
		Ratio of external assets to total assets	0,11	
		Ratio of foreign currency assets to foreign currency liabilities	0,11	
	Financial sector	M2 multiplier	0,11	
		Ratio of domestic credit to GDP	0,11	
	Real sector	Fiscal balance-to-GDP ratio	0,11	
		CPI inflation	0,11	
		GDP growth	0,11	
Regional Economic Climate Index		GDP growth of China	0,5	
		GDP growth of Hong Kong & Chinese Taiwan	0,5	

Petrovska and Mucheva (2013) have constructed two composite measures of financial stability – indicator of stability of the overall banking sector, which dominates the Macedonian financial system, and the financial conditions index. The first indicator comprises those quantitative indicators of banks' business operations that have been assessed as capable of having the greatest influence on the banking system stability. They are related to insolvency risk, credit risk, bank profitability, liquidity risk and currency risk, each group of indicators being assigned a weight in the total indicator based on professional judgement. The financial conditions index has been constructed by the method of principal component analysis by summing up the first five principal components, each of them weighted by its share in the total variability explained by it. The resulting index is then divided by the total variance explained. The influence of each variable on the total index is equal to the weighted sum of the loadings on each variable across the five principal components. Variables used to calculate the financial conditions index include the bank deleveraging process, capital adequacy ratio, market capitalisation of shares, real estate prices, real exchange rate, Macedonian stock exchange index, share of deposits in or indexed to foreign currency in total deposits, profitability of banks and the loans to deposits ratio, interest rates and FX interest spread.

Appendix 2

Table 4. Description and sources of data

Index	Indicators	Description	Expected influence on risk accumulation / risk materialisation / system resilience	Source
risk accumulation	Loans by interest rate variable within 1 year/ total loans	Fourth difference.	+	CNB.
	Loans indexed to foreign currency/total loans	Fourth difference.	+	CNB.
	Foreign currency deposits/total deposits	Fourth difference.	+	CNB.
	Indebtedness of corporates/GDP	Fourth difference.	+	CNB; CFSSA; DZS.
	Rate of change in corporate loans	Annual rate of change.	+	CNB.
	Indebtedness of households/GDP	Fourth difference.	+	CNB; CFSSA; DZS.
	Rate of change in household loans	Annual rate of change.	+	CNB.
	External debt/GDP	Fourth difference.	+	CNB; DZS.
	Public debt/GDP	Fourth difference.	+	MF; DZS.
	Current account balance/GDP	Fourth difference.	-	CNB; DZS.
	Hedonic real estate price index (HICN)	Annual rate of change.	+	CNB's calculations; author's calculations
	CROBEX stock exchange index	Annual rate of change.	+	ZSE; author's calculations.
risk materialisation	NPL to total loans ratio – corporates	Fourth difference.	+	CNB.
	NPL to total loans ratio – households	Fourth difference.	+	CNB.
	Household interest/income	Fourth difference.	+	CNB; DZS.
	ILO unemployment rate	Unemployment rate according to the International Labour Organization (ILO) methodology. Fourth difference.	+	Croatian Employment Service.
	Consumer price index	Annual rate of change.	+	CNB.
	Weighted exchange rate according to the structure of the assets of commercial banks	Fourth difference.	+	CNB; Bloomberg; author's calculations.
	Difference between interest rates on foreign currency deposits and foreign currency loans	Fourth difference.	+	CNB.
	CDS spread for the parent banks of the largest domestic banks	Shares of an inidividual bank in the assets of five banks were used as weights for the calculation of total risk premium for the observed banks	+	Bloomberg; author's calculations.
	Risk premium for Croatia – EMBI spread	Fourth difference.	+	J.P. Morgan.
system resilience	capital adequacy ratio	Ratio between own funds and total risk exposure weighted by credit risk and initial capital requirements for market risks and operational risk.	+	CNB.
	capital / assets	Share of capital of banks in total assets.	+	CNB.
	reserves of banks with CNB / assets of banks	Reserves of banks include deposits of commercial banks with the central bank.	+	CNB.
	international reserves / GDP	Gross international reserves.	+	CNB; DZS.
	return on assets of banks (ROA)	Net profit / total assets.	+	CNB.
	retail deposits / loans	Indicator of stable sources of funding.	+	CNB.
	coverage of foreign currency liabilities	Share of foreign currency claims in foreign currency liabilities and liabilities with currency clause.	+	CNB.
	liquid foreign assets / total assets	Liquid foreign assests include all foreign assets matuiring within one year.	+	CNB.

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EARLY WARNING MODELS FOR SYSTEMIC BANKING CRISES IN MONTENEGRO[1]

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Abstract

The purpose of this research is to create an adequate early warning model for systemic banking crises in Montenegro. The probability of banking crisis occurrence is calculated using discrete dependent variable models, more precisely, estimating logit regression. Afterwards, seven simple logit regressions that individually have two explanatory variables are estimated. Adequate weights have been assigned to all seven regressions using the technique of Bayesian model averaging. The advantage of this technique is that it takes into account the model uncertainty by considering various combinations of models in order to minimize the author's subjective judgment when determining reliable early warning indicators. The results of Bayesian model averaging largely coincide with the results of a previously estimated dynamic logit model. Indicators of credit expansion, thanks to their performances, have a dominant role in early warning models for systemic banking crises in Montenegro. The results have also shown that the Montenegrin banking system is significantly exposed to trends on the global level.

Key words: early warning systems, systemic banking crises, logit model, Bayesian model averaging, credit expansion, Montenegro

JEL Classification: G01; C25; C11

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1. Introduction

Considering high costs of resolving systemic banking crises and their significant negative effects on the economy and therefore on the standard of living, it is necessary to dedicate a lot of attention to research on how and why crises happen in order to try to predict them. Neither are the most developed economies spared of financial crises, including banking, currency and debt crises. The global economic crisis that has started as the US mortgage market crisis unequivocally shows that even developed economies do not pay enough attention to early warning models for systemic banking crises. Namely, these models, even when implemented, are not adequately used. Also, nowadays when there are very significant interdependencies between financial markets, consequences might hardly stay only within the borders of countries hit by the financial crisis. Unlike nowadays, during previous decades these models related mostly to currency crises since currency crises used to occur more often than banking crises.

Extensive empirical literature indicates that, in general, there are two approaches for designing early warning systems that are most commonly used. The first one is a signal approach (non-parametric) that studies and compares behavior of economic indicators for the period before and during the crisis. This approach developed by Kaminsky & Reinhart (1996), and Kaminsky, Lizondo & Reinhart (1998), is also known as the KLR method. The second approach (parametric) calculates the probability of banking crisis occurrence using discrete dependent variable models, estimating usually probit or logit regression (Demirgüç-Kunt & Detragiache, 1998; Eichengreen & Rose, 1998). Besides logit regression, the Bayesian model averaging technique is also applied in this paper. Bayesian model averaging (BMA) takes into account the model uncertainty by taking into consideration various combinations of models, and therefore it enables the author's subjective judgment to be minimized when determining reliable early warning indicators.

The basic motive for this research is a great importance that early warning models have, primarily for the stability of the banking system, as well as for the entire financial system of a country. There is no early warning model for banking crises in Montenegro. One of the main characteristics of the Montenegrin financial system is its relatively simple structure that is a common feature of many developing countries. Banks have a dominant role in the financial system; primarily in financing the private sector because it doesn't have enough own funds accumulated. The banking sector that consists of eleven banks and six microcredit financial institutions is based on the traditional banking. Development of the Montenegrin banking sector during the pre-crisis period is characterized with enormously high credit growth rates. Montenegro was one of European developing countries with the fastest economic growth. Therefore, in 2007 its economic growth reached the peak of 10.70%, while the lowest growth rate was -5.70% in 2009.

Economic slowdown and sudden stop of credit activity supported by the global economic crisis has led to much more deepening of the crisis in Montenegro. A significant problem is that some borrowers are not able to repay regularly loans approved mostly during the credit expansion. One of the reasons due to which the Montenegrin economy has found itself in a very unfavorable situation is the reduced intermediation function of Montenegrin banks. The banking crisis and later also the economic crisis have caused the deterioration of the fiscal position of Montenegro. One of the most significant consequences of the crisis is an intensive growth of sovereign debt. Namely, during 2010 and 2011, the emission of Euro bonds in the amount of EUR 380 million contributed largely to the growth of sovereign debt. In order to prevent a scenario like this to happen again, it is necessary to create and implement early warning models for systemic banking crises.

2. Methodology and availability of data

When compared with the signal approach, the advantage of the logit model is that it enables estimation of all variables simultaneously. However, unlike the signal approach, using this method it is not possible to rank indicators according to their relative prognostic power in predicting systemic banking crises. Ranking indicators according to their deviation from the normal behavior would be of a great help to monetary policy holders, because they could determine more easily what corrective measures would be necessary.

This shortcoming might be partially overcome using Bayesian model averaging. Namely, applying this technique it is possible to assign adequate weights to simple logit models with at most two explanatory variables. Although individual variables do not have weights, their relative importance can be approximately determined on the basis of weights assigned to the model that contains these variables.

Logit regression is used in this paper in the same manner as in the most papers dealing with early warning systems for banking crises. The observed time period is divided into two periods: the signal horizon where the dependent variable takes the value 1, and the period out of the signal horizon where the dependent variable takes the value 0. However, there is a difference between performances of the banking system and the overall economy in the period preceding the signal horizon and the period after the signal horizon, where the period after the signal horizon is considered to be the crisis period. Division in these two periods remains due to the still existing crisis in Montenegro, therefore there is probability that results will be biased to some extent.

Babecký et al. (2012) emphasize that there are at least two problems with simple regression when there are many potential explanatory variables. First, putting all potential variables in one regression might significantly increase standard errors if irrelevant variables are included. Second, the use of sequential testing in order to exclude unimportant variables might lead to misleading results taking into consideration the fact that there is a probability that a relevant variable is excluded every time when the test is done. In order to solve these problems, the technique of model averaging is usually applied (Babecký et al., 2012, p.19). Bayesian model averaging considers model uncertainty by taking into account combinations of models and assigning them weights in accordance with their performance. There are only two papers related to the model uncertainty in the literature dealing with early warning systems, and one of them is related to systemic banking crises. Article by Crespo-Cuaresma & Slacik (2009) studied currency crises in 27 developing countries, and Babecký et al. (2012) studied banking, debt and currency crises in 40 developed countries.

The main limitation of early warning models for systemic banking crises in this paper is the fact that models are created on the basis of only one systemic banking crisis that happened in Montenegro. However, all requisite information cannot be provided by studying only one case. Taking into consideration the fact that not all banking crises happen according to the same pattern and when making conclusions just on the basis of a small number of events, there is a high probability that conclusions will be biased. Also, it is necessary to emphasize that in situations when an adequate database of historic data is available, general conclusions are often made on relative importance of individual indicators.

Selection of potential indicators is based mostly on the economic reasoning that takes into account theoretical assumptions and indicators already used in previous researches. The choice of indicators also depends largely on the availability of data. Regarding the Montenegrin banking system, data on the monthly level are less available for the period until 2009, thus in terms of diversity it is more advisable to use quarterly data. However, concerning the data frequency, it is preferable to use monthly data because trends that indicate higher probability of crisis occurrence will be noticed earlier and necessary corrective measures will be undertaken in due time. Therefore, in this paper all indicators are used on the monthly basis starting from January 2005 to September 2012.

Variables in the paper which are not expressed as growth rates and interest rates, are expressed as natural logarithms. Applying the augmented Dickey-Fuller test for a unit root, it is determined that the most of time series are non-stationary. Therefore, non-stationary time series are differentiated, and by reapplying the ADF test after differencing time series it is determined that they are stationary. A few time series that are used in the paper have been differentiated two times in order to become stationary.

Although stationarizing implicitly brings the recent history of variables into the forecast, lagging of explanatory variables also allows varying amounts of recent history to be brought into the forecast. Therefore, lagging of explanatory variables enables predicting what will happen in the period t based on the knowledge of what happened up to the period t-1. A choice of the most adequate model is based upon the Information Criteria, what means that the model with the smallest value of the Schwarz Information Criterion (SIC) and the Akaike Information Criterion (AIC) is selected. Definitions of variables used in the paper are given in the following table.

Table 1: Definitions of variables used in the paper

Variable	Definition
ASSETS	Total assets at the aggregate level of the banking system
LOANS	Total gross loans at the aggregate level of the banking system
LLP	Total loan loss provisions at the aggregate level of the banking system
NET_LOANS	Total net loans at the aggregate level of the banking system, calculated as gross loans minus loan loss provisions
DEPOSITS	Total deposits at the aggregate level of the banking system
BORROWINGS	Borrowings from central banks, banks and other credit and financial institutions, and borrowings from the Government at the aggregate level of the banking system
CAPITAL	Total capital at the aggregate level of the banking system
LOANS_DEPOSITS	Loans-to-deposits coefficient at the aggregate level of the banking system
INT_INCOME	Total income from interest at the aggregate level of the banking system
RESERVE_REQ	Total amount of reserve requirements at the level of the banking system
MONEX20	Index value that consists of twenty the most liquid companies on the Montenegrin stock exchange
PRICES	Annual growth rate of consumer prices in Montenegro
PRICES_M	Monthly growth rate of consumer prices in Montenegro
EURIBOR_1M	1-month EURIBOR
EURIBOR_3M	3-month EURIBOR
INDPR_SERBIA	Index of industrial production in Serbia
EUR_USD	Exchange rate EUR to USD

3. Logit approach and Bayes model averaging

As Wooldridge (2002; p. 530-533) suggests, considering models of binary response, their interest lies primarily in the response probability:

$$P(y = 1|x) = P(y = 1|x_1, x_2, ..., xk)$$

where x denotes a set of explanatory variables.

In order to avoid limitations of the linear probability model, it is necessary to consider the class of binary response models which have the following form:

$$P(y = 1|x) = G(\beta_0 + \beta_1 x_1 + ... + \beta_k x_k) = G(\beta_0 + x\beta)$$

where G is a function that takes values strictly between 0 and 1, for all real numbers z. This enables that estimated probabilities are strictly between 0 and 1. The expression $x\beta$ denotes $\beta_1 x_1 + ... + \beta_k x_k$.

The following expression should be considered[2]:

$$Pi = E(Y = 1|X_i) = \frac{1}{1 + e^{-(\beta_1 + \beta_2 X_i)}}$$

which may be denoted in a simpler way:

$$Pi = \frac{1}{1 + e^{-Z_i}} = \frac{e^Z}{1 + e^Z}$$

2 See: Gujarati, 2004; p. 595-597.

as a cumulative logistic distribution function, where $Z_i=\beta_1+\beta_2 X_i$.

It is easy to verify that as Z_i ranges from -8 do +8, P_i ranges between 0 and 1, and that P_i is nonlinearly related to Z_i (i.e., X_i)[3]. P_i is nonlinear not only in X, but also in the parameters, what means that the standard OLS method can not be used for estimation of the logit model. However, this problem might be resolved in a relatively simple manner.

If P_i denotes the probability that crisis is going to occur, therefore $1\text{-}P_i$ denotes the probability that the crisis is not going to occur, presented like this:

$$1-P_i=\frac{1}{1+e^{Z_i}} \ .$$

The previous expression may also be denoted as:

$$\frac{P_i}{1-P_i}=\frac{1+e^{Z_i}}{1+e^{-Z_i}}=e^{Z_i} \ .$$

The expression $P_i/1\text{-}P_i$ represents the odds ratio in favor of crisis occurrence – the ratio of the probability that crisis will occur to the probability that crisis will not occur. Therefore, if for example P_i = 0,8, it means that odds are 4 to 1 in favor of crisis occurrence.

If we take the natural log of the previous expression, we obtain:

$$L_i=\ln\left(\frac{P_i}{1-P_i}\right)=Zi=\beta_1+\beta_2 X_i$$

where L, the log of the odds ratio, is not only linear in X, but also linear in the parameters[4]. L is called the logit model.

The criterion commonly used for determining the starting date of systemic banking crises is a share of nonperforming loans in total loans at the level of a bank ing system. Considering the threshold of a 10% share of nonperforming loans in total loans that is proposed by Demirgüç-Kunt & Detragiache (1998), the beginning of the systemic banking crisis in Montenegro should be June 2009 when this indicator reached 10.03%. However, few months earlier, deposits were withdrawn after a longer period of growth, and in the fourth quarter 2008 deposits decreased by -14.42% in comparison with the previous quarter. Furthermore, at the end of 2007, the Central Bank of Montenegro introduced a temporary measure of credit growth restriction since credit activity of banks has already become exaggerated. In accordance with the aforesaid, the author of this paper has determined October 2008 as the starting month of the crisis, when signs of crisis have already been shown in the form of deposit outflows. The signal horizon is defined 24 months prior to the crisis, what means that the dependent variable *y* takes the value 1 from November 2006 to October 2008. Estimation results of the dynamic logit model are presented in the following table.

3 *Gujarati* (2004, p. 595) notes that as Zi? +8, e- Zi tends to zero, and as Zi? -8, e-Zi increases indefinitely.

4 *Gujarati* (2004, p. 596) emphasizes that linearity assumption of OLS does not require that explanatory variables are linear, however linearity in the parameters is crucial.

Table 2: Estimation results of the dynamic logit model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-4.354124	1.189709	-3.659823	0.0003
LOANS	65.16109	20.44709	3.186815	0.0014
DEPOSITS	-45.13485	16.03267	-2.815181	0.0049
EURIBOR_1M	7.367738	2.893002	2.546745	0.0109
INDPR_SERBIA	-0.104783	0.050407	-2.078739	0.0376
LLP	31.47855	11.20501	2.809327	0.0050
EUR_USD	-23.04270	12.33094	-1.868689	0.0617
CAPITAL	26.51234	12.08045	2.194648	0.0282
LOANS_DEPOSITS_1	0.381331	0.167479	2.276891	0.0228
PRICES_3	1.180913	0.657362	1.796442	0.0724

McFadden R-squared	0.594652	Mean dependent var	0.269663
S.D. dependent var	0.446299	S.E. of regression	0.295038
Akaike info criterion	0.697293	Sum squared resid	6.876770
Schwarz criterion	0.976915	Log likelihood	-21.02953
Hannan-Quinn criter.	0.810000	Restr. log likelihood	-51.88017
LR statistic	61.70129	Avg. log likelihood	-0.236287
Prob(LR statistic)	0.000000		
Obs with Dep=0	65	Total obs	89
Obs with Dep=1	24		

Source: Author's calculations in EViews 6

Regarding nonlinear models, marginal effects give more information than coefficients. If only coefficients are taken into consideration, the size of change in probability of systemic banking crisis occurrence cannot be determined. Coefficients in the logit model show only the direction of change in probability, thus it shall be necessary to calculate marginal effects. Marginal effects of explanatory variables on dependent variable are presented in the following table.

Table 3: Marginal effects

Variable	**Marginal effects**
C	-0.206890
LOANS	3.096187
DEPOSITS	-2.144623
EURIBOR_1M	0.350085
INDPR_SERBIA	-0.004979
LLP	1.495731
EUR_USD	-1.094894
CAPITAL	1.259757
LOANS_DEPOSITS_1	0.018119
PRICES_3	0.056112

Source: Author's calculations in EViews 6

It is necessary to evaluate the predictive power of the estimated model. The cut-off value that separates the pre-crisis period from the normal period has been set at 0.5. The model has correctly predicted 88.76% observations. Furthermore, the model has precisely predicted the crisis in 79.17% cases (i.e. months), and the normal period in 92.31% cases. The model has proved to be unsuccessful in 11.24% cases. Prediction ability of the estimated logit model is presented in the following table.

Table 4: Prediction ability of the estimated logit model

	Estimated Equation			Constant Probability		
	Dep=0	Dep=1	Total	Dep=0	Dep=1	Total
P(Dep=1)<=C	60	5	65	65	24	89
P(Dep=1)>C	5	19	24	0	0	0
Total	65	24	**89**	65	24	89
Correct	**60**	**19**	**79**	65	0	65
% Correct	92.31	79.17	88.76	100.00	0.00	73.03
% Incorrect	7.69	20.83	11.24	0.00	100.00	26.97
Total Gain*	-7.69	79.17	15.73			
Percent Gain**	NA	79.17	58.33			
	Estimated Equation			Constant Probability		
	Dep=0	Dep=1	Total	Dep=0	Dep=1	Total
E(# of Dep=0)	58.26	6.74	65.00	47.47	17.53	65.00
E(# of Dep=1)	6.74	17.26	24.00	17.53	6.47	24.00
Total	65.00	24.00	89.00	65.00	24.00	89.00
Correct	58.26	17.26	75.52	47.47	6.47	53.94
% Correct	89.63	71.91	84.85	73.03	26.97	60.61
% Incorrect	10.37	28.09	15.15	26.97	73.03	39.39
Total Gain*	16.59	44.94	24.24			
Percent Gain**	61.53	61.53	61.53			

**Change in "% Correct" from default (constant probability) specification **Percent of incorrect (default) prediction corrected by equation*
Source: Author's calculations in EViews 6

Results of the Hosmer-Lemeshow test and the Andrews test are presented in the following table. A high value of the Andrews goodness-of- fit test and a low level of the Hosmer-Lemeshow test are desirable. Considering the Hosmer-Lemeshow test, if the associated p-value is significant ($p<0.05$), it might be an indication that the model doesn't fit the data. Since the H-L goodness-of- fit test statistic is much greater than 0.05, the null hypothesis that there is no difference between the observed and model-predicted values of the dependent variable is not rejected, implying that the model's estimates fit the data at an acceptable level.

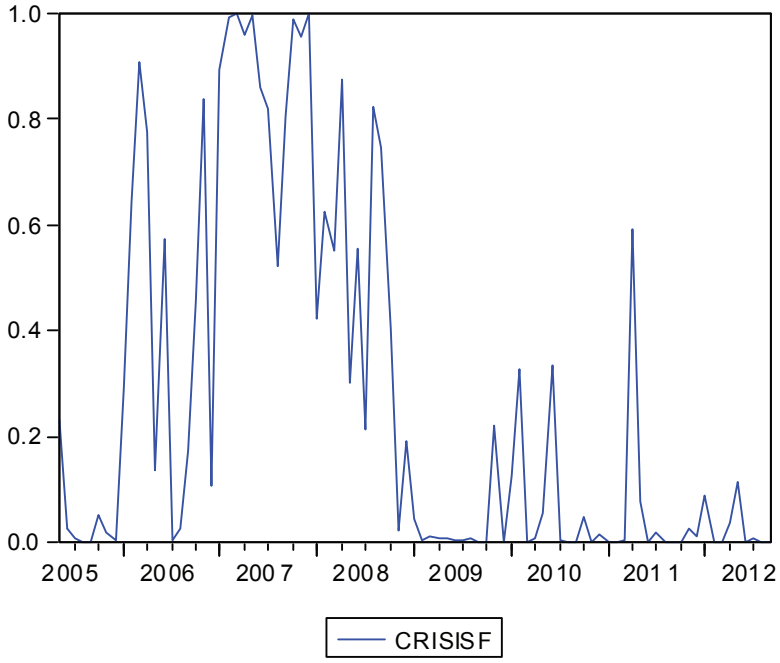
Table 5: Results of the Hosmer-Lemeshow test and the Andrews test

	Quantile of Risk		Dep=0		Dep=1		Total	H-L
	Low	High	Actual	Expect	Actual	Expect	Obs	Value
1	8.E-07	0.0002	8	7.99958	0	0.00042	8	0.00042
2	0.0004	0.0013	9	8.99276	0	0.00724	9	0.00725
3	0.0014	0.0043	9	8.97551	0	0.02449	9	0.02456
4	0.0049	0.0106	9	8.93227	0	0.06773	9	0.06824
5	0.0160	0.0423	9	8.77340	0	0.22660	9	0.23245
6	0.0479	0.1375	8	8.19409	1	0.80591	9	0.05134
7	0.1727	0.3344	7	6.71711	2	2.28289	9	0.04697
8	0.4049	0.6251	3	4.29662	6	4.70338	9	0.74874
9	0.6448	0.8755	2	1.80876	7	7.19124	9	0.02531
10	0.8926	0.9997	1	0.30990	8	8.69010	9	1.59156
		Total	65	65.0000	24	24.0000	89	2.79683
H-L Statistic			2.7968		Prob. Chi-Sq(8)		0.9465	
Andrews Statistic			42.1494		Prob. Chi-Sq(10)		0.0000	

Source: Author's calculations in EViews 6

The next graph represents the forecasted probability of systemic banking crisis calculated from the dyna mic logit model. The model sends signals within the signal horizon that is defined 24 months preceding the crisis – from November 2006 to October 2008. As it can be concluded from the graph, the highest probability of systemic banking crisis is during the first year of the signal horizon. This suggests that the model sends warning signals in the early stage, namely a year before the beginning of the crisis.

Graph 1: The forecasted probability of systemic banking crisis



Source: Author's calculations in EViews 6

In order to check the robustness of obtained results, Bayesian model averaging is also applied. As Babecký et al. (2012, p. 19-20) suggest, the following linear regression model should be considered:

$$y = a_y + X_y ß_y + e \qquad e \sim (0, d^2 I)$$

where y is a dummy variable denoting crisis, a_y is a constant, $ß_y$ is a vector of coefficients, and e is a white noise error term. X_y represents a subset of all available relevant explanatory variables, i.e. potential early warning indicators X. The number K of potential explanatory variables yields 2^K potential models. Mark $?$ is used to refer to one specific model from 2^K models. The information contained in models is then averaged using the *posterior* model probabilities that are considered under the Bayes' theorem:

$$p(M_?|y, X) \propto p(y|M_?, X)\, p(M_?)$$

where $p(M_?|y, X)$ represents *posterior* model probability, which is proportional to the marginal likelihood of the model $p(y|M_?, X)$ times the prior probability of the model $p(M_?)$.

The essence of Bayesian model averaging is assigning weights to estimated models in order to determine which models have the best performance. For this purpose it is necessary to calculate the Schwarz Information Criterion as one of the most commonly used information criteria in order to determine which specification is more appropriate for the data nature. This criterion is known as the Bayes Information Criterion which is actually approximation of the Bayes Factor. A higher value of weight is given to the model with a smaller value of SIC, thus the model that has a smaller value of SIC is considered to be a more favorable specification.

As already mentioned, using logit regression it is not possible to rank indicators according to their relative prognostic power when predicting systemic banking crises. This disadvantage can be partially overcome using Bayesian model averaging, because it is possible, by applying this technique, to assign adequate weights to simple logit models with at most two explanatory variables. Although individual variables do not have weights, their relative importance can be approximately determined on the basis of weights assigned to the model that contains these variables. Estimation results of implementation of the Bayesian model averaging technique are presented in the following table.

Table 6: Estimation results of implementation of the Bayesian model averaging technique

Model	Variable	Coefficient	Statistic significance	Weight (0-1)
	ASSETS	106.23	0.0001	
Model 1	DEPOSITS	-69.62	0.0010	0.14370
	CAPITAL	13.42	0.0153	
Model 2	BORROWINGS	19.33	0.0003	0.13973
	LOANS	50.23	0.0000	
Model 3	RESERVE_REQ	-11.66	0.0205	0.15971
	EURIBOR_1M	5.35	0.0043	
Model 4	LLP	16.08	0.0024	0.13106
	LOANS_DEPOSITS	37.15	0.0010	
Model 5	INT_INCOME	7.60	0.0226	0.13266
	EURIBOR_3M	6.06	0.0138	
Model 6	PRICES_M	1.44	0.0113	0.12907
	MONEX20	-9.46	0.0011	
Model 7	NET_LOANS	47.32	0.0000	0.16408

Source: Author's calculations in EViews 6

On the basis of weights assigned to individual models that are calculated using SIC, it may be concluded that estimated models have very similar performances. The best performance is that of the model with explanatory variables Monex20 which represents one of two indices on the Montenegrin stock exchange and net loans with weight 0.16408. The model with the lowest performances is one that contains variables - 3-month Euribor and monthly growth rate of consumer prices with weight 0.12907. Marginal effects of explanatory variables are presented in the following table.

Table 7: Marginal effects

Variable	Marginal effects
ASSETS	16.28
DEPOSITS	-10.67
CAPITAL	2.22
BORROWINGS	3.19
LOANS	7.46
RESERVE_REQ	-1.73
EURIBOR_1M	0.80
LLP	2.41
LOANS_DEPOSITS	5.87
INT_INCOME	1.20
EURIBOR_3M	0.98
PRICES_M	0.23
MONEX20	-1.25
NET_LOANS	6.24

Source: Author's calculations in EViews 6

Application of the Bayesian model averaging technique represents an important part of the analysis. Namely, this technique enables estimation of more variables that can be relevant indicators of systemic banking crises, than it would be possible by using only a regular logit model. Putting a higher number of variables in one single regression may cause problems, such as multicolinearity. As can be seen, the dynamic model has captured eight variables, while using the Bayesian model averaging technique 14 variables are included where six of them are the same as in the dynamic logit model. Instead of estimating only a set of simple logit regressions, Bayesian model averaging gives an insight into relative importance of some variables in comparison with other variables. Therefore, it is possible to determine which indicators are more reliable for prediction of systemic banking crises.

4. Interpretation and discussion

McFadden R^2 indicates a relatively good goodness-of- fit of the estimated model. Results of the estimated dynamic logit model suggest that loans have the highest marginal effect on the dependent variable. Therefore, if this indicator increases by 1%, the estimated probability of occurrence of the systemic banking crisis will increase by 3.10, holding constant the remaining variables. If the value of variable LLP that represents loan loss provisions increases by 1%, the probability of systemic banking crisis will increase by 1.50. Also, if the loans-to-deposits coefficient increases by 1%, the probability of systemic banking crisis will go up by 0.02. On the other hand, if deposits increase by 1%, the probability of systemic banking crisis will decrease by 2.14. If capital increases by 1%, the probability of systemic banking crisis will increase by 1.26.

Considering macroeconomic variables, it can be concluded that if 1- month Euribor increases by 1%, the probability of systemic banking crisis will go up by 0.35. Similarly, if EUR/USD exchange

rate increases by 1%, the estimated probability of occurrence of systemic banking crisis will decrease by 1.09. Montenegro is a euroised economy, and one of the main advantages of fixed exchange rate regimes is that they enable achieving the macroeconomic stability thanks to a solid nominal anchor. However, it is necessary to emphasize that fixed exchange rates do not a priori provide macroeconomic stability. The main deficiency of fixed exchange rates is that they reduce flexibility of monetary policy. The reason for considering EUR/USD exchange rate as an early warning indicator is that Montenegro is a small and open euroised economy, so the trend of this variable might have a significant impact on the domestic economy. Concerning inflation, if the annual growth rate of consumer prices in Montenegro increases by 1%, the probability of systemic banking crisis will increase by 0.06.

One of the most important variables that are related to international indicators is economic growth of the country tha t represents the main trading partner of the domestic country. According to available data starting from 2005, the largest portion of Montenegro's trading exchange, taking into account both export and import, has been realized with Serbia, therefore the most significant trading partner of Montenegro is Serbia. If the index of industrial production in Serbia increases by 1%, the probability of systemic banking crisis occurrence will decrease by 0.005. It can be concluded that it is a variable with the lowest marginal effect in this model.

Seven simple logit regressions that individually have two explanatory variables are estimated, and thus there are 14 statistically significant indicators, while in the previous dynamic logit regression there are 9 indicators. Adequate weights have been assigned to all seven regressions using the technique of Bayesian model averaging. These results largely coincide with results of the previously estimated logit model.

If indicator that represents total assets in the banking system increases by 1%, the probability of systemic banking crisis occurrence will increase by 16.28, holding constant the remaining variables. Similarly, if loans increase by 1%, the probability of systemic banking crisis occurrence will go up by 7.46, and if net loans increase by 1%, the probability of systemic banking crisis occurrence will increase by 6.24. If loan loss provisions increase by 1%, the probability of systemic banking crisis occurrence will go up by 2.41. That can be explained by the fact that banks approved more risky loans during credit expansion, therefore, relatively shortly after that, they had to allocate a larger amount of loan loss provisions.

If deposits increase by 1%, the probability of systemic banking crisis occurrence will decrease by 10.67. Also, if the loans-to-deposits coefficient increases by 1%, the estimated probability that the systemic banking crisis will occur increases by 5.87. If capital increases by 1%, the probability of systemic banking crisis occurrence will go up by 2.22. Also, if borrowings which banks mostly take from their parent bank increase by 1%, the probability of systemic banking crisis occurrence will increase by 3.19.

Variable reserve requirements represent one of very few monetary instruments which the Central Bank of Montenegro has at its disposal, since Montenegro is a euroized economy. Actually, it is more appropriate to say that it is a liquidity instrument. If this variable increases by 1%, the probability of systemic banking crisis occurrence will decrease by 1.73. If 1- month Euribor increases by 1%, the estimated probability that systemic banking crisis will occur increases by 0.80, and with the increase of 3- month Euribor by 1%, the probability of systemic banking crisis occurrence will increase by 0.98.

If interest income increases by 1%, the probability of systemic banking crisis occurrence will go up by 1.20. Also, if the monthly growth rate of consumer prices in Montenegro increases by 1%, the probability of systemic banking crisis occurrence will increase by 0.23. Finally, if variable Monex20 increases by 1%, the probability of systemic banking crisis occurrence will decrease by 1.25.

Indicators relating to a credit boom thanks to very good performances, have a dominant role in early warning models for systemic banking crises. The accelerated economic growth influenced the banks to initiate the exaggerated lending activity that led to credit expansion with three-digit yearly credit growth rates, and that in turn even additionally encouraged overheating of the economy. Funds taken as borrowings from parent banks during the credit expansion were mostly used for the lending activity. It was just a question of time when it would come to the bursting of the bubble that reached enormous proportions especially on the housing market. Besides developments in the domestic banking

sector and in the overall economy, the crisis occurrence is also accelerated by negative global trends influenced by the global economic crisis.

It is interesting that some indicators related to macroeconomic developments in the region and in the European Union, have also shown very good performances. These are 1- month Euribor and 3-month Euribor, EUR/USD exchange rate and the index of industrial production in Serbia. Therefore, it can be concluded that the Montenegrin economy and the banking system are exposed significantly to the trends on the global level. Developments on international markets have a significant impact on the domestic banking system and its stability, and therefore on the probability of systemic banking crisis occurrence.

5. Concluding remarks

Although many economists, especially critics of economics as science, consider that these models have proved to be unsuccessful because they failed to predict occurrence of the present global crisis, the economic policy can not be conducted today in an appropriate and efficient manner without reliable quantitative information. However, it is necessary to take into account qualitative estimates made by economic experts. The use of early warning models for systemic banking crises have to be adequately integrated within broader analyses that take into consideration all important aspects, as it is inevitable that some of these aspects will be overlooked by one of these models. These models can have an important complementary role as an objective measure of the banking system vulnerability.

Regarding developing countries, it should be taken into account that they usually go through the catching- up phase in order to reach developed economies, and therefore they have higher economic growth rates. Economic growth during that phase is relying largely on the lending activity and it is sometimes difficult to differentiate between the credit expansion and the increased credit activity.

Results of the estimated models have shown that the systemic banking crisis in Montenegro has its roots in the domestic economy. Causes of crises originate from the period of unsustainable credit expansion. A very low level of credit activity during the period before the beginning of the credit expansion has encouraged banks to race for a market share. Also, results have shown that although roots of crisis are in the domestic economy, there is a significant impact of international trends on the Montenegrin banking system and overall economy.

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ASYMMETRIC BEHAVIOUR OF INFLATION AROUND THE TARGET IN INFLATION-TARGETING EMERGING MARKETS

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Abstract

We explore the asymmetric behaviour of inflation around the target level for inflation-targeting emerging markets. The first rationale behind this asymmetry is the asymmetric policy response of the central bank around the target. Central banks could have a stronger bias towards overshooting rather than undershooting the inflation target. Consequently, the policy response would be stronger once the inflation jumps above the target, compared to a negative deviation. Second rationale is the asymmetric inflation persistence. We suggest that recently developed Asymmetric Exponential Smooth Transition Autoregressive (AESTAR) model provides a convenient framework to capture the asymmetric behaviour of inflation driven by these two effects. We further conduct an out-of-sample forecasting exercise and show that the predictive power of AESTAR model for inflation is high, especially at long-horizons.

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I. Introduction

The last two decades revealed adoption of inflation-targeting (IT) regime by central banks of numerous developed countries and emerging markets. The forward-looking nature of the IT regime calls for a rich information set of robust indicators and reliable inflation forecasts for policymakers. Accordingly, many inflation-targeting central banks aim to improve their forecasting ability through employing alternative approaches including econometric models as well as expert judgements[2]. This paper contributes to this literature by showing that the recently developed Asymmetric Exponential Smooth Transition Autoregressive (AESTAR) model (Sollis, 2009) can capture the asymmetric behaviour of inflation against deviations from a pre-determined target level in an IT framework. Conducting an empirical analysis covering fourteen inflation-targeting emerging markets, we further show that the performance of this model for predicting inflation is high, especially at long-horizons.

The asymmetric behaviour of inflation captured by AESTAR model is explicated by two rationales affecting the adjustment towards policy target. First one is the asymmetric response of the policymaker against upwards or downwards deviations of inflation from a pre-determined target level (or band) in an IT framework. Second one is the asymmetry in the persistence of shocks to the inflation process. We argue that the cross-country differences among the degree of asymmetry and adjustment process in our set of inflation-targeting countries could be explained by the relative strength of these two drives. This introductory section provides further motivation for these two different types of asymmetries. The second section introduces the econometric methodology built on these premises and presents a brief literature review.

The first motivation above; the asymmetric monetary policy response against departures from policy target, is based on two conjectures, as follows. First, as Orphanides and Wieland (2000) argue, many inflation-targeting central banks aim to keep inflation within a target range rather than focusing on a point target. Consequently, the policy response function of the central bank shows a nonlinear behaviour depending on inflation being inside or outside of a specific zone:

"As a consequence, if the policymaker assigns at least some weight to output stabilization, the output objective will dominate at times when inflation is within the zone but will recede in importance when inflation is outside the zone." (Orphanides and Wieland, 2000).

According to this view when the deviation in inflation from the target level is *above or below* a certain threshold, then central bank takes necessary actions to take the inflation back to the target level. As will be detailed in the second section, Exponential Smooth Transition Autoregressive (ESTAR) model provides a suitable framework for modelling this kind of a response structure.

Our second conjecture is that, in addition to this kind of threshold behaviour, there is a further asymmetry in monetary policy response of central banks against deviations of inflation from a pre-defined target level. Policymakers in inflation-targeting emerging markets are more *biased* against *upwards* jumps in inflation rather than downward movements. As the argument goes, undershooting the inflation target does not affect the credibility of the inflation-targeting central bank as much as overshooting. Moreover, the tendency of central bank to focus on other objectives than inflation could be stronger when inflation rate stays below the target level. Accordingly, the monetary policy response would be more immediate and strong in case of a positive deviation from the target level rather than its negative equivalent, provided that the deviation is above a certain threshold[3].

The second motivation behind the asymmetric behaviour in inflation is a possible asymmetry in the persistence of shocks to the inflation process. Positive deviations of inflation from a target level could be larger and more persistent compared to downward movements. As a matter of fact, in a more general perspective, one might argue that inflation is more persistent at high levels compared to low

2 See Andersson and Löf (2007) for Riksbank, Kapetanios et al. (2008) for Bank of England, Bjørnland et al. (2008) for Norges Bank and Ogunc et al. (2013) for Central Bank of Turkey.

3 Obviously, one would argue that a negative deviation should also raise concerns for deflation spiral for a central bank. However, the historically high inflation rates in many emerging markets led to a perception in public mind that inflation would not go down as easily as it goes up.

levels.[4] This might be a result of gradual adjustment of inflation expectations to the central bank's target due to imperfect credibility of the monetary authority, which increases the cost of disinflation (Erceg and Levin, 2003). Under such a scenario, the central bank should be more aggressive than otherwise to bring back the inflation to its target level. This paper suggests that the recently proposed AESTAR model provides a convenient framework to capture the asymmetric inflation behaviour which includes these two effects.

The approach pursued in this study is connected with two recently developing strands of literature. First, non-linear models are frequently employed to analyse the mean-reverting behaviour of different macroeconomic variables recently. Moreover, these models have also been valuable in inflation forecasting practices. Second, our conjecture above is in line with the recent literature that points out a departure from the well-known linear-quadratic approach that assumes a quadratic loss function and a corresponding linear policy rule for central banks. We summarize these two avenues of literature in the next section by a focus on the treatment of loss-function of central banks on the theoretical side and a focus on self-exciting threshold models on the empirical side.

The third section follows the steps of nonlinear model building as described in Teräsvirta (2005). At first, linearity tests are conducted along with the unit root and structural break tests. Linearity testing is an important pre-requisite of building smooth transition models since these models nests a linear regression model which would be unidentified in case of a linear data generating process. Accordingly, we conduct ESTAR and AESTAR unit root tests among fourteen inflation-targeting emerging markets in our sample. After detecting non-linearities in inflation series for six of these countries, we estimate an AESTAR model and report the set of parameters that determine the degree of asymmetry and the speed of adjustment.

In the fourth section, we conduct an out-of-sample forecasting exercise for these six countries where we show that the predictive power of AESTAR model is much better than that of a benchmark random walk model, especially at long-horizons. This result corroborates with some recent studies in the literature which points out high performance of nonlinear models in forecasting macroeconomic variables in the long-run. Fifth and the last section will conclude. We believe that our results would be useful for researchers and in particular central bankers in search of accurate inflation forecasts.

II. Literature Review and Econometric Methodology

Nonlinear models are widely adopted in the recent literature in order to capture the asymmetric behaviour of several macroeconomic variables. A broad classification of these models can be based on the presumed regime-switching behaviour of the series. Markov-switching models contain transition probabilities described by a Markov-chain process under the assumption that the regime change is determined by an unobservable variable. Alternatively, threshold models assume that the shift from one regime to another is determined by an observable variable. In particular, self-exciting threshold models assume that the regime switching behaviour is determined by the past values of the time series under consideration.

Recent non-linear modelling literature reveals prevalence of self-exciting threshold models such as Threshold Autoregressive (TAR) or Smooth Transition Autoregressive (STAR) models. Among these two types, TAR models assume an immediate transition to a long-run level, once the series crosses a certain threshold (Tong, 1990). Alternatively, STAR type models suggest a gradual or smooth adjustment to the mean (Granger and Teräsvirta, 1993).

4 The evidence on the effect of adoption of an inflation targeting regime on persistence of inflation is somewhat mixed. Levin, Natalucci, and Piger (2004) documents lower persistence of inflation after implentation of IT regimes for a number of industrial countri es. Siklos (2008) shows that only four out of thirteen emerging market inflation targeters displayed a decilne in inflation persistence after adoption of IT regime. Gerlach and Tillmann (2012) also confirms the relationship for some Asian countries that implements IT.

A popular extension of STAR models is the ESTAR model (Kapetanios et al., 2003), which assumes a *symmetric* and gradual adjustment. This approach provides us a convenient framework to capture the inflation behaviour in an IT regime. As the argument goes, policymakers respond to deviations in inflation from the target level, only if these deviations are beyond a certain threshold.

This aforementioned nonlinear response of monetary policy points out a departure from the traditional linear-quadratic approach that describes the behaviour of central banks with inflation and output objectives. This well-established line of literature assumes a quadratic loss function for central bank with a linear aggregate supply constraint which in turn leads to a linear monetary policy rule (Svensson, 1997, and Clarida et al.,1999). This view is questioned by many studies in the recent literature[5]. For example, Orphanides and Wieland (2000) argue that many inflation-targeting central banks aim to keep inflation within a target range rather than focusing on a point target[6]. They point out *nonlinearity in the policy response function* which is determined by the inflation being inside or outside a specific zone. ESTAR model provides an appropriate representation of this view. Once the inflation is *above* or *below* the inflation target to a certain extent, then the central bank would respond and the inflation would come back to the target level in a *gradual* manner. Kapetanios et al. (2008) apply this model as a part of their inflation forecasting exercise for Bank of England (BOE) and documents good forecasting performance of ESTAR model for UK inflation[7,8].

The formal model in Kapetanios et.al (2003) can be written as:

$$\Delta\pi_t = a_1\pi_{t-1} + a_2\pi_{t-1}\left[1-\exp(-\theta(\pi_{t-d}-\lambda)^2)\right]+\varepsilon_t \quad (1)$$

The transition function inside the brackets includes the coefficient of the speed of adjustment, θ which determines the smoothness of the transition between the regimes. Similar to Kapetanios et.al (2003) we impose a mean-zero stochastic process, setting $\lambda = 0$ and further choose $a_1 = 0$ assuming that the series display unit root behaviour when it is close to its long-run value, yet shows mean-reverting behaviour when it is far away from it. Selecting the delay parameter as $d = 1$, we obtain:

$$\Delta\pi_t = a_2\pi_{t-1}\left[1-\exp(-\theta\pi^2{}_{t-1})\right]+\varepsilon_t \quad (2)$$

As argued in Teräsvirta (2005) the first step in nonlinear model building is linearity testing. In equation (2) above the null hypothesis is $H_0 : \theta = 0$ against the alternative $H_1 : \theta > 0$. However, a common problem in these type of models is that the parameter (a_2) is unidentified under the null. To address this problem, Kapetanios et.al (2003) suggest an auxiliary regression, using a first order Taylor series approximation. The general model including serially correlated errors then reads:

$$\Delta\pi_t = \sum_{j=1}^{p} p_j\Delta\pi_{t-j} + \gamma\pi_{t-1}{}^3 + error \quad (3)$$

The asymptotic critical values for the t-statistics by employing the OLS estimation of γ ($\hat{\gamma}$) are given in Kapetanios et.al (2003).

A recent extension ESTAR type of modelling is proposed by Sollis (2009) as the AESTAR model. The adjustment is gradual again but this time, an *asymmetric* response is allowed for the policymaker. As explained in the introductory section of our paper, the policy response of the central bank could be stronger and more immediate against overshooting the target rather than undershooting, provided that the deviation from the inflation target is above a certain threshold.

This aforementioned view also follows the same lines with the literature that confronts the linear-quadratic paradigm. Martin and Milas (2004) examine the UK monetary policy after the adoption

5 For a review of this literature see Dolado (2004).

6 Also, see Orphanides and Wilcox (2002) and Aksoy et al. (2006) for a discussion of the opportunistic approach to disinflation.

7 The policy mandate of Bank of England (BOE) is keeping inflation at 2 %. ESTAR model assume that if the deviation in inflati on from this target level is high enough (in either way) then BOE conduct policies to bring inflation back to the %2 target level.

8 Lundberg and Teräsvirta (2006) also develops smooth transition autoregressive model to examine the target zone behavior of exchange rates for Sweden and Norway.

of inflation targeting in 1992. Using a quadratic logistic function they assign different weights to regimes which define different Taylor-like policy rules. The width of the band, inside which inflation can deviate from the target level, is different in both regimes. Using nonlinear policy rules they show that BOE aimed to contain inflation within a target zone rather than a point target during these years, as suggested by Orphanides and Wieland (2000) above. Their results further support our central hypothesis. They argue that monetary policy response by BOE in this period is asymmetric in the sense that the policy response is stronger against positive deviations from the target rather than negative deviations.

Ruge-Murcia (2003) develops a game-theoretic model where central bank is allowed to assign different weights to deviations in their loss function, depending on the deviations being above or below the target. His empirical analysis also provides supporting evidence for such asymmetric preferences for Canada, Sweden and UK. Dolado et al. (2004) also reports evidence for asymmetric inflation preferences for US FED after 1983.

To capture such asymmetric policy response we demonstrate AESTAR model below. Sollis (2009) extend the Kapetanios et al. (2003) model in a way to allow for asymmetric nonlinear adjustment:

$$\Delta\pi_t = G(\theta_1, \pi_{t-1})\left[S(\theta_2, \pi_{t-1})a_1 + \{1 - S(\theta_2, \pi_{t-1})\}a_2\right]\pi_{t-1} + \varepsilon_t \tag{4}$$

Where

$$G(\theta_1, \pi_{t-d}) = 1 - \exp(-\theta_1 \pi^2_{t-1}), \quad \theta_1 > 0 \tag{5}$$

$$S(\theta_2, \pi_{t-d}) = \left[1 + \exp(-\theta_2 \pi_{t-1})\right]^{-1}, \quad \theta_2 > 0 \tag{6}$$

In equation 4, assuming without loss of generality $\theta_1 > 0$ and $\theta_2 \rightarrow \infty$, if π_{t-1} moves from 0 to $-\infty$ then $S(\theta_2, \pi_{t-d}) \rightarrow 0$ and ESTAR transition occurs between the central regime model $\Delta\pi_t = \varepsilon_t$ and the outer regime model $\Delta\pi_t = a_2\pi_{t-1} + \varepsilon_t$ where speed of transition is determined by θ_1. Similarly, if π_{t-1} moves from 0 to ∞ then $S(\theta_2, \pi_{t-d}) \rightarrow 1$ and ESTAR transition occurs between the central regime model $\Delta\pi_t = \varepsilon_t$ and the outer regime model $\Delta\pi_t = a_1\pi_{t-1} + \varepsilon_t$ where speed of transition is determined by θ_1. Asymmetric response is maintained by account for serially correlated errors as: $a_1 \neq a_2$. The model is generalized to*k*

$$\Delta\pi_t = G(\theta_1, \pi_{t-1})\left[S(\theta_2, \pi_{t-1})a_1 + \{1 - S(\theta_2, \pi_{t-1})\}a_2\right]\pi_{t-1} + \sum_{i=1}^{k} \kappa_i \Delta\pi_{t-i} + \varepsilon_t \tag{7}$$

Once the unitroot testing is concerned, the same identification problem with the ESTAR case is present. To overcome this problem in a similar fashion to Kapetanios et al. (2003), Sollis (2009) recommends a two-step Taylor series expansions; first around θ_1 and then around θ_2 where the resulting model is:

$$\Delta\pi_t = \phi_1(\pi_{t-1})^3 + \phi_2(\pi_{t-1})^4 + \sum_{i=1}^{k} \kappa_i \Delta\pi_{t-i} + \mu_t \tag{8}$$

with $\phi_1 = a_2^*\theta_1$ and $\phi_2 = c(a_2^* - a_1^*)\theta_1\theta_2$ where c=0.25, a_1^* and a_2^* are functions of a_1 and a_2 as described in Sollis (2009). The null hypothesis is:

$$H_0: \phi_1 = \phi_2 = 0$$

in the auxiliary model in equation (8). The standard critical values cannot be used to test for the unit root. Accordingly, Sollis (2009) derives asymptotic distribution of an F-test and tabulate critical values for zero mean non-zero mean and deterministic trend cases.

III. Data, Preliminary Diagnostics and Estimation

Our empirical investigation includes linearity tests, unit root tests, structural break tests, AESTAR estimations and an out-of sample forecasting exercise over a monthly data set consisting of consumer price indices of fourteen inflation-targeting emerging markets including Brazil, Chile, Colombia, Czech Republic, Hungary, India, Mexico, Peru, Philippines, Poland, Romania, South Africa, Thailand and Turkey[9]. All series start at January 1995 and end at March 2013 with 219 data points each (with exceptions of Indonesia and Chile series starting at December 1996 and January 1999 respectively).

Table 1 presents the countries in our sample and transition year of each country to the IT regime. While the table denotes a single year for the official adoption of the IT regime, the transition to a full-fledged IT regime was not immediate for most of the emerging markets. Instead, many countries have gradually developed their implementation capacity over years[10]. During this period, many of these countries conducted an implicit IT regime by either announcing an informal target or a band which operates as an anchor to lower uncertainty and influence expectations. This is one of the reasons behind our choice of a common starting point for all countries in our sample as January 1995, instead of differentiating the data coverage for each individual country. We will provide further motivation for this choice of ours in the second subsection of this section while we discuss the impact of structural breaks.

Table 1
Inflation-Targeting Emerging Markets and Year of Adoption of IT Regime

Country	IT Adoption
Brazil	1999
Chile	1999
Colombia	1999
Czech Republic	1997
Hungary	2001
Indonesia	2005
Mexico	2001
Peru	2002
Philippines	2002
Poland	1998
Romania	2005
South Africa	2000
Thailand	2000
Turkey	2006

Source: Mukherjee and Bhattacharya (2011).

Figure 1 depicts the annual inflation rate for all countries. A first look at these graphs suggests the presence of multiple structural breaks in these series. Accordingly, we conduct and report the results of structural break tests in the next section and further motivate our methodology. The following subsection presents the linear and nonlinear unit root test results. The last subsection provides a discussion of the AESTAR estimation results before we proceed to the out-of-sample exercise in the next section.

9 Data source is Bloomberg.

10 A recent IMF study, Ltaifa (2012), documents that this transition phase was around 2 to 5 years for most of the countries that adopted IT regime.

III. a. Structural break test

Rapach and Wohar (2005) reports evidence of multiple structural breaks in the mean inflation rate for 13 industrial countries, using Bai and Perron (2003, hereafter BP) methodology. We conduct a similar analysis for inflation-targeting emerging markets. The first two columns of Table 2 are double maximum test statistics with null hypothesis of no structural break against an unknown number of breaks as described in BP. The following five columns, F(i/0) with i=5, tests are for no breaks versus a fixed number of breaks[11,12].

Figure 1
CPI Inflation
(*y-o-y*)

11 Trimming value is selected as 0.15 as suggested by BP.
12 We also applied F(l+i/i) tests for l breaks versus l+1 breaks as proposed by BP. The results are insignificant, hence we did not report them here. However, these results are available upon request.

Table 2
Test for Multiple Structural Breaks (Bai-Perron, 2003)

	Udmax	Wdmax	F(1/0)	F(2/0)	F(3/0)	F(4/0)	F(5/0)	Break Dates
Brazil	3.63	9.06	0.46	0.81	0.08	2.39	3.63 *	
Chile	63.81 ***	159.72 ***	1.08	14.22 ***	2.15	5.77 **	63.81 ***	Jan-97, Feb-99, Dec-01, Jan-04, Feb-07
Colombia	4.07	8.08	0.60	0.77	1.07	4.07	0.79	
Czech Republic	57.21 ***	143.21 ***	0.67	3.67	16.08 ***	4.67 *	57.21 ***	Aug-97, Dec-00, Jan-05, Sep-08, Jul-10
Hungary	3.94	9.85	0.00	1.60	1.38	2.67	3.94 *	
Indonesia	12.59 ***	31.51 ***	0.25	2.22	4.53	7.13 ***	12.59 ***	May-97,Jan-00, Oct-03, Mar-06, Aug-08
Mexico	2.24	5.60	0.73	0.16	0.61	1.37	2.24	
Peru	7.20	18.01 ***	1.61	0.78	1.54	2.14	7.20 ***	Aug-97, Apr-00, Jan-04, Sep-08, Jul-10
Philippines	21.31 ***	53.35 ***	0.54	0.73	0.86	2.44	21.31 ***	Jan-98, Oct-00, Nov-04, Sep-08, Jul-10
Poland	18.96 ***	47.45 ***	0.23	2.12	1.24	3.48	18.96 ***	Aug-97, Apr-00, Mar-04, Nov-07, Jul-10
Romania	10.45 **	26.16 ***	2.56	1.63	2.92	1.79	10.45 ***	Feb-99, Oct-01, Jun-04, Aug-08, Jul-10
South Africa	5.11	12.78	0.11	0.40	2.00	4.87 *	5.11 ***	
Thailand	34.06 ***	85.27 ***	1.42	0.55	1.13	7.96 ***	34.06 ***	Aug-97, Mar-98, Mar-05, Oct-08, Jul-10
Turkey	17.63 ***	44.12 ***	1.19	4.99	5.59 *	8.51 ***	17.63 ***	Feb-99, Oct-01, Sep-04, Oct-07, Jul-10

*Notes: *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.*

Double maximum test statistics suggest the presence of multiple structural breaks for 9 countries out of fourteen. Both UDmax and WDmax statistics are significant at 1 per cent for Chile, Czech Republic, India, Philippines, Poland, Romania, Thailand and Turkey whereas for Peru only WDmax statistics is significant at 1 per cent. F(5/0) test is also significant at 1 per cent level, for these countries. Once the presence of breaks is established, BP suggests the use of BIC criteria in order to determine the number of break points. Hence, while other F(i/0) statistics are also significant for some cases, we consider BIC criteria which suggest five breaks for these nine countries.

The last column of Table 2 documents the break dates suggested by the test. For most of the countries, worsening global economic conditions following 1997 Asian crisis, 2008 global crisis and 2010 Eurozone crisis seem to cause a break in inflation[13].

The impact of structural breaks in our analysis could be observed on two different stages: linearity tests and estimation. Regarding the first issue, Carrasco (2002) shows that tests with a threshold alternative have more power against parameter instability that stems from structural change. However, when the data generating process has a nonlinear character, the power of structural change tests is low. Hence, it is suggested to use threshold type linearity tests to detect the presence of a shift. To put it another way, tests including threshold model, as we will present in the next section, identify parameter instability in time series regardless of its nature.

The second issue is the effect of structural change on estimation and ultimately on the robustness of forecasts. Structural break might induce a bias on forecasts in the sense that forecasts are derived from the most recent observations instead of an average one. However, Teräsvirta (2005) argues that while estimation with post-break specifications might lead to an unbiased forecasts, the variance might be greater compared to the model including pre-break data with lower mean square errors. This bias-variance trade-off is further detailed in Pesaran and Timmermann (2002).

Table 2 suggests that latest global crisis in 2008 caused a structural shift for many countries in our sample. Hence, using post-break series would sharply reduce our data coverage which would significantly increase the variance. Accordingly, we opt to start all series from January 1995. Obviously, forecasters that would use these models in future should compare the performance of estimations with post-break series, once more data points are available.

13 In addition to these common break dates, a change in monetary policy could lead to a shift for individual countries, most probably with some lags.

III. b. Linear and Non-linear Unit Root tests

The stationarity of inflation is clearly a methodologically essential issue for robustness of the predictive models in use. Indeed, employing linear unit root tests, literature suggests that many price indices have an integration of order one. Furthermore as Gregoriou and Kontonikas (2006) argues, a typical IT implementation suggests that, not only the inflation level but also deviations of inflation from a pre-specified target level could be stationary as discussed in the previous section. As the argument goes, central banks react to deviations from the inflation target which would lead to the inflation to stabilize around the target level in the long-run. This view could be tested by the help of nonlinear unit root tests.

Table 3 presents linear unit root tests for all series. We employ two Augmented Dickey Fuller (ADF) type tests, namely ADF and ERS tests; Phillips-Perron test and Perron (1997) test that accounts for possible structural breaks. Almost all series display an integration of order one character. Since both ESTAR and AESTAR estimations of the next subsection make use of self-exciting threshold variables, this I(1) result ensures the stationarity of threshold variables in those estimations.

Table 3
Linear Unit Root Tests

	ADF	PP	ERS	P		
				bi	bt	bb
Brazil	1.15	1.50	1489.27	-2.79	-3.04	-3.81
d(Brazil)	-6.25 ***	-6.27 ***	0.47 ***	-7.52 ***	-6.85 ***	-7.56 ***
Chile	-0.11	-0.07	291.08			
d(Chile)	-4.46 ***	-9.57 ***	-0.84 ***			
Colombia	-2.36	-4.12 ***	4520.20	-2.36	-2.66	-2.77
d(Colombia)	-1.96	-5.46 ***	34.23	-9.17 ***	-8.80 ***	-9.36 ***
Czech Republic	-1.45	-2.16	605.84	-3.32	-2.70	-2.79
c(Czech)	-2.78 *	-12.97 ***	5.94	-14.19 ***	-13.40 ***	-14.22 ***
Hungary	-1.18	-1.63	3891.17	-3.97	-3.39	-4.25
d(Hungary)	-3.24 **	-11.18 ***	2.98 **	-8.92 ***	-8.90 ***	-8.17 ***
Indonesia	-0.23	-0.56	921.40	-4.35	-3.93	-4.59
d(Indonesia)	-10.83 ***	-11.02 ***	1.67 ***	-6.48 ***	-5.54 ***	-7.49 ***
Mexico	-0.59	-4.38 ***	2000.65	-4.51	-4.08	-5.15
d(Mexico)	-2.78 *	-6.98 ***	29.85	-8.36 ***	-8.41 ***	-8.41 ***
Peru	-1.86	-2.17	1428.63	-4.33	-3.07	-3.51
d(Peru)	-9.28 ***	-9.23 ***	0.66 ***	-7.58 ***	-7.48 ***	-7.69 ***
Philippines	0.47	0.48	2427.13	-4.18	-2.62	-3.84
d(Philliphines)	-11.91	-11.89 ***	0.25 ***	-12.58 ***	-12.03 ***	-12.53 ***
Poland	-1.52	-3.82	776.45	-3.97	-3.17	-3.36
d(Poland)	-1.90	-9.40 ***	56.37	-7.51 ***	-7.21 ***	-7.83 ***
Romania	-0.50	-0.31	3036.26	-3.90	-3.44	-3.97
d(Romania)	-9.72 ***	-10.10 ***	0.55 ***	-10.92 ***	-11.41 ***	-11.69 ***
S. Africa	2.95	2.77	2104.52	-2.27	-2.65	-3.56
d(S. Africa)	-9.79 ***	-10.35 ***	0.64 ***	-10.94 ***	-10.64 ***	-10.94 ***
Thailand	-0.54	-0.51	430.91	-3.94	-3.44	-3.78
d(Thailand)	-10.20 ***	-10.27 ***	0.26 ***	-11.51 ***	-10.42 ***	-11.34 ***
Turkey	1.41	1.79	1347.00	-4.58	-2.70	-4.48
d(Turkey)	-9.64 ***	-9.78 ***	0.43 ***	-6.06 ***	-5.74 ***	-7.18 ***

*Notes: *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Difference variables are denoted by d(.). ADF, PP, ERS and denotes Augmented-Dickey-Fuller, Elliot-Rothenberg-Stock, Phillips-Perron and Perron (1997) test statistics respectively. Bi, bt and bb stand for break at intercept, break at trend and break at both trend and intercept options for Perron (1997) test.*

Table 4 presents ESTAR and AESTAR joint tests of unit root and nonlinearity as described in previous section. None of the inflation series display ESTAR type nonlinearity. However, AESTAR test results report asymmetric behaviour for Brazil, Colombia, Indonesia, Mexico, Peru and Poland. Accordingly, we exclude eight countries with insignificant test results from our forecasting exercise with AESTAR model that we present in the next section and continue with these six countries. The reason behind our exclusion is that, as argued by Teräsvirta (2005), fitting a nonlinear model to a linear time series would generate inconsistent parameter estimates that would lower the robustness of forecasts.

Table 4
Nonlinear Unit Root Tests

	testar	Faestar	
Brazil	2.22	4.91	*
Chile	-1.06	0.99	
Colombia	-2.16	4.46	*
Czech Republic	-1.39	1.91	
Hungary	-1.36	0.92	
Indonesia	-2.00	11.38	***
Mexico	0.33	5.58	*
Peru	-0.95	10.08	***
Philippines	0.02	0.39	
Poland	-1.48	4.18	*
Romania	-0.90	2.97	
South Africa	1.29	3.18	
Thailand	-0.70	0.39	
Turkey	0.38	3.62	

*Notes: *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively. testar and Faestar denote t-statistics for ESTAR test and F-statistics for AESTAR test, respectively. The critical values are -3.48, -2.93, -2.66 for ESTAR and 6.806, 4.971, 4.173 for AESTAR, for 1%, 5%, and 10% levels respectively. Lags chosen by AIC.*

III. c. Model Estimation

Figure 2 illustrates monthly inflation series that are employed in our estimations. As expected, all monthly inflation series seem to have a strong seasonal component. Hence, estimations contain seasonal dummies.[14] We do not impose a time-trend in our analysis[15].

After rejecting the linearity hypothesis for six countries in the previous section, the AESTAR model is estimated in its raw form in Equation 4 with restrictions θ_1 ,θ_2 >0 and a_1 , a_2 <0. Table 5 documents the set of $\{\theta_1,\theta_2,a_1,a_2\}$ values for each country. The figures in parenthesis are standard errors[16].

As discussed in the previous section and described in more detail in Sollis (2009), asymmetry requires $a_1 \neq a_2$. Otherwise, the system would be closer to an ESTAR model then an AESTAR one. In the model, the degree of asymmetry and speed of transition are determined by the difference (a_1-a_2)

14 An alternative way to overcome seasonality problem would be using seasonally adjustment filters at pre-estimation stage. In practice, many researchers employ popular computer programs such as Tramo-Seats or X-12 for seasonal adjustment. However, once the estimations are carried with seasonal adjusted series, the forecasted series would be seasonally adjusted as well. Since, these programs use non-linear filters at the first place, it would be hard to extract the unadjusted forecast figure. In a similar spirit, we opt out using year-on-year series.

15 Both ESTAR and AESTAR unit root tests are designed to allow for a time trend in the series. However, in our case, theory would not suggest any trend in inflation series. Hence, we did not use a time-trend in linearity tests or estimations.

16 For some parameters, the estimation returns the smallest value to comply with the restrictions. For these cases, standard errors are very close to zero.

and the coefficient θ_1, respectively. Consequently, in addition to the AESTAR test, we also conduct a Wald test with the null hypothesis $H_0=a_1-a_2=_0$. The results of this test in the last column indicate that inflation in Colombia reveal a relatively more asymmetric behaviour around the attractor, compared to the rest of the group. Furthermore, for a given value of (a_1-a_2) difference, the magnitude of θ_2 gives an idea of the degree of asymmetry. Accordingly, for Colombia, Indonesia, Peru and Poland a relatively higher θ_2 value indicates a relatively more asymmetric behaviour around the attractor, compared to the rest of the group.

The sign of the (a_1-a_2) difference is also of interest for our analysis. For example, for Brazil, when the inflation is below its attractor, the combined function:

$$G\left(0.01,\pi^{*}_{t-1}\right)\left[S\left(0.12,\pi^{*}_{t-1}\right)(-0.04)+\left\{1-S\left(0.12,\pi^{*}_{t-1}\right)\right\}(-0.01)\right]\pi^{*}_{t-1}$$

changes between -0.01 and 0. However, when the inflation is above its attractor, the function changes between -0.04 and 0. Consequently, for countries with a negative (a1-a2) difference (Brazil, Indonesia, Mexico and Poland), the mean-reverting behaviour is stronger once the inflation is *above* the mean, relative to the adjustment in case of a negative deviation. As discussed in the introductory section, this could indicate that the impact of the central bank's response offsets the persistence effect . As the argument goes, once the inflation is *above* the mean, central bank takes on a more aggressive policy response towards inflation. Even though there might be a certain degree of inflation persistence, this would be outweighed by the strong policy response of the central bank, hence the adjustment towards the target level is relatively *sharp*. However, once the inflation is *below* the mean, the adjustment towards mean takes more time compared to the previous case. This might be due to a relatively weaker response of the central bank which could still dominate the persistence effect, but in a more *gradual* manner.

The opposite is the case for Colombia and Peru. This time the adjustment towards mean is stronger once the inflation is *below* its attractor compared to the adjustment once the inflation is above its attractor. This suggest that once the inflation is *above* the mean, inflation is so persistent that even though there might be a strong response by the central bank, adjustment takes a longer than the similar case in previous paragraph. When the inflation is *below* the mean, the adjustment is sharp due to strong persistence and a relatively weaker policy reaction. It is important to underline that these results do not provide a comparison between the countries in these two groups, in terms of the strength of their policy response or the degree of inflation-persistence. Instead, our results suggest a comparison of *relative* strength of these competing drives above or below the attractor.

Lastly, as indicated in Sollis (2009) a higher coefficient θ_1 indicates a higher speed of transition. Accordingly, a final look at Table 5 highlights that for Peru and Poland the mean-reverting behaviour is relatively faster compared to the rest of the group.

Figure 2

Monthly CPI Inflation

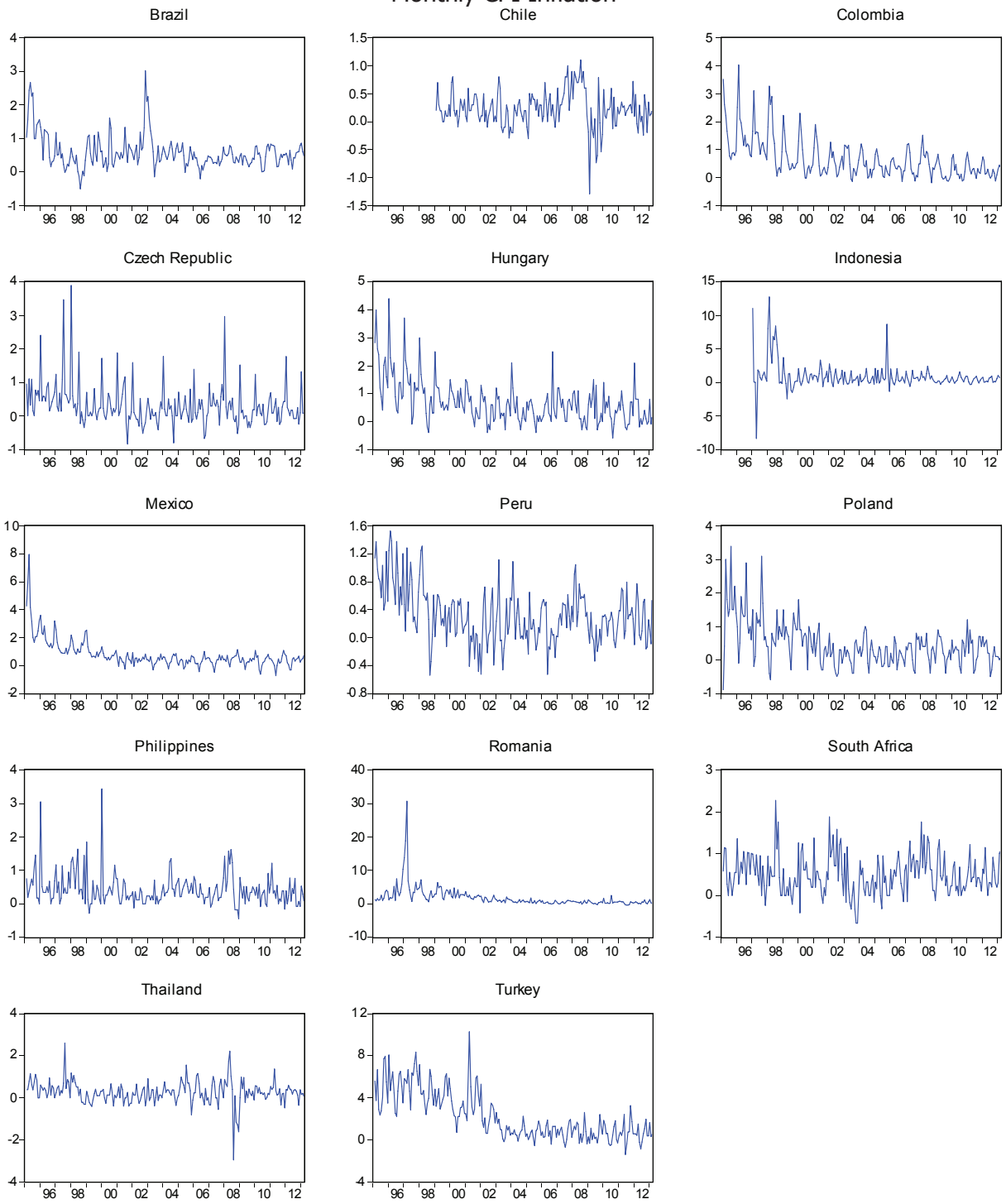

Table 5
AESTAR Model Estimation

	θ_1	θ_2	a_1	a_2	a1 - a2	$W_{a1 - a2}$
Brazil	0.01	0.12	-0.04	-0.01	-0.03	0.21
	(0.00)	(0.26)	(0.02)	(0.00)		
Colombia	0.01	0.18	-0.01	-0.10	0.09	3.73 *
	(0.03)	(0.17)	(0.01)	(0.34)		
Indonesia	0.01	0.24	-0.02	-0.01	-0.01	0.00
	(0.01)	(0.44)	(0.00)	(0.00)		
Mexico	0.01	0.04	-0.07	-0.01	-0.06	1.45
	(0.00)	(0.02)	(0.01)	(0.04)		
Peru	0.04	0.27	-0.01	-0.13	0.12	1.60
	(0.31)	(1.11)	(0.05)	(1.21)		
Poland	0.11	0.19	-0.02	-0.01	-0.01	0.03
	(0.65)	(1.74)	(0.01)	(0.16)		

*Notes: Figures in parenthesis are standard errors. W_{a1-a2} stands for the Wald test statistics of the test with null hypothesis $H_0=_{a1-a2}=0$. *, ** and *** indicate significance at the 10%, 5%, and 1% levels, respectively.*

IV. Out-of-Sample Forecasting Analysis

Central banks make use of alternative econometric models as well as expert judgements for forecasting inflation[17]. Throughout these analyses, out-of-sample forecasting exercises are frequently employed in order to compare the predictive power of alternative models. A good in-sample forecasting performance of a model does not necessarily indicate a good performance during an actual forecasting practice. Hence, we conduct an out-of-sample forecasting exercise to assess the forecasting performance of our AESTAR model for six inflation-targeting emerging markets in our sample.

We divide our sample period (1995M1:2013M3) into two parts: the training sample (1995M1:2011M9) and the forecasting sample (2011M10: 2013M3). As a first step, we derive forecasts from the estimation using the training sample and derive 1,3,6,9 and 12 months ahead forecasts. Then, we extend the estimation period one period at a time and report the forecasts at each step again. This exercise is repeated until the end of pseudo out-of-sample period. Then, the result of this rolling out-of-sample exercise is compared with that of a naïve random walk model by means of relative root mean square errors (RRMSE) for each forecast horizon.

The results of out-of-sample forecasting exercise are reported in Table 6. In the table, columns represent alternative forecast horizons. The forecasting power of AESTAR model is better than that of a random walk benchmark in all countries for all horizons with exceptionof Indonesia for six months ahead. We also conducted Diebold-Mariano (1995) test which provides a comparison of the forecast accuracy of alternative models. For each country, we strongly reject the null hypothesis of equal forecast accuracy of random walk and AESTAR models[18].

17 Forecasts from these different models and judgements usually complement each other in the course of generating a single-best forecast. Usually, the final forecasts that are reported are produced as a combination of the forecasts from different models including expert judgements. For details of the forecast combination technique see Timmermann (2006).

18 The test is only conducted for the longest series of the forecasting sample (2011M10: 2013M3) due to the finite sample problem. In all tests, p-values are almost zero and are not reported due to space considerations. The results are availabile upon request.

Table 6
RRMSE's of the Out-of-Sample Exercise

	h=1	h=3	h=6	h=9	h=12
Brazil	0.99	0.94	0.93	0.18	0.22
Colombia	0.88	0.74	0.49	0.21	0.18
Indonesia	0.96	0.84	1.08	0.45	0.35
Mexico	0.99	0.81	0.69	0.59	0.52
Peru	0.90	0.62	0.53	0.27	0.21
Poland	0.94	0.62	0.38	0.25	0.20
average	**0.94**	**0.76**	**0.68**	**0.32**	**0.28**

Note: h denotes the forecast horizon. Diebold-Mariano test is conducted for the longest series of the forecasting sample (2011M10-2013M3).

On average, RRMSE of all countries goes down with the forecast horizon as indicated in the last row. For 9 and 12 months ahead forecasts, RRMSE figures go down to 0.32 and 0.28 respectively. This indicates that the predictive performance of AESTAR model is especially better at long-horizons. This result corroborates with some previous studies in the literature. For example, Kilian and Taylor (2003) suggests that the predictive power of ESTAR model for exchange rate determination relative to that of a random walk is higher in longer-horizons. Similarly, Altavilla and De Grauwe (2010) compares the forecasting power of alternative models for exchange rate determination and conclude that the nonlinear models are superior relative to the linear ones in longer- horizons, particularly when the deviations from long-run mean is large. That being said, there is still no consensus on the predictive performance of nonlinear models with respect to the linear ones and the issue still deserves more empirical inquiry as emphasized in Teräsvirta (2006)[19].

V. Conclusion

This paper explores the asymmetric behaviour of inflation around a pre-determined target level in inflation targeting emerging markets around two motivations. First one is the supposition that central banks might assign more weight to other objectives if the inflation is under control, yet fight with inflation aggressively if inflation is above the target level, provided that the deviation is above a certain threshold. Second one is asymmetric inflation persistence. It is suggested that the recently proposed AESTAR framework helps us to model the asymmetric behaviour of inflation. Following the steps of nonlinear model building, i.e. linearity testing, model specification, estimation; and further conducting an out-of-sample forecasting exercise we show that the predictive power of AESTAR model is high for inflation, especially at longer-horizons. We believe that our results would be beneficial for researchers and in particular central bankers in search of accurate inflation forecasts.

19 Terasvirta et.al (2005) also provides a comparison of the forecasting accuracy of alternative models including nonlinear specifications and reports mixed evidence.

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THE EFFECT OF CURRENCY BOARD ARRANGEMENTS ON INFLATION PERFORMANCE IN EUROPEAN TRANSITION COUNTRIES[1]

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Abstract

The aim of this paper is to empirically investigate whether the European countries which adopted a currency board arrangement (hereafter CBA) in the early stage of transition had better inflation performances than countries with other monetary-exchange rate regimes. The sample consists of panel data, which includes 25 transition countries in period 1998-2009. Unlike the previous empirical studies which treated a CBA only as a type of an exchange rate regime, in this analysis a CBA is treated as a monetary framework (which defines a monetary rule, the level of central bank independence and exchange rate regime), and its effect on inflation is compared to the effect of other monetary frameworks. Inflation regression is estimated by using both static and dynamic estimator. Since period observed does not include years before a CBA introduction in all European transition countries the CBA variable is time-invariant. Therefore, in order to estimate its effect on inflation by controlling for the country specifics the recently introduced fixed effect vector decomposition (FEVD) estimator is applied. However, since the discussion about the consistency of the FEVD estimator is still on-going and since it is likely that there is the "inflation inertia" in the transition countries, a dynamic estimator is also applied. Both approaches imply that countries with a CBA have lower inflation than countries with other monetary frameworks. Additionally, after dividing countries into those with stronger (more rigid) and weaker (more flexible) CBAs the results imply that countries with more rigid CBA had lower inflation than the other group. These results suggest that there is a continuous need for a strict rules imposed by a CBA in the countries that operate under the CBA and that it continues to contribute these countries with respect to inflation in the current period.

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1. Introduction

A CBA is usually defined as an arrangement under which a country fixes its nominal exchange rate to some foreign currency and maintains 100 percent backing of its monetary base with foreign exchange. Adoption of a CBA therefore limits the monetary authority discretion which is likely to result in an increase of the credibility of announced policies and greater confidence that the target(s) of the monetary authority will be achieved. Maintenance of a low inflation is usually pointed out as one of the major advantages of CBA. The theoretical rationale for expecting the countries with a CBA to have lower inflation than countries with other monetary-exchange rate regimes is given in Section 2. The previous studies which investigated the effect of a CBA on inflation performance are critically evaluated also in Section 2. A CBA is usually introduced in countries which need to achieve macroeconomic stability and credibility and which are in the process of transition to market economy and/or have desire to further integrate with a country to which they are pegging their currencies. Currently this regime is in use in few European transition countries (Bosnia and Herzegovina, Bulgaria, Lithuania, and Estonia until its EMU accession in 2011). In Section 3 the main characteristics of the sample are shortly presented.

The effect of CBA on inflation performance is examined by comparing it with other monetary frameworks in European transition countries by using a panel data. Unlike the previous studies which compare CBA only with other exchange rate regimes this paper treats CBA as a monetary framework, which defines a monetary rule, the level of central bank independence and exchange rate regime, and compare it with other monetary frameworks (this issue is elaborated in details in Section 4.1). In the following sections the model is specified and estimated by using both static and dynamic estimator. Finally, the results are compared and elaborated in the concluding section.

2. Theoretical rationale and critical analysis of the empirical evidence

The prediction of orthodox economic theory is that countries with a fixed exchange rate regime will have a better inflation performance than countries with a flexible exchange rate regime since pegs are likely to lower inflationary expectations ("confidence effect") and the rate of money growth ("discipline effect"). This is confirmed by empirical research in many studies (e.g. Levy- Yeyati and Sturzengger, 2001; De Grauwe and Schnable, 2004; Domac et al., 2004), although the size of the effect differs depending on the level of development of the countries observed and exchange rate regime (hereafter ERR) classification used. As a type of a pegged ERR (usually classified as a "hard" peg) CBAs are expected to reduce inflation even more than other pegged ERRs, due to the greater increase in credibility of the monetary authority (Wolf et al., 2008). Namely, in the world of free capital movements the other fixed exchange rate regimes can alter the exchange rate parity, while the institutional arrangements of CBA do not allow a central bank to alter the exchange rate or money supply. Moreover, the abolition of a CBA is more difficult than the abolition of other pegged ERRs and there is no time-inconsistency problem in the CBA countries. Consequently, the inflation rate is expected to be lower and more stable in the CBA countries than in countries with other pegged ERRs.

There are a lot of studies estimating the effects of different ERRs on inflation, some of which include a CBA, together with dollarization (and in some cases a conventional pegged arrangement) as a type of a "hard" peg (De Grauwe and Schnabl, 2004; Bleaney and

Francisco, 2007; Ghosh et al., 2011). However, there are only few studies which focus exclusively on a CBA and its effect on inflation. Those studies which focus on a CBA estimate its effect by comparing different countries with different ERRs ("comparison" approach) or by observing one country during the periods before and during the CBA ("experimental" approach). The "comparison" approach allows comparison of inflation performance between countries with a CBA and countries with other types of fixed ERRs and flexible ERRs, after controlling for other factors. The potential limitation of this approach might emerge when the sample is large and relatively few observations are related to countries with a CBA, which is a case for most of the studies which estimate the effect of CBA on inflation performance. On the other hand, the "experimental" approach allows comparison of inflation performance within the

country prior and after the introduction of CBA which might be beneficial since there are fewer factors which should be controlled for. Moreover, this approach might be more reliable for policymakers since it is focused only on the country of interest. However, this approach requires data for a long time period.

Moreover, Kwan and Lui (1999, p.407) argued that "sufficiently rich data variation is necessary for statistical purposes" since "if the economic conditions of the two periods had remained perfectly stable, the data would hardly contain enough information for inferring the macroeconomic performance of the two systems". Since our focus is on transition countries, for which there is not enough data for the estimation of latter approach, the former method will be used and studies which use this approach discussed in more detail. Among the few studies which estimate the effect of CBA on macroeconomic performance the most cited ones, which use the "comparison" approach, are Glosh et al. (1998) Anasstasova (1999), Ghosh et al. (2000) and Wolf et al. (2008) (presented in Table 1 and text below).

Table 1. Summary of the empirical research of the currency board effect on inflation

Study	Data and sample	The effect of CBA on inflation compared to other regimes†	Control variables	Technique	Endogeneity	Robustness checking
Ghosh et al. (1998)	1970-1996, all IMF members	- **	money supply; openness; GDP growth, central bank governor turnover	OLS	Addressed through the simultaneous equation model	No
Anastassova (1999)	1984-1997, 22 countries	- ***	money growth, openness	Panel data analysis (static)	Not addressed	No
Ghosh et al. (2000)	1975-1996, all IMF members	-***	the growth rate of money and output, openness, and annual dummies	Panel data analysis (static)	Addressed through the simultaneous equation model	No
Wolf et al. (2008)	1972-2002, 99 countries	-***	money supply growth, GDP growth, openness, central bank governor turnover, terms of trade, fiscal balance	Panel data analysis (static)	Addressed	Yes - results robust

*Note: ***, **, * donates that variables are statistically significant at the 1%, 5% and 10%, respectively*

† Different studies have different comparison group(s)

In the empirical studies which estimate the effect of CBA on macroeconomic performance using the "comparison" approach the effect of CBA on inflation, growth and other macroeconomic variables is captured by inclusion of a dummy variable in an appropriate equation. *Anastassova (1999)* who argues that a currency board is "the fastest and most miraculous remedy for curing the economic discrepancies" (p.6) uses panel data analysis of 22 countries for the period 1984-1997 and estimates the effect of CBA on inflation, GDP growth per capita and nominal and real interest rates. Anastassova (1999) divides the sample into three groups: the first consists of CBA countries, the second of countries with a similar-to-CBA regime and the third of countries with pegged ERR or crawling band. Beside addressing the possible difference in the effect of CBA and other pegged ERRs on macroeconomic indicators Anastassova also addresses the effect of "strong" and "weak" CBA on macroeconomic indicators, since the institutional arrangements of CBAs adopted in 1990s differ significantly among themselves. The equations for inflation includes a dummy for CBA, dummy for the regime similar to CBA, variables for money growth and openness. According to the results the CBA countries have lower inflation than other pegged ERRs countries (and countries with regimes similar to CBA). When CBA dummy is split between "strong" and "weak" CBAs the results indicate that "adopting strict institutional arrangements will have much stronger impact on the main economic variables" (p.19). However, there are some limitations in the analysis presented in this paper. First, it is not clear what the comparison group for the "strong" and "weak" CBA dummies is (all other countries from the sample, countries with regime similar to CBA or other pegged ERRs). Moreover, a control for some other variables in the inflation regression is suggested in the literature, such as central bank independence, GDP growth and global inflation shocks

(Ghosh et al, 1998). A further important limitation is that potential endogeneity of the regime choice is not controlled for, since according to Ghosh et al. (1998, p.3) "countries with a greater proclivity towards low inflation may be more likely to adopt a currency board". Moreover, the observed period after the adoption of CBA is quite short (being only a year for some countries, such as Bulgaria). Bosnia and Herzegovina is not included in the sample, due to unavailability of data (as the analysis was done in 1999). Finally, diagnostic tests of the empirical analysis are not reported.

Ghosh et al. (1998) include dummy variable in the inflation equations which indicates the effect of CBA on inflation compared to other pegged ERR from their sample. Although their sample consists of countries with floating ERR as well, they do not compare the effect of CBA with the floating ERR on inflation; they only use those countries in the descriptive statistics. Their sample consists of all IMF member countries for period 1970-1996 which gives 2,386 observations, of which 1,691 countries are related to the pegged ER observations and 115 represent CBAs. Beside money supply growth, openness and a dummy variable for CBA the GDP growth and a measure of central bank's independence are included in the inflation regression as controls. Additionally, annual dummies are added to control for global inflation shocks. Since it is usually argued that countries which are prone to low inflation are more likely to adopt a CBA, Ghosh et al. treated the resulting potential endogeneity issue by estimating a probit maximum likelihood model using the fitted values as instruments. Their results suggest that the average inflation rate under a CBA is about 4 percentage point lower than inflation rate in other pegged exchange rate countries. However, there are few limitations emphasised by the authors. Firstly, they argue that "it is difficult to determine whether the observed differences in performance between existing currency board arrangements and other pegged exchange rate regimes result from the regime itself or from some peculiarity specific to the countries since many of the currency board countries in the sample are small, island economies, subject to specific shocks, and with particular economic structures which makes their experience perhaps less relevant to other countries" (p. 18). We may argue that these country' specifics could have been controlled by including the country's fixed effects. Secondly, since CBAs are usually argued to adjust slowly to shocks the authors argue that "currency board arrangements may appear better for economic growth than they really are" if the sample, as in this study, does not include periods of economic disruptions (Ghosh et al., 1998, p. 18). Indeed, their sample contains a relatively small number of CBA countries and only a short period after the introduction of most CBAs. Hence, a more satisfactory sample would include a period such as the recent financial crisis and a longer period under a CBA. Finally, these authors do not report diagnostic tests either. A similar group of authors (*Ghosh et al., 2000*) additionally conducted a similar analysis, extended for the robustness check, in which the fiscal balance, nominal exchange rate variability, institutional and quality index are included in the inflation regression. These additional controls did not alter the negative relationship and significance of CBA's effect on inflation. Again, a short period observed after the CBA introduction puts constraints on "fuller assessment, especially of the [unspecified] downsize risks" (p. 294). Diagnostic tests are not reported again.

Wolf et al. (2008) conduct analysis similar, but more comprehensive, to these conducted by Ghosh et al. (2000). Their inflation equation includes a 'central bank's governor turnover' variable which is a proxy for central bank's independence, terms of trade shocks and fiscal balance. GDP growth, money growth rate and fiscal balance are instrumented by their lagged values to control for their potential endogeneity. The results again indicate that, on average, the CBA countries had lower inflation than countries with other pegged or flexible ERRs. The results are robust after excluding the first few years following the adoption (to control for the potential "contamination"), inclusion of fixed effects and accounting for the possible endogeneity of the regime choice. Additionally, Wolf et al. (2008) tested the success (defined as the ability to maintain inflation below its pre-stabilisation period after three years) and durability (defined as the ability to maintain inflation below its initial post-stabilisation period after three years) of positive effects of CBA on inflation performance compared to other ERRs. They found that the levels of "success" and "durability" were considerably higher for CBA countries than countries with other ERRs. They also estimated that CBAs have been more successful in lowering inflation in countries that started with high inflation.

The last three studies divided countries into three groups according to their exchange rate regime which was in use, with one group being the group of countries with a CBA. They estimated the effect of CBA by including dummy variables for two groups of exchange rate regimes while omitting the third one. However, these authors did not note what type of ERR classification (de jure or de facto) they

have been using for dividing the countries (exchange rate regimes) into a specific group. Moreover, all of the above studies do not control for differences in monetary policy regimes (e.g. inflation targeting) which may affect macroeconomic performance, additional to the ERR. Moreover, they treat a CBA only as an ERR, not a monetary framework. Although it is defined as an ERR in the IMF classification, CBA is a monetary regime as well, and therefore it might be useful to compare it with other monetary regimes beside treating it as a type of ERR (this issue will be discussed in more detail in Section 4.1). Moreover, it might be justified to differentiate between more and less strict CBAs (as conducted in Anastassova, 1999), since some of CBA countries have more strict rules (and lower monetary discretion) than others, which may (differently) affect country's inflation performance. Finally, none of the above studies control for the potential inflation hysteresis by using the dynamic estimator(s).

3. Choice of the sample and sample specifics

In the attempt to estimate the effect of CBA on inflation performance panel data comprising of 25 transition countries from the Central, South-Eastern Europe and former Soviet Union for the period 1998-2009 is used. The main reason for not including the period prior 1998 is the data constraint. However, the first years of transition (at the beginning of 1990s) were very volatile in terms of trends in the major macroeconomic variables and if included, might have biased the estimates. Since Serbia and Montenegro separated in 2006 there is a lack of data for Montenegro and therefore it is excluded from the sample. Moreover, due to lack of data for some macroeconomic variables Turkmenistan and Uzbekistan are also excluded from the sample. Since data on the EBRD indicator for Czech Republic for years 2008 and 2009 is missing[3] and data on general government balance for Serbia in 1998 and 1999 and on openness for Hungary and Lithuania for 2009 are missing the panel is unbalanced. Data for all countries and all years for certain variables are not always available from the same source. For most of the countries the data used are those from international databases, such as IMF's and World Bank's databases, but for some countries national statistics had to be consulted (for the data on some variables) (the sources for each variable are noted in Table 2).

Some authors emphasise that transition (and developing) countries should be treated separately from developed countries since they have specific features (such as lack of policy makers' credibility, limited access to international markets, high default risk, weak and underdeveloped institutions) and are going through the process of transition towards a market-oriented economy, which is likely to affect macroeconomic variables significantly (Domac et al., 2004; Barlow, 2010; Frankel, 2010). Moreover, most of the counties in this sample changed their monetary and/or ERRs as a part of transition process (Domac et al., 2004). Typically a CBA was introduced as a means of establishing stability which was disturbed at the beginning of transition process in all observed countries. Therefore, it is important to estimate the difference that those different regimes had on macroeconomic performance. Moreover, when estimating this effect it is important to control for the effect of progress in transition since that process is characterised by liberalisation, privatisation and tighter monetary and fiscal policies, which are likely to influence macroeconomic performance. Barlow (2010) controls for this by using the EBRD transition indices for liberalisation, privatisation and credit reform. Since our focus is not on the effect of the progress of transition on inflation and in order to save degrees of freedom, the aggregate transition indicator which reflects the general progress made in transition is used. It is calculated as an average of eight transition indicators related to liberalisation, privatisation and credit reform reported in the EBRD transition reports. These indicators are available for the whole sample except for Czech Republic in years 2008, 2009. Furthermore, macroeconomic performance is likely to be affected by the EU accession process of some countries in this sample, first informally (through stabilisation programmes before EU accession) and then formally (through endeavour to fulfil the Maastricht criteria after EU accession, before EMU accession). According to their EU orientation the countries from the sample might be divided in two groups: Commonwealth of Independent States (CIS) which are not EU oriented and EU oriented countries: Central-Eastern Europe and Baltic countries (CEB) and South-Eastern European countries (SEE). Nine countries from the second group are already EU members, three of them EMU members (Slovenia, from 2007, Slovakia, from 2009 and Estonia from 2011), while other countries from this group are heading towards accession. Furthermore, BH (from 1997), Bulgaria (from 1997),

3 EBRD Transition Reports do not include Czech Republic after 2008.

Estonia (from 1992 until EMU accession), Lithuania (switched from the dollar peg to the euro in 2002) pegged their currencies to the euro through a CBA, while Latvia (since 2005) Macedonia (since 1997) fixed their currencies against the euro. This convergence towards the EU/EMU may lower the effect of monetary-ERRs on inflation performance since countries in the process of accession endeavour to converge towards the economic trends in EU countries. Since, after the EU accession, countries are highly influenced by EU trends it will be controlled for this convergence process by including an EU dummy variable.

4. Estimation of the effect of CBA on inflation

4.1. CBA as a monetary framework

Previous studies which aimed to estimate the effect of CBA on macroeconomic performance treated a CBA only as an ERR and compared it with the other ERRs. These studies emphasised that the more rigid the ERR is the lower the inflationary expectations should be due to the restraints posed on the domestic monetary authority. Most of the early studies which estimate the effect of different ERRs on macroeconomic performance used the IMF's de jure classification of ERRs. This classification is based on the ERRs which countries report they are utilising, which is not necessarily the ERR which they employ in practice. Some countries, for example, report that they have a flexible ERR while they are intervening in currency markets to retain stability of their exchange rate (this phenomenon is called the "dirty float" which is motivated by a "fear of floating" (Calvo and Reinhart, 2000). On the other hand, some countries that peg their currencies allow for some flexibility in order to respond to external shocks or to stimulate their real economy. In order to facilitate the assessment of the actual ERR, Levy-Yeyati and Sturzengger (2005) and Reinhart and Rogoff (2004) developed their own classifications which are based on consideration of the actual behaviour of nominal exchange rates. Although widely used, both classifications were criticised for not capturing all relevant features that represent the actual ERR[4]. Domac (2004, p.5) argues that de facto classifications fail "to capture the distinction between stable nominal exchange rates resulting from the absence of shocks, and stability that stems from policy actions offsetting shocks" and "to reflect the commitment of the central bank to intervene in the foreign exchange market" which is reflected in the de jure classification. Kuttner and Posen (2001) argue that de facto classifications do not account for the differences in the (inflationary) expectations which are usually affected by announced/declared policies. Ghosh et al. (2011) argue that there is a significant difference between de jure and de facto ERR classifications and there is also a difference in the effect of de jure and de facto pegged ERRs on inflation performance since "de facto pegs that are not supported by a formal commitment may not deliver the full disinflationary benefits of pegs" (p.16). Clearly, both classifications have some disadvantages and are likely to result in relatively different inferences. However, neither classification separates CBA from pre-announced pegs and regimes with no separate legal tender and none of the classifications takes into account the combination of ERR and monetary rule, which are usually interrelated, and in the case of CBA jointly determined.

Beside the adoption of a rigid ERR there are other methods used by the monetary authorities to anchor inflationary expectations, such as the announced monetary target and (increased) central bank independence. Assessing whether the effects of these policies (additional to the rigid ERR) will be supplementary, negligible or counterproductive in increasing the credibility of monetary authority is not

4 Levy-Yeyati and Sturzengger's (2005) classification includes measures of exchange rate volatility, volatility of exchange rate changes and volatility of reserves to capture the actual behaviour of exchange rate. However, this classification is criticised for not accounting for capital controls and for classifying ERR in countries which do not exert much volatility in these variables as inconclusive (Petreski, 2011). On the other hand, Reinhart and Rogoff (2004) incorporate data on parallel and dual exchange rate markets and data on exchange controls and currency reforms. However, this classification is criticised for not accounting for foreign exchange reserves which may signal government commitment to maintain peg (Petreski, 2011).

straightforward[5]. Kuttner and Posen (2001) argue that in order to answer this dilemma one should take all three elements of the monetary framework (namely, the type of ERR, announced domestic target and central bank independence) into account. They argue that "… the partial view taking exchange rates alone is misleading" (p.9). Although monetary and ER regimes are highly correlated and interdependent the same ERR may not have the same effect on inflation due to different monetary rule/domestic target and different level of central bank independence in compared countries. Sepp and Randveer (2002), who estimate the effect of alternative (combined) regimes on macroeconomic performance in Estonia, specify the monetary regime as a "combination of a specific exchange rate regime with the concrete monetary rule" and monetary rule as "a specific monetary instrument setting "designed to keep a target variable close to its specified target path" (p.369). Kuttner and Posen (2001) call this augmented regime the monetary framework. Beside the monetary rule (or, how Kuttner and Posen call it, domestic target) and ERR, Kuttner and Posen also consider the degree of central bank independence when defining the monetary framework. In their analysis they include 41 countries from the OECD, Latin America and East Asia. Their results imply that the combination of inflation target plus exchange rate float and central bank autonomy would appear to be a full substitute for a hard exchange rate commitment in terms of the resulting inflation level. Souza (2002) obtain the same results for the 10 EU countries prior their accession in 2004. Therefore, taking into account only the effect of ERR, without its interactions with the domestic target/monetary rule, might be misleading.

In the case of CBA the choice of monetary and ERR are jointly determined since, beside the commitment to keep the domestic currency fixed to the anchor currency, a CBA sets rules which restrain the discretion of the monetary authority. In Kuttner and Posen's (2001) (ERR-domestic target) combined classification a CBA is set as both a domestic target and ERR. Therefore, by including only a CBA dummy variable we are comparing the effect of CBA with the effect of all other monetary –ER regime combinations (not only with the other ERRs as done in previous studies which estimated the effect of CBA on macroeconomic performance). One more advantage of this approach is that we do not have to choose between the de facto and de jure classifications of ERRs, both of which, as discussed above, have some limitations. Additionally, the inclusion of only a CBA dummy variable instead of a full set of ERR dummies simplifies the model and saves degrees of freedom therefore gaining efficiency for the small sample properties. Moreover, by including only a CBA variable we may argue that the endogeneity problem between the choice of ERR and inflation, which is usually emphasised in the studies, is likely to be avoided. Namely, simultaneity between a CBA and inflation may occur since it is argued that "countries with a greater proclivity towards low inflation may be more likely to *adopt* a currency board" (Ghosh et al., 1998, p.3, emphasis added). Therefore, periods of inflation might explain the origins of a CBA, but not its maintenance. Since the sample period does not include a period before CBA introduction in any of our observed countries we may argue that simultaneity is not likely to be an issue, since the maintenance (and the abandonment) of a CBA is an institutional and political matter rather than determined by countries' inflation aversion. Finally, we may argue that a CBA variable is also capturing some institutional characteristics which are different from the other regimes, such as the inability to finance government, full coverage of monetary base and inability of central bank to act as a lender of last resort. Some of these features are also assessed within the central bank independence (CBI) index which is usually argued to influence inflation in transition countries (Maliszewski, 2000; Cukierman et al., 2002).

The Cukierman's CBI index (CCBI), which is usually used in similar studies, is constructed for every country by assigning the points on certain features/questions which are assumed to affect central bank independence (such as "Who appoints the Governor?", "Limits on the level of CB credit to government" and "Provisions for dismissal of the CB governor") and by assigning certain weights to these features. Since this assessment is based on provisions in central bank laws (and CBA laws in

5 As Kuttner and Posen (2001, p.12) argue: "One could argue that the effect would be nil, because the exchange rate commitment already credibly limited the central banker's discretion. One could instead argue the effect would be still greater credibility, albeit perhaps with diminishing returns, because inflationary government officials are escape artists, and the more restraints the better. Or one could argue that the additional restraints are counterproductive, because just handcuffs in the form of inflation targeting leave a necessary limited amount of discretion as well as a clear release method, while the excessively tight duct tape of exchange rate targets, let alone multiple constraints, interferes. Theory gives no single answer to this empirical question."

countries with a CBA) it may be argued that a CBA variable is capturing most of the features assessed in the CCBI[6].

However, although the monetary policy is rule-bound under a CBA that does not necessarily mean that all CBA countries have high CCBI index. For example, Lithuania had 0.78 CCBI from 1998 until 2000, which is lower than CCBI index for some countries with more flexible ER-monetary regimes (e.g. Poland). We may argue that the level of central bank independence is related to the "strictness" of a CBA. Namely, by observing the CCBI indices in the CBA countries it can be noted that it is the highest in the country which has had the strictest CBA (Bosnia and Herzegovina), while country with the lowest level of CCBI index (Lithuania) has had a more flexible CBA (the one which deviates most from the orthodox rules)[7]. The "strictness" of CBA can be observed through the pre-commitment index calculated by Camilleri[8] (2002 and 2004) which controls for deviations of modern CBAs from the theoretical (orthodox) benchmark, according to which no instrument and monetary authority discretion is allowed. The Camilleri's pre-commitment index includes a wide range of CBA features associated with credibility: clarity of legal basis; quality of reserve backing in terms of denomination and liquidity; coverage of the monetary rule; vulnerability to alternative claims on reserves; operational autonomy; transparency and accountability provisions and regime revocation arrangement. This index partially overlaps with the Cukierman's CBI index. This index is also the highest for the country with the most rigid CBA (Bosnia and Herzegovina) and the lowest in the country which has the most flexible CBA (which is again Lithuania).

However, a CBA is supposed to be capturing more than a CBI index since the (high degree of) CBI is just a part of the regime's design. Considering all the above, and the characteristics of CBA elaborated in the Section 2, we may expect that CBA variable is capturing what Kuttner and Posen (2001) call the monetary framework with fixed ERR, non-discretionary monetary policy (therefore, no specific domestic target) and explicitly defined central bank independence as well as other features that might be captured in some broader central bank independence index.

4.2. Inflation determinants

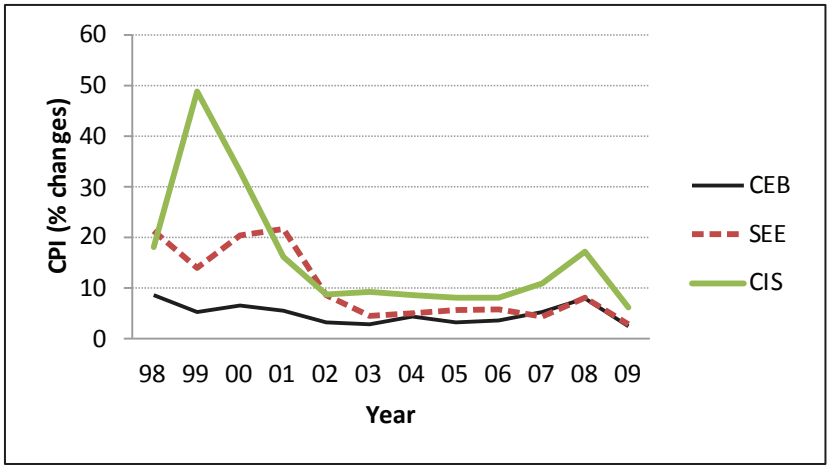
At the beginning of the transition process all countries from the sample experienced periods of high inflation. However, the inflation rates decreased significantly over time in all countries in the sample (Graph 1). As noted earlier, some of the countries switched from one regime to another during the first years of transition as a part of stabilisation process. The effect of a specific regime on inflation performance is not straightforward and inference about this effect should be based on an empirical analysis.

6 The monetary autonomy, the independence of central bank from the government, as well as some other features captured/assessed in the CBI index are defined in the CBA laws.

7 Central bank independence indices calculated as implied by Cukierman (1992) and Cukierman et al. (1992) suggest that central bank independence in CBA countries is not necessarily (very) high: BH (0.979), Bulgaria (0.859), Estonia (1998–2001: 0.78; 2002–2004: 0.88; 2005-2009: 0.907) and Lithuania (1998-2000:0.78; 2001-2009:0.912).

8 Camilleri pre-commitment index differs between CBA countries and suggests that CBAs differ institutionally: 0.93 for BH; 0.62 for Bulgaria; 0.86 for Estonia; 0.39 for Lithuania.

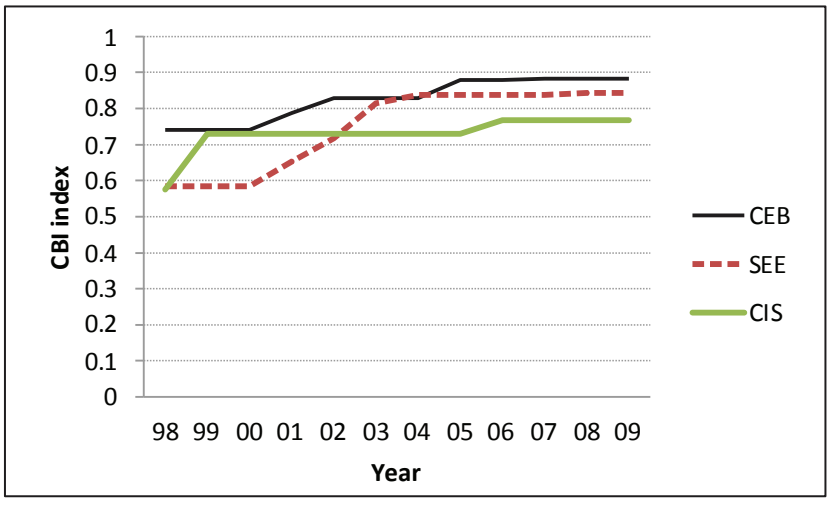
Graph 1. Inflation rates (measured as percentage changes in consumer price index) in CEB, SEE and CIS countries



Source: Based upon the World Bank Indicator database

In determining the inflation regression a monetary inflation model in which inflation is determined by the growth in money supply (MSG) and output growth (GDPG) is used as a baseline to which variables of interest and control variables, which are likely to influence inflation in transition countries, are added. For the *inflation variable* (which is the dependent variable) the percentage changes in consumer price index in log terms (in order to reduce the effect of outliers) are used. As suggested by monetary theory the *growth in money supply* is likely to increase inflation, holding other factors constant. The positive effect of money supply growth on inflation is found in many studies (Wolf et al., 2008; Ghosh et al., 2011). In developing countries money supply growth and inflation might be considered endogenous since higher nominal price of goods and services increases money demand which may put pressure on the authorities to increases money supply (Sargent and Wallace, 1981). However, we may argue that this is not likely to be the case in many transition countries which established more independent central banks during the first years of the stabilisation process (see Graph 2).

Graph 2. Average Cukierman's central bank independence index (updated) for CEB, SEE and CIS countries



Source: Based upon the updated Cukierman's index calculated by Bogoev et al. (forthcoming)

However, since we are using the broadest monetary aggregate, the increase in money demand is likely to result in increases in the broad money supply, even when the central bank is not increasing the monetary base, through increase in demand and saving deposits (secondary monetary emission). Since there is usually a time gap until the old situation adjusts to the new one and since the consumer prices are argued to be sticky the effect of money supply growth on inflation is likely to be lagged.

The usually emphasised reasons are: inventories, forward and future contracts, the time needed for firms to notice higher costs and time needed for firms to change their prices. Moreover, in order not to lose customers firms may not change prices until they are sure that increase in costs is not temporary. This lag is usually argued to be 1-2 years[9] although it is likely to be different in different countries depending on the level of development of country, monetary regime, type of dominant transmission mechanism, (changes in) money velocity and the degree of product market competition. The inclusion of lagged money supply growth is likely to resolve the potential endogeneity between money supply growth and inflation. *Real GDP growth* is expected to be negatively correlated with inflation, ceteris paribus, since faster output growth should raise money demand and consequently decrease inflation for a given expansion of money supply (Wolf et al., 2008). However, in some studies it is argued that this relationship holds only in countries with pegged ERR since in countries with flexible ERRs output growth is likely to affect the exchange rate rather than inflation (Abbott and De Vita, 2011). The difference between the effect of CBA, which is a variable of interest, and other regimes on inflation is estimated by using a *dummy variable for the CBA*. The expected effect of CBA on inflation is appraised in Section 2 in comparison to other exchange rate regimes. As explained in Section 4.1 we may assume that a CBA variable is capturing a "broader" effect (not just the effect of the ERR). Therefore, we expect that CBA countries had lower inflation than countries with other monetary-ER regimes. In order to determine the model specification and additional variables which should be included, recent studies which examine the effect of ERRs on inflation and studies which examine the sources of inflation in transition countries are next consulted.

Beside growth of money supply and output growth, the control variables usually included in the inflation models are: fiscal balance, openness and terms of trade. A higher *fiscal deficit* is usually argued to increase inflation in developing countries since in these countries fiscal deficit is usually financed by increase in the money supply growth (seigniorage) (Lozano, 2008, Habibulah, 2011). However, with the development and progress in transition a monetisation of fiscal deficit is less likely to occur since countries increase central bank independence and have more developed financial markets (Catao and Torres, 2001; Naypati, 2003; Henry et al., 2004). If we expect that the effect of fiscal deficit on inflation will not be through monetisation of deficit then the potential endogeneity, which is usually argued to exist between fiscal deficit and inflation, is not an issue. Since we use fiscal balance (in percentages of GDP) (FB) as a measure, if there is a significant effect, we expect it to be negative, since a fiscal surplus in the context explained above is likely to reduce inflation. A measure of the *openness* (OPEN) of economy is usually included in the inflation regression "to control for the potential disciplinary effect elicited by international arbitrage" (Levy-Yeyati and Stuzengger, 2001, p.8). Studies which include this variable as a control (Levy-Yeyati and Stuzengger, 2001; Wolf et al., 2008; Ghosh et al., 2011) suggest that the expected effect of openness on inflation is negative. These studies refer to Romer (1993) in their explanation of expected negative effect. Romer (1993) explains this relationship through the commitment mechanism (and time-inconsistency problem) as a main channel through which openness influences inflation. He argues that higher openness leads to lower inflation since the inflation costs of the "surprise" monetary expansion are higher (and output gains lower) when country is more open, assuming a floating ERR. As Romer (1993, p. 1) further explains: "because unanticipated monetary expansion causes real exchange rate depreciation, and because the harms of real depreciation are greater in more open economies, the benefits of surprise expansion are a decreasing function of the degree of openness." However, studies which deal with issue of openness and inflation causation in more detail note that this link is highly dependent on particular country circumstances and the level of central bank independence.

Fisher (1993) argues that the changes in *terms of trade* (TOT) are the major source of supply shocks for most developing countries. The commonly used measure for the terms of trade is a ratio of the export unit value index to the import unit value index. Accordingly, it is argued that when a country's terms of trade are improving (increasing) a country can afford more imports for the exported value, due to increase in earnings from the exports, which may be result of increase of export prices and/or increase of export quantity, and/or decrease of import prices relative to export prices. These improvements are likely to increase import quantity (of relatively cheaper import goods), which is considered as a supply-shock, and consequently lead to a decrease in inflation, in the short-run. However, even though they are

9 Chen (2009) emphasised Friedman's findings that approximately 6 - 9 months is needed for changes in monetary supply to change nominal national income and output, and a further 6 - 9 months for changes in nominal national income and output to affect prices. So the time lag is about one or one and a half years from the changes of monetary supply to the changes of price.

expressed in simple terms, the TOT might have a quite different implications for inflation under a wide range of circumstances, such as the type of the exchange rate regime, prices within the TOT measure that are changing and whether the changes are seen to be temporary or long-lasting (Archer, 1993). If a country is a predominantly a price taker rather than price setter, which is the case for most countries in our sample, in both export and import markets it may be argued that changes in the TOT result virtually entirely from international developments (Archer, 1993). Moreover, as most countries from the sample are small, open economies (with a few exceptions) their price levels are strongly influenced by import prices. Sepp and Randveer (2002, p.377) argue that in small, open economies import prices are "predominantly relevant in domestic price formation". Therefore, improvements in TOT are usually the result of a decrease in the prices of imported goods, which is consequently expected to lower domestic inflation. However, whether the TOT will affect inflation depends on the persistence in the change in prices, as the short-run changes in international trade prices are not expected to spill over the domestic ones (Archer, 1993; Gruen and Dwyer (1996).

Empirical studies which examine the inflation determinants in transition countries emphasise the importance of accounting for the effects of economic liberalisation, central bank independence and other institutional characteristics (Cukierman, 2002; Inoue, 2005; Barlow, 2010). In transition economies, there are many structural and institutional changes, which are expected to influence the inflation generating process. To account for these changes the EBRD transition indices, as the most widely used transition indicators, are included in the model. The aggregate EBRD index (EBRDI), which indicates the overall progress in transition, assigning the scores from 1 (which indicates little or no progress) to 4 (for the highest progress)10, is formed. Better progress in transition is expected to result in lower inflation due to trade liberalisation (through increase in competition), privatisation (through increase in enterprises efficiency) and credit reforms (through the increase in monetary policy efficacy via raising the effectiveness of credit allocation) which are included in the aggregate EBRD index (Barlow, 2010).

An increase in central bank's independence (CBI) is also argued to be characteristic for the transition process and to affect inflation rate (Frankel, 2010). Therefore it is also important to perceive if and how the changes in the institutional and legal framework of monetary authority affect inflation. Since an increase in central bank's independence is associated with decrease in time-inconsistency problem it is expected to lower inflationary expectations and therefore to decrease inflation. This relationship is found in many studies (Grilli et al., 1991; Cukierman, 1992; Panagiotidis and Triampella, 2006, as cited in Bogoev et al., forthcoming). What is also of particular interest is how to measure the level of CBI. In this respect there are a few indices calculated which mainly assess the level of autonomy of central banks in determining monetary policy. The most widely used indices in the empirical studies are those designed by Grilli, Masciandaro and Tabellini (1991) and Cukierman et al. (2002) which consider a broad variety of legal provisions which are assumed to contribute CBI (as cited in Bogoev et al., forthcoming). The weighted Cukierman's indices used in this chapter are updated from the original Cukierman indices which are considered to be the most comprehensive (Bogoev et al., forthcoming). The issue recognised by most of the recent studies is that the relationship between inflation and CBI is likely to be endogenous since countries with higher CBI are expected to have lower inflation but, on the other hand, the low inflation countries are likely to adopt more independent central banks, causing an inverse relationship between inflation and CBI. Most of the studies avoided this potential endogeneity by including a lagged CBI variable (Maliszewsky, 2000; Cukierman et al., 2002; Eijffinger and Stadhouders, 2003, as cited in Bogoev et al., forthcoming). Inclusion of lagged CBI is also justified on theoretical grounds since there is a time lag between the dates when the central bank law has been imposed and when it is actually implemented in the practice. Therefore, we also include this variable lagged one period. However, this variable is assumed to be capturing the level of central bank's credibility and therefore may lower the influence of the CBA on inflation which is also thought to be capturing this effect (as discussed in Section 4.1). The same applies for *the dummy variable for fixed exchange rate*. By incrementally including the CCBI and 'defactoFIX' (variable which refers to an actual/de facto fixed exchange rate) variables we will observe whether the effect of CBA on inflation is the result of central bank independence and fixed exchange rates (imposed by the implementation of a CBA) in those countries or a CBA reduces inflation additional to the effect of fixed exchange rate. In order to control for the effect of the fixed ER we used Ilzetski, Reinhart and Rogoff's (2010) exchange rate classification (IRR) which is based on actual

10 In 1995 an additional category of 4* was added for equating policies and performance standards with those of an advanced industrial economy, and in 1997 pluses and minuses were introduced to allow for finer distinctions among the different categories (with 4* redefined as 4+ (EBRD, 2010).

variations in the exchange rate. This variable therefore includes the CBA countries, except Lithuania for period 2002-2009, since IRR classification classifies the Lithuanian ERR as limited-flexible in this period. Inflation in the EU member countries is likely to be influenced by the inflation in the Euro-zone due to the convergence process (as discussed in Section 3). In order to capture this effect a dummy variable for *EU membership* (EU) is included in the model.

One more potential determinant of short-run increases in inflation in transition countries might be the introduction of *value added tax* (VAT), which occurred in most of the countries in the sample during the early stages of transition[11]. Bird (2005) argues that the introduction of VAT is one of the most important fiscal issues in transition and developing countries. Bye et al. (2003, p.13) note that "the general VAT reform increases the share of indirect taxation in the consumer prices, and the aggregate price index of material consumption rises". A general result of all analyses conducted by Viren (2009) is that more than one half of a tax increase shifts to consumer prices. However, it is sometimes argued that VAT is not inflationary. Tait (1991) conducts the empirical analysis about the effect of VAT on CPI for forty countries and does not find evidence of causality for thirty three countries. Sarili (2000) does not find significant relationship between the introduction of VAT and inflation in Turkey. None of the studies revised in Section 2 controls for this effect. However, since it is believed that the introduction of VAT affected inflation in transition countries a dummy variable which indicates the year of VAT introduction is included in the model. Finally, *year dummies* are included to control for shocks that are common for all countries such as increase in oil price or event of financial crisis. This control is usually included in the studies and all studies from Section 2 also include this control. All above specified variables with their measures, labels, and expected signs are presented in Table 2 below.

11 VAT is introduced in Russia and ex-Soviet Union countries in 1992, after the dissolution of Soviet Union. In most of the Central Europen countries it is introduced in the early 90's (Czezh Republic 1993, Slovak Republik 1993, Poland, 1993) and in South Easter European countries in late 90's, early 2000 (Croatia in 1998, Slovenia in 1999, Macedonia in 2000, Montenegro in 2003, Serbia in 2005 and BH in 2006).

Table 2. Inflation regression variables – label, description, expected sign and data source

Variable name	Label	Description	Expected sign	Data source	Notes
Inflation	lnINF	Natural log of consumer price index (annual % change)	Dependent variable	WDI	For BH national statistics is used; inflation in BH is measured by using the retail price index until 2007
Countries with currency board arrangement	CBA	Dummy variable for countries with a CBA	-		
Real GDP growth	GDPG	Based on the market prices based on constant local currency (annual % change)	-	WDI	
Broad money supply growth	(L1)MSG	The first lag of the broad money supply growth which is the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bankand traveller's checks; and other securities such as certificates of deposit and commercial paper (annual % change)	+	WDI	Data on broad money for Slovenia taken from various EBRD transition reports
Fiscal balance/GDP	FB	The ratio of fiscal balance toreal GDP (%)	-	EBRD	Data for Moldova taken from various EBRD transition reports and EconStat
Openness	OPEN	(exports + imports) / GDP (%)	-	WDI	
Terms of trade	TOT	Ratio of the export unit value index to the import unit value index (base year 2000)	?	UNCTAD STAT	Data not available for years 1998 and 1999 and data for Serbia is joint with data for Montenegro, therefore data for 2008 and 2009 missing for this county
EBRD progress in transition indicator	EBRDI	Average of eight EBRD transition indicators (for the liberalisation, privatisation and credit reform) (index)	-	EBRD	Available for all countries in the sample except for Czech Republic in years 2008 and 2009
Central bank's independence	(L1)CCBI	The first lag of updated Cukierman's index of central bank independence (index)	-	Bogoev et al., forthcoming	Data not available for 8 CIS countries (96 missing observations)
Fixed exchange rate	defactoFIX	Dummy variable for countries with fixed exchange rate (de facto fixed exchange rate regime)	-	Ilzetski, Reinhart and Rogoff (2010)	
EU membership	EU	Dummy variable for EU member countries	-		
Introduction of value added tax	VAT	Dummy variable for the year of VAT introduction	+	Background paper for International Tax Dialogue Conference on the VAT, 2005	

4.3. Descriptive statistics and model specification

In the previous section variables which will be included in the inflation model were specified and their expected effect of inflation elaborated. In this section the main trends in these determinants in countries with a CBA will be compared with their trends in countries with other regimes. Afterwards, the model will be specified.

Table 3. Comparison of average trends in inflation and inflation determinants between countries with a CBA and countries with other regimes

Variable	CBA				Other regimes			
	Mean	Standard deviation	Min	Max	Mean	Standard deviation	Min	Max
INF	5.03	3.90	0.28	18.67	12.64	24.65	0.05	293.68
GDPG	5.36	4.79	-15.03	15.60	5.11	5.55	-18.01	34.50
MSG	19.68	14.41	-0.40	90.00	28.04	30.85	-14.13	276.00
FB	-0.47	2.77	-9.20	3.40	-2.69	3.99	-13.10	25.50
OPEN	123.67	23.22	87.28	172.80	99.29	31.38	45.13	203.20
TOT	110.53	16.78	97.95	148.35	105.76	21.39	73.51	238.18
EBRDI	3.29	0.55	2.10	4.00	3.07	0.54	1.40	4.00
CCBI	0.89	0.07	0.78	0.98	0.75	0.17	0.34	0.95

According to Table 3 countries with a CBA recorded, on average, lower inflation, higher GDP growth rate, lower money supply and lower fiscal deficit than countries with other regimes. Furthermore, CBA countries were more open and had more improved (increased) terms of trade compared to the countries with other regimes. CBA countries also recorded higher EBRD and CCCBI indices than countries with other regimes.

However, these are only observations of averages of variables. Therefore, before making any inference about the difference in macroeconomic performance in countries with CBA compared to those with other regimes a more formal empirical analysis should be conducted. Therefore, the effect of CBA (compared to other regimes) on inflation performance will be estimated by using the appropriate static and dynamic estimator, taking into account all the above specified controls. The natural logarithm of consumer price index will be used as a measure of inflation in order to decrease the influence of outliers and to induce a linear relationship among the variables. Since there are only eight observations with negative change in inflation these observations are dropped in order to use logarithms. The first lag of money supply growth and Cukierman's CBI index will be included as discussed in Section 4.2. Other variables are included in the current values. The correlation matrix suggests that there are no signs of high correlation between the explanatory variables (Appendix 1). As suggested by other studies, a time dummy variables (period fixed effects - γ_t) will be included in order to control for price shocks. Test for the significance of time dummy variables also suggests that time dummies should be included in the regression (Appendix 2). Accordingly, the model that will be estimated is:

$$\mathrm{LnINF}_{i,t} = \alpha_0 + \alpha_1 \mathrm{CBA}_{i,t} (+ \alpha_2 \mathrm{defactoFIX}_{i,t} + \alpha_3 \mathrm{CCBI}_{i,t-1}) + \alpha_4 \mathrm{GDPG}_{i,t} + \alpha_5 \mathrm{MSG}_{i,t-1} + \alpha_6 \mathrm{FB}_{i,t}$$
$$+\alpha_7 \mathrm{OPEN}_{i,t} + \alpha_8 \mathrm{TOT}_{i,t} + \alpha_9 \mathrm{EBRDI}_{i,t} + \alpha_{10} \mathrm{EU}_{i,t} + \alpha_{11} \mathrm{VAT}_{i,t} + \gamma_t + \varepsilon_{i,t} \quad (1)$$

4.4. Static panel model estimations

Estimation results of Equation 1 by pooled OLS suggest that CBA variable is highly significant with the expected (negative) sign implying that countries with CBA have, on average, lower inflation rates than countries with other regimes. GDP growth, money supply and CBI index are also significant with expected signs (OLS results are presented in Table 4). Diagnostic tests indicate that the assumptions of normality, linearity and homoscedasticity cannot be rejected at all conventional levels of significance (Appendix 2). However, since we cannot expect to capture all countries' specifics by the exogenous variables we should control for the country effects which is not done within OLS. Botric and Cota (2006) emphasise that inflation generating processes in transition economies differ, and that country specifics should be taken into account when analysing inflation in those countries. Therefore, since it ignores the countries' specifics, one may argue that the OLS is likely to result in the biased estimates. In order to account for the countries' effects a fixed effects (FE) model is next utilized (Equation 2).

FE model (Stage 1 in FEVD)

$$\text{LnINF}_{i,t} = \alpha_0 + (\alpha_1 \text{CBA}_{i,t}) + \alpha_2 \text{defactoFIX}_{i,t} + \alpha_3 \text{CCBI}_{i,t-1} + \alpha_4 \text{GDPG}_{i,t} + \alpha_5 \text{MSG}_{i,t-1} + \alpha_6 \text{FB}_{i,t} + \alpha_7 \text{OPEN}_{i,t} + \alpha_8 \text{TOT}_{i,t} + \alpha_9 \text{EBRDI}_{i,t} + \alpha_{10} \text{EU}_{i,t} + \alpha_{11} \text{VAT}_{i,t} + \gamma_t + u_i + \varepsilon_{i,t} \quad (2)$$

The F-test, after estimation of Equation 2, suggests that the hypothesis that the unit fixed effects (u_i) are equal to zero is rejected at all conventional levels of significance (p-value 0.000) (Appendix 3). This implies that the FE should be preferred over the OLS estimator. However, using the FE model disables the estimation of the time-invariant variables since it uses only within variation. Therefore, if we are interested in the effects of the time-invariant variables, the FE model will not tell us anything about their effect on the dependent variable (since it disregards additional information contained in the between variation). This is an important issue for our model since the variable of interest (CBA) is not changing during the observed period (as discussed in Section 4.1). Additionally, Plumper and Troeger (2007) argued that the FE estimator is also unreliable when estimating the effect of slowly changing variables (variables with the small within variation) which is usually a characteristic of the institutional variables such as the transition indicator variable (EBRDI) and the central bank independence index (CCBI). However, when interested in the time-invariant and/or slowly changing variables one may use the random effects (RE) model or Hausman-Taylor estimator. However, both estimators are argued to give biased and inefficient estimates of the true betas in relatively small sample (Plumper and Troeger, 2004). Moreover, the RE requires the strict exogeneity of regressors and orthogonality between regressors and unit effects which is a rarely-fulfilled condition. As Plumper and Troeger (2004, p.6) argued: "the real world data rarely satisfied the conditions under which RE estimators are consistent". As a solution, Plumper and Troeger (2004, 2007) suggested the usage of the fixed effects vector decomposition (FEVD) estimator which allows estimation of time-invariant variables and variables with low within variance in the presence of unit effects. Other advantages of FEVD, pointed out by its creators, are that it maintains small sample properties and it is unbiased in estimating the coefficients of time-varying variables that are correlated with the unit effects. It is argued that the FEVD is more efficient than FE since it uses more information (both within and between variations) but is also argued to be more biased (Plumper and Troeger, 2007). Therefore, the decision about which estimator should be used is based on a trade-off between efficiency and consistency and depends on the researcher's interest. Plumper and Troeger (2011) argue that FEVD estimation has characteristics that combine the FE with the pooled-OLS model[12]. Specifically, it is induced by including the estimated unit effects from the FE model in the pooled OLS regression. The FEVD estimator is described as a three-stage procedure: the first stage estimates the model with the FE estimator (Equation 2); the second stage regresses the time-invariant and slowly moving variables on the predicted unit effects $\widehat{u_i}$ from the first stage (Equation 3); the third stage estimates the time-varying, time-invariant and slowly changing variables by using the OLS and including the estimated residuals from the second stage $\widehat{h_i}$ (Equation 4).

Stage 2 in FEVD

$$\widehat{u_i} = \beta_0 + \beta_1 \text{CBA}_{i,t} + \beta_2 \text{EBRDI}_{i,t} + (\beta_2 \text{CCBI}_{i,t-1}) + h_i \quad (3)$$

where:

$\widehat{u_i}$ - the estimated unit effects (from 2); and

hi - the error term, i.e. the unobservable, hence unexplained part of the unit effects

Stage 3 in FEVD

$$\text{LnINF}_{i,t} = \delta_0 + \delta_1 \text{CBA}_{i,t} + \alpha_2 \text{defactoFIX}_{i,t} + \alpha_3 \text{CCBI}_{i,t-1} + \alpha_4 \text{GDPG}_{i,t} + \alpha_5 \text{MSG}_{i,t-1} + \alpha_6 \text{FB}_{i,t} + \alpha_7 \text{OPEN}_{i,t} + \alpha_8 \text{TOT}_{i,t} + \delta_2 \text{EBRDI}_{i,t} + \alpha_9 \text{EU}_{i,t} + \alpha_{10} \text{VAT}_{i,t} + \alpha_{10} + \gamma_t + \varepsilon_{i,t} \quad (4)$$

12 "... FEVD analyzes variables that are best analyzed by FE by a de facto FE model and variables that are best analyzed by pooled OLS by a de facto pooled OLS model. As we concluded in our 2007 Political Analysis article, FEVD does better than FE in estimating time-invariant (and rarely changing and exogenous time varying) variables and better than pooled OLS and random effects in estimating endogenous time-varying variables" (Plumper and Troeger, 2011, p. 149).

Plumper and Troeger (2004, 2007) argue that only the third stage controls for potential multicollinearity between time-variant and time-invariant variables, and it is also needed to adjust the degrees of freedom (by u_i-1) and to obtain the correct SEs. However, the FEVD estimator was criticised as producing inconsistent estimates (Greene, 2011a) and small/incorrect standard errors (Greene, 2011a and Breusch et al., 2011). The SEs were eventually changed in the subsequent FEVD version (xtfevd4.0 which replaced xtfevd2.0) by Plumper and Troeger to account for the additional variance (more detailed discussion about the SEs is provided below). Therefore, the separate estimation of three stages (stage by stage) will not yield the correct standard errors since they are not corrected for the extra variance. In his "Reply to Rejoinder" Greene (2011b) argues that "although it produces the right coefficient estimates, it produces the wrong SEs for the estimator of β [the coefficients on time-varying variables] and an ambiguous result for the SEs for the estimator of γ [the coefficients on time-invariant variables]" (p. 171). He argues that the step 3 estimator is incorrect and suggests relying entirely on step 2 plus a side calculation for γ and that "a fair amount of mechanical detail, including the crucial statement about how to compute SEs is simply omitted from PT [Plumper and Troeger]" (Greene, 2011b, p.172). However, Greene, with two other authors, published an empirical paper (Greene et al., 2010) in which they utilise the FEVD method. In their paper they argue that the FEVD "becomes a useful tool only when slowly changing variables are included in the second stage" (p.5) and they emphasise the importance of the between to within ratio as a criterion for the inclusion of time-varying variables in the second stage (as suggested by Plumper and Troeger, 2007). Although the ratio cannot be exactly determined since it depends on the correlation between the variable and the unit heterogeneity, which is unobservable, Plumper and Troeger (2007) suggested the ratio of 2.8 as sufficient to justify the inclusion of the variable in the second stage. However, it is not clear whether Greene et al. (2010) utilise exactly the same procedure suggested by Plumper and Troeger (2011) or they made some changes, but they note that the accuracy of the SEs cannot be claimed. However, by using the FEVD himself Greene tacitly approved its usage when both time-invariant and slowly changing variables are included in the second stage.

We estimate the model by utilising the three stages and additionally by using the 'xtfevd4.0' command. CBA variable is included as a time-invariant variable (since countries with a CBA had this regime during the whole observed period) and EBRDI as a slowly changing variable (since its between-to-within ration is 2.7). CCBI variable is also treated as slowly changing, since it changes infrequently during the observed period, even though - since it is not varying much between countries either - it also has a low between variance (and consequently low between to within ratio) (Appendix 4). Since the 'xtfevd' does not allow us to do post-estimation tests we run the three stages step by step as suggested in Plumper and Troeger (2007) which allows us to do post-estimations (since OLS estimation is used in the last stage). The tests suggest that the hypotheses about homoscedasticity, normality and linearity cannot be rejected at all conventional levels of significance[13] (Appendix 5a). However, although the coefficients from the third stage are the same as ones provided by the 'xtfevd' estimator the two have different degrees of freedom and in the third stage (when estimating stage by stage) the SEs are not adjusted for the variance from the previous stage (which is done in 'xtfevd', as discussed above)[14], and therefore we will report and interpret results from the 'xtfevd' (Table 4).

We implement a sequential approach to estimation of our variables of interest. Since we argue that a CBA is a monetary framework which captures the effect of fixed ERR, central bank independence and discretion of the monetary authority the first specification (S1) includes only the CBA variable (Appendix 5b). In the second specification (S2) we control for the fixed exchange rate in order to see whether a CBA still has a significant effect on inflation or its effect is a result of a fixed ER (Appendix 5c). Finally, in the third specification (S3) we also include the central bank independence variable in order to observe whether the effect of a CBA on inflation is a result of the high central bank independence or whether it has an additional effect on inflation over the effect of central bank independence (Appendix 5d).

13 Although Cameron and Trivedi"s decomposition of IM-test ('imtest') suggests that the hypothesis of homoscedasticity cannot be rejected, the Breusch–Pagan (1979) and Cook–Weisberg (1983) test for heteroskedasticity ('hettest') suggests a rejection of this hypothesis at all conventional levels of significance.

14 By comparing the results one may note that most of the variables lost their significance when 'xtfevd' is applied, compared to their significance in the third stage when estimating stage by stage.

Table 4. Results from the OLS and FEVD (Estimation of the effect of CBA on inflation)

Estimation technique	**OLS** (estimation of the E quation 1)	**FEVD**		
Independent variables		**S1**	**S2**	**S3**
CBA	-0.631 **	-0.704 **	-0.601 *	-0.614
DefactoFIX	0.084		-0.156	0.047
L1CCBI	-1.578 **			-1.992 **
GDPG	-0.062 **	-0.019	-0.019	-0.055
L1MSG	0.024 ***	0.008 **	0.008 **	0.012 **
FB	0.076 **	-0.009	-0.009	0.035
OPEN	0.004	0.012 **	0.012 **	0.007
TOT	0.008	0.004	0.004	0.023
EBRDI	0.173	-0.630 **	-0.662 **	-0.149
VAT	0.999	0.935 *	0.933 *	0.895
EU	0.011	-0.163	-0.166	-0.284

*Note: ***, **, * donates that variables are statistically significant at the 1%, 5% and 10%, respectively*

As summarised in Table 4 when a CBA variable is, and dejureFIX and CCBI variables are not, included in the model (S1) it is significant at the 5% level in both the OLS and FEVD estimations and has the expected negative sign, holding other factors constant. After introducing the dummy variable for fixed ER (S2) the negative effect of a CBA on inflation is still significant, though only at the 10% level, while the variable for the fixed ER is insignificant. After including the CCBI variable (S3) the CBA variable loses its significance, while a CCBI has a significant negative effect on inflation. These results suggest that a CBA has an additional effect on inflation reduction when a fixed exchange rate is accounted for. However, once the degree of central bank independence is controlled for then neither fixed exchange rates not a CBA are significant; instead, central bank independence is "doing the work" of inflation reduction. The inclusion of CCBI variable also has the effect on the coefficients on openness, EBRDI and VAT variables becoming insignificant. Money supply is significant and positive through all specifications suggesting that an increase in the previous period's money supply is likely to increase current inflation.

However, the interpretation of the results from the FEVD is not straightforward since there are still some unresolved issues about this estimator. Firstly, the appropriateness of the structure (adjustment) of the standard errors is not agreed upon. All the authors which engaged in the discussion about the FEVD proposed similar but somewhat different structure of the standard errors (for the comparison of the variance formula used by Plumper and Troeger; Greene and Breusch et al. see Plumper and Troeger, 2011, p. 160). However, in their paper in which they apply the FEVD Greene et al. (2010, p.14, emphasis added) argue that: *"It is not clear yet whether and how any adjustment should be made to the standard errors in the rarely-changing variable case and this will doubtless be a subject of debate in the future"* and that "gains in precision have arisen from more plausible parameter estimates, not from greatly reduced standard errors." Plumper and Troeger's improved estimator (xtfevd4.0) is adjusting the standard errors in the third stage by taking into account the extra variation from the previous stage which could be seen from its structure (Equation 6). In order to see the additionally added part of SEs the Plumper and Troeger variance formula provided in 2011[15] (6) is compared with the sampling variance of the linear regression estimator (Equation 5): As noted in Baum (2006, p.134) the sampling variance of the linear regression estimator (independent and identically distributed i.i.d. errors assumed) is a scaling the variance of data against the data itself:

$\mathrm{var}[\beta \mid x] = (X'X)^{-1}(X'\Sigma_u X)\,(X'X)^{-1}$, where Σ_u is $\sigma^2 I_N$ and σ^2 is a constant variance, X is a data matrix and X' is a transposed data matrix (5)

while the xtfevd4.0 variance formula is as follows:

15 It cannot be compared with the variance formula used in the previous version of FEVD (xtfevd2.0) since it is not provided in the PT's 2007 paper, but they argue in their 2011 paper that that "the OLS is overconfident and that "this was the main reason for why xtfevd2.0beta was overconfident, with computed SEs being much smaller than the sampling distribution" (p.160).

$X_{FEVD4.0}(\beta,\gamma) = (H'W)^{-1}H'\Omega H(W'H)^{-1}$, where $\Omega = \sigma^2_{\varepsilon} I_{NT} + \sigma^2_{ue} I_N \otimes l_N l_N$ (6)

where the σ^2_{ue} is the variance of the residuals of the 2nd stage regression of the FEVD procedure, the unexplained part of the unit specific effects.

From the equations 5 and 6 we can see that these formulas have similar but different structures. First, the FEVD accounts for two different types of variables, namely time varying (X) and time-invariant and slowly changing variables (Z). Second, the H matrix takes into account demeaned form of X: H = [Ẍ, Z]. Finally, the middle matrix is different; while the default SEs assumes constant variance the FEVD SEs allow for extra variance from the second stage and therefore additional information compared to $\sum_u$. However, when Plumper and Troeger's SEs (Equation 6) are compared to the SEs which account for heteroscedasticity (Equation 7), for arbitrary correlations within clusters (Equation 8) it should be noted that Plumber and Troeger's SEs do not account for potential heteroscedasticy and/or serial correlation in the residuals since they do not include the group effect (i or j subscript) which indicate that variance is no longer constant.

The robust estimator of the variance component estimation (VCE)

$$\text{var}[\hat{\beta}|x] = \frac{N}{N-k}(X'X)^{-1}\left(\sum_{i=1}^{N} \hat{u}_i^2 x_i' x_i\right)(X'X)^{-1} \quad (7)$$

where N is the number of observations, k is the number of coefficients estimated, u_i is the ith regression residual and x_i is the ith row of the regressor matrix: a 1 x k vector of sample values.

The cluster-robust VCE estimator

$$\text{var}[\hat{\beta}|x] = \frac{N-1}{N-k}\frac{M}{M-1}(X'X)^{-1}\left(\sum_{j=1}^{M} \tilde{u}_j' \tilde{u}_j\right)(X'X)^{-1} \quad (8)$$

where M is the number of clusters, $\tilde{u}_j = \sum_{i=1}^{Nk} \hat{u}_i x_i$, N_j is the number of observations in the jth cluster, $\hat{u}_i$ is the ith residual from the jth cluster, x_i is the 1xk vector of regressors from the ith observation in the jth cluster, where the subscript j indicates that the arbitraty patterns of within group correlation (autocorrelation of various different kinds) is taken into account.

Plumper and Troeger in their 2007 paper (where they introduced 'xtfevd2') noted that FEVD estimation can account for potential heteroscedasticy and/or serial correlation by running a robust Sandwich estimator or a model with panel-corrected SEs and that in the presence of serial correlation the Prais-Winston regression should be used instead of OLS in the first and the third stage. However, in relation to their revised estimator ('xtfevd4.0') they are silent about model diagnostics and corresponding strategies to address diagnostic failures. Indeed, the options for accounting for heteroscedasticity and serial correlation described in the help file are not working within the 'xtfevd4.0' and Plumper notes on his website that the help file is not adjusted for the new version of FEVD. Additionally, Plumper and Troeger (2011, p.5) emphasise that the FEVD is consistent only when $\varepsilon_{i,t}$ is an i.i.d. error term, which also suggests that the potential diagnostic failures are not accounted for within the FEVD. However, they point out the trade-off between the consistency and efficiency and that "researchers necessarily face a choice between using as much information as possible and using an unbiased estimator" (Plumper and Troeger, 2007, as cited in Plumper and Troeger 2011, p.150).

Consequently, we may not fully rely on the results from the FEVD as the debate about the SEs is on-going and there is no verdict that they are correct. Further, Plumper and Troeger (2011) note that i.i.d. is a precondition for FEVD consistency. Additionally, we should not rely on the FEVD results since the time span is shorter than 20, for which Plumper and Troeger (2011, p.160) argue to be "problematic". Furthermore, Plumper and Troeger (2011, p.7) note that "FEVD is inconsistent if and only if the time-invariant-variables are correlated with the unit effects", which cannot be tested. Moreover, it is not clear which variables should be treated as slowly moving variables (and therefore included in the second stage) since the relationship between the rarely changing variable and the unobserved unit effects is unobservable. Finally, the FEVD does not allow for diagnostic tests or for standard responses to diagnostic failure. Therefore, as suggested in most recent studies, dynamics will next be included in our next modelling approach since it is likely that there is "inflation inertia" in the countries in the sample.

This will also allow us to check the consistency of the results, which, due to the limitations discussed above, may not be fully reliable.

4.5. Dynamic panel model estimations

As it is likely that the inflation rate from the previous year affects the current inflation rate a dynamic panel will be estimated. Although none of the studies which estimate the effect of CBA on inflation (reviewed in Section 2) addressed this issue, recent studies of inflation emphasise the importance of taking the dynamics into account (Levy-Yeyati and Stuzengger, 2001; Loungani and Swagel, 2001; Bleaney and Fransisco, 2005; Barlow, 2010). Levy-Yeyati and Stuzengger (2001, p. 8) argued that lagged dependent variable should be included "to capture the effect of past policies on currency expectations, as well as to control for the possibility of backward-looking indexation". This inflation persistence is captured by inclusion of one lag of inflation (Equation 9).

$$\mathrm{LnINF}_{i,t} = \alpha_0 + \alpha_1 \ln\mathrm{INF}_{i,t-1} + (\alpha_2 CBA_{i,t} + \alpha_3 dejureFIX_{i,t} + \alpha_4 CCBI_{i,t}) + \alpha_5 \mathrm{GDPG}_{i,t} + \alpha_6 \mathrm{MSG}_{i,t} + \alpha_7 \mathrm{FB}_{i,t} + \alpha_8 \mathrm{OPEN}_{i,t} + \alpha_9 \mathrm{TOT}_{i,t} + \alpha_{10} \mathrm{EBRDI}_{i,t} + \alpha_{11} \mathrm{EU}_{i,t} + \alpha_{12} \mathrm{VAT}_{i,t} + \gamma_t + \varepsilon_{i,t} \quad (9)$$

Where $\varepsilon_{i,t} = u_i + v_{i,t}$ (u_i is a group-specific effect and $v_{i,t}$ is a white noise)

In order to estimate the dynamic model the General Method of Moments (GMM) is used. All GMM techniques for estimating dynamic panel models are argued to be suitable for panels with wide cross section (N) and short time series (T) which is the case with our sample (25 countries and 12 years of data). Dynamic panel estimators require as few as three periods of data to be usable, although "four or more will be preferable" (Greene, 2007, E11-83, as cited in Pugh, 2009). Other advantages of GMM are that distributional assumptions, such as normality, are not required and that it enables us to control for unobserved heterogeneity of the same countries over time (Verbeek, 2000, as cited in Pugh, 2009). The Arellano-Bond approach (the so called 'difference' GMM) which uses lagged values of the levels as instruments for the equations in the first differences is not conducted since it drops out the variable of interest which is time-invariant. Therefore, we use only the Arellano-Bover/Blundell-Bond (so called 'system' GMM) which builds a system of two equations: a difference equation which is instrumented by levels; and a levels equation instrumented by the first difference. Additionally, 'system' GMM is more comprehensive than "difference" GMM since lagged levels (used in 'difference' GMM) are argued to be rather poor instruments for the first difference variables, especially for variables that are close to a random walk which is frequently the case with macroeconomic variables (Baum, 2006, p.234). Although the system GMM as developed by Arellano-Bover/Blundell-Bond can be estimaed by using the Stata'a command 'xtdpdsys', we estimated it by the command 'xtabond2' which was subsequently developed by Roodman (2006). Roodman's 'xtabond2' is preferred over 'xtdpdsys' as it offers a much more flexible syntax than official Stata's 'xtabond', which does not allow the same specification of instrument sets. Since the variable of interest drops out when two-step estimator is used we applied the one-step 'system' GMM estimator. Again, the same three specifications are estimated: the first which includes the CBA variable only (Appendix 6a); the second with CBA and defactoFIX (appendix 6b) and the third with CBA, defactoFIX and CCBI variables (Appendix 6c).

For the reasons discussed in Section 4.2, the money supply growth and central bank independence variables are treated as endogenous. However, since a switch in the exchange rate regime is sometimes argued to be the result of high inflation rates this variable should be treated as endogenous as well. The Sargan test is at the border line of significance when the defactofix variable is treated as endogenous (Appendix 11). However, since we already have too many instruments for valid implementation of the Hansen test (see below) we will treat this variable as exogenous. Additionally, most of the countries in the sample which had fixed exchange rate during the observed period had it through the whole sample period and we argued that the endogeneity of ERR is expected when there is a switch in the regime. Due to our small sample, we used the minimum number of lags. However, even with a minimum number of lags we still have more instruments than groups (the number of instruments for each specification are 56, 57, 74, respectively, while number of groups is 17). Consequently, the Hansen version of the Sargan test is too weak, which is indicated by the p-value = 1.00, meaning that it is unable to reject the null hypothesis of instrument validity. Although the number of instruments could be decreased by using the "collapse" option within the 'xtabond2', this option is not used since it also reduces the additional

information and, in consequence, all variables in the sample are imprecisely estimated. However, the Sargan test is available and suggests that there is no problem with instrument validity in the final, third, specification, while in the first two specifications the Sargan test suggests that the hypothesis of instrument validity is rejected. Moreover, tests for the first (m1) and second order autocorrelation (m2) suggest no problem with autocorrelation through all specifications also suggesting the instrument validity. The m2+m1 procedure requires rejection of the null of m1, meaning that there is first-order autocorrelation, and "acceptance" of m2 null, meaning that there is no second-order autocorrelation; conditions which are satisfied for all specifications.

Table 5. Results from the one-step 'system' GMM (Estimation of the effect of CBA on inflation)

Estimation technique	One-step 'system' GMM		
Independent variables	**S4**	**S5**	**S6**
L1.lninf	0.464***	0.466***	0.413***
CBA	-0.306*	-0.303*	-0.274**
DefactoFIX		-0.014	0.126
CCBI			-0.937
GDPG	-0.006	-0.006	-0.013
MSG	0.009**	0.008**	0.023***
FB	0.003	0.004	0.003
OPEN	0.003**	0.003**	0.004*
TOT	0.004**	0.004**	0.004
EBRDI	-0.223	-0.240	0.292
VAT	0.621***	0.619***	0.534***
EU	0.169	0.185	-0.065

*Note: ***, **, * donates that variables are statistically significant at the 1%, 5% and 10%, respectively*

Results from the one-step 'system' GMM (summarised in Table 5) suggest that, in all specifications, the lagged dependent variable is highly significant and positive, indicating that inflation is persistent in these countries. Results also suggest that CBA has a significant and negative effect on inflation, even after controlling for the fixed ER and central bank independence (S6). The coefficient on the CBA variable suggests that countries with a CBA have, on average, 27.4 percentage points lower inflation rate than countries without a CBA, holding other factors constant. Variables for the fixed ER and central bank independence are not found to have an important influence on inflation (since these variables are insignificant). The money supply variable is again significant and positive in all specifications. The dummy variable for the introduction of VAT is also highly significant and positive in all specifications indicating that it has a positive short-run effect on inflation (in the year of introduction). The differences between the inferences from the static and dynamic estimators will be explained in Section 4.7.

4.6. Examining differences between CBAs

As argued in Section 2 CBAs in transition countries are not the same, some of them are stricter while others are more flexible and therefore should be expected to have different effect on inflation. In order to distinguish the effect of CBAs which are stricter from the more flexible ones the CBA variable is divided into strong CBA and weak CBA. Bosnia and Herzegovina's and Estonian CBAs are classified as 'strong', since they are argued to be more strict (and to have a higher pre-commitment index), while Bulgarian and Lithuanian CBAs are classified as 'weak' since they deviate significantly from the orthodox rules (and have a lower pre-commitment index) (for the values of pre-commitment indices see Section 4.1, footnote 7). The same specifications (but with CBA divided for strong and weak CBAs) are estimated by using FEVD (Appendix 8) and one-step 'system' GMM (Appendix 9). Diagnostic tests do not significantly differ from those results reported above.

Table 6. Strong and weak CBA specifications estimated by FEVD and system GMM (Estimation of the effect of 'strong' and 'weak' CBA on inflation)

Estimation technique	FEVD			One-step 'system' GMM		
Independent variables	**S1'**	**S2'**	**S3'**	**S4'**	**S5'**	**S6'**
L1. lninf				0.464***	0.469***	0.413***
StrongCBA	-1.123***	-0.955**	-1.088	-0.536***	-0.548***	-0.597***
WeakCBA	-0.329	-0.233	-0.180	-0.174	-0.187	-0.147
DefactoFIX		-0.211	0.047		0.011	0.123
(L1)CCBI			-1.744**			-0.849
GDPG	-0.021	-0.021	-0.055	-0.008	-0.008	-0.012
(L1)MSG	0.010***	0.009***	0.012**	0.008**	0.008**	0.020***
FB	-0.010	-0.010	0.035	0.001	0.003	0.005
OPEN	0.013**	0.013**	0.007	0.004***	0.004***	0.005*
TOT	0.005	0.004	0.023	0.005**	0.005**	0.010*
EBRDI	-0.634**	-0.667**	-0.250	-0.268*	-0.281**	0.124
VAT	0.954*	0.953*	0.895	0.675***	0.663***	0.575***
EU	-0.162	-0.167	-0.284	0.170	0.188	-0.058

*Note: ***, **, * donates that variables are statistically significant at the 1%, 5% and 10%, respectively ' Equation are the same as the specifications S1-S6, with the difference that the CBA variable is divided into 'strongCBA' and 'weakCBA'*

Results summarised in Table 6 suggest that strong CBAs have a negative and significant effect on inflation (except in the FEVD when central bank independence variable is included after which the strongCBA variable loses significance), while the effect of weak CBAs is insignificant through all specifications. When estimated by the 'system' GMM the strongCBA variable is highly significant and negative in all specifications. Moreover, after dividing the CBA variable between strong and weak the effect of strong CBA on inflation is higher compared to the effect of the combined CBA variable. The coefficient on the strong CBA variable suggests that countries with a 'strong' CBA have, on average, 59.7 percentage points lower inflation rate than countries without a CBA and with 'weak' CBA, holding other factors constant.

4.7. Comparison between preferred static and preferred dynamic estimations and discussion of the results

Given that the dependent variable is included as a lagged regressor in the dynamic model, the coefficients estimated by the dynamic estimator indicate the short-run or impact effects. Specifically, the lagged dependent variable is netting out the historical effect of all independent variables and, consequently, the coefficient estimates on the independent variables are capturing any current (impact) effect on dependent variable. On the other hand, the static model gives the long-run (overall) effects of the independent variable. Therefore, in order to compare the coefficients from the static estimator with the coefficients from the dynamic estimator we have to calculate the long-run coefficients from the dynamic estimator. This is done by dividing the (short-run) coefficient on variable of interest from the dynamic estimator with (1-coefficient on the lagged dependent variable) (Equation 10) (for a derivation see Pugh et al., 2008). The long-run coefficients on CBA and strong CBA and weak CBA are estimated by the 'nlcom' command in STATA which also gives us SEs and confidence intervals (Appendix 7 and Appendix 10). This adjustment of the short-run (SR) coefficients on variable(s) of interest obtained from the dynamic panel model for the long-run (LR) closely replicates the coefficients from the static panel equation (Table 7).

$$\text{Long-run coefcient} = \frac{\text{Regressor's (short-run) coefficient}}{1 - \text{Coefficient of the lagged dependent variable}} \quad (10)$$

Table 7. Comparison of the long run coefficients on CBA, strongCBA, weak CBA and CBI from the preferred static and dynamic model

		CBA	CBI	Strong CBA	Weak CBA	CBI
Static coefficient		-0.614	-1.992 **	-1.088	-0.180	-1.744 **
Dynamic	SR coefficient	-0.274 **	-0.937	-0.597 ***	-0.147	-0.849
	LR coefficient	-0.466 **	-1.597	-1.017 ***	-0.249	-1.446

*Note: ***, **, * donates that variables are statistically significant at the 1%, 5% and 10%, respectively*

When the coefficients on CBA and CBI are compared it can be noticed that the coefficient on CBI is always higher than coefficient on CBA, although their significance differs (Table 7). The static estimator suggests that after controlling for the CBI this variable (CBI) has a significant and negative effect on inflation, while the overall effect of CBA becomes insignificant. Since in the static estimations the coefficients are indicating the long-run (history) effects of independent variables on inflation this implies that if country's central bank has high degree of independence for entire history it does not need a CBA, since high CBI contributes most with respect to inflation reduction. On the other hand, results of the dynamic estimator suggest that the short-run effect of CBA is still significant and negative after inclusion of the CBI variable, while the latter's short-run effect on inflation is insignificant. These results suggest that when the overall (contemporaneous) effect on inflation is estimated a CBA is not adding anything more than a higher degree of central bank independence with respect to inflation. On the other hand, the dynamic estimator suggests that the CBA continues to be important with respect to inflation even after the history of CBA and CBI is accounted for, while the short-run effect of CBI on inflation is estimated to be insignificant. Moreover, in the static estimator the effect of lagged CBI on current inflation is estimated while this effect in the dynamic estimator is captured by the lagged dependent variable (see equations below) and the coefficient on the CBI is giving us the impact effect of CBI on inflation, which is, according to the results, insignificant.

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_1 X_{i,t} + \varepsilon_{i,t} \tag{11}$$

If the whole Equation 11 is lagged once

$$Y_{i,t-1} = \beta_0 + \beta_1 Y_{i,t-2} + \beta_1 X_{i,t-1} + \varepsilon_{i,t-1} \tag{12}$$

If 12 is substituted into 11

$$Y_{i,t} = \beta_0 + \beta_1[(\beta_0 + \beta_1 Y_{i,t-2} + \beta_1 X_{i,t-1} + \varepsilon_{i,t-1}] + \beta_1 X_{i,t} + \varepsilon_{i,t} \tag{13}$$

This algebra indicates that in the dynamic estimation the historical effect of all independent variables is captured by the lagged dependent variable.

5. Conclusion

The existing literature about the effect of CBA on inflation performance lack comprehensive empirical analysis and the aim of this paper is to fill this gap. Moreover, this paper is exclusively focused on the transition countries and in the empirical analysis it is controlled for the country specifics. The simplest specification which includes a CBA variable (before controlling for fixed exchange rate and central bank independence, S1 and S4) suggests that CBA reduces inflation more than all the other monetary and exchange rate regime combinations. This result is consistent within both static and dynamic estimations. As elaborated in Section 4.1 the CBA variable is treated as monetary framework, not just as the ERR, and therefore it is compared to all other monetary-ERR combinations. In order to test whether its negative effect on inflation is a result of fixed exchange rate, central bank independence or the fact that its major features are embedded in law and that it "ties" the hands of the monetary authority, we control first for the fixed exchange rate (S2 and S5) and then, in addition, for the level of

central bank independence (S3 and S6). Although its significance decreases once a fixed exchange rate is included, the CBA variable is still negative and significant at 10% level in both the static and dynamic estimations. However, when controlling for the degree of central bank independence the sign of the CBA variable does not change, although its significance is qualitatively different within static and dynamic estimations.

One more important finding is that the degree of strictness of the CBA appears to be important in respect to the reduction in inflation, since the division of the CBA variable into 'strong' and 'weak' suggests that they do not have the same significant effect on inflation. According to the results from both static and dynamic estimations, the 'weak' CBAs, the ones which deviate more from the orthodox rules, do not have a significant effect on inflation, while the 'strong' CBAs, the ones which are the most strict, have a significant and negative effect through all specifications (except in FEVD after the CBI variable is introduced). However, it is important to note that we are operating with a very small sample and therefore it was not possible to implement some of the diagnostic tests. Moreover, the results from the static estimator should be considered only as indicative since the high and systematic significance of lagged dependent variable might suggest that the static model is misspecified. Moreover, discussion about the consistency of the FEVD estimator is still on-going. However, the dynamic estimation suggests that a CBA should be treated as a monetary framework and that it has a current effect on inflation reduction over and above the fixed exchange rate and high degree of central bank independence, which is presumably the result of the additional credibility of the monetary authority which operates under a strong CBA. This also implies that there is a continuous need for a CBA in the countries that operate under the CBA and that it continues to contribute these countries with respect to inflation in the current period.

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Appendices

Appendix 1. Correlation matrix between explanatory variables

```
. correlate cba gdpg l1msg fb open tot ebrdi l1ccbi defactofix vat eu
(obs=155)

             |      cba     gdpg    l1msg       fb     open      tot    ebrdi   l1ccbi defact~x   vat    eu
-------------+---------------------------------------------------------------------------------------------
------
         cba |   1.0000
        gdpg |   0.1451   1.0000
       l1msg |   0.0160   0.1802   1.0000
          fb |   0.4730   0.5050   0.1282   1.0000
        open |   0.2494   0.1306  -0.1989   0.2023   1.0000
         tot |   0.4521   0.0387   0.0519   0.2405   0.2443   1.0000
       ebrdi |   0.0125  -0.0712  -0.5061  -0.1767   0.4658   0.2678   1.0000
      l1ccbi |   0.3640  -0.0400  -0.3634   0.1022   0.3188   0.1289   0.3727   1.0000
  defactofix |   0.5670  -0.0147   0.0587   0.3503   0.2363   0.3974  -0.0552   0.2447   1.0000
         vat |   0.0750   0.0317   0.0163   0.1546  -0.0790  -0.0021  -0.1550   0.0228   0.0347   1.0000
          eu |   0.0545  -0.0257  -0.2207  -0.0077   0.3646   0.2056   0.5699   0.3233   0.0495  -0.0743   1
```

Appendix 2. Estimation of inflation regression by OLS

```
. xi: regress lninf cba gdpg l1msg fb open tot ebrdi l1ccbi defactofix vat eu i.time
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
note: _Itime_1999 omitted because of collinearity
note: _Itime_2009 omitted because of collinearity

      Source |       SS       df       MS              Number of obs =     155
-------------+------------------------------           F( 20,   134) =    5.00
       Model |  78.5777266    20  3.92888633           Prob > F      =  0.0000
    Residual |  105.337836   134  .786103254           R-squared     =  0.4272
-------------+------------------------------           Adj R-squared =  0.3418
       Total |  183.915563   154   1.1942569           Root MSE      =  .88662

------------------------------------------------------------------------------
       lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         cba |  -.6308146   .2571821    -2.45   0.015    -1.139476   -.1221532
        gdpg |  -.0621849   .0271283    -2.29   0.023    -.1158399   -.0085298
       l1msg |   .0237804   .0050624     4.70   0.000     .0137678    .033793
          fb |    .076469   .0362129     2.11   0.037     .0048461    .1480918
        open |   .0043217   .0028773     1.50   0.135    -.0013692    .0100125
         tot |   .0078802   .0088849     0.89   0.377    -.0096927    .025453
       ebrdi |   .1734574   .2608658     0.66   0.507    -.3424897    .6894045
      l1ccbi |  -1.578377   .6110523    -2.58   0.011    -2.786932   -.3698222
  defactofix |   .0840839   .1969969     0.43   0.670    -.3055416    .4737094
         vat |   .9993783   .6663563     1.50   0.136    -.3185583    2.317315
          eu |   .0106969   .2309324     0.05   0.963    -.4460471    .4674409
 _Itime_1999 |  (omitted)
 _Itime_2000 |   .7701197   .5065317     1.52   0.131    -.2317117    1.771951
 _Itime_2001 |   .4267333   .4970574     0.86   0.392    -.5563596    1.409826
 _Itime_2002 |  -.3849064   .4968536    -0.77   0.440    -1.367596    .5977835
 _Itime_2003 |  -.2420223   .5103924    -0.47   0.636     -1.25149     .767445
 _Itime_2004 |   .3851175   .5211349     0.74   0.461    -.6455965    1.415832
 _Itime_2005 |    .064517   .5065685     0.13   0.899    -.9373872    1.066421
 _Itime_2006 |   .2955697    .520528     0.57   0.571    -.7339441    1.325083
 _Itime_2007 |   .3762072   .5204501     0.72   0.471    -.6531523    1.405567
 _Itime_2008 |   .8754101   .4785967     1.83   0.070    -.0711708    1.821991
 _Itime_2009 |  (omitted)
       _cons |   .6716565   1.125689     0.60   0.552     -1.55476    2.898073
------------------------------------------------------------------------------
```

***Test for joint significance of time dummies**

```
. test   _Itime_1999 _Itime_2000 _Itime_2001 _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005
_Itime_2006 _Itime_2007 _Itime_2008 _Itime
> _2009

 ( 1)  o._Itime_1999 = 0
 ( 2)  _Itime_2000 = 0
 ( 3)  _Itime_2001 = 0
 ( 4)  _Itime_2002 = 0
```

```
 ( 5)  _Itime_2003 = 0
 ( 6)  _Itime_2004 = 0
 ( 7)  _Itime_2005 = 0
 ( 8)  _Itime_2006 = 0
 ( 9)  _Itime_2007 = 0
 (10)  _Itime_2008 = 0
 (11)  o._Itime_2009 = 0
       Constraint 1 dropped
       Constraint 11 dropped

       F(  9,   134) =    3.04
            Prob > F =    0.0025

. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |     155.00    154    0.4622
            Skewness |      16.94     20    0.6570
            Kurtosis |       1.89      1    0.1696
---------------------+-----------------------------
               Total |     173.82    175    0.5109
---------------------------------------------------

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lninf

         chi2(1)      =     4.78
         Prob > chi2  =   0.0288

. estat ovtest

Ramsey RESET test using powers of the fitted values of lninf
       Ho:  model has no omitted variables
                 F(3, 131) =      2.19
                  Prob > F =      0.0926
```

Appendix 3. Estimation of inflation regression by FE and RE model + Hausman test

```
. xi: xtreg lninf cba gdpg l1msg fb open tot ebrdi l1ccbi defactofix vat eu i.time, fe
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
note: cba omitted because of collinearity
note: _Itime_1999 omitted because of collinearity
note: _Itime_2002 omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       155
Group variable: ctyno                           Number of groups   =        17

R-sq:  within  = 0.3489                         Obs per group: min =         7
       between = 0.2582                                        avg =       9.1
       overall = 0.2870                                        max =        10

                                                F(19,119)          =      3.36
corr(u_i, Xb)  = -0.2561                        Prob > F           =    0.0000

------------------------------------------------------------------------------
       lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         cba |  (omitted)
        gdpg |  -.0546837   .0271802    -2.01   0.046    -.1085032   -.0008642
       l1msg |   .0124851   .0050748     2.46   0.015     .0024364    .0225337
          fb |    .035328   .0410985     0.86   0.392    -.0460511    .1167072
        open |   .0067485   .0087291     0.77   0.441     -.010536    .0240331
         tot |   .0233886   .0157799     1.48   0.141    -.0078571    .0546344
      ebrdi |  -.7084684   .6253588    -1.13   0.260    -1.946741    .5298046
     l1ccbi |  -1.329348    .664849    -2.00   0.048    -2.645815   -.0128804
  defactofix |   .0467399   .3033178     0.15   0.878    -.5538597    .6473394
         vat |   .8948198   .6044297     1.48   0.141    -.3020114    2.091651
          eu |  -.2835026   .2478527    -1.14   0.255    -.7742756    .2072704
```

```
 _Itime_1999 |  (omitted)
 _Itime_2000 |    .827447   .2975542     2.78   0.006       .23826    1.416634
 _Itime_2001 |   .7263703   .2706621     2.68   0.008     .1904323    1.262308
 _Itime_2002 |  (omitted)
 _Itime_2003 |  -.0168307   .2833613    -0.06   0.953    -.5779143     .5442529
 _Itime_2004 |   .7549974   .3206077     2.35   0.020      .120162    1.389833
 _Itime_2005 |   .6172059   .3259445     1.89   0.061    -.0281967    1.262608
 _Itime_2006 |   .8646385    .342647     2.52   0.013     .1861632    1.543114
 _Itime_2007 |   .9742344   .3715395     2.62   0.010     .2385491     1.70992
 _Itime_2008 |   1.497097   .3806897     3.93   0.000     .7432935    2.250901
 _Itime_2009 |   .2962255   .5236054     0.57   0.573    -.7405655    1.333016
       _cons |   1.229915   2.867919     0.43   0.669     -4.44885    6.908681
-------------+----------------------------------------------------------------
     sigma_u |  .68312727
     sigma_e |  .75493878
         rho |  .45018805   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(16, 119) =     4.11                 Prob > F = 0.0000

. estimates store fe

. xi: xtreg lninf cba gdpg l1msg fb open tot ebrdi l1ccbi defactofix vat eu i.time, re
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
note: _Itime_1999 omitted because of collinearity
note: _Itime_2009 omitted because of collinearity

Random-effects GLS regression                   Number of obs      =       155
Group variable: ctyno                           Number of groups   =        17

R-sq:  within  = 0.3310                         Obs per group: min =         7
       between = 0.5579                                        avg =       9.1
       overall = 0.4204                                        max =        10

Random effects u_i ~ Gaussian                   Wald chi2(20)      =     84.43
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
       lninf |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         cba |  -.6471789   .3061231    -2.11   0.035    -1.247169   -.0471888
        gdpg |  -.0600399   .0263035    -2.28   0.022    -.1115938   -.0084861
       l1msg |   .0186279   .0049564     3.76   0.000     .0089135    .0283422
          fb |   .0612712   .0370175     1.66   0.098    -.0112817    .1338241
        open |   .0045083   .0036017     1.25   0.211    -.0025509    .0115674
         tot |   .0135639   .0100987     1.34   0.179    -.0062293    .0333571
       ebrdi |   .0018316   .2900018     0.01   0.995    -.5665615    .5702246
     l1ccbi |  -1.550297   .6113205    -2.54   0.011    -2.748464   -.3521311
  defactofix |   .0791879   .2217125     0.36   0.721    -.3553605    .5137363
         vat |   .9094053   .6203551     1.47   0.143    -.3064684    2.125279
          eu |  -.0749511   .2267764    -0.33   0.741    -.5194246    .3695224
 _Itime_1999 |  (omitted)
 _Itime_2000 |   .7672598    .480852     1.60   0.111    -.1751929    1.709712
 _Itime_2001 |   .5200251   .4718278     1.10   0.270    -.4047404    1.444791
 _Itime_2002 |  -.2676336   .4701534    -0.57   0.569    -1.189117    .6538501
 _Itime_2003 |  -.2042607   .4820654    -0.42   0.672    -1.149092    .7405702
 _Itime_2004 |   .4663733   .4899871     0.95   0.341    -.4939838     1.42673
 _Itime_2005 |   .2132034   .4741583     0.45   0.653    -.7161298    1.142537
 _Itime_2006 |   .4551041   .4862486     0.94   0.349    -.4979257    1.408134
 _Itime_2007 |   .5368049   .4872725     1.10   0.271    -.4182317    1.491841
 _Itime_2008 |   1.035671    .443925     2.33   0.020     .1655944    1.905748
 _Itime_2009 |  (omitted)
       _cons |   .6088284    1.26771     0.48   0.631    -1.875837    3.093494
-------------+----------------------------------------------------------------
     sigma_u |  .26079691
     sigma_e |  .75493878
         rho |  .10661539   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. estimates store re

. hausman fe re

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       fe           re          Difference          S.E.
-------------+----------------------------------------------------------------
        gdpg |   -.0546837    -.0600399        .0053562        .0068477
```

```
       l1msg |    .0124851     .0186279       -.0061428        .0010899
          fb |     .035328     .0612712       -.0259432        .0178548
        open |    .0067485     .0045083        .0022403        .0079515
         tot |    .0233886     .0135639        .0098247        .0121252
      ebrdi |   -.7084684     .0018316       -.7102999        .5540511
     l1ccbi |   -1.329348    -1.550297        .2209495        .2613645
  defactofix |    .0467399     .0791879       -.0324481         .206991
         vat |    .8948198     .9094053       -.0145855               .
          eu |   -.2835026    -.0749511       -.2085515        .1000172
 _Itime_2000 |     .827447     .7672598        .0601872               .
 _Itime_2001 |    .7263703     .5200251        .2063452               .
 _Itime_2003 |   -.0168307    -.2042607          .18743               .
 _Itime_2004 |    .7549974     .4663733        .2886241               .
 _Itime_2005 |    .6172059     .2132034        .4040025               .
 _Itime_2006 |    .8646385     .4551041        .4095344               .
 _Itime_2007 |    .9742344     .5368049        .4374295               .
 _Itime_2008 |    1.497097     1.035671        .4614259               .
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                chi2(18) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                         =   -20.38    chi2<0 ==> model fitted on these
                                       data fails to meet the asymptotic
                                       assumptions of the Hausman test;
                                       see suest for a generalized test
```

Appendix 4. Between and within variance for all variables

```
. xtsum lninf cba gdpg l1msg fb open tot ebrdi l1ccbi defactofix vat eu

Variable         |      Mean   Std. Dev.       Min        Max |    Observations
-----------------+--------------------------------------------+----------------
lninf    overall |   1.78142   1.140335   -2.99537    5.68249 |     N =      291
         between |             .7921285   .6006939   3.406685 |     n =       25
         within  |             .8346604  -1.814644   4.208096 | T-bar =   11.64
                 |                                            |
cba      overall |  .1546392   .3621832          0          1 |     N =      291
         between |             .3741657          0          1 |     n =       25
         within  |                    0   .1546392   .1546392 | T-bar =   11.64
                 |                                            |
gdpg     overall |  5.149239   5.437408   -18.0147       34.5 |     N =      291
         between |             2.779035   2.799421    15.9049 |     n =       25
         within  |             4.772553    -17.613   23.74434 | T-bar =   11.64
                 |                                            |
l1msg    overall |  28.37699    29.4667   -14.1329    276.004 |     N =      266
         between |             17.78962   8.150274   89.80534 |     n =       25
         within  |             23.54474  -35.08755   214.5757 | T-bar =   10.64
                 |                                            |
fb       overall | -2.347059   3.903684      -13.1       25.5 |     N =      289
         between |             2.590408  -6.516667       3.84 |     n =       25
         within  |             2.973249  -11.35539   19.31294 | T-bar =   11.56
                 |                                            |
open     overall |  103.0023   31.49195    45.1349    203.203 |     N =      289
         between |             28.61242   57.85231   157.6787 |     n =       25
         within  |             14.02616   55.97229   185.8942 | T-bar =   11.56
                 |                                            |
tot      overall |   106.485   20.79161    73.5077    238.183 |     N =      242
         between |             14.45807   91.55393   145.8427 |     n =       25
         within  |             15.13587   53.74685   198.8254 | T-bar =    9.68
                 |                                            |
ebrdi    overall |  3.107154   .5478565        1.4          4 |     N =      289
         between |             .5205618   1.833333      3.925 |     n =       25
         within  |             .1938693   2.207154   3.807154 | T-bar =   11.56
                 |                                            |
l1ccbi   overall |  .7750055   .1651642         .34       .979 |     N =      177
         between |              .112309   .5425202       .979 |     n =       17
         within  |             .1228211    .425051   1.064324 | T-bar = 10.4118
                 |                                            |
defact~x overall |  .2886598     .45392          0          1 |     N =      291
         between |              .398462          0          1 |     n =       25
         within  |             .2376522  -.5446735   1.205326 | T-bar =   11.64
                 |                                            |
```

```
vat      overall |  .0171821   .1301735          0          1 |     N =     291
         between |             .0361258          0         .1 |     n =      25
         within  |             .1253834  -.0828179   .9338488 | T-bar =   11.64
                 |                                           |
eu       overall |  .1821306    .386617          0          1 |     N =     291
         between |             .2344437          0   .5454545 |     n =      25
         within  |             .3104754   -.363324   .9321306 | T-bar =   11.64
```

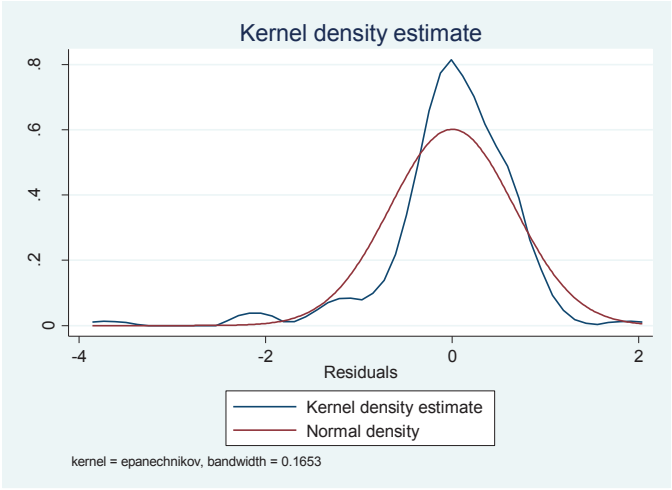
Appendix 5. FEVD (with 4 CBA countries)

Appendix 5a *Stage-by-stage estimation*

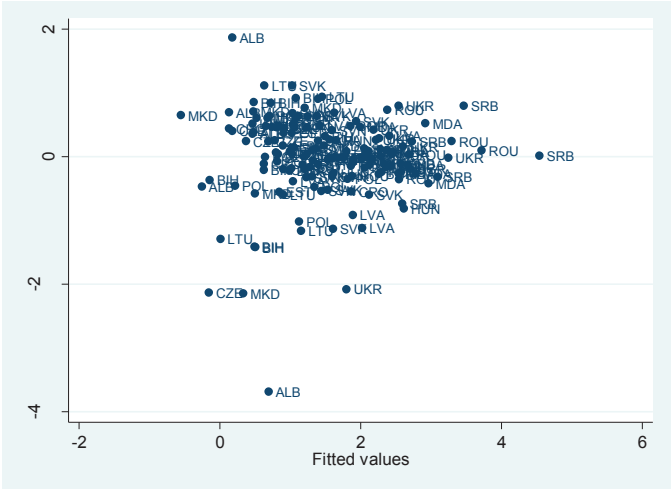
```
. *Stage 1 (panel robust SE)
. xi: xtreg lninf cba gdpg l1msg fb open tot ebrdi l1ccbi defactofix vat eu i.time , fe robust
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
note: cba omitted because of collinearity
note: _Itime_1999 omitted because of collinearity
note: _Itime_2002 omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       155
Group variable: ctyno                           Number of groups   =        17

R-sq:  within  = 0.3489                         Obs per group: min =         7
       between = 0.2582                                        avg =       9.1
       overall = 0.2870                                        max =        10

                                                F(16,16)           =         .
corr(u_i, Xb)  = -0.2561                        Prob > F           =         .

                                  (Std. Err. adjusted for 17 clusters in ctyno)
------------------------------------------------------------------------------
             |               Robust
       lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         cba |  (omitted)
        gdpg |  -.0546837   .0196203    -2.79   0.013     -.096277   -.0130905
       l1msg |   .0124851   .0052811     2.36   0.031     .0012897    .0236805
          fb |    .035328   .0371683     0.95   0.356    -.0434652    .1141213
        open |   .0067485   .0080507     0.84   0.414    -.0103183    .0238153
         tot |   .0233886    .013262     1.76   0.097    -.0047256    .0515028
       ebrdi |  -.7084684   .8168121    -0.87   0.399    -2.440033    1.023096
     l1ccbi |  -1.329348   .5704019    -2.33   0.033    -2.538546   -.1201497
  defactofix |   .0467399   .5175766     0.09   0.929    -1.050473    1.143953
         vat |   .8948198   .1930988     4.63   0.000     .4854686    1.304171
          eu |  -.2835026    .245017    -1.16   0.264    -.8029153    .2359102
 _Itime_1999 |  (omitted)
 _Itime_2000 |    .827447   .5764563     1.44   0.170    -.3945857     2.04948
 _Itime_2001 |   .7263703   .3033033     2.39   0.029      .083396    1.369345
 _Itime_2002 |  (omitted)
 _Itime_2003 |  -.0168307   .3726068    -0.05   0.965    -.8067219    .7730605
 _Itime_2004 |   .7549974   .2426289     3.11   0.007     .2406472    1.269348
 _Itime_2005 |   .6172059   .3413577     1.81   0.089    -.1064402    1.340852
 _Itime_2006 |   .8646385    .280688     3.08   0.007     .2696065     1.45967
 _Itime_2007 |   .9742344   .2977478     3.27   0.005     .3430371    1.605432
 _Itime_2008 |   1.497097   .3528985     4.24   0.001     .7489858    2.245209
 _Itime_2009 |   .2962255   .4149905     0.71   0.486    -.5835152    1.175966
       _cons |   1.229915   3.620088     0.34   0.738    -6.444328    8.904159
-------------+----------------------------------------------------------------
     sigma_u |  .68312727
     sigma_e |  .75493878
         rho |  .45018805   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. *Save fixed effect (unit effects) from stage 1
. predict fixeff, u
(136 missing values generated)

. *Stage 2 (regression of the FE vector on the time-invariant and slowly changing explantory
variables - by OLS)
. reg fixeff cba ebrdi l1ccbi

      Source |       SS       df       MS              Number of obs =     155
-------------+------------------------------           F(  3,   151) =   24.54
       Model |  22.2052649     3  7.40175495           Prob > F      =  0.0000
    Residual |  45.5462998   151  .301631125           R-squared     =  0.3277
```

```
-------------+------------------------------           Adj R-squared =  0.3144
       Total |  67.7515647   154  .439945225           Root MSE      =  .54921

------------------------------------------------------------------------------
      fixeff |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         cba |  -.6141823   .1144441    -5.37   0.000    -.8403007   -.3880638
      ebrdi |   .5598661   .1025604     5.46   0.000     .3572274    .7625048
      l1ccbi |  -.6626595   .3234178    -2.05   0.042    -1.301668   -.0236509
       _cons |   -1.20862   .3358441    -3.60   0.000    -1.872181   -.5450599
------------------------------------------------------------------------------

. * Save the residuals from stage 2
. predict resfevd, residuals
(136 missing values generated)

. *Stage 3 (estimation of pooled OLS by including all explanatory time-variant, time-invariant
variables and unexplained part of the F
> E vector - error term from the stage 2)
. regress lninf cba gdpg l1msg fb open tot ebrdi l1ccbi defactofix vat eu  resfevd i.time

      Source |       SS       df       MS              Number of obs =     155
-------------+------------------------------           F( 21,   133) =   10.84
       Model |  116.093589    21  5.52826613           Prob > F      =  0.0000
    Residual |   67.821974   133  .509939654           R-squared     =  0.6312
-------------+------------------------------           Adj R-squared =  0.5730
       Total |  183.915563   154   1.1942569           Root MSE      =   .7141

------------------------------------------------------------------------------
       lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         cba |  -.6141823   .2071473    -2.96   0.004    -1.023912   -.2044528
        gdpg |  -.0546837    .021867    -2.50   0.014    -.0979359   -.0114316
       l1msg |   .0124851   .0042847     2.91   0.004       .00401    .0209601
          fb |    .035328   .0295582     1.20   0.234    -.0231369     .093793
        open |   .0067485   .0023346     2.89   0.004     .0021307    .0113664
         tot |   .0233886   .0073809     3.17   0.002     .0087894    .0379878
       ebrdi |  -.1486023   .2134339    -0.70   0.487    -.5707663    .2735617
      l1ccbi |  -1.992007   .4945076    -4.03   0.000    -2.970124    -1.01389
  defactofix |   .0467399   .1587239     0.29   0.769    -.2672099    .3606896
         vat |   .8948198   .5368316     1.67   0.098    -.1670124    1.956652
          eu |  -.2835026   .1891326    -1.50   0.136    -.6575995    .0905943
     resfevd |          1   .1165875     8.58   0.000     .7693945    1.230606
             |
        time |
        2001 |  -.1010767    .255624    -0.40   0.693     -.606691    .4045376
        2002 |   -.827447    .264803    -3.12   0.002    -1.351217    -.303677
        2003 |  -.8442777   .2637907    -3.20   0.002    -1.366046   -.3225099
        2004 |  -.0724496   .2845577    -0.25   0.799    -.6352937    .4903944
        2005 |  -.2102411   .2930076    -0.72   0.474    -.7897988    .3693166
        2006 |   .0371915   .2950501     0.13   0.900    -.5464062    .6207891
        2007 |   .1467874   .3035534     0.48   0.629    -.4536296    .7472043
        2008 |   .6696502   .3071827     2.18   0.031     .0620547    1.277246
        2009 |  -.5312215   .4089178    -1.30   0.196    -1.340045    .2776019
             |
       _cons |   .8487422   .8537954     0.99   0.322     -.840032    2.537516
------------------------------------------------------------------------------

. *Diagnostic tests after 3rd stage*
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |     155.00    154    0.4622
            Skewness |      21.95     21    0.4022
            Kurtosis |       1.74      1    0.1868
---------------------+-----------------------------
               Total |     178.70    176    0.4292
---------------------------------------------------

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
```

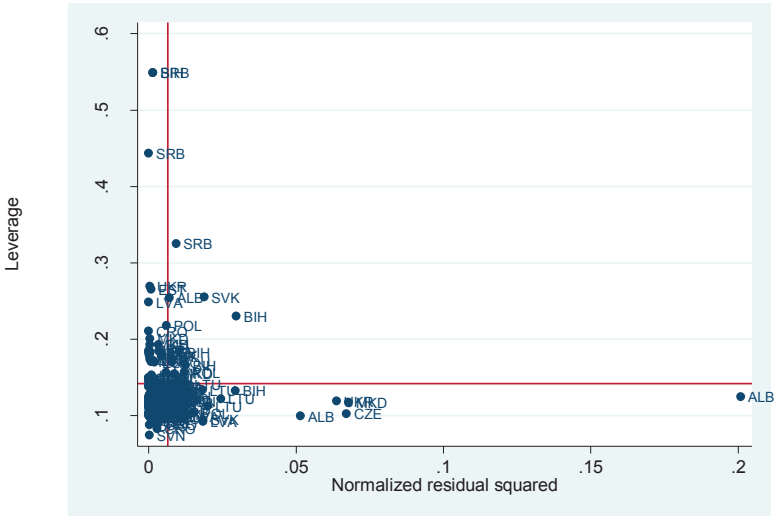
```
          Variables: fitted values of lninf

          chi2(1)      =    32.67
          Prob > chi2  =   0.0000

. estat ovtest

Ramsey RESET test using powers of the fitted values of lninf
       Ho:  model has no omitted variables
                 F(3, 130) =      0.62
                  Prob > F =      0.6061

.
end of do-file


.
Predict resid, residuals

Kdensity resid, normal
```




```
. rvfplot, mlabel(cntry)
```




```
. lvr2plot, mlabel(cntry)
```




```
. hilo resi ctyno time
10 lowest and highest observations on resi
```

resi	ctyno	time
-3.690872	1	2000
-2.144845	16	2005
-2.134328	8	2003
-2.079443	25	2002
-1.421205	5	2002
-1.412706	5	2004
-1.289507	15	2002
-1.166808	15	2000
-1.130314	22	2009
-1.11768	14	2001

resi	ctyno	time
.7954019	21	2000
.7956773	25	2000
.8416286	5	2000
.8534227	5	2005
.9085998	18	2000
.9203253	5	2008
.9382645	15	2008
1.113313	15	2007
1.11936	22	2003
1.870186	1	2002

```
. predict levi, leverage
(136 missing values generated)

. hilo levi cntry time, show(5)high
5 highest observations on levi
```

levi	cntry	time
.268995	UKR	2009
.3250492	SRB	2000
.4431643	SRB	2001
.5485758	BIH	2006
.5485758	SRB	2005

Appendix 5b *Xtfevd (only CBA included)

```
. xtfevd lninf cba gdpg l1msg fb open tot ebrdi vat eu  _itimeb2001 _itimeb2002 _itimeb2003
_itimeb2004 _itimeb2005 _itimeb2006 _itime
> b2007 _itimeb2008 _itimeb2009, invariant(cba ebrdi)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      194           number of obs       =      237
mean squared error         = .4203354           F( 20, 194)         = 4.910439
root mean squared error    = .6483328           Prob > F            = 4.76e-09
Residual Sum of Squares    = 99.61948           R-squared           = .6374333
Total Sum of Squares       = 274.7618           adj. R-squared      = .5589395
Estimation Sum of Squares  = 175.1423

------------------------------------------------------------------------------
             |                fevd
      lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
       gdpg |  -.0186843   .0187171    -1.00   0.319    -.0555995    .0182308
      l1msg |   .0078899   .0033026     2.39   0.018     .0013762    .0144035
         fb |  -.0089355   .0251457    -0.36   0.723    -.0585295    .0406585
       open |   .0122116   .0054566     2.24   0.026     .0014497    .0229736
        tot |   .0044066   .0050605     0.87   0.385     -.005574    .0143873
        vat |   .9350791   .5049941     1.85   0.066    -.0609043    1.931063
         eu |  -.1626722   .2653044    -0.61   0.540    -.6859234    .3605791
_itimeb2001 |  -.0754908   .2225219    -0.34   0.735    -.5143636     .363382
_itimeb2002 |   -.651487   .2187473    -2.98   0.003    -1.082915   -.2200589
_itimeb2003 |  -.7015375   .2223031    -3.16   0.002    -1.139979   -.2630963
_itimeb2004 |  -.2855623   .2371017    -1.20   0.230    -.7531903    .1820656
_itimeb2005 |  -.4099703   .2448656    -1.67   0.096    -.8929108    .0729703
_itimeb2006 |  -.2606088    .246929    -1.06   0.293    -.7476188    .2264013
_itimeb2007 |  -.1253398   .2581695    -0.49   0.628    -.6345192    .3838396
_itimeb2008 |   .3327671   .2679142     1.24   0.216    -.1956313    .8611655
_itimeb2009 |  -.6760545   .3296745    -2.05   0.042    -1.326261   -.0258481
        cba |  -.7038182   .3345448    -2.10   0.037     -1.36363   -.0440062
      ebrdi |  -.6298597   .2894539    -2.18   0.031     -1.20074   -.0589791
        eta |          1          .        .       .            .           .
      _cons |   2.193502   1.104957     1.99   0.049     .0142299    4.372773
------------------------------------------------------------------------------
```

Appendix 5c *Xtfevd (CBA and defactofix included)

```
. xtfevd lninf cba gdpg l1msg fb open tot ebrdi defactofix vat eu  _itimeb2001 _itimeb2002
_itimeb2003 _itimeb2004 _itimeb2005 _itimeb
> 2006 _itimeb2007 _itimeb2008 _itimeb2009, invariant(cba ebrdi)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      193           number of obs       =      237
mean squared error         = .4194591           F( 21, 193)         = 4.670842
root mean squared error    = .6476567           Prob > F            = 8.65e-09
Residual Sum of Squares    = 99.41182           R-squared           = .6381891
Total Sum of Squares       = 274.7618           adj. R-squared      = .5575784
Estimation Sum of Squares  =   175.35

------------------------------------------------------------------------------
             |                fevd
      lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
       gdpg |  -.0189399   .0187468    -1.01   0.314    -.0559149    .0180351
      l1msg |   .0075539   .0032817     2.30   0.022     .0010813    .0140265
         fb |  -.0090471   .0249388    -0.36   0.717    -.0582348    .0401406
       open |   .0122489    .005459     2.24   0.026     .0014819    .0230158
        tot |   .0042656   .0050699     0.84   0.401    -.0057339    .0142651
 defactofix |  -.1559313   .2408224    -0.65   0.518     -.630913    .3190503
        vat |   .9328164   .5018904     1.86   0.065    -.0570779    1.922711
         eu |  -.1662221   .2650648    -0.63   0.531    -.6890178    .3565736
_itimeb2001 |  -.0640545   .2224051    -0.29   0.774    -.5027111     .374602
_itimeb2002 |  -.6555547   .2197275    -2.98   0.003     -1.08893   -.2221792
_itimeb2003 |  -.7005997   .2227122    -3.15   0.002    -1.139862   -.2613374
_itimeb2004 |  -.2840184   .2376834    -1.19   0.234    -.7528089     .184772
_itimeb2005 |  -.3992297   .2440055    -1.64   0.103    -.8804894    .0820301
_itimeb2006 |  -.2485361   .2459721    -1.01   0.314    -.7336747    .2366025
_itimeb2007 |  -.1111487   .2562446    -0.43   0.665    -.6165481    .3942506
_itimeb2008 |   .3494022    .266294     1.31   0.191    -.1758179    .8746223
_itimeb2009 |  -.6554932   .3300719    -1.99   0.048    -1.306505   -.0044819
        cba |  -.6012392   .3501566    -1.72   0.088    -1.291864    .0893857
```

```
       ebrdi |  -.6621008   .2853098    -2.32   0.021    -1.224826   -.0993752
         eta |          1          .        .       .           .           .
       _cons |   2.342948   1.100545     2.13   0.035      .172308    4.513588
------------------------------------------------------------------------------
```

Appendix 5d *Xtfevd (CBA, defactofix and CCBI included)

```
. xtfevd lninf cba gdpg l1msg fb open tot ebrdi defactofix l1ccbi vat eu _itimeb2001
_itimeb2002 _itimeb2003 _itimeb2004 _itimeb2005 _
> itimeb2006 _itimeb2007 _itimeb2008 _itimeb2009, invariant(cba ebrdi l1ccbi)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      118           number of obs       =      155
mean squared error         = .4375611           F( 22, 118)         = 3.194856
root mean squared error    =  .661484           Prob > F            = .0000445
Residual Sum of Squares    = 67.82197           R-squared           = .6312331
Total Sum of Squares       = 183.9156           adj. R-squared      = .5187279
Estimation Sum of Squares  = 116.0936

------------------------------------------------------------------------------
             |                fevd
       lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        gdpg |  -.0546837   .0402868    -1.36   0.177    -.1344626    .0250951
       l1msg |   .0124851   .0062977     1.98   0.050     .0000139    .0249562
          fb |    .035328   .0641731     0.55   0.583    -.0917522    .1624083
        open |   .0067485   .0092904     0.73   0.469     -.011649    .0251461
         tot |   .0233886   .0241193     0.97   0.334    -.0243742    .0711514
  defactofix |   .0467399    .339528     0.14   0.891    -.6256179    .7190976
         vat |   .8948198   .7115343     1.26   0.211    -.5142117    2.303851
          eu |  -.2835026   .2735224    -1.04   0.302    -.8251514    .2581462
 _itimeb2001 |  -.1010767   .2943891    -0.34   0.732    -.6840473    .4818939
 _itimeb2002 |   -.827447    .320393    -2.58   0.011    -1.461912   -.1929816
 _itimeb2003 |  -.8442777   .3226181    -2.62   0.010    -1.483149   -.2054061
 _itimeb2004 |  -.0724496   .3710893    -0.20   0.846    -.8073076    .6624083
 _itimeb2005 |  -.2102411    .392175    -0.54   0.593    -.9868544    .5663722
 _itimeb2006 |   .0371915   .3896512     0.10   0.924     -.734424     .808807
 _itimeb2007 |   .1467874   .4352834     0.34   0.737    -.7151922    1.008767
 _itimeb2008 |   .6696502   .4129752     1.62   0.108    -.1481531    1.487454
 _itimeb2009 |  -.5312215   .5314657    -1.00   0.320    -1.583668    .5212253
         cba |  -.6141823   .5673333    -1.08   0.281    -1.737657    .5092921
       ebrdi |  -.1486023   .5152978    -0.29   0.774    -1.169032    .8718276
      l1ccbi |  -1.992007   .8656309    -2.30   0.023    -3.706192   -.2778224
         eta |          1          .        .       .           .           .
       _cons |   .8487422   2.421635     0.35   0.727    -3.946754    5.644239
------------------------------------------------------------------------------
```

Appendix 6. System GMM (4 CBA countries) MSG and CCBI treated as endogenous

Appendix 6a *One-step robust System GMM with one lag of dependent variable and minimum number of instruments (only with CBA)

```
. xi: xtabond2 lninf L.lninf cba gdpg msg fb open tot ebrdi vat eu i.time, gmm(L.lninf,
laglimits(1 1)) gmm( msg, laglimits (2 2)) iv(
> cba gdpg fb open tot ebrdi vat eu i.time)  robust
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, perm.
_Itime_1999 dropped due to collinearity
_Itime_2009 dropped due to collinearity
Warning: Number of instruments may be large relative to number of observations.
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate robust weighting matrix for Hansen test.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, one-step system GMM
------------------------------------------------------------------------------
Group variable: ctyno                           Number of obs      =       229
Time variable : time                            Number of groups   =        25
Number of instruments = 56                      Obs per group: min =         7
Wald chi2(19) =   2361.63                                      avg =      9.16
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |               Robust
```

```
       lninf |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lninf |
         L1. |   .4639305   .0527785     8.79   0.000     .3604865    .5673746
             |
         cba |  -.3061125   .1713281    -1.79   0.074    -.6419095    .0296844
        gdpg |  -.0064315   .0084673    -0.76   0.448    -.0230271    .0101642
         msg |   .0088429   .0040539     2.18   0.029     .0008974    .0167885
          fb |   .0025863   .0167791     0.15   0.878    -.0303001    .0354727
        open |   .0034007   .0014445     2.35   0.019     .0005696    .0062319
         tot |   .0037916   .0018184     2.09   0.037     .0002277    .0073555
       ebrdi |  -.2232649   .1572676    -1.42   0.156    -.5315037    .0849739
         vat |   .6211287   .0989985     6.27   0.000     .4270953    .8151621
          eu |   .1692215   .1754875     0.96   0.335    -.1747277    .5131707
 _Itime_2000 |   .5309532   .2761268     1.92   0.054    -.0102453    1.072152
 _Itime_2001 |   .5661692   .2160038     2.62   0.009     .1428094    .9895289
 _Itime_2002 |   .0170196    .280702     0.06   0.952    -.5331462    .5671853
 _Itime_2003 |   .1426942   .2994785     0.48   0.634    -.4442729    .7296614
 _Itime_2004 |   .5305055   .2307795     2.30   0.022     .0781861    .9828249
 _Itime_2005 |   .1986226   .2774023     0.72   0.474    -.3450759    .7423211
 _Itime_2006 |   .3889961   .2341876     1.66   0.097    -.0700032    .8479955
 _Itime_2007 |   .4316993   .2407429     1.79   0.073    -.0401481    .9035468
 _Itime_2008 |   1.013989   .1920099     5.28   0.000     .6376569    1.390322
       _cons |   .2571777   .6634739     0.39   0.698    -1.043207    1.557563
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(cba gdpg fb open tot ebrdi vat eu _Itime_1999 _Itime_2000 _Itime_2001
    _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006 _Itime_2007
    _Itime_2008 _Itime_2009)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.L.lninf
    L2.msg
Instruments for levels equation
  Standard
    _cons
    cba gdpg fb open tot ebrdi vat eu _Itime_1999 _Itime_2000 _Itime_2001
    _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006 _Itime_2007
    _Itime_2008 _Itime_2009
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.L.lninf
    DL.msg
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -3.11  Pr > z =  0.002
Arellano-Bond test for AR(2) in first differences: z =  -0.92  Pr > z =  0.356
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(36)   =  70.68  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(36)   =   8.13  Prob > chi2 =  1.000
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(16)   =   6.51  Prob > chi2 =  0.982
    Difference (null H = exogenous): chi2(20)   =   1.62  Prob > chi2 =  1.000
  gmm(L.lninf, lag(1 1))
    Hansen test excluding group:     chi2(17)   =   7.99  Prob > chi2 =  0.967
    Difference (null H = exogenous): chi2(19)   =   0.14  Prob > chi2 =  1.000
  gmm(msg, lag(2 2))
    Hansen test excluding group:     chi2(17)   =   4.82  Prob > chi2 =  0.998
    Difference (null H = exogenous): chi2(19)   =   3.31  Prob > chi2 =  1.000
  iv(cba gdpg fb open tot ebrdi vat eu _Itime_1999 _Itime_2000 _Itime_2001 _Itime_2002
_Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006
>  _Itime_2007 _Itime_2008 _Itime_2009)
    Hansen test excluding group:     chi2(18)   =   6.53  Prob > chi2 =  0.994
    Difference (null H = exogenous): chi2(18)   =   1.60  Prob > chi2 =  1.000
```

Appendix 6b *One-step robust System GMM with one lag of dependent variable and minimum number of instruments (with CBA and defactofix)

```
. xi: xtabond2 lninf L.lninf cba gdpg msg fb open tot ebrdi defactofix vat eu i.time,
gmm(L.lninf, laglimits(1 1)) gmm( msg , laglimit
> s (2 2)) iv(cba gdpg fb defactofix open tot ebrdi  vat eu i.time)  robust
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, perm.
_Itime_1999 dropped due to collinearity
```

```
_Itime_2009 dropped due to collinearity
Warning: Number of instruments may be large relative to number of observations.
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate robust weighting matrix for Hansen test.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, one-step system GMM
------------------------------------------------------------------------------
Group variable: ctyno                           Number of obs      =       229
Time variable : time                            Number of groups   =        25
Number of instruments = 57                      Obs per group: min =         7
Wald chi2(20) =   3983.41                                      avg =      9.16
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |               Robust
       lninf |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lninf |
         L1. |   .4657802   .0517046     9.01   0.000     .3644411    .5671194
             |
         cba |  -.3028429   .1634869    -1.85   0.064    -.6232713    .0175855
        gdpg |  -.0063912   .0082364    -0.78   0.438    -.0225344    .0097519
         msg |   .0083968    .003905     2.15   0.032     .0007431    .0160504
          fb |   .0043333   .0174643     0.25   0.804    -.0298962    .0385628
        open |   .0034576   .0014343     2.41   0.016     .0006464    .0062688
         tot |   .0038242   .0018474     2.07   0.038     .0002033    .0074451
       ebrdi |  -.2400691   .1600861    -1.50   0.134    -.5538321    .0736938
  defactofix |  -.0138704   .0821436    -0.17   0.866     -.174869    .1471282
         vat |   .6189535   .0978384     6.33   0.000     .4271937    .8107133
          eu |   .1852163   .1779883     1.04   0.298    -.1636343    .5340669
 _Itime_2000 |   .5390328   .2676489     2.01   0.044     .0144506    1.063615
 _Itime_2001 |   .5701964   .2067132     2.76   0.006      .165046    .9753469
 _Itime_2002 |   .0155312   .2709071     0.06   0.954     -.515437    .5464994
 _Itime_2003 |   .1451683   .2937011     0.49   0.621    -.4304752    .7208119
 _Itime_2004 |   .5292617    .228246     2.32   0.020     .0819079    .9766156
 _Itime_2005 |   .1959581   .2706275     0.72   0.469    -.3344621    .7263782
 _Itime_2006 |   .3883307   .2326415     1.67   0.095    -.0676382    .8442997
 _Itime_2007 |   .4292987   .2383272     1.80   0.072    -.0378142    .8964115
 _Itime_2008 |   1.005695   .1929883     5.21   0.000     .6274447    1.383945
       _cons |   .3131708   .6786487     0.46   0.644    -1.016956    1.643298
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(cba gdpg fb defactofix open tot ebrdi vat eu _Itime_1999 _Itime_2000
    _Itime_2001 _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006
    _Itime_2007 _Itime_2008 _Itime_2009)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.L.lninf
    L2.msg
Instruments for levels equation
  Standard
    _cons
    cba gdpg fb defactofix open tot ebrdi vat eu _Itime_1999 _Itime_2000
    _Itime_2001 _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006
    _Itime_2007 _Itime_2008 _Itime_2009
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.L.lninf
    DL.msg
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -3.10  Pr > z =  0.002
Arellano-Bond test for AR(2) in first differences: z =  -0.93  Pr > z =  0.355
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(36)   =  71.95  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(36)   =   7.28  Prob > chi2 =  1.000
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(16)   =   4.97  Prob > chi2 =  0.996
    Difference (null H = exogenous): chi2(20)   =   2.31  Prob > chi2 =  1.000
  gmm(L.lninf, lag(1 1))
    Hansen test excluding group:     chi2(17)   =   9.65  Prob > chi2 =  0.918
    Difference (null H = exogenous): chi2(19)   =  -2.37  Prob > chi2 =  1.000
  gmm(msg, lag(2 2))
    Hansen test excluding group:     chi2(17)   =   2.99  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(19)   =   4.29  Prob > chi2 =  1.000
```

```
  iv(cba gdpg fb defactofix open tot ebrdi vat eu _Itime_1999 _Itime_2000 _Itime_2001
_Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005
> _Itime_2006 _Itime_2007 _Itime_2008 _Itime_2009)
    Hansen test excluding group:     chi2(17)   =   5.75  Prob > chi2 =  0.995
    Difference (null H = exogenous): chi2(19)   =   1.53  Prob > chi2 =  1.000
```

Appendix 6c *One-step robust System GMM with one lag of dependent variable and minimum number of instruments (with CBA, defactofix and CCBI)

```
. xi: xtabond2 lninf L.lninf cba gdpg msg fb open tot ebrdi ccbi defactofix vat eu i.time,
gmm(L.lninf, laglimits(1 1)) gmm( msg ccbi
> , laglimits (2 2)) iv(cba gdpg fb defactofix open tot ebrdi  vat eu i.time)  robust
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, perm.
_Itime_1999 dropped due to collinearity
_Itime_2009 dropped due to collinearity
Warning: Number of instruments may be large relative to number of observations.
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate robust weighting matrix for Hansen test.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, one-step system GMM
------------------------------------------------------------------------------
Group variable: ctyno                           Number of obs      =       153
Time variable : time                            Number of groups   =        17
Number of instruments = 74                      Obs per group: min =         7
Wald chi2(21) =  61247.98                                      avg =      9.00
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |               Robust
       lninf |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lninf |
         L1. |   .4133376   .0923474     4.48   0.000       .23234    .5943352
             |
         cba |  -.2735989   .1209112    -2.26   0.024    -.5105806   -.0366172
        gdpg |  -.0127862   .0227034    -0.56   0.573    -.0572839    .0317116
         msg |   .0227702   .0075813     3.00   0.003     .0079112    .0376293
          fb |    .003244   .0385821     0.08   0.933    -.0723755    .0788636
        open |   .0039723   .0022929     1.73   0.083    -.0005217    .0084664
         tot |   .0037358   .0057687     0.65   0.517    -.0075705    .0150422
       ebrdi |   .2923156   .2116847     1.38   0.167    -.1225788      .70721
        ccbi |  -.9374185   .6811244    -1.38   0.169    -2.272398    .3975608
  defactofix |   .1261089   .1015027     1.24   0.214    -.0728328    .3250506
         vat |   .5340823   .1606154     3.33   0.001      .219282    .8488826
          eu |  -.0650747   .1790189    -0.36   0.716    -.4159453     .285796
 _Itime_2000 |  -.0106298    .305064    -0.03   0.972    -.6085443    .5872847
 _Itime_2001 |  -.0515282   .3080127    -0.17   0.867     -.655222    .5521657
 _Itime_2002 |  -.4385532   .3836107    -1.14   0.253    -1.190416      .31331
 _Itime_2003 |  -.4083327   .3386198    -1.21   0.228    -1.072015    .2553499
 _Itime_2004 |   .2190135   .2733053     0.80   0.423     -.316655     .754682
 _Itime_2005 |  -.1600374   .3527307    -0.45   0.650    -.8513768     .531302
 _Itime_2006 |   .0598999   .2451646     0.24   0.807     -.420614    .5404137
 _Itime_2007 |   .0013767   .2781369     0.00   0.996    -.5437617     .546515
 _Itime_2008 |   .8208721   .2662447     3.08   0.002      .299042    1.342702
       _cons |  -.5378359    1.09392    -0.49   0.623     -2.68188    1.606208
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(cba gdpg fb defactofix open tot ebrdi vat eu _Itime_1999 _Itime_2000
    _Itime_2001 _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006
    _Itime_2007 _Itime_2008 _Itime_2009)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.L.lninf
    L2.(msg ccbi)
Instruments for levels equation
  Standard
    _cons
    cba gdpg fb defactofix open tot ebrdi vat eu _Itime_1999 _Itime_2000
    _Itime_2001 _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006
    _Itime_2007 _Itime_2008 _Itime_2009
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.L.lninf
    DL.(msg ccbi)
------------------------------------------------------------------------------
```

```
Arellano-Bond test for AR(1) in first differences: z =  -3.01  Pr > z =  0.003
Arellano-Bond test for AR(2) in first differences: z =  -0.85  Pr > z =  0.397
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(52)   =  65.79  Prob > chi2 =  0.095
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(52)   =   0.00  Prob > chi2 =  1.000
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(24)   =   0.00  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(28)   =   0.00  Prob > chi2 =  1.000
  gmm(L.lninf, lag(1 1))
    Hansen test excluding group:     chi2(33)   =   0.00  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(19)   =   0.00  Prob > chi2 =  1.000
  gmm(msg ccbi, lag(2 2))
    Hansen test excluding group:     chi2(16)   =   0.00  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(36)   =   0.00  Prob > chi2 =  1.000
  iv(cba  gdpg  fb  defactofix  open  tot  ebrdi  vat  eu  _Itime_1999  _Itime_2000  _Itime_2001
_Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005
> _Itime_2006 _Itime_2007 _Itime_2008 _Itime_2009)
    Hansen test excluding group:     chi2(34)   =   0.00  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(18)   =   0.00  Prob > chi2 =  1.000
```

Appendix 7. *Calculation of the long-run coefficient on CBA

```
. nlcom _b[cba]/(1-_b[l.lninf])

       _nl_1:  _b[cba]/(1-_b[l.lninf])

------------------------------------------------------------------------------
      lninf |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      _nl_1 |  -.4663652   .2230883    -2.09   0.037    -.9036101   -.0291202
------------------------------------------------------------------------------
```

Appendix 8. FEVD (strong and weak CBA)

Appendix 8a *Stage-by-stage estimation*

```
. *Stage 1 (panel robust SE)
. xi: xtreg lninf strongcba weakcba gdpg l1msg fb open tot ebrdi l1ccbi defactofix vat eu
i.time , fe robust
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
note: strongcba omitted because of collinearity
note: weakcba omitted because of collinearity
note: _Itime_1999 omitted because of collinearity
note: _Itime_2002 omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       155
Group variable: ctyno                           Number of groups   =        17

R-sq:  within  = 0.3489                         Obs per group: min =         7
       between = 0.2582                                        avg =       9.1
       overall = 0.2870                                        max =        10

                                                F(16,16)           =         .
corr(u_i, Xb)  = -0.2561                        Prob > F           =         .

                                (Std. Err. adjusted for 17 clusters in ctyno)
------------------------------------------------------------------------------
             |               Robust
      lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   strongcba |  (omitted)
     weakcba |  (omitted)
        gdpg |  -.0546837   .0196203    -2.79   0.013     -.096277   -.0130905
       l1msg |   .0124851   .0052811     2.36   0.031     .0012897    .0236805
          fb |    .035328   .0371683     0.95   0.356    -.0434652    .1141213
        open |   .0067485   .0080507     0.84   0.414    -.0103183    .0238153
         tot |   .0233886    .013262     1.76   0.097    -.0047256    .0515028
       ebrdi |  -.7084684   .8168121    -0.87   0.399    -2.440033    1.023096
      l1ccbi |  -1.329348   .5704019    -2.33   0.033    -2.538546   -.1201497
  defactofix |   .0467399   .5175766     0.09   0.929    -1.050473    1.143953
         vat |   .8948198   .1930988     4.63   0.000     .4854686    1.304171
          eu |  -.2835026    .245017    -1.16   0.264    -.8029153    .2359102
```

```
 _Itime_1999 |  (omitted)
 _Itime_2000 |    .827447   .5764563     1.44   0.170    -.3945857     2.04948
 _Itime_2001 |   .7263703   .3033033     2.39   0.029      .083396    1.369345
 _Itime_2002 |  (omitted)
 _Itime_2003 |  -.0168307   .3726068    -0.05   0.965    -.8067219    .7730605
 _Itime_2004 |   .7549974   .2426289     3.11   0.007     .2406472    1.269348
 _Itime_2005 |   .6172059   .3413577     1.81   0.089    -.1064402    1.340852
 _Itime_2006 |   .8646385    .280688     3.08   0.007     .2696065     1.45967
 _Itime_2007 |   .9742344   .2977478     3.27   0.005     .3430371    1.605432
 _Itime_2008 |   1.497097   .3528985     4.24   0.001     .7489858    2.245209
 _Itime_2009 |   .2962255   .4149905     0.71   0.486    -.5835152    1.175966
       _cons |   1.229915   3.620088     0.34   0.738    -6.444328    8.904159
-------------+----------------------------------------------------------------
     sigma_u |  .68312727
     sigma_e |  .75493878
         rho |  .45018805   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. *Save fixed effect (unit effects) from stage 1
. predict fixedef, u
(136 missing values generated)

. *Stage 2 (regression of the FE vector on the time-invariant and slowly changing explantory
variables - by OLS)
. reg fixedef strongcba weakcba ebrdi l1ccbi

      Source |       SS       df       MS              Number of obs =     155
-------------+------------------------------           F(  4,   150) =   28.17
       Model |  29.0629202     4  7.26573004           Prob > F      =  0.0000
    Residual |  38.6886445   150  .257924297           R-squared     =  0.4290
-------------+------------------------------           Adj R-squared =  0.4137
       Total |  67.7515647   154  .439945225           Root MSE      =  .50786

------------------------------------------------------------------------------
     fixedef |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   strongcba |   -1.08795   .1401487    -7.76   0.000    -1.364871   -.8110297
     weakcba |   -.180387   .1351932    -1.33   0.184     -.447516    .086742
       ebrdi |   .4587825   .0968441     4.74   0.000     .2674278    .6501372
      l1ccbi |  -.4150091   .3029014    -1.37   0.173    -1.013514    .1834953
       _cons |  -1.058327    .311925    -3.39   0.001    -1.674661   -.4419925
------------------------------------------------------------------------------

. * Save the residuals from stage 2
. predict rsifevd, residuals
(136 missing values generated)

. *Stage 3 (estimation of pooled OLS by including all explanatory time-variant, time-invariant
variables and unexplained part of the F
> E vector - error term from the stage 2)
. regress lninf strongcba weakcba gdpg l1msg fb open tot ebrdi l1ccbi defactofix vat eu
rsifevd i.time

      Source |       SS       df       MS              Number of obs =     155
-------------+------------------------------           F( 22,   132) =   10.27
       Model |  116.093589    22   5.2769813           Prob > F      =  0.0000
    Residual |  67.8219739   132  .513802833           R-squared     =  0.6312
-------------+------------------------------           Adj R-squared =  0.5698
       Total |  183.915563   154   1.1942569           Root MSE      =   .7168

------------------------------------------------------------------------------
       lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   strongcba |   -1.08795   .3106867    -3.50   0.001    -1.702519   -.4733812
     weakcba |   -.180387   .2283862    -0.79   0.431    -.6321574    .2713834
       gdpg |  -.0546837   .0220891    -2.48   0.015    -.0983782   -.0109893
      l1msg |   .0124851   .0043159     2.89   0.004     .0039478    .0210223
         fb |    .035328   .0299553     1.18   0.240    -.0239266    .0945826
       open |   .0067485   .0024272     2.78   0.006     .0019472    .0115498
        tot |   .0233886   .0088334     2.65   0.009     .0059153    .0408619
      ebrdi |  -.2496858   .2367197    -1.05   0.293    -.7179408    .2185692
     l1ccbi |  -1.744357   .5120116    -3.41   0.001    -2.757167   -.7315473
  defactofix |   .0467399   .1594452     0.29   0.770    -.2686585    .3621383
        vat |   .8948198   .5433936     1.65   0.102    -.1800664    1.969706
         eu |  -.2835026   .1899735    -1.49   0.138     -.659289    .0922838
    rsifevd |          1   .1241242     8.06   0.000       .75447    1.24553
            |
```

```
        time |
        2001 |  -.1010767   .2565943    -0.39   0.694    -.6086456    .4064923
        2002 |   -.827447   .2658057    -3.11   0.002    -1.353237   -.3016571
        2003 |  -.8442777   .2647934    -3.19   0.002    -1.368065   -.3204902
        2004 |  -.0724496   .2860272    -0.25   0.800    -.6382396    .4933404
        2005 |  -.2102411   .2943228    -0.71   0.476    -.7924407    .3719584
        2006 |   .0371915   .2966494     0.13   0.900    -.5496104    .6239934
        2007 |   .1467874   .3053766     0.48   0.632    -.4572777    .7508525
        2008 |   .6696502   .3084295     2.17   0.032     .0595463    1.279754
        2009 |  -.5312215    .410756    -1.29   0.198    -1.343738    .2812945
             |
       _cons |   .9990358   .9215329     1.08   0.280    -.8238473    2.821919
------------------------------------------------------------------------------

. *Diagnostic tests after 3rd stage*
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |     155.00    154    0.4622
            Skewness |      23.79     22    0.3585
            Kurtosis |       1.74      1    0.1868
---------------------+-----------------------------
               Total |     180.53    177    0.4122
---------------------------------------------------

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lninf

         chi2(1)      =    32.67
         Prob > chi2  =   0.0000

. estat ovtest

Ramsey RESET test using powers of the fitted values of lninf
       Ho:  model has no omitted variables
                 F(3, 129) =      0.62
                  Prob > F =      0.6008


.
end of do-file
```

Appendix 8b xtfevd (only strongcb and weakcba included)

```
. xtfevd lninf strongcba weakcba gdpg l1msg fb open tot ebrdi vat eu  _itimeb2001 _itimeb2002
_itimeb2003 _itimeb2004 _itimeb2005 _iti
> meb2006 _itimeb2007 _itimeb2008 _itimeb2009, invariant(strongcba weakcba ebrdi)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      193           number of obs       =      237
mean squared error         = .4176935           F( 21, 193)         = 5.007147
root mean squared error    = .6462921           Prob > F            = 1.46e-09
Residual Sum of Squares    = 98.99337           R-squared           = .6397121
Total Sum of Squares       = 274.7618           adj. R-squared      = .5594406
Estimation Sum of Squares  = 175.7684

------------------------------------------------------------------------------
             |               fevd
       lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        gdpg |  -.0207467   .0185194    -1.12   0.264    -.0572731    .0157797
       l1msg |   .0095006   .0033904     2.80   0.006     .0028135    .0161876
          fb |  -.0095807   .0244901    -0.39   0.696    -.0578833    .0387219
        open |   .0126077   .0053225     2.37   0.019       .00211    .0231054
         tot |   .0045037   .0049164     0.92   0.361    -.0051931    .0142005
         vat |   .9537611   .5000911     1.91   0.058    -.0325844    1.940107
          eu |  -.1618953   .2591259    -0.62   0.533    -.6729777     .349187
 _itimeb2001 |  -.0554761   .2208511    -0.25   0.802    -.4910677    .3801155
 _itimeb2002 |  -.6552779   .2177573    -3.01   0.003    -1.084767   -.2257884
```

```
 _itimeb2003 |  -.6880249   .2209066    -3.11   0.002    -1.123726   -.2523238
 _itimeb2004 |  -.2728506   .2349661    -1.16   0.247    -.7362816    .1905804
 _itimeb2005 |  -.4082294   .2428364    -1.68   0.094    -.8871834    .0707245
 _itimeb2006 |  -.2616122   .2447868    -1.07   0.287     -.744413    .2211886
 _itimeb2007 |  -.1347947   .2563835    -0.53   0.600     -.640468    .3708786
 _itimeb2008 |   .3123235   .2657191     1.18   0.241    -.2117628    .8364097
 _itimeb2009 |   -.681964   .3264695    -2.09   0.038     -1.32587   -.0380579
   strongcba |  -1.123176   .4110094    -2.73   0.007    -1.933823   -.3125292
     weakcba |  -.3289956   .4066039    -0.81   0.419    -1.130953    .4729622
       ebrdi |  -.6337204   .2840473    -2.23   0.027    -1.193956    -.073485
         eta |          1          .        .       .            .           .
       _cons |   2.121916   1.070609     1.98   0.049     .0103208    4.233512
------------------------------------------------------------------------------
```

Appendix 8c *Xtfevd (strongCBA, weakCBA and defactofix included)

```
. xtfevd lninf strongcba weakcba gdpg l1msg fb open tot ebrdi defactofix vat eu _itimeb2001
_itimeb2002 _itimeb2003 _itimeb2004 _itime
> b2005 _itimeb2006 _itimeb2007 _itimeb2008 _itimeb2009, invariant(strongcba weakcba ebrdi)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      192           number of obs       =      237
mean squared error         = .4161365           F( 22, 192)         =  4.83689
root mean squared error    = .6450864           Prob > F            = 1.90e-09
Residual Sum of Squares    = 98.62434           R-squared           = .6410551
Total Sum of Squares       = 274.7618           adj. R-squared      = .5587969
Estimation Sum of Squares  = 176.1375

------------------------------------------------------------------------------
             |                fevd
      lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       gdpg |  -.0213817   .0185746    -1.15   0.251    -.0580181    .0152548
      l1msg |   .0092708   .0033454     2.77   0.006     .0026723    .0158693
         fb |  -.0098222   .0243086    -0.40   0.687    -.0577684    .0381239
       open |   .0127136   .0053448     2.38   0.018     .0021715    .0232557
        tot |   .0043262   .0049485     0.87   0.383    -.0054341    .0140865
 defactofix |  -.2112894   .2420742    -0.87   0.384    -.6887558    .2661769
        vat |     .95331   .4980363     1.91   0.057    -.0290152    1.935635
         eu |  -.1665969   .2599386    -0.64   0.522    -.6792989    .3461052
 _itimeb2001 |  -.0371784   .2209248    -0.17   0.867    -.4729297    .3985729
 _itimeb2002 |  -.6613203   .2188709    -3.02   0.003     -1.09302   -.2296202
 _itimeb2003 |  -.6848629   .2215356    -3.09   0.002    -1.121819   -.2479069
 _itimeb2004 |  -.2689794   .2360137    -1.14   0.256    -.7344919    .1965331
 _itimeb2005 |  -.3934321   .2422239    -1.62   0.106    -.8711937    .0843296
 _itimeb2006 |   -.245394    .243941    -1.01   0.316    -.7265424    .2357544
 _itimeb2007 |  -.1168889   .2545226    -0.46   0.647    -.6189084    .3851307
 _itimeb2008 |    .332003   .2641302     1.26   0.210    -.1889664    .8529724
 _itimeb2009 |  -.6549303   .3273902    -2.00   0.047    -1.300674   -.0091871
   strongcba |  -.9550537   .4584606    -2.08   0.039     -1.85932   -.0507877
     weakcba |  -.2331633   .3901961    -0.60   0.551    -1.002785    .5364581
       ebrdi |   -.666561   .2795846    -2.38   0.018    -1.218013   -.1151094
         eta |          1          .        .       .            .           .
       _cons |   2.278551   1.064645     2.14   0.034     .1786493    4.378453
------------------------------------------------------------------------------
```

Appendix 8d *Xtfevd (strongcba, weakcba, defactofix and CCBI included)

```
. xtfevd lninf strongcba weakcba gdpg l1msg fb open tot ebrdi defactofix l1ccbi vat eu
_itimeb2001 _itimeb2002 _itimeb2003 _itimeb2004
>   _itimeb2005 _itimeb2006 _itimeb2007 _itimeb2008 _itimeb2009, invariant(strongcba weakcba
ebrdi l1ccbi)

panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      117           number of obs       =      155
mean squared error         = .4375611           F( 23, 117)         = 3.187405
root mean squared error    =  .661484           Prob > F            = .0000359
Residual Sum of Squares    = 67.82197           R-squared           = .6312331
Total Sum of Squares       = 183.9156           adj. R-squared      = .5146145
Estimation Sum of Squares  = 116.0936

------------------------------------------------------------------------------
```

```
             |               fevd
       lninf |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        gdpg |  -.0546837   .0398703    -1.37   0.173    -.1336447    .0242773
       l1msg |   .0124851   .0061298     2.04   0.044     .0003452    .0246249
          fb |    .035328   .0623575     0.57   0.572    -.0881676    .1588237
        open |   .0067485   .0088012     0.77   0.445    -.0106817    .0241788
         tot |   .0233886   .0227529     1.03   0.306    -.0216723    .0684495
  defactofix |   .0467399   .3239702     0.14   0.886    -.5948661    .6883458
         vat |   .8948198   .6930653     1.29   0.199    -.4777597    2.267399
          eu |  -.2835026   .2645627    -1.07   0.286    -.8074553    .2404501
 _itimeb2001 |  -.1010767   .2915248    -0.35   0.729    -.6784263    .4762729
 _itimeb2002 |   -.827447   .3158774    -2.62   0.010    -1.453026   -.2018683
 _itimeb2003 |  -.8442777   .3179071    -2.66   0.009    -1.473876   -.2146793
 _itimeb2004 |  -.0724496   .3628616    -0.20   0.842     -.791078    .6461787
 _itimeb2005 |  -.2102411   .3822739    -0.55   0.583    -.9673146    .5468324
 _itimeb2006 |   .0371915   .3805621     0.10   0.922    -.7164919    .7908748
 _itimeb2007 |   .1467874   .4247336     0.35   0.730    -.6943754    .9879501
 _itimeb2008 |   .6696502    .402042     1.67   0.098    -.1265729    1.465873
 _itimeb2009 |  -.5312215   .5236243    -1.01   0.312    -1.568232     .505789
  strongcba  |   -1.08795   .8019846    -1.36   0.178    -2.676239    .5003383
    weakcba  |   -.180387   .4686723    -0.38   0.701    -1.108568     .747794
      ebrdi  |  -.2496858   .5158172    -0.48   0.629    -1.271235    .7718631
      l1ccbi |  -1.744357   .8660747    -2.01   0.046    -3.459572   -.0291414
         eta |          1          .        .       .            .           .
       _cons |   .9990358   2.235198     0.45   0.656    -3.427657    5.425729
------------------------------------------------------------------------------


.
end of do-file
```

Appendix 9. System GMM (strong and weak CBA countries)

Appendix 9a. *One-step robust System GMM with one lag of dependent variable and minimum number of instruments (with strong and weak CBA only)

```
. xi: xtabond2 lninf L.lninf strongcba weakcba gdpg msg fb open tot ebrdi vat eu i.time,
gmm(L.lninf, laglimits(1 1)) gmm( msg , lagli
> mits (2 2)) iv(strongcba weakcba gdpg fb open tot ebrdi vat eu i.time)  robust
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, perm.
_Itime_1999 dropped due to collinearity
_Itime_2009 dropped due to collinearity
Warning: Number of instruments may be large relative to number of observations.
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate robust weighting matrix for Hansen test.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, one-step system GMM
------------------------------------------------------------------------------
Group variable: ctyno                           Number of obs      =       229
Time variable : time                            Number of groups   =        25
Number of instruments = 57                      Obs per group: min =         7
Wald chi2(20) =   1586.46                                      avg =      9.16
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |               Robust
       lninf |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lninf |
         L1. |   .4641078   .0526576     8.81   0.000     .3609008    .5673148
             |
  strongcba  |  -.5363993   .1737119    -3.09   0.002    -.8768684   -.1959302
    weakcba  |  -.1737023   .1743658    -1.00   0.319    -.5154529    .1680484
        gdpg |  -.0076536    .008517    -0.90   0.369    -.0243467    .0090395
         msg |   .0081731   .0039815     2.05   0.040     .0003695    .0159768
          fb |    .000564   .0168245     0.03   0.973    -.0324115    .0335395
        open |   .0040079   .0015229     2.63   0.008      .001023    .0069928
         tot |   .0047989   .0019469     2.46   0.014      .000983    .0086148
       ebrdi |  -.2683651   .1417887    -1.89   0.058    -.5462659    .0095357
         vat |   .6754365   .0831459     8.12   0.000     .5124735    .8383995
          eu |   .1704956    .178119     0.96   0.338    -.1786112    .5196023
 _Itime_2000 |   .5760229   .2816288     2.05   0.041     .0240406    1.128005
 _Itime_2001 |   .6189559   .2122865     2.92   0.004      .202882     1.03503
```

```
 _Itime_2002 |   .0577665   .2785236     0.21   0.836    -.4881297    .6036626
 _Itime_2003 |   .1889474   .2980574     0.63   0.526    -.3952343    .7731292
 _Itime_2004 |   .5784878   .2282359     2.53   0.011     .1311537    1.025822
 _Itime_2005 |   .2452591   .2854024     0.86   0.390    -.3141193    .8046374
 _Itime_2006 |   .4343248   .2367211     1.83   0.067    -.0296401    .8982897
 _Itime_2007 |    .477025   .2367251     2.02   0.044     .0130522    .9409977
 _Itime_2008 |   1.036203   .1987245     5.21   0.000     .6467103    1.425696
       _cons |   .2161296   .6591434     0.33   0.743    -1.075768    1.508027
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(strongcba weakcba gdpg fb open tot ebrdi vat eu _Itime_1999 _Itime_2000
    _Itime_2001 _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006
    _Itime_2007 _Itime_2008 _Itime_2009)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.L.lninf
    L2.msg
Instruments for levels equation
  Standard
    _cons
    strongcba weakcba gdpg fb open tot ebrdi vat eu _Itime_1999 _Itime_2000
    _Itime_2001 _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006
    _Itime_2007 _Itime_2008 _Itime_2009
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.L.lninf
    DL.msg
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -3.12  Pr > z =  0.002
Arellano-Bond test for AR(2) in first differences: z =  -0.89  Pr > z =  0.372
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(36)   =  70.05  Prob > chi2 =  0.001
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(36)   =   8.55  Prob > chi2 =  1.000
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(16)   =   3.52  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(20)   =   5.03  Prob > chi2 =  1.000
  gmm(L.lninf, lag(1 1))
    Hansen test excluding group:     chi2(17)   =   8.11  Prob > chi2 =  0.964
    Difference (null H = exogenous): chi2(19)   =   0.44  Prob > chi2 =  1.000
  gmm(msg, lag(2 2))
    Hansen test excluding group:     chi2(17)   =   3.80  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(19)   =   4.75  Prob > chi2 =  1.000
  iv(strongcba weakcba gdpg fb open tot ebrdi vat eu _Itime_1999 _Itime_2000 _Itime_2001
_Itime_2002 _Itime_2003 _Itime_2004 _Itime_20
> 05 _Itime_2006 _Itime_2007 _Itime_2008 _Itime_2009)
    Hansen test excluding group:     chi2(17)   =   4.38  Prob > chi2 =  0.999
    Difference (null H = exogenous): chi2(19)   =   4.17  Prob > chi2 =  1.000
```

Appendix 9b. *One-step robust System GMM with one lag of dependent variable and minimum number of instruments (with strong and weak CBA and defactofix)

```
. xi: xtabond2 lninf L.lninf strongcba weakcba gdpg msg fb open tot ebrdi defactofix vat eu
i.time, gmm(L.lninf, laglimits(1 1)) gmm(m
> sg , laglimits (2 2)) iv(strongcba weakcb gdpg fb defactofix open tot ebrdi  vat eu i.time)
robust
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, perm.
_Itime_1999 dropped due to collinearity
_Itime_2009 dropped due to collinearity
Warning: Number of instruments may be large relative to number of observations.
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate robust weighting matrix for Hansen test.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, one-step system GMM
------------------------------------------------------------------------------
Group variable: ctyno                           Number of obs      =       229
Time variable : time                            Number of groups   =        25
Number of instruments = 58                      Obs per group: min =         7
Wald chi2(21) =   2392.62                                      avg =      9.16
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |               Robust
```

```
       lninf |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lninf |
         L1. |   .4687924   .0514528     9.11   0.000     .3679468    .5696381
             |
   strongcba |  -.5480212   .1774193    -3.09   0.002    -.8957565   -.2002858
     weakcba |  -.1867495   .1635761    -1.14   0.254    -.5073527    .1338537
        gdpg |  -.0078169   .0083088    -0.94   0.347    -.0241018    .0084679
         msg |   .0076595   .0037731     2.03   0.042     .0002644    .0150546
          fb |   .0027238   .0177167     0.15   0.878    -.0320003    .0374478
        open |    .003975   .0014852     2.68   0.007     .0010641    .0068859
         tot |   .0047488   .0019532     2.43   0.015     .0009206    .0085769
       ebrdi |  -.2805028   .1425631    -1.97   0.049    -.5599213   -.0010843
  defactofix |   .0109525   .0811646     0.13   0.893    -.1481272    .1700323
         vat |   .6631541   .0833685     7.95   0.000     .4997549    .8265533
          eu |   .1883841   .1807319     1.04   0.297    -.1658438    .5426121
 _Itime_2000 |   .5938111   .2749572     2.16   0.031      .054905    1.132717
 _Itime_2001 |   .6311181   .2043528     3.09   0.002      .230594    1.031642
 _Itime_2002 |   .0646181   .2706158     0.24   0.811    -.4657791    .5950153
 _Itime_2003 |   .2007303   .2946386     0.68   0.496    -.3767507    .7782113
 _Itime_2004 |   .5868322   .2302435     2.55   0.011     .1355632    1.038101
 _Itime_2005 |   .2507414   .2821554     0.89   0.374    -.3022729    .8037557
 _Itime_2006 |     .44309   .2401043     1.85   0.065    -.0275057    .9136858
 _Itime_2007 |   .4828501   .2381383     2.03   0.043     .0161077    .9495926
 _Itime_2008 |   1.033911   .2030037     5.09   0.000     .6360312    1.431791
       _cons |   .2608055   .6775174     0.38   0.700    -1.067104    1.588715
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(strongcba weakcba gdpg fb defactofix open tot ebrdi vat eu _Itime_1999
    _Itime_2000 _Itime_2001 _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005
    _Itime_2006 _Itime_2007 _Itime_2008 _Itime_2009)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.L.lninf
    L2.msg
Instruments for levels equation
  Standard
    _cons
    strongcba weakcba gdpg fb defactofix open tot ebrdi vat eu _Itime_1999
    _Itime_2000 _Itime_2001 _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005
    _Itime_2006 _Itime_2007 _Itime_2008 _Itime_2009
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.L.lninf
    DL.msg
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -3.10  Pr > z =  0.002
Arellano-Bond test for AR(2) in first differences: z =  -0.89  Pr > z =  0.373
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(36)   =  72.24  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(36)   =   2.74  Prob > chi2 =  1.000
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(16)   =   4.60  Prob > chi2 =  0.997
    Difference (null H = exogenous): chi2(20)   =  -1.86  Prob > chi2 =  1.000
  gmm(L.lninf, lag(1 1))
    Hansen test excluding group:     chi2(17)   =   5.74  Prob > chi2 =  0.995
    Difference (null H = exogenous): chi2(19)   =  -3.00  Prob > chi2 =  1.000
  gmm(msg, lag(2 2))
    Hansen test excluding group:     chi2(17)   =   1.50  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(19)   =   1.24  Prob > chi2 =  1.000
  iv(strongcba weakcba gdpg fb defactofix open tot ebrdi vat eu _Itime_1999 _Itime_2000
_Itime_2001 _Itime_2002 _Itime_2003 _Itime_200
> 4 _Itime_2005 _Itime_2006 _Itime_2007 _Itime_2008 _Itime_2009)
    Hansen test excluding group:     chi2(16)   =   3.61  Prob > chi2 =  0.999
    Difference (null H = exogenous): chi2(20)   =  -0.87  Prob > chi2 =  1.000
```

Appendix 9c. *One-step robust System GMM with one lag of dependent variable and minimum number of instruments (with strong and weak CBA, defactofix and CCBI)

```
 . xi: xtabond2 lninf L.lninf strongcba weakcba gdpg msg fb open tot ebrdi ccbi defactofix vat
eu i.time, gmm(L.lninf, laglimits(1 1))
```

```
> gmm( msg ccbi , laglimits (2 2)) iv(strongcba weakcba gdpg fb defactofix open tot ebrdi  vat
eu i.time)  robust
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, perm.
_Itime_1999 dropped due to collinearity
_Itime_2009 dropped due to collinearity
Warning: Number of instruments may be large relative to number of observations.
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate robust weighting matrix for Hansen test.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, one-step system GMM
------------------------------------------------------------------------------
Group variable: ctyno                           Number of obs      =       153
Time variable : time                            Number of groups   =        17
Number of instruments = 75                      Obs per group: min =         7
Wald chi2(22) =   7503.61                                      avg =      9.00
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |               Robust
       lninf |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lninf |
         L1. |   .4130802   .0904698     4.57   0.000     .2357627    .5903977
             |
   strongcba |  -.5970075   .2130635    -2.80   0.005    -1.014604   -.1794107
     weakcba |  -.1466866   .1520962    -0.96   0.335    -.4447898    .1514165
        gdpg |  -.0119486   .0222416    -0.54   0.591    -.0555413    .0316442
         msg |   .0200228   .0071955     2.78   0.005     .0059199    .0341256
          fb |   .0051923   .0374304     0.14   0.890    -.0681698    .0785545
        open |   .0048776   .0025334     1.93   0.054    -.0000878     .009843
         tot |   .0100397   .0055771     1.80   0.072    -.0008912    .0209707
       ebrdi |   .1238593   .2101311     0.59   0.556      -.28799    .5357086
        ccbi |  -.8486154   .7000709    -1.21   0.225    -2.220729    .5234985
  defactofix |   .1232278     .09563     1.29   0.198    -.0642036    .3106591
         vat |   .5752745   .1617938     3.56   0.000     .2581644    .8923846
          eu |  -.0575058   .1734746    -0.33   0.740    -.3975097    .2824982
 _Itime_2000 |   .0594779    .312698     0.19   0.849    -.5533989    .6723546
 _Itime_2001 |   .0176935   .2768351     0.06   0.949    -.5248933    .5602803
 _Itime_2002 |  -.4107094   .3641861    -1.13   0.259    -1.124501    .3030822
 _Itime_2003 |  -.3787647    .338734    -1.12   0.263    -1.042671    .2851418
 _Itime_2004 |   .2520283   .2680688     0.94   0.347     -.273377    .7774336
 _Itime_2005 |  -.1120071   .3529503    -0.32   0.751     -.803777    .5797628
 _Itime_2006 |   .1047999   .2409124     0.44   0.664    -.3673796    .5769795
 _Itime_2007 |   .0432424     .26864     0.16   0.872    -.4832823    .5697671
 _Itime_2008 |   .8475828   .2560735     3.31   0.001      .345688    1.349478
       _cons |  -.7529306   1.176178    -0.64   0.522    -3.058196    1.552335
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(strongcba weakcba gdpg fb defactofix open tot ebrdi vat eu _Itime_1999
    _Itime_2000 _Itime_2001 _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005
    _Itime_2006 _Itime_2007 _Itime_2008 _Itime_2009)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.L.lninf
    L2.(msg ccbi)
Instruments for levels equation
  Standard
    _cons
    strongcba weakcba gdpg fb defactofix open tot ebrdi vat eu _Itime_1999
    _Itime_2000 _Itime_2001 _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005
    _Itime_2006 _Itime_2007 _Itime_2008 _Itime_2009
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.L.lninf
    DL.(msg ccbi)
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -3.00  Pr > z =  0.003
Arellano-Bond test for AR(2) in first differences: z =  -0.81  Pr > z =  0.419
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(52)   =  67.95  Prob > chi2 =  0.068
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(52)   =   0.00  Prob > chi2 =  1.000
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(24)   =   0.00  Prob > chi2 =  1.000
```

```
    Difference (null H = exogenous): chi2(28)    =  -0.00  Prob > chi2 =  1.000
  gmm(L.lninf, lag(1 1))
    Hansen test excluding group:     chi2(33)    =   0.00  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(19)    =  -0.00  Prob > chi2 =  1.000
  gmm(msg ccbi, lag(2 2))
    Hansen test excluding group:     chi2(16)    =   0.00  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(36)    =   0.00  Prob > chi2 =  1.000
  iv(strongcba weakcba gdpg fb defactofix open tot ebrdi vat eu _Itime_1999 _Itime_2000
_Itime_2001 _Itime_2002 _Itime_2003 _Itime_200
> 4 _Itime_2005 _Itime_2006 _Itime_2007 _Itime_2008 _Itime_2009)
    Hansen test excluding group:     chi2(33)    =   0.00  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(19)    =   0.00  Prob > chi2 =  1.000
```

Appendix 10. *Calculation of the long-run coefficients on stronCBA and weakCBA

```
. nlcom _b[strongcba]/(1-_b[l.lninf])

       _nl_1:  _b[strongcba]/(1-_b[l.lninf])

------------------------------------------------------------------------------
       lninf |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -1.017188   .3722709    -2.73   0.006    -1.746825   -.2875501
------------------------------------------------------------------------------

. nlcom _b[weakcba]/(1-_b[l.lninf])

       _nl_1:  _b[weakcba]/(1-_b[l.lninf])

------------------------------------------------------------------------------
       lninf |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _nl_1 |  -.2499262    .271412    -0.92   0.357     -.781884    .2820315
------------------------------------------------------------------------------
```

Appendix 11. *Preferred dynamic model with defactofix treated as endogenous

```
. xi: xtabond2 lninf L.lninf cba gdpg msg fb open tot ebrdi ccbi defactofix vat eu i.time,
gmm(L.lninf, laglimits(1 1)) gmm( msg ccbi
> defactofix, laglimits (2 2)) iv(cba gdpg fb  open tot ebrdi  vat eu i.time)  robust
i.time            _Itime_1998-2009    (naturally coded; _Itime_1998 omitted)
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, perm.
_Itime_1999 dropped due to collinearity
_Itime_2009 dropped due to collinearity
Warning: Number of instruments may be large relative to number of observations.
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate robust weighting matrix for Hansen test.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, one-step system GMM
------------------------------------------------------------------------------
Group variable: ctyno                           Number of obs      =       153
Time variable : time                            Number of groups   =        17
Number of instruments = 87                      Obs per group: min =         7
Wald chi2(21) =  14429.42                                      avg =      9.00
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |               Robust
       lninf |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lninf |
         L1. |   .4392953   .0898076     4.89   0.000     .2632756     .615315
             |
         cba |  -.2044083   .1588469    -1.29   0.198    -.5157424    .1069259
        gdpg |  -.0127972   .0229637    -0.56   0.577    -.0578052    .0322107
         msg |   .0215845   .0080562     2.68   0.007     .0057946    .0373744
          fb |  -.0007123   .0354056    -0.02   0.984    -.0701059    .0686813
        open |   .0039272    .002135     1.84   0.066    -.0002573    .0081118
         tot |   .0050696   .0057321     0.88   0.376    -.0061651    .0163044
       ebrdi |   .2465187   .2370199     1.04   0.298    -.2180318    .7110691
        ccbi |  -.8513596    .560217    -1.52   0.129    -1.949365    .2466455
  defactofix |   .0241084   .1598802     0.15   0.880    -.2892511    .3374678
         vat |   .5556165   .1374824     4.04   0.000      .286156     .825077
          eu |   -.051247   .1871418    -0.27   0.784    -.4180381    .3155441
```

```
 _Itime_2000 |   .0521562    .322855     0.16   0.872     -.580628    .6849404
 _Itime_2001 |   .0086322   .3090609     0.03   0.978    -.5971161    .6143805
 _Itime_2002 |  -.4152494   .3677885    -1.13   0.259    -1.136102    .3056028
 _Itime_2003 |  -.3537186   .3174832    -1.11   0.265    -.9759742    .2685371
 _Itime_2004 |   .2851059   .2639978     1.08   0.280    -.2323204    .8025321
 _Itime_2005 |   -.102917    .328698    -0.31   0.754    -.7471533    .5413192
 _Itime_2006 |   .1176817   .2116082     0.56   0.578    -.2970628    .5324262
 _Itime_2007 |   .0533394   .2473593     0.22   0.829    -.4314759    .5381548
 _Itime_2008 |   .8508683   .2394767     3.55   0.000     .3815026    1.320234
       _cons |  -.6449889   .9789124    -0.66   0.510    -2.563622    1.273644
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(cba gdpg fb open tot ebrdi vat eu _Itime_1999 _Itime_2000 _Itime_2001
    _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006 _Itime_2007
    _Itime_2008 _Itime_2009)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.L.lninf
    L2.(msg ccbi defactofix)
Instruments for levels equation
  Standard
    _cons
    cba gdpg fb open tot ebrdi vat eu _Itime_1999 _Itime_2000 _Itime_2001
    _Itime_2002 _Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006 _Itime_2007
    _Itime_2008 _Itime_2009
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.L.lninf
    DL.(msg ccbi defactofix)
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -2.96  Pr > z =  0.003
Arellano-Bond test for AR(2) in first differences: z =  -0.83  Pr > z =  0.409
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(65)   =  83.36  Prob > chi2 =  0.062
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(65)   =   0.00  Prob > chi2 =  1.000
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(32)   =   0.00  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(33)   =  -0.00  Prob > chi2 =  1.000
  gmm(L.lninf, lag(1 1))
    Hansen test excluding group:     chi2(47)   =   0.00  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(18)   =   0.00  Prob > chi2 =  1.000
  gmm(msg ccbi defactofix, lag(2 2))
    Hansen test excluding group:     chi2(14)   =   0.00  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(51)   =   0.00  Prob > chi2 =  1.000
  iv(cba gdpg fb open tot ebrdi vat eu _Itime_1999 _Itime_2000 _Itime_2001 _Itime_2002
_Itime_2003 _Itime_2004 _Itime_2005 _Itime_2006
>  _Itime_2007 _Itime_2008 _Itime_2009)
    Hansen test excluding group:     chi2(48)   =   0.00  Prob > chi2 =  1.000
    Difference (null H = exogenous): chi2(17)   =   0.00  Prob > chi2 =  1.000
```

UDC 330.567.28:303.6(4-11)

HOUSEHOLDS' EXPECTATIONS AND MACROECONOMIC OUTCOMES - EVIDENCE FROM THE EURO SURVEY

Elisabeth Beckmann and Isabella Moder[1]

Abstract

Using evidence from the OeNB Euro Survey, we show that households in Central, Eastern and Southeastern Europe (CESEE) are more optimistic about the development of their own financial situation than the development of their national economies. There are significant cross-country differences regarding the level and volatility of expectations; however, since the onset of the financial and economic crisis, the movements of expectations have become more homogeneous within CESEE. Households' expectations about the economy are positively correlated with subsequent GDP and consumption growth. These results indicate that data on expectations could add predictive power to forecasting models for CESEE, especially if observed at a higher frequency and released without large time lags.

JEL classification: D14, G01, D12, E21

Keywords: Expectations, survey data, Central, Eastern and Southeastern Europe

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Countries in Central, Eastern and Southeastern Europe (CESEE) were among those hit hardest by the global financial crisis, with aggregate real GDP falling by 3.6% in 2009 and recording subdued or negative growth since then. Renewed catching-up after the crisis will depend on the external environment and the development of domestic demand. Therefore, from a policymaker's perspective, it is crucial to know how domestic consumption and investment will develop.[2]

Against this background we explore the question whether consumer expectations in CESEE provide an indication of likely future macroeconomic outcomes. We present unique and comparative evidence for ten CESEE countries revealing how consumers think the financial situation of their respective households and national economies will develop. The data used were collected in the course of the semiannual OeNB Euro Survey of households and cover the period before and after the global financial crisis from fall 2007 to fall 2012. We investigate how consumer expectations developed over this time within each country and across countries. We then turn to the question if and how consumer expectations are related to consumption3 and GDP growth.

We show that consumer expectations dropped sharply in all CESEE countries during the crisis. In line with evidence from other countries, Euro Survey data show that, on average, consumers in CESEE expect their households' situation to develop more favorably than that of the national economy (we will refer to this phenomenon as "household bias" - see Bovi, 2009). Overall, there are significant differences in the level of economic expectations across countries but since 2009 the movements of expectations have become more homogeneous. Moreover, our descriptive results suggest that there is a relationship between expectations regarding the development of the national economy and macroeconomic outcomes.4 We find that economic expectations are positively correlated with future consumption growth in most countries and future GDP growth in all countries. At the same time, expectations regarding the financial situation of the household do not seem to have an impact on macroeconomic outcomes.

The first section below will present a brief overview of the related literature. We then introduce the data and present descriptive results on expectations regarding the financial situation of the household and the development of the national economy. Section 3 relates these expectations to macroeconomic variables, namely private consumption and GDP growth, before we summarize our results and conclude.

1. Literature Overview

The global financial crisis has also been a crisis of consumer confidence. Therefore, interest in consumer confidence research has increased.[5] A prominent example of related research is the paper by Akerlof and Shiller (2010), who argue that changes in confidence, fairness, corruption and bad faith may trigger changes in economic expectations and should be taken into account for explaining boom - bust cycles.

Consumer confidence surveys are regularly conducted in all developed economies and in many emerging markets as well as in some developing economies. Results from these surveys have been used for a broad spectrum of research - ranging from studies seeking to improve the forecasting properties of standard macroeconomic models to contributions that focus on identifying whether consumer confidence has a causal impact on macroeconomic outcomes. A further strand of literature seeks to explain the dynamics of how expectations are formed. The majority of empirical papers are based on surveys from the United States; for transition economies the literature is scarce. A recent exception is the contribution by Kuzmanovic and Sanfey (2012), who study the forecasting power of consumer´ expectations for a range of macroeconomic variables in Croatia. They find that consumer expectations help to explain

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3 In this paper, we will refer to private consumption simply as "consumption."

4 Due to the relatively short time period and the relatively large survey interval we cannot address this in a full-fledged econometric analysis.

5 In this paper, we will use "consumer confidence" to describe consumers' trust and certainty regarding both their current situation and their future. The term "expectations" on the other hand only refers to perceptions of future events and assessments of likely future developments in this study.

retail turnover and imports. Expectations about forthcoming major purchases and imports have strong predictive power with regard to retail turnover, which in turn is highly correlated with quarterly GDP.

Perhaps one of the most obvious research questions is how consumer expectations affect consumption. It is clear that consumer expectations should determine consumption patterns; however, the direction of their impact is not clear. If consumer confidence reflects precautionary savings motives, it should be negatively correlated with consumption *growth* (Ludvigson, 2004). Following this interpretation, consumer confidence reflects lower (higher) uncertainty about the future, which reduces (increases) the need to accumulate precautionary savings and hence increases (reduces) consumption today. Consumers who are more confident regarding the future do not need to accumulate precautionary savings. Thus, they consume more today and this reduces the change in consumption from the present to the future, which means consumption growth will be lower.

If consumer confidence is based on expectations regarding future income and wealth, it should be positively correlated with consumption growth. However, the permanent income hypothesis, which in its empirical application assumes rational expectations, would predict a positive correlation between expectations and consumption.

Ludvigson (2004) investigates these two competing hypotheses with U.S. data and finds little support for the precautionary savings interpretation. Instead, he finds that changes in consumer confidence are related to income and wealth growth but also directly to consumption. Souleles (2004) also tests the permanent income hypothesis, but allows for heterogeneity in the importance of confidence shocks. He shows that high- and low-income households are affected differently by shocks, stressing the role of time-varying group-level shocks. However, he finds that the reaction in consumption to consumer confidence shocks, which goes beyond that predicted by the permanent income hypothesis, cannot be fully explained by the heterogeneous effect of shocks on different sociodemographic groups.

2. Data and Measurement

The data analyzed in this paper have been taken from the OeNB Euro Survey, which is carried out semiannually on behalf of the OeNB in Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, FYR Macedonia[6], Hungary, Poland, Romania and Serbia.[7] In each survey wave a representative sample of 1,000 respondents aged 14 years and older is polled in every country. The survey collects information on households' saving and loan decisions as well as their economic expectations. We will focus on two questions about expectations regarding the households' financial situation and the national economy. Respondents are asked whether they agree or disagree with the following statements on a scale from 1 (strongly agree) to 6 (strongly disagree):

1. "Over the next five years, the economic situation of [my country] will improve."
2. "Over the next 12 months, I expect the financial situation of my household to get better."

We will refer to results gained from the first question as "expectations regarding the national economy" and those derived from the second question as "expectations regarding the households' financial situation." For the first question, we have a continuous time series from fall 2007 to fall 2012. The second question has only been asked since spring 2009.[8] The questions are very similar to those used in other surveys, the main differences between the questions being the scale and the time horizon. Of course, one could argue that the time horizon of one year versus five years in expectations in the two questions above makes for a big difference. However, additional evidence from the Euro Survey regarding exchange rate expectations provides support for our assumption that the difference in time horizon does not matter to such an extent that we cannot compare the results for expectations regarding the national economy over five years and expectations regarding the households' financial situation over

6 Former Yugoslav Republic of Macedonia.

7 For more information on the OeNB Euro Survey, please visit: ceec.oenb.at.

8 Neither question was included in the spring wave of 2012.

one year.[9] Furthermore, Bovi (2009) also compares expectations regarding the national economy and regarding the households' financial situation with a time horizon of one year for both questions and gets similar results overall, in particular regarding the "household bias," which we will discuss later. For our analysis, we exclude respondents answering "Don't know" and "No Answer," assuming that nonresponse is random. We think this assumption is reasonable because the overall nonresponse rate is below 10%.

In order to compare expectations over time and between countries and analyze the link to macroeconomic developments, we compute the following balance statistics:

$$\textit{Balance statistic} = \textit{(strongly agree} + 0.7^{*}\textit{ agree} + 0.3^{*}\textit{ somewhat agree)} - \textit{(}0.3^{*}\textit{ somewhat disagree} + 0.7^{*}\textit{ disagree} + \textit{strongly disagree)}$$

where the levels of agreement are percentages of respondents choosing the respective answer. Therefore, balance statistics range from 100 (all respondents "strongly agree") to -100 (all respondents "strongly disagree"). Positive values indicate that on average households expect their national economy to improve[10] or their own financial situation to get better,[11] whereas negative values indicate the opposite. The weights for the respective response categories are arbitrary, of course. Therefore, we also computed unweighted balance statistics. This does not change the pattern of expectations over time.

3. Expectation Patterns - Some Stylized Facts

Chart 1 presents the balance statistics for the two questions over time broken down by country. In some countries the balance statistics have decreased constantly since the beginning of the survey (e.g. Poland and to a lesser extent the Czech Republic), while in other countries expectations started to improve again in early 2011 (Romania, Serbia). Interestingly, the development of expectations over time in Hungary resembles a hump-shaped pattern with a peak in 2009, when the Hungarian economy contracted by 6.6%.[12]

Expectations regarding the households' financial situation and those regarding the national economy are highly correlated in all countries (chart 1). When comparing the results for the two questions it is striking that in most countries the financial future of the household is perceived to be brighter than the future of the whole economy. Notable exceptions are households in the Czech Republic and Hungary (chart 1), where respondents are more optimistic about the future of the economy than the future of their household. However, if we compute the balance statistics for expectations regarding the national economy and the financial situation of the household based on the Eurobarometer data for these two countries, we find that - as in all other countries - households are more optimistic about their own financial situation. This result that households are biased in their expectations is in line with Bovi (2009). He finds the same pattern to be valid for ten Western European countries over 22 years.

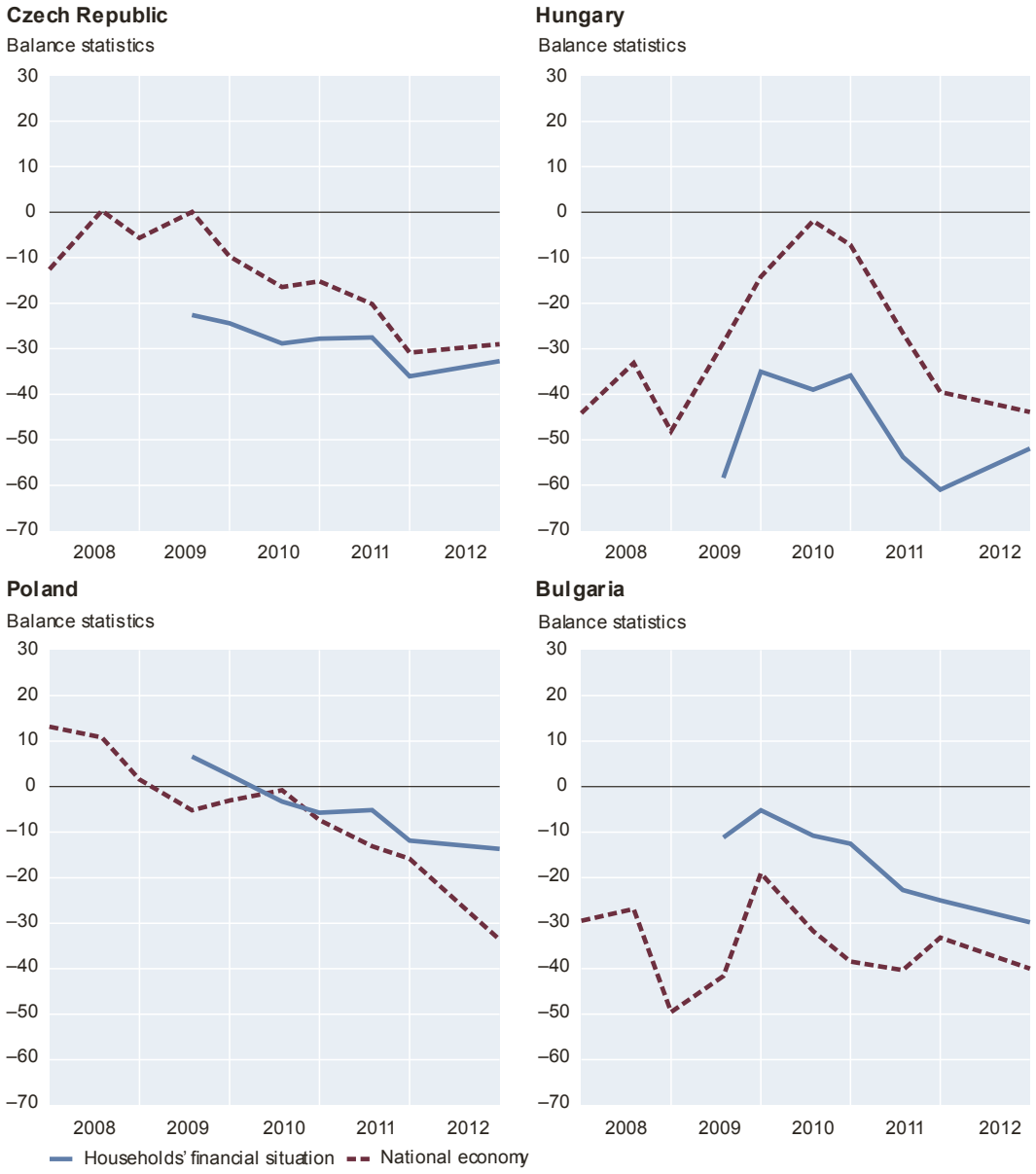
9 The Euro Survey elicits data on expectations about exchange rate developments over one year and over five years. If we compare the exchange rate expectations for the two time horizons we find that expectations do not differ a great deal. Detailed results are available from the authors upon request.

10 From a household's perspective, an improvement of the national economy could refer to a range of factors, i.e. GDP growth, less volatile inflation or exchange rates, greater stability of the financial system, etc. What exactly " improvement" refers to most likely depends on the individual respondent's situation and experience. Exploring this at an individual level would amount to a research question in its own right.

11 Improvement of the household's situation - as with expectations regarding the national economy - could mean a number of things, e.g. being able to consume or save more, or struggling less to repay a loan. Understanding the individual connotations of the answers would require separate research and, most likely, additional survey questions.

12 Interestingly, this hump shape found for Hungary is similar for expectations regarding the national economies in the European Union as collected by the Eurobarometer.

Chart 1
Development of Expectations regarding the Households' Financial Situation and regarding the National Economy

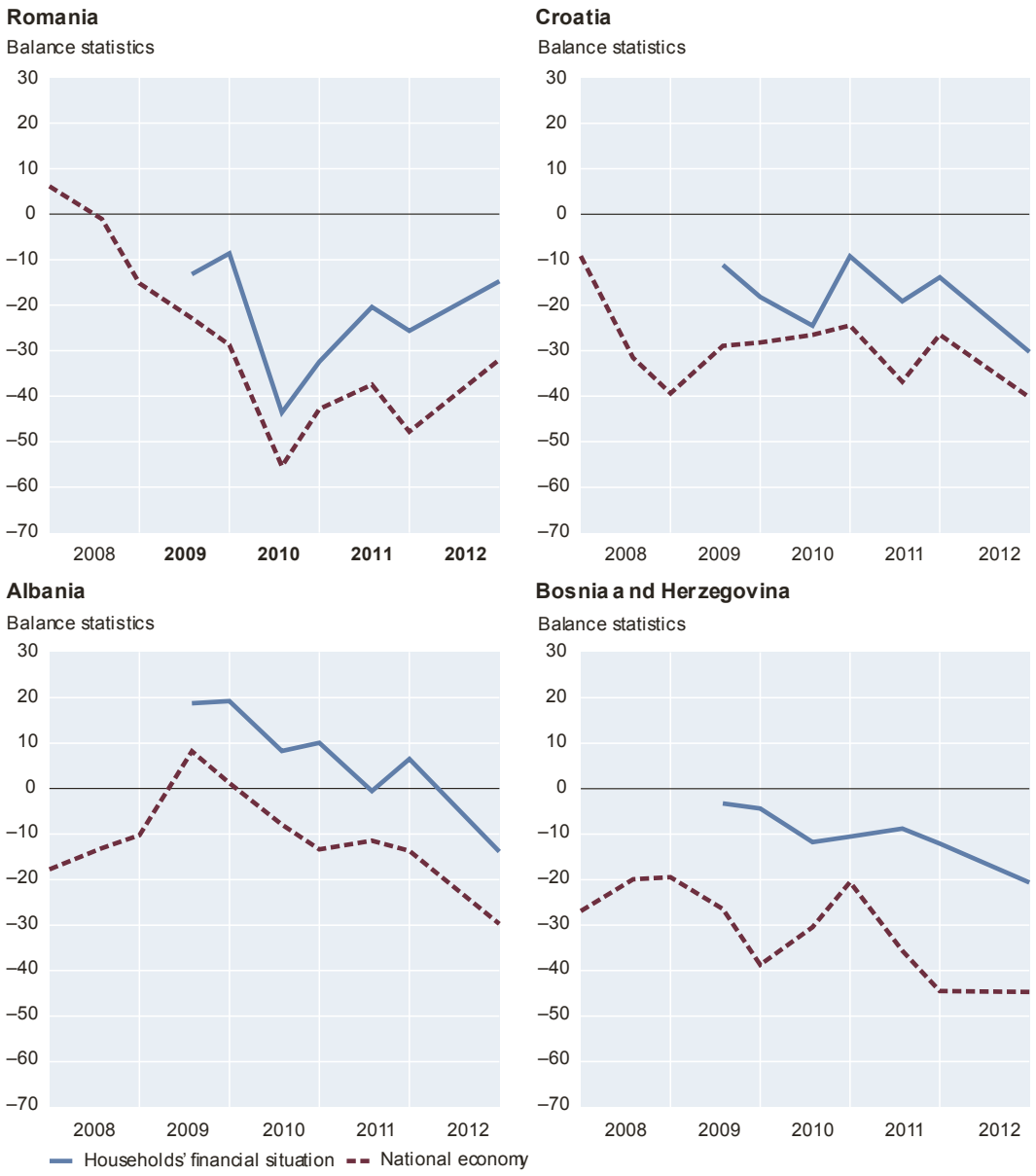


Source: OeNB Euro Survey (authors' calculations).
Note: The years indicate the year in which the survey was carried out, with the spring wave recorded at the grid line and the fall wave between grid lines.

What could be the reason for the more optimistic bias of expectations toward the situation of one's own household? There are three possible explanations: Households might misjudge the future development of the economy, that of their own household finances, or possibly both. Bovi (2009) refers to the distortion in households' expectations as "illusion of control" and argues that people think that "their own future situation will get better against all odds."[13]

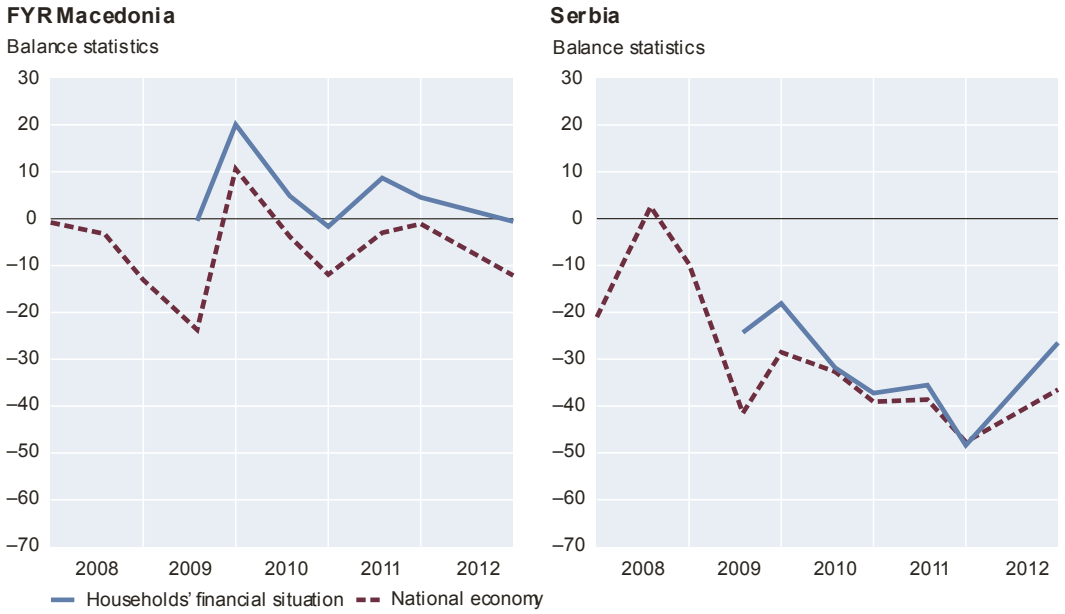
13 Another reason for the incongruity of expectations could be the different time horizons, since respondents in the Euro Survey are asked what they expect within the next year for their household situation and within the next five years with regard to economic development. However, Bovi (2009) asks both questions for the same time horizon (one year) and obtains similar results.

Chart 1 continued
Development of Expectations regarding the Households' Financial Situation and regarding the National Economy



Source: OeNB Euro Survey (authors' calculations).
Note: The years indicate the year in which the survey was carried out, with the spring wave recorded at the grid line and the fall wave between grid lines.

Chart 1 continued
Development of Expectations regarding the Households' Financial Situation and regarding the National Economy



Source: OeNB Euro Survey (authors' calculations).
Note: The years indicate the year in which the survey was carried out, with the spring wave recorded at the grid line and the fall wave between grid lines.

Table 1
Summary Statistics on Expectations regarding the National Economy

	Mean	Standard deviation
Czech Republic	–13.92	10.79
Hungary	–28.73	16.27
Poland	–5.33	13.55
Bulgaria	–35.01	8.73
Romania	–27.71	19.86
Croatia	–29.17	8.99
Albania	–10.78	10.23
Bosnia and Herzegovina	–30.72	9.74
FYR Macedonia	–6.22	9.33
Serbia	–29.29	15.63

Source: OeNB Euro Survey (authors' calculations).

Previous research highlights heterogeneities in economic expectations within countries across socio-demographic groups (Souleles, 2004). These heterogeneities are also present in our sample of CESEE countries: In all ten CESEE countries high-income households on average are more optimistic regarding the future of the economy than low-income households. However, this difference is not observed for different levels of education. Respondents with a higher level of education are not always more optimistic about the future of the economy.[14]

Given that some countries in our sample show significant regional differences in terms of economic development, we also look at expectations within the country. Somewhat surprisingly, we do not find that expectations vary a great deal across regions. The one exception in this respect is Bosnia and Herzegovina.

14 This is somewhat surprising given that education and income are generally thought to be highly correlated. As expected, we find a positive correlation between education and income but it is not very high. However, a higher level of education is correlated with greater financial literacy, which in turn is negatively correlated with expectations.

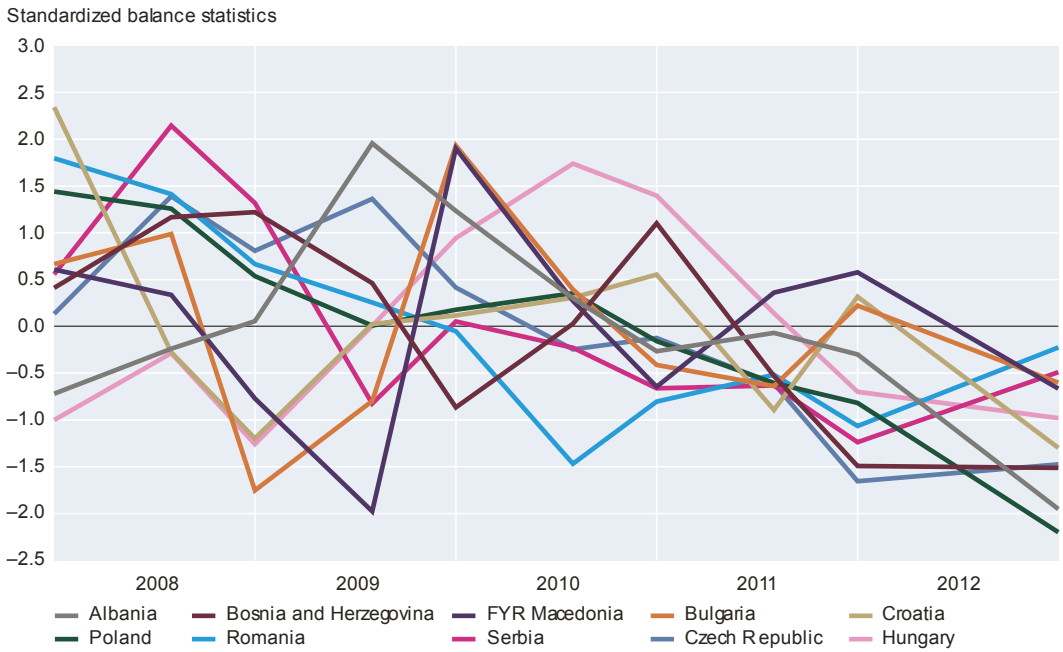
As can be seen in chart 1, the levels of expectations differ substantially across countries. Table 1 presents the summary statistics on expectations regarding the national economy.

Average expectations regarding the national economy are negative in all countries, Bulgaria being the most pessimistic country with a balance statistic of roughly -35. The most optimistic countries are the Czech Republic, Albania and FYR Macedonia. Regarding households' financial situation (results not shown in the table), we find that households in Hungary have the most pessimistic expectations.

Apart from the high heterogeneity in levels, the development of expectations over time also differs across countries, both in terms of direction and in terms of volatility (as can be seen from the standard deviations in table 1). It would be interesting to know whether expectations have moved in a more uniform direction since the onset of the financial crisis, which - as an external factor - could also have driven swings in expectations at the CESEE level.

Chart 2 shows the development of standardized balance statistics on expectations regarding the national economy corrected by country-specific levels and standard deviations (given the different levels and volatilities of expectations among the countries this allows a better comparison). The chart reveals a downward trend in most countries' expectations starting in 2009 and intensifying around 2010. This downward trend is not surprising given the outbreak of the financial and economic crisis in 2008 and the subsequent sovereign debt crisis from 2010 onward, which became an additional influence next to the country-specific factors that had dominated the development of expectations before.

Chart 2
Standardized Balance Statistics on Expectations regarding the National Economy's Development over the Next Five Years



Source: OeNB Euro Survey (authors' calculations).
Note: Values are standardized balance statistics (balance statistics minus mean and divided by standard deviation). The years indicate the year in which the survey was carried out, with the spring wave recorded at the grid line and the fall wave between grid lines.

Does the importance of external factors mean that expectations only mirror global economic developments and are thus less relevant for national policymakers? To explore this question, we will now focus on the relation between expectations and macroeconomic outcomes.

4. Expectations and Macroeconomic Outcomes

To what extent are expectations related to macroeconomic outcomes? As our survey is only carried out semiannually we only have ten balance statistics observations. Based on this limited amount of data it is not possible to answer the above question using VAR estimations or other standard econometric techniques. However, we can approach this question descriptively.

We use data on year-on-year growth in consumption and GDP in real terms. The literature does not reach a conclusive result regarding the relation between consumption/GDP growth and expectations, although it does indicate, at least for the U.S.A., that the effect runs from expectations to consumption and not vice versa. We study both the relation between expectations and previous consumption/ GDP growth (i.e. the difference of the half-year preceding the survey against the prior half-year) and the relationship between expectations and future consumption/GDP growth (i.e. the difference of the half-year following the survey against the prior half-year) by computing Spearman correlation coefficients. We employ the Spearman correlation because the balance statistics are based on ordinal data, which we do not assume to be normally distributed.

Table 2 shows some interesting results: The correlation of subsequent consumption growth with expectations regarding the national economy is positive for most countries, except for Hungary and Romania. Previous consumption growth is also correlated with expectations regarding the national economy but the pattern is weaker and overall the picture is less clear. Subsequent GDP growth is positively correlated with expectations in all countries. Again, the relationship between past developments and expectations is less clear. The negative correlation in some countries is somewhat surprising but weak.

Table 2
Correlation of Expectations regarding the National Economy with Subsequent and Previous Consumption and GDP Growth (Spearman Correlation Coefficients)

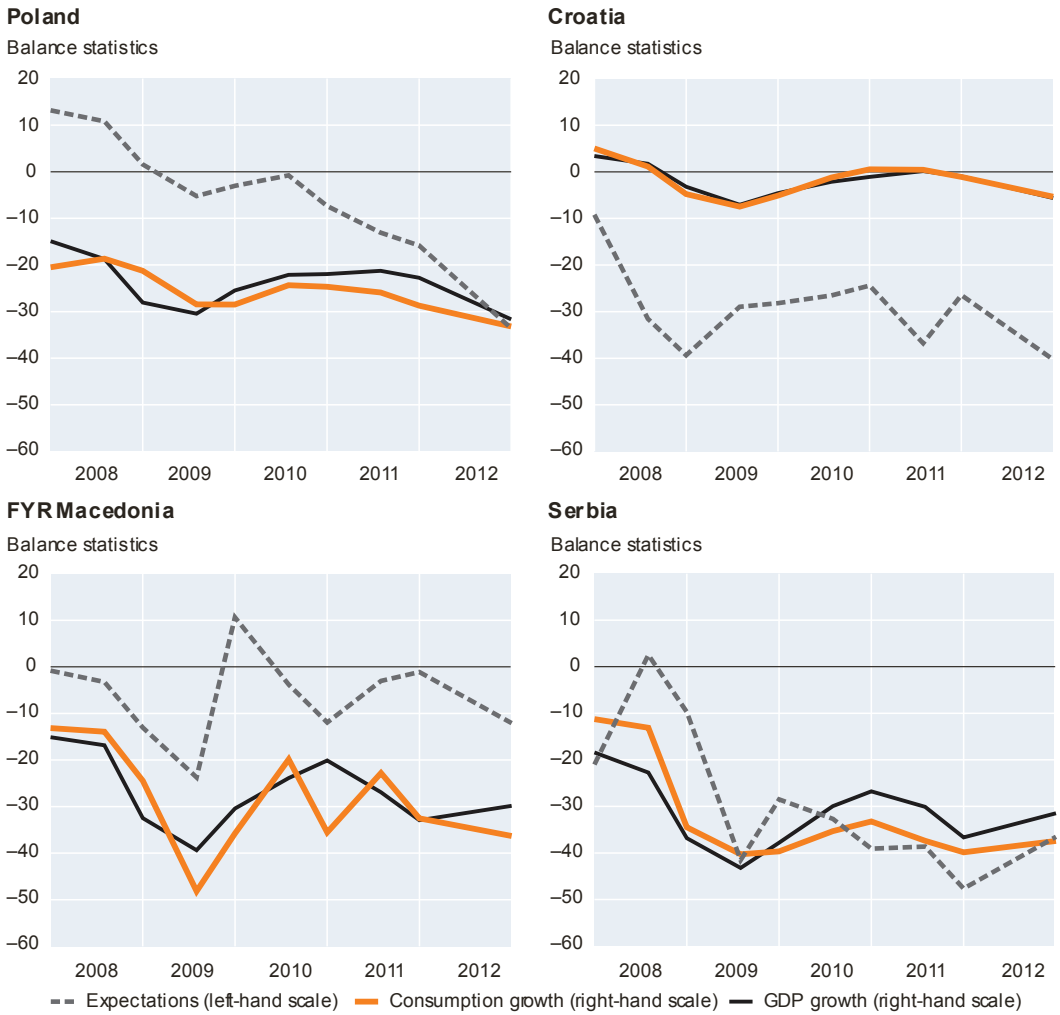
	Subsequent consumption growth	Subsequent GDP growth	Previous consump - tion growth	Previous GDP growth
Czech Republic	0.357	0.042	0.515	0.176
Hungary	–0.321	0.515	–0.612	–0.164
Poland	0.679	0.503	0.661	0.539
Bulgaria	0.107	0.176	–0.055	–0.067
Romania	–0.536	0.321	0.491	0.576
Croatia	0.571	0.43	0.03	–0.006
Bosnia and Herzegovina	. .	0.667	. .	0.697
FYR Macedonia	0.5	0.317	–0.03	–0.006
Serbia	0.357	0.358	0.442	0.394

Source: OeNB Euro Survey (authors' calculations).
Note: No quarterly consumption data available for Bosnia and Herzegovina; no data available for Albania. The number of observations per country is ten. "Subsequent" refers to the two quarters following the survey whereas "previous" refers to the two quarters preceding the survey.

These correlations allow two conclusions. The extent to which expectations and macroeconomic outcomes are related varies strongly across countries. Overall, however, the correlation between subsequent economic outcomes and expectations is somewhat stronger than in the case of previously observed growth. Hence, expectations regarding the national economy could have some predictive power for consumption and GDP growth.

The positive correlation between consumption growth and expectations could provide some indication that the permanent income hypothesis holds for most CESEE countries. By extension, this positive correlation would then indicate that our measure of expectations regarding the national economy captures expectations regarding future income and wealth.

Chart 3
Expectations regarding the National Economy, Consumption and GDP Growth for Selected Countries



Source: OeNB Euro Survey (authors' calculations), Eurostat, NCBs.
Note: The years indicate the year in which the survey was carried out, with the spring wave recorded at the grid line and the fall wave between grid lines.

For Romania and Hungary, the negative correlation between consumption growth and expectations could point to the precautionary savings hypothesis, which would suggest that better expectations regarding the future increase consumption today and hence reduce subsequent consumption growth.

Chart 3 plots the development of expectations regarding the national economy, consumption and GDP growth for Poland, Croatia, FYR Macedonia and Serbia, for which the correlations are especially strong. Confirming the correlation results, there is a clear co-movement of expectations and subsequent consumption and GDP growth and some indication for the leading role of expectations.

5. Summary

Using evidence from the OeNB Euro Survey, we show that households in most CESEE countries are more optimistic about the development of their own finances than about the development of their national economies. This "household bias" is in line with results presented in existing literature on other countries. Within the CESEE region, high-income households are more optimistic about the future of their national economy than low-income households.

We find that the levels of expectations differ substantially across countries in CESEE; however, since the onset of the financial and economic crisis the movements of expectations have become more homogeneous within CESEE.

Regarding the link between expectations and macroeconomic outcomes, we find a positive correlation between households' expectations regarding the national economy and future GDP growth. For consumption growth, the correlation is also positive with the exception of two countries. Our descriptive analysis, of course, cannot identify whether expectations drive these macroeconomic variables or vice versa. What we can say is that the correlation of expectations with subsequent consumption and GDP growth across countries is more clear-cut than that of expectations with previous growth.

Altogether, these results might indicate that expectations, especially if observed at a higher frequency and released without large time lags, could add predictive power to forecasting models for CESEE. By extension, policymakers could possibly gain insights into likely future developments by monitoring expectations. Also, by keeping track of expectations, policymakers might obtain a greater understanding of the volatility in expectations, which may also indicate a strong sensitivity to certain news and announcements. However, our results - as the general results from the literature - are still inconclusive and further research is needed. For policymakers it would be important to also better understand the determinants of expectations in CESEE countries. In particular, understanding heterogeneities in expectations across sociodemographic groups would be a next step toward designing targeted policy measures. Furthermore, it would be useful to understand which events trigger swings in expectations.

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EFFECTS OF FISCAL POLICY ON THE POST-CRISIS RECOVERY OF EUROPEAN ECONOMIES

Rilind Kabashi and Ana Mitreska[1]

Abstract

This paper analyses the effects of fiscal policy on the recovery of output in European economies. It first uses relatively simple statistical tests to analyse the differences in the dynamics of fiscal adjustment and output movements across the main country groups. Results indicate that there were considerable differences in the reaction and the composition of fiscal policy on crisis impact, as well as during post-crisis recovery stages. The study also applies a formal analysis of the effects of fiscal policy, which includes a wide array of pre-crisis and post-crisis factors usually analysed in the literature. Econometric results indicate that fiscal consolidation had a relatively small, but fairly robust positive impact on output recovery in European countries. These findings lend support to the argument for expansionary fiscal consolidation as European policymakers are still struggling to strengthen the pace of output recovery.

JEL classification: C21, E62, E00, O57

Keywords: fiscal policy, European countries, global crisis, cross-section estimation.

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Introduction

The episode of fiscal expansion, followed by a rapid reversal of the fiscal support in many European countries, has reignited many studies on the impact of fiscal consolidation on growth. The issue is gaining even larger weight, as a new wave of additional fiscal consolidation seems to be under way on the backdrop of anticipated further rise in public debt levels.

This paper extends the recent literature by investigating the impact of the latest episode of fiscal consolidation in Europe on the post-crisis recovery. It starts with rather simple statistical tests aimed at analysing differences in fiscal policy and growth behaviour across several country groups: Baltic States, new EU-7 countries, the so called GIIPS group with Cyprus added, core euro area countries and 6 South-eastern European countries. Differences across the time dimension are explored, as well as the significance of differences in fiscal and growth variables in different country groups compared to core euro area countries as a benchmark. With a rather scarce literature in terms of a more formal comparison among different country groups, the paper contributes to the existing literature in this respect.

The paper proceeds with a formal econometric investigation by running cross-section regressions on a sample 37 European countries: 28 current EU members, 5 countries from South-eastern Europe, Norway, Turkey, Switzerland and Iceland. The econometric estimates aim to provide an assessment of the impact of the change in the fiscal stance in Europe after the peak of the crisis on the post-crisis GDP recovery. Regressions use the budget balance as a fiscal indicator, and are augmented with a wide spectrum of explanatory variables as possible determinants of short-term growth. The endogeneity problem has been alleviated by using different periods for defining the growth recovery and the change in the fiscal stance, as well as by using cyclically adjusted budget balances.

The results from these estimates provide some evidence in favour of the expansionary fiscal austerity hypothesis, with the main results being quite robust in most of the specifications. Therefore, they suggest a need for a more prudent fiscal policy in the period to come, if the economic recovery is to be sustained. However, it should be noted that the results should be taken cautiously as a) alternative measures of fiscal stance might yield different results and b) policy solutions should be adjusted to specific country circumstances.

The rest of the paper is organized as follows. Section 1 one provides a review of the recent literature. Section 2 discusses stylized facts through statistical tests. Section 3 explains the data and methodology. Section 4 explains the main findings from econometric estimations and the final section provides conclusions and some policy recommendations.

1. Literature Review

In general, the literature offers different views on the short-term effects of fiscal consolidation. The traditional Keynesian view argues that cutting government spending or raising revenues has an adverse effect on the aggregate demand in the short term. On the other hand, there are views which oppose the "conventional wisdom", arguing that fiscal consolidation might have a positive impact on growth. A small increase in taxes today may create expectations for absence of a need for a larger, more disruptive fiscal adjustment later, or expectations that there will be substantial tax cuts in the future. It can raise the expected future disposable income and increase investor confidence. Therefore, fiscal consolidation can support private consumption and investment even in the short term, a phenomenon known as "expansionary fiscal contraction" or "expansionary austerity." The issue of expansionary fiscal contractions attracted considerable attention since early 1990s, with several prominent studies such as Giavazzi and Pagano (1990, 1996) and Alesina and Perotti (1997). The Great Recession and the fiscal consolidation packages adopted by numerous countries brought this issue back to the focus of the literature, which is briefly reviewed here.

Gujardo et al. (2011) investigate the short-term effects of fiscal consolidation on economic activity in OECD economies, arguing that the frequent finding of expansionary contractions is in fact a biased result reflecting the failure of standard cyclically adjusted fiscal indicators to properly identify exogenous fiscal policy shocks. Therefore, they carry out the estimations by using two different measures of fiscal policy stance. The first one is a conventional measure, the fiscal balance in cyclically adjusted terms, and the results support the expansionary fiscal contraction hypothesis. The second measure of the fiscal stance is derived through the examination of the historical record, including budget speeches and IMF documents, in order to identify changes in fiscal policy motivated by a desire to reduce the budget deficit and not by responding to prospective economic conditions. Using this new dataset (described in Devries et al. (2011)), they conclude that fiscal consolidation in fact has contractionary effects on private domestic demand and GDP, and that the manner of identification of fiscal consolidations has an important effect on the results.

Alesina at al. (2012) argue that the correct experiment to evaluate the effects of a fiscal adjustment is the simulation of multi-year fiscal plans rather than of single-period fiscal shocks. They use narratively identified fiscal adjustments to build plans that are exogenous to the business cycle. Plans consist of the announcement of a sequence of fiscal actions, some to be implemented in the same year as the announcement (unanticipated) and some to be implemented in the following years (anticipated). They build a database of episodes of consolidations in 17 advanced countries, and then use panel estimation to investigate the effects of tax-based and expenditure-based consolidations on output (and some other variables). Their data set is an extension of the international database of narratively identified fiscal adjustments constructed at the IMF by Devries et al. (2011), which covers 17 OECD countries between 1978 and 2009. The main findings suggest that adjustments based on spending cuts are much less costly in terms of output losses than tax-based ones. The difference cannot be explained by accompanying policies and it is mainly due to the different response of business confidence and private investment.

The focus in Pennings and Ruiz (2013) is somewhat different, as they investigate whether the multiplier during episodes of fiscal consolidation is associated with the speed at which the adjustment takes place. They modify the standard regression of growth on consolidation size with an additional term interacting size and speed. In addition, they develop an index to measure speed, and create a new sample of multi-year episodes to look at the path of fiscal consolidations using the database by Devries et al. (2011). Their main empirical finding is that fast adjustment episodes have higher multipliers than gradual consolidations. In addition, their study provides some preliminary support for consolidating at a steady pace, subject to sufficient market access and a credible adjustment plan.

Unlike the previous studies, in 't Veld (2013) and Semmler and Semmler (2013) focus on the European countries. Semmler and Semmler (2013) review empirical studies that have used regime change models and Multi-Regime VARs to estimate and evaluate state dependent fiscal and monetary policies in the European Union. Their main conclusion is that there is no single multiplier for all time. Indeed, fiscal consolidations in certain regimes can be very contractionary, and this finding is replicated in a dynamic model. The results indicate that the fiscal multiplier is state-dependent and highly conditional on the economic environment and regimes, i.e. the success of debt stabilization depends on the level of financial stress, the state of the banking system, monetary policy actions, the internal and external demand and the exchange rate. In addition, there is some evidence about the importance of the composition of fiscal consolidation (health, education, public infrastructure, government consumption) for the effects on growth. In that respect they conclude that "the hastily enacted EU austerity programs had, and still have, distributional effects and are likely to endanger the future of the EU Welfare State."

In 't Veld (2013) uses a structural multi-country model to assess the impact of fiscal consolidation measures undertaken in 2011-13 in the euro area periphery and core. The simulations assume prevailing 'crisis' conditions (high share of constrained households and the zero lower bound). The GDP effects depend crucially on the composition of the consolidation and on how quickly are expectations affected. He finds that expenditure-based consolidations have larger impact multipliers than revenue-based consolidations. Average multipliers for domestic fiscal shocks range between 0.5 and 1, depending on the degree of openness. But spillovers of fiscal consolidations are large, with both the demand channel and the competitiveness channel adding to the negative GDP effects. Higher risk premia further exacerbate the negative effects on GDP. This implies that spillovers from consolidations in Germany and

core euro area countries have worsened the overall economic situation. He concludes that a temporary fiscal stimulus in surplus countries can boost output and help reduce their current account surpluses, although results show that the improvement in current account deficits in the periphery is relatively small.

Chari and Henry (2014) compare the post-crisis growth and employment paths in Asian economies after the 1997-1998 crisis and in the European economies after the sovereign debt crisis. They note the different policies that the two groups of countries began with, and also note that the fiscal adjustment in Asia was far more modest while the switch from stimulus to austerity in Europe was quite abrupt. The paper provides a detailed descriptive analysis of economic developments and policy actions in the two groups of countries. It separates the periods in pre-crisis and post-crisis, and tests whether differences in the two groups are significant across various variables. Their statistical results confirm that Asian countries loosened fiscal policy as the need for countercyclical fiscal policy became clear. According to the statistical tests, Europe began with fiscal stimulus, but tightened it before economic recovery started. They proceed with formal estimation, using relatively simple panel regression estimates with country-fixed effects of GDP on the structural balance and additional control variables. Both approaches conclude that the differences in the changes in the fiscal policy stance explain the response of output across the two regions.

2. Stylized facts

The occurrence of the global financial and economic crisis severely impaired public finances of the European economies. The intensity of the impact and the nature of transmission were not homogenous across countries. They were conditioned on the initial fiscal space, the role of automatic stabilizers, the role of the government in terms of growth support packages, and the assumption of liabilities which arose amidst the crisis (for instance the bail out of the banking system). As result, in many of the countries fiscal balances deteriorated sharply, causing a rapid increase in public debt and questioning the sustainability of public finances in some countries. As financial markets started to worry and to focus on the near term debt evolution and the capacity of countries to repay their obligations, calls for fiscal consolidation became the main policy advice for many of the European countries.

Following Chari and Henry (2014), in this section we analyse the fiscal policy and growth performances in European countries by using simple statistical tests. We present means and t-tests on the statistical difference of the means of several fiscal and growth variables for 30 European countries divided in 5 groups according to common aspects in economic movements and fiscal policy before and during the crisis: Baltic states, 7 new EU member-states from Central and Eastern Europe, the so called GIIPS group with Cyprus added, 8 core euro area countries and 6 South-eastern European countries[2]. Our main aim is to check the size, direction and significance of the dynamics of growth and fiscal policy responses at various points in time, as well as to analyse differences between country groups. Therefore, we explore the differences in means across the time dimension by comparing the performance at the peak of the crisis in 2009 to the pre-crisis average (2005-2008), followed by a comparison of the marginal changes of the behaviour in the first two years of the recovery (2010-2011), denoted as "post crisis 1", and the following two years (2012 - 2013), denoted as "post crisis 2", as well as a comparison of the current state compared to the pre-crisis average (post 2 to pre-crisis). The other dimension is briefly testing the significance of differences in fiscal and growth variables in different country groups compared to core euro area countries.

The fiscal deterioration in the peak of the crisis (2009), measured through the headline and structural fiscal balances was present in almost all of the countries within the sample (Table 1 below and Figure 1 in Appendix 2). The severity of the fiscal deterioration was different on impact in different groups of countries. The t-test on the difference in the means of the headline primary budget balance

2 Baltic states include Estonia, Latvia and Lithuania. The CEE group includes Bulgaria, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic and Slovenia. The CGIIPS group includes Cyprus, Greece, Italy, Ireland, Portugal and Spain. The core group includes Austria, Belgium, France, Finland, Germany, Luxembourg, Malta and Netherlands. The SEE group includes Albania, Bosnia and Herzegovina, Croatia, Macedonia, Montenegro and Serbia. Croatia is included in the latter group as it only acceded to the EU in 2013, which is the final year of the analysis.

clearly points to large and statistically significant differences in fiscal performances in the peak of the crisis compared to the pre-crisis period in all group of countries (while in only some of them does the statistical significance hold for the cyclically adjusted primary balance). The largest deterioration on crisis impact was observed in CGIIPS countries, or the so called euro periphery. This is a group of countries with severe macroeconomic imbalances prior to the crisis. As nominal interest rates across the euro area started to converge, regardless of the different fundamentals of different countries, all of the countries in this group experienced a phase of easy access to finance. The root of the problems in Greece and Portugal was public sector over-borrowing, while in Spain and Ireland the borrowing of the private sector was the major issue. Regardless of the roots, the final result was a considerable deterioration of public finances on impact, mostly due to the rescue packages for the financial sector by the government. The economic position worsened further as the risk premium for these countries started to increase and private investors were reluctant to continue their financing operations. The fiscal erosion was also very large in the group of Baltic countries, where externally- financed domestic demand boom resulted in severe imbalances and a burst of the bubble, even before the crisis occurred in the other countries. As public expenditures rose significantly during the boom years, their elevated level was not in line with the falling revenues, which yielded a sharp widening of the fiscal gap. The crisis also led to a considerable worsening of the fiscal stance in the groups of CEE and SEE countries. The magnitude of the deterioration on impact was similar in both groups and so was the level of the average fiscal deficit at the peak of the crisis. For both groups of countries, the room for fiscal manoeuvre was not large. First, the initial fiscal space was estimated not to be large enough to support massive fiscal support to growth. Second, after the difficulties of Baltic States and GIIPS countries in particular, financial markets went from state of "over-optimism" to "over-scepticism", which made the access to financing for these groups for countries much more difficult. Third, particularly relevant for the group of SEE countries, the crisis was weathered relatively well, and the economy initially did not require enormous fiscal packages. The decomposition of the fiscal balance shows that the weakening of the fiscal position in 2009 was driven exclusively by the expenditure component across all groups of countries, with the SEE countries being the only exception in terms of the statistical significance of the change.

Table 1. Average budget indicators and changes in sub-periods

Unadjusted primary budget balance, in % of nominal GDP

	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - Pre-crisis	Post 1 - Crisis	Post 2 - Post 1	Post 2 - Pre-crisis
balt	-0.3	-6.1	-2.7	-0.6	-5.9*	3.4	2.1	-0.3
cee	-0.7	-4.5	-2.5	-1.7	-3.9***	2.0	0.8	-1.0
cgiips	0.7	-7.2	-6.1	-2.9	-7.9***	1.1	3.2	-3.5***
core	2.1	-1.8	-1.1	-0.4	-3.9***	0.7	0.7	-2.5***
see	0.5	-3.3	-2.5	-1.7	-3.8***	0.8	0.8	-2.1***

Cyclically adjusted primary budget balance, in % of nominal GDP

	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - Pre-crisis	Post 1 - Crisis	Post 2 - Post 1	Post 2 - Pre-crisis
balt	-3.4	-2.9	-0.1	0.2	0.5	2.8	0.3	3.6***
cee	-2.4	-4.6	-2.5	-0.8	-2.2	2.1	1.7	1.6
cgiips	-1.1	-7.4	-6.1	-1.1	-6.3**	1.3	5**	0.0
core	1.0	-0.4	-0.9	0.3	-1.4	-0.5	1.2**	-0.7
see	-1.0	-3.9	-2.7	-0.7	-2.9***	1.2*	2***	0.3

Cyclically adjusted government revenues, in % of nominal GDP

	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - Pre-crisis	Post 1 - Crisis	Post 2 - Post 1	Post 2 - Pre-crisis
balt	32.3	40.5	38.8	36.3	8.2	-1.7	-2.5	4**
cee	37.3	38.3	38.8	39.8	1.0	0.5	1.0	2.5
cgiips	39.1	38.8	40.2	42.9	-0.3	1.4	2.7	3.8**
core	45.3	47.8	46.7	48.5	2.5	-1.1	1.8	3.2**
see	37.2	36.9	36.3	37.1	-0.3	-0.6	0.8	-0.1

Table 1 continued

Cyclically adjusted government primary expenditures, in % of nominal GDP

	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - Pre-crisis	Post 1 - Crisis	Post 2 - Post 1	Post 2 - Pre-crisis
balt	35.7	43.3	38.9	36.1	7.6***	-4.4**	-2.8*	0.4
cee	39.6	42.9	41.3	40.6	3.3**	-1.6	-0.7	1.0
cgiips	40.2	46.2	46.3	44.0	6.0***	0.1	-2.3	3.8**
core	44.3	48.2	47.6	48.1	3.9*	-0.6	0.5	3.8**
see	38.1	40.7	39.0	37.8	2.6	-1.7	-1.2	-0.3

The rising fiscal deficits, amidst severe deterioration of the economic performances, led to sharp worsening of the public debt dynamics (Table 2). The comparison of movements across country groups again points to CGIIPS and Baltic countries as two groups with the most pronounced increase of public debt compared to pre-crisis levels. Nevertheless, public debt was on a rising track in all the groups of countries. In addition, the country-by country comparison reveals negative outliers in all of the country groups (France, Bosnia and Herzegovina, Slovenia and Hungary being particular examples with public debt to GDP ratio increasing by over 10 percentage points in a single year compared to their respective pre-crisis averages). Somewhat surprisingly, considerable increases in public debt levels in all country groups across all separate sub-periods are not statistically significant. However, the current debt level is significantly larger compared to the pre-crisis average, thus clearly indicating potential pressures on fiscal policy to curb further debt increases in the recent future.

Table 2. Average debt levels and changes in sub-periods

General government gross debt, in % of nominal GDP

	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - Pre-crisis	Post 1 - Crisis	Post 2 - Post 1	Post 2 - Pre-crisis
balt	11.1	23.1	27.9	29.7	12.1	4.8	1.8	18.6**
cee	33.3	39.3	44.3	50.7	6.0	5.0	6.4	17.4***
cgiips	68.4	84.4	101.7	121.9	16.1	17.3	20.2	53.5***
core	55.5	63.1	66.9	71.3	7.6	3.8	4.4	15.8**
see	36.0	38.5	43.6	53.3	2.5	5.1	9.7**	17.3***

On the backdrop of one of the most severe global crisis in the recent economic history, the economic performances of the European economies deteriorated rapidly during the acute phase of the crisis (Table 3). The severe economic consequences of the crisis were also conditioned on the pre-crisis initial conditions, i.e. the level of imbalances, the trade and financial inter-linkages, the presence and the strength of structural reforms. The economic growth was mostly impaired in the Baltic countries, where pre-crisis growth, supported by the EU integration optimism, was fuelled with large capital flows, resulting in large external imbalances. However, t-tests of the difference in means indicate that growth performances in 2009 were significantly negative compared to the pre-crisis period in all groups. Further, the results for most of the groups indicate that the growth dynamics was predominantly being affected by the severe and fast deterioration in the investment sentiment and hence considerably lower shares of investment in GDP in 2009 compared to the pre-crisis period, while the reaction of private consumption was somewhat delayed and statistically insignificant (Appendix 1). SEE countries are again an exception, as the export channel was the only component with a statistically significant difference in the peak of the crisis compared to the pre-crisis period, probably reflecting the relatively higher trade openness of this group (although the export share of GDP fell on impact in all groups). The CGIIPS and Baltics are the only two groups of countries where statistical tests reveal important expansionary switches in government consumption in the peak of the crisis, thus pointing towards significant fiscal turbulences in these groups (details on the means and t-tests of differences for GDP components can be found Appendix 1).

Table 3. Average GDP growth rates and levels and changes in sub-periods

Real GDP level, 2008=100

	Averages				Changes in sub-periods			
	2008	2009	2011	2013	2009 - 2008	2011-2009	2013-2011	2013-2008
balt	100	84.4	91.1	97.5	-15.6***	6.7	6.4	-2.5
cee	100	95.1	98.9	99.7	-4.9***	3.8	0.8	-0.3
cgiips	100	96.1	95.1	90.4	-3.9***	-1.0	-4.7	-9.6**
core	100	95.5	100.2	100.6	-4.5***	4.7***	0.4	0.6
see	100	97.5	100.7	101.4	-2.5	3.2	0.7	1.4

Real GDP growth rate, in %

	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - pre-crisis	Post 1 - crisis	Post 2 - Post 1	Post 2 - pre-crisis
balt	6.6	-15.6	3.9	3.5	-22.2***	19.5***	-0.4	-3.1*
cee	5.6	-4.9	2.0	0.4	-10.5***	6.9***	-1.6**	-5.2***
cgiips	2.6	-4.0	-0.5	-2.5	-6.6***	3.5***	-2*	-5.1***
core	2.8	-4.5	2.4	0.2	-7.3***	6.9***	-2.2***	-2.6***
see	5.5	-2.6	1.6	0.3	-8.1***	4.2**	-1.3*	-5.2***

Despite the severity of the crisis and the economic consequences, the European experience indicates that the fiscal stimulus was relatively short lived. Soon after the burst of the crisis, most of the European countries started the fiscal consolidation process (Table 1). The rationale behind the prompt start of the consolidation was different across country groups. For the countries in the GIIPS group, where the financing needs were enormous and inherent vulnerabilities were large, the consolidation was forced by financial markets. In structural terms, fiscal consolidation was large and mostly concentrated in the last two years, when the structural fiscal balance was brought down to the pre-crisis level. Difficult reforms measures were undertaken, with downsizing of public administration, wage cuts and efficiency saving measures, even cuts in capital projects in some of the countries. At the same time, newly introduced revenue measures were largely targeted toward an increase of the rates of the already existing taxes. Statistical t-tests indicate that, unlike the deterioration of the balance in the wake of the crisis, these countries started to implement fiscal consolidation in the first recovery sub-periods, which accelerated rapidly the last two years. The structure of the adjustment indicates that it relied exclusively on revenue increases over the entire period, whereas expenditures were also higher as a share of GDP for the same amount; in both cases the difference is statistically significant.

The Baltic countries started the fiscal consolidation before the occurrence of the global crisis. The fiscal austerity was part of the internal devaluation process, which was supposed to enhance competiveness and drag the economies out of the recession phase. Therefore it was implemented mostly through a reduction in expenditures. This conclusion is supported by the statistical tests, which indicate significant cumulative fiscal adjustment, with sharp adjustment in fiscal expenditures in the two recovery sub-periods, while revenues proved to be significantly different on cumulative basis only. For the core countries, the fiscal consolidation was significant in the second recovery period, largely as a result of a stronger growth in revenues than expenditures. For some countries in this group others (Germany, Netherlands) the consolidation was marked as "pre-emptive", i.e. these were countries in which fiscal deficits were substantial, but the policy response was proactive and fiscal consolidation plans were announced. In other countries like France (Poland in the CEE group as well), the necessary consolidation was delayed until the economic recovery was perceived as sustainable. The CEE and SEE countries also went through fiscal adjustment process, on average improving their structural position compared the pre-crisis levels. The consolidation in both these groups was mostly expenditure based, although certain revenue measures were introduced as well.

After the peak of the crisis, economic performances started to improve, and in terms of the formal testing they were significantly different compared to the peak of the crisis (Table 3). However, with the euro area debt crisis intensifying again in the middle of 2011, recovery halted and growth figures weakened. Indeed, they are significantly lower in the second compared to first two post-crisis years (the Baltic States being exception in terms of significance, as the positive shift in the GDP growth

in 2010-2011 period was enormous). In the last two years (2012-2013), despite the cumulative recovery, growth rates are significantly lower compared to the pre-crisis period in all country groups. In addition, with the exception of core and SEE countries, the GDP level in 2013 is still below the pre-crisis level, a fact particularly pertinent to the CGIIPS group of countries. Apparently, in the near future, the main priority for all groups of countries is the achievement of sustainable economic recovery. On the other hand, despite the sizeable fiscal adjustment already undertaken by most of the countries, the public debt level requires further fiscal adjustment. Hence, the main issue is how to implement fiscal adjustment which would not be harmful to growth. The literature offers many recommendations in terms of the size, speed and the structure of consolidation, which would not significantly jeopardize the economic recovery. On the other hand, there are views which relate the growth impact of the fiscal adjustment to the way it affects business confidence and private investment (Alesina and Ardagna, 2012). Although no straightforward answer can be found, some lessons can be drawn form the past fiscal consolidation episodes. The fiscal consolidation between 2009 and 2013 in Europe is such an episode, and can be useful in drawing certain inferences. Therefore, the next section provides a formal econometric estimation in order to assess the impact of fiscal consolidation on the post-crisis recovery in Europe.

The other dimension which we explore before moving to formal estimation is the comparison of fiscal performances of the different groups of countries compared to the euro area core, which was chosen as a benchmark in terms of fiscal performances. The comparison of the structural fiscal balance in the pre-crisis period reveals higher structural deficit in all groups of countries compared to core countries, with the Baltics and CEE standing out in terms of the size of the difference (Table 4). With the occurrence of the crisis, the gap compared to the core countries widened further (except in Baltic countries), meaning that their fiscal policies were relaxed even more compared to the core countries. As the Baltics started the consolidation before the crisis, their gap to the core countries narrowed during 2009. For all the other groups, the gap widened further on impact, with the largest deterioration, which is also statistically significant, appearing in the CGIIPs group of countries. In both post-crisis periods, the gap in all country groups generally decreased, meaning that they were implementing stronger fiscal consolidation than core countries.

The structural decomposition indicates that, overall, the differences in the budget balance are driven primarily by a larger reduction of expenditures compared to the core countries (Table 4 below and Figure 2 in Appendix 2). Indeed, all country groups had a considerably lower share of revenues to GDP in the pre-crisis period. Initially, they all responded to the crisis by increasing this gap (i.e. further lowering revenues), except Baltic countries which narrowed the gap by increasing revenues relatively more than core countries. However, during the post-crisis years these movements largely cancelled out, so the negative difference in the share of revenues compared to core countries at the end of the period was fairly close to the one before the crisis. The largest difference in the share of revenues can be noticed for SEE countries, where it is now considerably lower than in the core countries, implying that there is room the fiscal consolidation that would be based on revenues. On the other hand, the share of expenditures to GDP is considerably lower compared to core countries in all groups in the end of the period compared to the pre-crisis negative difference, with the exception of CGIIPS countries. Indeed, while there were some divergent movements on impact and during the recovery, the results show that all groups of countries had a considerably lower expenditure ratio than core countries before the crisis, and that in the end of the period this difference became even larger in all of them except in CGIIPS countries (where the difference was similar). This implies that, compared to the core countries, fiscal adjustment in most other European countries was much more reliant on expenditure reduction.

Table 4. Differences of budget indicators to core countries and difference-in-differences in sub-periods

Cyclically adjusted primary budget balance, in % of nominal GDP
T-tests of means compared to core countries in event time

	Average difference to core countries				Difference-in-difference		
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - Pre-crisis	Post 1 - Crisis	Post 2 - Post 1
balt	-4.3	-2.4	0.8	-0.1	1.9	3.2*	-0.9
cee	-3.4	-4.1	-1.6	-1.2	-0.8	2.5**	0.5
cgiips	-2.1	-6.9	-5.2	-1.4	-4.9**	1.7	3.8
see	-2.0	-3.4	-1.8	-1.0	-1.5	1.6	0.8

Cyclically adjusted government revenues, in % of nominal GDP
T-tests of means compared to core countries in event time

	Average difference to core countries				Difference-in-difference		
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - Pre-crisis	Post 1 - Crisis	Post 2 - Post 1
balt	-12.9	-7.3	-7.9	-12.2	5.6	-0.6	-4.3**
cee	-8.0	-9.5	-7.9	-8.7	-1.5	1.6*	-0.8
cgiips	-6.2	-9.0	-6.5	-5.6	-2.8*	2.5*	0.9
see	-8.1	-10.9	-10.4	-11.4	-2.8**	0.5	-1.0

Cyclically adjusted government primary expenditures, in % of nominal GDP
T-tests of means compared to core countries in event time

	Average difference to core countries				Difference-in-difference		
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - Pre-crisis	Post 1 - Crisis	Post 2 - Post 1
balt	-8.6	-4.9	-8.7	-12.1	3.7*	-3.8**	-3.3
cee	-4.6	-5.4	-6.3	-7.5	-0.7	-0.9	-1.3
cgiips	-4.1	-2.0	-1.3	-4.2	2.1*	0.8	-2.9
see	-6.2	-7.5	-8.6	-10.4	-1.3	-1.1*	-1.8**

Despite the changes in the difference of the fiscal balance compared to core countries, the respective difference of public debt levels compared to core countries did not change too much during and after the peak of the crisis, with the exception of the CGIIPS group where the gap in debt levels is much larger than in core countries (Table 5). However, these results do not mean that debt problems are exclusively related to the CGIIPS countries. On the contrary, they should be viewed in conjunction with previous results which showed that the debt is on a rising track in all country groups, well above the pre-crisis average, thus indicating the primary challenge in terms of debt management across the whole Europe.

Table 5. Differences of debt levels and GDP growth rates to core countries and difference-in-differences in sub-periods

General government gross debt, in % of nominal GDP
T-tests of means compared to core countries in event time

	Average difference to core countries				Difference-in-difference		
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - Pre-crisis	Post 1 - Crisis	Post 2 - Post 1
balt	-44.4	-40.0	-39.0	-41.6	4.4	0.9	-2.6
cee	-22.2	-23.8	-22.6	-20.6	-1.6	1.2	2.0
cgiips	12.9	21.3	34.8	50.6	8.4	13.5**	15.8***
see	-19.4	-24.6	-23.3	-18.0	-5.2	1.3	5.3*

Real GDP growth rate, in %
T-tests of means compared to core countries in event time

	Average difference to core countries				Difference-in-difference		
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - Pre-crisis	Post 1 - Crisis	Post 2 - Post 1
balt	3.8	-11.1	1.5	3.3	-14.9***	12.6***	1.8
cee	2.8	-0.4	-0.4	0.1	-3.2*	0.0	0.6
cgiips	-0.2	0.5	-2.9	-2.7	0.7	-3.4*	0.2
see	2.8	1.9	-0.8	0.1	-0.8	-2.7*	0.9*

GDP growth rates in all groups of countries were higher than the core euro area average growth rate in the pre-crisis period, with the exception of CGIIPS. The immediate impact of the crisis was to open a negative gap in GDP growth rates compared to core countries in all country groups except in CGIIPS, with a particularly large gap in the Baltic states, which however rebounded relatively quickly. In addition, the three country groups have stronger growth than core countries in the final two years of the period. On the other hand, the effects of the crisis on GDP growth in CGIIPS countries were somewhat delayed, since initially they had better growth than core countries, while the situation worsened considerably in the post-crisis period, when their growth rates are considerably lower.

3. Data and methodology

The previous section provided several important insights into output movements and fiscal policy actions prior, during and after the crisis in European countries. In this section we extend the analysis by carrying out a formal econometric investigation into the effects of fiscal policy on the post-crisis recovery in European countries.

The design of our empirical investigation is largely determined by the question being analysed - what are the effects of fiscal policy on the post-crisis recovery in European countries. This both determines our sample and has a great impact on the choice of the empirical method. In particular, our sample is consisted of 37 European countries: 28 current EU members, 5 countries from South-eastern Europe, Norway, Turkey, Switzerland and Iceland[3]. Further, since we are interested in the recovery, we focus mostly on the period between 2009 and 2013, although earlier years are also used while constructing some of the variables. As quarterly data are not available for several variables for some countries, we use annual data from various sources.

The choice of the empirical method when analysing the effects of fiscal police is a fairly complicated one, primarily due to the inherent endogeneity between fiscal policy and output and the

3 This means that we extend the sample used in the stylized facts section above by 7 countries: Great Britain, Denmark, Sweden, Iceland, Norway, Switzerland and Turkey. This is a fairly diverse group and hence difficult to reconcile with any of the other country groups above, yet their inclusion increases the sample for the empirical analysis.

need to properly identify exogenous fiscal policy actions. For instance, there is a vast and inconclusive literature on fiscal multipliers, mostly using various types of structural VARs (see Gechert and Will, (2012) and Rusnak (2011) for useful recent surveys of the empirical literature). In addition, a relatively smaller, but considerable and increasingly important body of literature focuses on the issues of effects of fiscal adjustments (e.g. Alesina and Ardagna (2012), Yang et al. (2013), Guajardo et al. (2011)). In the latter case, most authors use various panel estimation methods, often trying to identify particular episodes of fiscal consolidation and to analyse their effects on output.

Our paper deviates from both these traditions, mainly because it tries to answer a related, but different question. Indeed, here we are not interested in general, medium- or long-run effects of fiscal policy in a group of country, and neither are we interested in particular episodes of fiscal consolidation in a large group of countries. Instead, we are focused in a particular episode in the recent economic history in a particular group of countries - the Great Recession in the European countries. More specifically, we are interested on the effects of fiscal policy during and after the peak of the crisis on the recovery of output compared to the crisis trough. This precludes the use of conventional methods such as fiscal structural VARs or panel methods in our case. Bearing all this on mind, we decided to use cross-section regressions with OLS estimation. Although cross-section analysis does have its weaknesses, primarily in terms of the endogeneity problem and the possible neglect of dynamics, it is often used in the literature when the focus is on particular determinants of growth: e.g de Carvalho Filho (2011) on the effects of the inflation targeting regime on post-crisis growth; Tsangaraides (2010) on the role of the exchange rate regime on the impact of the recent crisis and the recovery; Cuaresma and Feldkircher (2012) on the determinants of output loss during the 2008-09 crisis (with Bayesian Model Averaging).

In our case, in order to capture the entire recovery period, and not only a particular year, we make extensive use of various period averages, as explained below. This enables us to both capture determinants of recovery better and to at least partially capture some of the dynamics of the variables. We believe that our definition of the dependent variable and the fiscal policy variable enables us to significantly ameliorate the endogeneity problem arising from probable reverse causality. In particular, we define the dependant variable as the difference between the GDP level in 2013 and the one in 2009 as the trough of the crisis[4]. In line with this, in most of our regressions, fiscal policy is defined as the cumulative cyclically adjusted primary balance as a share of nominal GDP between 2009 and 2012. The use of the cyclically adjusted indicator is intended to capture policymaker intentions, isolated from the effect of automatic stabilizers. Related to this, another important advantage of the use of cyclically adjusted balance is the fact that, by removing the automatic effects of output on fiscal balances, it considerably helps to lower the endogeneity problem arising from reverse causality. Further, using the lagged indicator to analyse fiscal policy effects on output is a standard assumption in the literature on fiscal multipliers, mostly as a reflection of policy implementation lags. In order to capture the effects of other factors, which might be important for the recovery of GDP, we also include in the regressions a wide array of variables before or during the crisis. After analysing the effects of fiscal policy on the recovery of output conditional on various pre-crisis and post-crisis variables, we also check the robustness of the main findings on policy effects by defining fiscal policy in several alternative manners and briefly analysing the effects of main policy components.

A word is also in order regarding the process of investigation. Since we have a limited list of cross-section units (37), but a fairly long list of possible determinants of recovery, it is not feasible to carry out a general-to-specific procedure, since the initial specification would be contaminated by multicollinearity and a very low number of degrees of freedom. In addition, perhaps even more than the one on long-term growth, the literature on short-term growth has no consensus on the factors that affect growth, but there is instead a wide list of possible factors analysed in various studies (e.g. Blanchard et al. (2010); Berkmen et al. (2012); de Carvalho Filho (2011); Cuaresma and Feldkircher (2012); Jovanovic (2012)). Therefore, we use a procedure that is closer to the specific-to-general method: we start from the unconditional effect of policy on output, and then add other variables one at a time, keeping the ones which are significant. Although this approach is less common, it is used in parts of the literature which also investigate the effects of particular factors on output recovery (e.g. de Carvalho Filho (2011); Tsangaraides (2010)). This procedure enables us to analyse the possible effect of numerous other

4 This is approximately equivalent to the sum of GDP growth rates between 2010 and 2013.

factors on recovery, and also to analyse whether their inclusion affects the effects of fiscal policy on the recovery[5].

4. Results from the econometric estimation

As noted above, the dependant variable in our analysis is defined as difference in the GDP level between 2013 and 2009. The end of the period is defined by data availability, whereas 2009 is used as the beginning of the crisis because that is the year when the vast majority of countries in our sample reached the lowest level of GDP as a result of the crisis. Fiscal policy is defined as the cumulative cyclically adjusted primary balance between 2009 and 2012, thus accounting for the lagged effects of fiscal policy on output, although later we also check some slightly different periods as well. Defined in this manner, the coefficient on the cyclically adjusted primary balance (CAPB) shows the increase in cumulative output growth in percentage points as a result of a policy consolidation of 1 percentage point over the period. In order to account for country heterogeneity, in all the regressions we also include the log of the 2008 per capita real GDP in euros. Our sample includes a fairly diverse group of countries, and including an indicator of heterogeneity is supported both by a priori expectations and the ex-post analysis of results. Indeed, we maintain the per capita GDP in all the specifications, although it becomes insignificant in some of them, possibly because of the high correlation with some of the other independent variables.

The initial specification in column 1 of Table 6 shows the effect of policy on cumulative growth conditional only on the initial per capita GDP. Results indicate that, during the recovery from the Great Recession in European countries, contractionary fiscal policy has a relatively small, but significantly positive effect on output growth. Indeed, for a relatively strong additional cumulative fiscal consolidation of 1 percentage point, the GDP level in 2013 is higher than the trough in 2009 for around 0.2 points. In addition, in line with expectations, the coefficient on per capita GDP indicates that the recovery has been larger in less developed European countries.

The other columns in this table add various pre-crisis indicators in order to check whether factors before 2009 had any effect on the recovery, as well as whether their inclusion changes the results on the effects of fiscal policy. As noted above, we add one additional variable at a time, and keep each variable which has a significant effect on the recovery before proceeding. In columns 2, 3 and 4 we add indicators that are intended to capture possible over-heating of the economy before the crisis. If there was over-heating before 2009, it would be expected that it would affect the post-crisis recovery, since part of the fall of GDP during and after the crisis would reflect cyclical adjustments of the economy. We start by adding the deviation between actual and HP-trend output in 2008 in column 2, which is a fairly conventional indicator of the cyclical stance of the economy but in this case does not have an effect on the recovery. Next we analyse two alternative indicators of overheating: the average current account balance between 2005 and 2008 (column 3) and the difference in the ratio of loans to nominal GDP between 2008 and 2005 (column 4). However, neither indicator of pre-crisis overheating has any effect on the post-crisis recovery. In addition, while there are some variations in the size of the effect of fiscal policy, its significance and sign is maintained when the output gap and the loan growth are added, whereas the inclusion of the current account balance makes it marginally insignificant (at $p=0.12$). Therefore, we do not maintain any of the indicators of pre-crisis overheating and proceed with analysing more structural indicators in the following two columns. However, neither the openness of the economy (column 5) nor the dummy for pegged exchange rate regimes (column 6) have any effect on the recovery, whereas the results on the fiscal indicator are almost unchanged compared to the initial specification. The final 3 columns analyse the effects of the main vulnerability indicators before the crisis. According to column 7, the size of the public debt before the crisis has a significantly negative effect on the post-crisis recovery. We suspect that this might be related to the effects of debt levels on consumer and business confidence, as well as on the instability in financial markets resulting in more difficult conditions for financing. In addition, the inclusion of public debt has no effect on the coefficient on fiscal policy, as the expansionary effects of fiscal contractions are maintained. Therefore, we keep

5 A useful extension of this investigation would be to use Bayesian Model Averaging, which is left for further research of this issue.

public debt in further specifications and in column 8 we introduce the level of total external debt in 2008, which is insignificant, same as the short-term external debt (results not shown). In the last column we add the total foreign reserves in months of imports in 2008, which also has no effect on the results. Overall, the analysis in Table 6 indicates that, apart from the public debt, other pre-crisis factors had little impact on output recovery, as well as on the effects of fiscal policy on the recovery.

Table 6. Pre-crisis determinants of recovery

Columns	1	2	3	4	5	6	7	8	9
Dependant variable	real GDP level in 2013 compared to 2009								
cumulative CAPB, % of NGDP, 2009-12	0.18**	0.16*	0.13	0.27*	0.18**	0.16*	0.18**	0.18**	0.20**
	(0.08)	(0.08)	(0.08)	(0.14)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
log of per capita real GDP in EUR, 2008	-2.50**	-3.15**	-4.23**	-2.29**	-2.76**	-2.27**	-1.10	-1.02	-1.77
	(1.11)	(1.50)	(1.74)	(1.06)	(1.15)	(1.06)	(1.15)	(1.37)	(1.52)
output gap as % of HP-trend output, 2008		-0.42							
		(0.57)							
average current account balance as % of NGDP, 2005-08			0.26						
			(0.16)						
difference in the loan/NGDP ratio between 2008 and 2005				0.02					
				(0.02)					
opennes, 2008 (exports+imports of G&S as % of NGDP)					0.03				
					(0.02)				
dummy for exchange rate regime in 2008, 1 for hard pegs						-2.16			
						(2.34)			
gross public debt, % of NGDP in 2008							-0.14**	-0.14**	-0.14**
							(0.05)	(0.06)	(0.05)
gross external debt as % of NGDP, 2008								-0.00	
								(0.00)	
total foreign reserves in months of imports, 2008									-0.57
									(1.01)
Constant	12.36***	16.40**	18.04***	12.44***	9.97**	13.00***	14.99***	14.92***	18.32***
	(3.57)	(6.65)	(5.46)	(3.73)	(4.35)	(3.79)	(3.78)	(3.84)	(6.13)
Observations	37	37	37	36	37	37	37	37	37
R-squared	0.18	0.20	0.22	0.22	0.21	0.19	0.35	0.35	0.36
Adjusted R-square	0.13	0.13	0.15	0.15	0.14	0.12	0.30	0.27	0.28
F-statistic	3.21	2.28	2.46	1.87	2.61	2.17	4.13	3.38	3.52
Prob>F	0.05	0.10	0.08	0.15	0.07	0.11	0.01	0.02	0.02

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

After analysing the pre-crisis determinants of recovery, in Table 7 we turn to the effects of various factors during the period of the recovery. In order to alleviate potential endogeneity issues for some of them, most of the variables analysed are defined to only capture the period between 2009 and 2012, which is also in line with their expected delayed effects on GDP.

For ease of comparison, in column 1 we reproduce the final specification from the previous table, which analyses the effects of fiscal policy on output recovery conditional on the initial per capita GDP and public debt in 2008. Then in column 2 we add cumulative effective foreign demand growth between 2009 and 2012. Bearing on mind the fact that our sample is consisted of small open economies, the growth of foreign demand is expected to have a significant effect on the recovery from the crisis, mostly via the exports channel, but also potentially via the formation of expectations. Therefore, effective foreign demand was constructed for each country, reflecting the weighted GDP growth of their main export partners, with weights calculated as the normalised shares of the 10 main export partners for each country in 2006 and 2007. Results indicate that foreign demand growth had a strong positive effect on output recovery of European countries. This is in line with the a priori expectations, and also with the considerably higher share of exports to GDP after the crisis compared to the pre-crisis period (Appendix 1). Therefore, we maintain foreign demand growth in all our further specifications. In line with parts of the literature, in column 3 we add the GDP rate in 2009 in order to capture possible rebound effects. However, results indicate that there are no rebound effects in our sample. On the contrary, the coefficient on the GDP growth rate in 2009 is significantly positive, indicating that countries with higher growth (or lower fall) in the peak of the crisis had a stronger post-crisis recovery, and we keep this variable in future specifications. The significantly positive coefficient might reflect certain country-specific structural factors, which both increased their resilience during the crisis and enabled faster recovery later on.

We proceed by adding net financial flows between 2009 and 2012 as a share of GDP in column 4. Somewhat contrary to expectations, financial flows during the post-crisis period do not have any effect on the recovery. This result is maintained in column 5, which aims to analyse possible different effects of FDI and non-FDI flows. In column 6 we introduce a dummy on IMF arrangements during the post-crisis period. While several countries in our sample did enter or continue their IMF programs, it appears that this factor had no impact on the output recovery. Column 7 adds the CPI-based real exchange rate change between 2009 and 2012, due to the fact that some countries in our sample pursued internal devaluation as a way out of the crisis. However, this factor also has no impact on the recovery. Finally, the last two columns aim to analyse possible effects of monetary policy, albeit in a relatively simple manner. In column 8 we introduce the cumulative change of the exchange rate to the US dollar between 2009 and 2012, whereas in column 9 we introduce the main central bank policy rate, defined as a difference between average rates in 2012 and 2009. However, neither of these factors had any impact on the recovery, so they are dropped from future specifications. Finally, it should be noted that in all specifications in this table the results on fiscal policy are unchanged, as it maintains both its size and significance.

Table 7. Determinants of recovery during the crisis

Columns	1	2	3	4	5	6	7	8	9
Dependant variable	real GDP level in 2013 compared to 2009								
cumulative CAPB, % of NGDP, 2009-12	0.18**	0.16**	0.15**	0.16*	0.18**	0.13*	0.13*	0.14*	0.13*
	(0.08)	(0.07)	(0.07)	(0.08)	(0.08)	(0.07)	(0.07)	(0.08)	(0.07)
log of per capita real GDP in EUR, 2008	-1.10	-2.03	-2.14*	-1.83	-1.69	-2.76*	-2.22*	-2.48*	-1.80
	(1.15)	(1.26)	(1.23)	(1.35)	(1.29)	(1.49)	(1.27)	(1.23)	(1.22)
gross public debt, % of NGDP in 2008	-0.14**	-0.11*	-0.14**	-0.15**	-0.15**	-0.12**	-0.14**	-0.14**	-0.15**
	(0.05)	(0.06)	(0.06)	(0.07)	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)
cumulative foreign demand growth from 2009		0.71***	1.13***	1.14***	1.33***	0.99***	1.10***	1.13***	1.34***
		(0.21)	(0.30)	(0.31)	(0.38)	(0.32)	(0.28)	(0.29)	(0.38)
real GDP growth rate in 2009			0.57*	0.57*	0.67**	0.46	0.51*	0.55*	0.79**
			(0.28)	(0.29)	(0.31)	(0.31)	(0.29)	(0.29)	(0.36)
cumulative net financial flows as a % of NGDP, 2009-12				0.02					
				(0.05)					
cumulative net FDI flows as a % of NGDP, 2009-12					0.11				
					(0.09)				
cumulative net non-FDI flows as a % of NGDP, 2009-12					0.06				
					(0.06)				
dummy=1 if purchases made from IMF 2009-13						-2.94			
						(2.63)			
cumulative change of the CPI-based real effective exchange rate, 2009-12							0.19		
							(0.16)		
cumulative change of the exchange rate to USD, 2009-12								-0.08	
								(0.15)	
difference in the policy rate between 2012 and 2009									-0.55
									(0.53)
Constant	14.99***	12.99***	15.49***	15.08***	13.82***	17.17***	15.46***	16.64***	13.97***
	(3.78)	(3.89)	(4.37)	(4.13)	(3.92)	(5.23)	(4.52)	(4.29)	(4.54)
Observations	37	37	37	37	37	37	37	37	35
R-squared	0.35	0.44	0.48	0.48	0.50	0.50	0.50	0.48	0.51
Adjusted R-square	0.30	0.37	0.39	0.38	0.38	0.40	0.39	0.38	0.41
F-statistic	4.13	8.15	6.10	6.70	7.53	5.18	5.30	6.32	5.74
Prob>F	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The analysis of the pre-crisis and post-crisis indicators in the previous two tables indicates fairly robust evidence for the expansionary effect of fiscal contractions during the Great Recession in Europe. However, one of the important issues arising from such a conclusion is whether the result is an artefact of the way in which fiscal consolidation is defined. The literature uses numerous various ways to define fiscal consolidations (e.g. the survey in Yang et al. (2013)), which motivates us to provide several alternative definitions to our baseline specification, which is repeated in column 1 of Table 8. In column 2 we shorten the period over which fiscal consolidation is calculated. Now the cyclically adjusted primary balance is cumulated not from 2009 but from 2010 to 2012, since 2009 might have in fact been an outlier determined by the severity of the crisis impact. However, changing the years included in the calculation of the fiscal indicator has no impact on its coefficient, as the effects of consolidations are again significantly positive. In column 3 we bring back the fiscal indicator to the cumulative cyclically adjusted balance between 2009 and 2013, but now replace the dependant variable with the difference in GDP levels between 2009 and 2014 (not 2013 as in baseline). Arguably, this would further ease endogeneity concerns, since the fiscal indicator is now effectively lagged twice compared to output recovery (2009-2012 for CAPB, 2009-2014 for recovery). However, extending the period captured by the dependant variable also has no effects on the effects of fiscal policy, which maintains the significantly positive coefficient with an effectively unchanged size.

In column 4 we replace the cumulative fiscal indicator with the cyclically adjusted balances in 2010, 2011 and 2012, which appear to have no separate effects on the cumulative recovery between 2009 and 2013. However, additional tests show that the linear combination of these three coefficients[6] is positive and significant, thus confirming previous findings that fiscal consolidation has a positive effect on recovery. Further, in column 5 we replace the values of the budget balance with a dummy variable that equals one if the cumulative cyclically adjusted balance between 2009 and 2012 is positive and zero otherwise. Results indicate that countries that implemented fiscal consolidation had a significantly stronger recovery than countries with more relaxed fiscal policy after the crisis. Variations of this analysis are also presented in columns 6 and 7, where the fiscal indicator is equal to the cumulative cyclically adjusted balance if it is positive, and zero otherwise, i.e. only amounts of consolidation are included (2009-2012 in column 6 and 2010-2012 in column 7). Fiscal consolidation maintains its positive effect on recovery, although in both cases it is now borderline insignificant (at p=0.11). Finally, some studies define fiscal consolidation only if it is implemented over a period of several years (e.g. Alesina and Ardagna, 2012). Therefore, in column 8 we enter a variation of this specification. More precisely, we enter the cumulative cyclically adjusted balance between 2010 and 2012 only if it has been increasing for each year in that period (i.e. if countries have continuously tightened fiscal policy), and enter zero otherwise. The coefficient on consolidation remains significant, and is somewhat higher than in other specifications, indicating that countries which implemented continuously stronger consolidation had stronger recovery compared to the countries with no or unstable fiscal consolidation.

6 A similar approach to calculate the effects of fiscal policy over several years is also used in some of the specifications in Alesina and Ardagna (2012) and Yang et al. (2013).

Table 8. Additional checks on the effects of fiscal consolidation

Columns	1	2	3	4	5	6	7	8
Dependant variable	real GDP level in 2013 compared to 2009		real GDP level in 2014 compared to 2009	real GDP level in 2013 compared to 2009				
cumulative CAPB, % of NGDP, 2009-12	0.15**		0.17**					
	(0.07)		(0.07)					
cumulative CAPB, % of NGDP, 2010-12		0.17**						
		(0.08)						
CAPB, % of NGDP, 2012				0.39				
				(0.50)				
CAPB, % of NGDP, 2011				-0.20				
				(0.39)				
CAPB, % of NGDP, 2010				0.32				
				(0.29)				
DV=1 if positive cummulative CAPB/NGDP 2009-12					6.66**			
					(2.63)			
cumulative CAPB/NGDP 2009-12 if positive, 0 otherwise						0.11		
						(0.07)		
cumulative CAPB/NGDP 2010-12 if positive, 0 otherwise							0.14	
							(0.08)	
cumulative CAPB/NGDP 2010-12 if CAPB/NGDP continuously growing 2010-12, 0 otherwise								0.32**
								(0.14)
log of per capita real GDP in EUR in 2008	-2.14*	-1.90	-2.78*	-1.96	-3.15**	-2.09	-2.05	-2.47**
	(1.23)	(1.23)	(1.38)	(1.26)	(1.33)	(1.30)	(1.30)	(1.20)
gross public debt, % of NGDP in 2008	-0.14**	-0.15**	-0.15**	-0.14**	-0.14**	-0.14**	-0.14**	-0.14***
	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.07)	(0.07)	(0.05)
cumulative foreign demand growth from 2009	1.13***	1.15***	1.32***	1.25***	1.25***	1.25***	1.26***	1.31***
	(0.30)	(0.30)	(0.41)	(0.30)	(0.27)	(0.31)	(0.31)	(0.31)
real GDP growth rate in 2009	0.57*	0.60**	0.60*	0.64**	0.74**	0.60*	0.61*	0.63**
	(0.28)	(0.29)	(0.34)	(0.30)	(0.29)	(0.30)	(0.30)	(0.28)
constant	15.49***	14.90***	18.90***	14.55***	15.37***	13.48***	13.51***	16.15***
	(4.37)	(4.35)	(4.80)	(4.46)	(4.03)	(4.28)	(4.29)	(4.27)
Observations	37	37	37	37	37	37	37	37
R-squared	0.48	0.45	0.49	0.46	0.52	0.41	0.41	0.49
Adjusted R-square	0.39	0.37	0.41	0.33	0.44	0.31	0.31	0.41
F-statistic	6.10	5.82	5.94	4.19	5.73	5.08	4.97	5.65
Prob>F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Conclusion

This paper analyses the effects of fiscal policy on the recovery of output in European countries during the Great Recession. After a brief survey of the relevant literature, it tries to answer the question in two ways. First it analyses the dynamics of output movements and fiscal policy by t-tests of means of main variables during 2009 as the main crisis year and two post-crisis recovery stages. In this part, it also sheds some light on the differences in fiscal policy and output recovery in the main country groups. After this detailed analysis of stylised facts, it then turns to a formal econometric analysis, which is focused on the effects of budget balances on the recovery, but also investigates the effects of numerous factors before the crisis and during the recovery, both on the recovery itself and on the effects of fiscal policy.

Several important conclusions appear from the paper. The section using t-tests of means reveals that the output recovery from the crisis is still incomplete, as no single group of countries has reached pre-crisis GDP growth rates. Further, there are several differences on the response of fiscal policy on the crisis impact and during the two recovery stages. While the size of the adjustment differs, cyclically adjusted balances became more negative in 2009 in almost all country groups, but were then tightened in both post-crisis periods also in almost all groups as countries embarked on fiscal consolidation (i.e. balances became less negative or more positive). However, the structure of this adjustment differs considerably across country groups. For a start, all country groups reacted with considerably higher cyclically adjusted primary expenditures on impact, thus trying to minimise the effects of the crisis by implementing a fairly conventional Keynesian response. In Baltic, core and CEE countries this was also accompanied by higher revenues. The process of post-crisis fiscal adjustment was consisted of considerable cuts in expenditures in Baltic, SEE and CEE countries. In CEE countries this was accompanied by a rise in revenues, while they fell in both periods in Baltic countries and in the first post-crisis period in SEE countries, thus partially undermining the fiscal consolidation process. On the other hand, the adjustment in core and CGIIPS countries was more mixed in terms of the movement of expenditures and revenues in post-crisis years.

The paper also offers a more formal analysis on the effects of fiscal policy on output recovery in European countries. Although the use of cross-section methods does have its drawbacks in these cases, due to the potential endogeneity between output and fiscal policy, the paper tries to minimise this problem by using (the lag of) cyclically adjusted primary balances which are intended to remove the automatic effects of output on budget balances. Results of econometric analysis indicate that fiscal consolidation had a small but fairly robust positive impact on the output recovery in European countries after the 2009 crisis, thus lending support to the idea of expansionary fiscal consolidations. This finding is robust to the inclusion of a wide array of potential determinants of recovery, both before the crisis and during and after the crisis. Indeed, results indicate that there are only a few factors which had a consistent effect on output recovery: European countries with higher pre-crisis debt levels and higher incomes had weaker post-crisis GDP growth, while stronger recovery of main export partners considerably helps the recovery. On the other hand, the investigation finds no evidence that any of the other pre-crisis determinants or post-crisis factors had any impact on the recovery.

What is most important is that the result on the expansionary effect of fiscal consolidations is maintained in almost all specifications. Notwithstanding the weaknesses of the estimation method and the cyclical adjustment procedure, as well as the need to take into consideration country specifics when designing policy, our findings provide an important recommendation for policymakers in European countries. As they are still struggling to stimulate GDP growth rates to pre-crisis figures, these results indicate that more disciplined fiscal policies would have a positive impact on successful attainment of this goal.

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Appendix 1

Real GDP growth rate, in %

	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - pre-crisis	Post 1 - crisis	Post 2 - Post 1	Post 2 - pre-crisis
balt	6.6	-15.6	3.9	3.5	-22.2***	19.5***	-0.4	-3.1*
cee	5.6	-4.9	2.0	0.4	-10.5***	6.9***	-1.6**	-5.2***
cgiips	2.6	-4.0	-0.5	-2.5	-6.6***	3.5***	-2*	-5.1***
core	2.8	-4.5	2.4	0.2	-7.3***	6.9***	-2.2***	-2.6***
see	5.5	-2.6	1.6	0.3	-8.1***	4.2**	-1.3*	-5.2***

Real private consumption, in % of GDP

	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - pre-crisis	Post 1 - crisis	Post 2 - Post 1	Post 2 - pre-crisis
balt	63.9	62.6	60.5	60.9	-1.3	-2.1	0.4	-3.0
cee	59.7	60.3	59.2	58.3	0.6	-1.1	-0.9	-1.4
cgiips	60.8	62.1	61.8	60.1	1.3	-0.3	-1.7	-0.7
core	51.7	53.2	52.4	52.1	1.5	-0.8	-0.3	0.4
see	77.1	79.3	78.2	75.9	2.2	-1.1	-2.3	-1.2

*No data for Albania and Bosnia and Hercegovina

Real gross capital formation, in % of GDP

	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - pre-crisis	Post 1 - crisis	Post 2 - Post 1	Post 2 - pre-crisis
balt	32.5	18.8	23.9	24.4	-13.7***	5.1	0.5	-8.1**
cee	27.7	23.1	23.0	21.2	-4.6**	-0.1	-1.8	-6.5***
cgiips	24.4	20.0	18.7	16.0	-4.4***	-1.3	-2.7**	-8.4***
core	21.1	18.7	19.6	18.9	-2.4***	0.9	-0.7	-2.2*
see	27.3	25.1	22.0	23.5	-2.2	-3.1	1.5	-3.8*

*No data for Albania and Bosnia and Hercegovina

Real government consumption, in % of GDP

	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - pre-crisis	Post 1 - crisis	Post 2 - Post 1	Post 2 - pre-crisis
balt	17.0	19.0	17.5	16.5	2**	-1.5	-1.0	-0.5
cee	18.2	18.7	18.1	17.7	0.5	-0.6	-0.4	-0.5
cgiips	18.6	20.3	19.7	19.3	1.7**	-0.6	-0.4	0.7
core	20.5	22.1	21.7	21.9	1.6	-0.4	0.2	1.4
see	19.7	20.2	19.6	19.0	0.5	-0.6	-0.6	-0.7

*No data for Albania and Bosnia and Hercegovina

Nominal exports of goods and services, in % of GDP

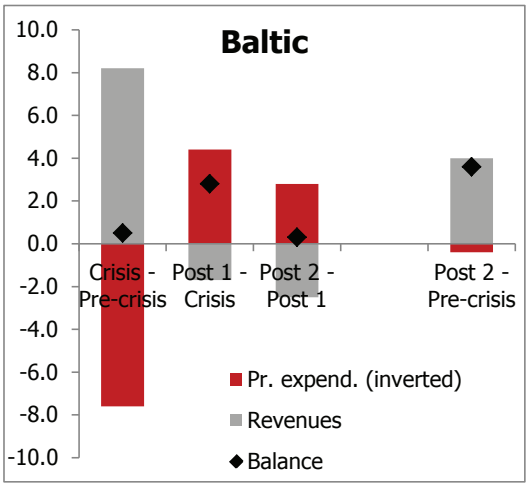
	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - pre-crisis	Post 1 - crisis	Post 2 - Post 1	Post 2 - pre-crisis
balt	58.1	54.0	71.1	78.0	-4.1	17.1*	6.9	19.9**
cee	59.7	54.9	65.2	72.0	-4.8	10.3	6.8	12.3*
cgiips	39.5	37.7	43.0	47.2	-1.8	5.3	4.2	7.7
core	73.3	67.4	75.7	78.2	-5.9	8.3	2.5	4.9
see	37.2	32.1	38.5	41.1	-5.1*	6.4*	2.6	3.9

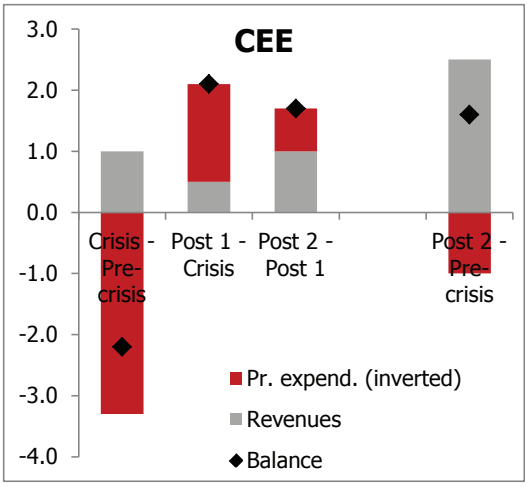
Nominal imports of goods and services, in % of GDP

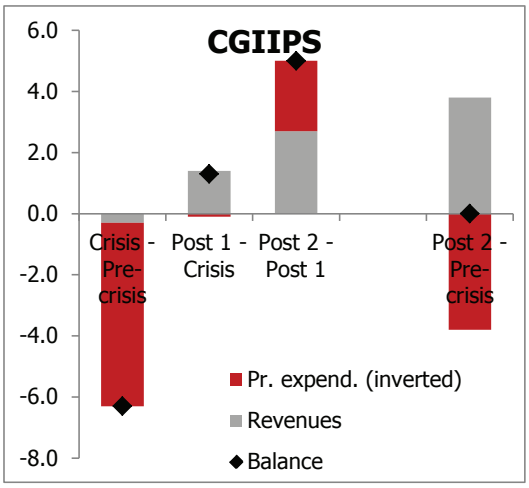
	Averages				Changes in sub-periods			
	Pre-crisis	Crisis	Post-crisis 1	Post-crisis 2	Crisis - pre-crisis	Post 1 - crisis	Post 2 - Post 1	Post 2 - pre-crisis
balt	69.9	53.2	71.2	78.6	-16.7**	18**	7.4	8.7
cee	64.7	55.5	64.6	69.1	-9.2	9.1	4.5	4.4
cgiips	43.5	39.4	43.5	43.2	-4.1	4.1	-0.3	-0.3
core	66.9	61.4	69.6	71.4	-5.5	8.2	1.8	4.5
see	61.1	53.0	56.3	57.6	-8.1	3.3	1.3	-3.5

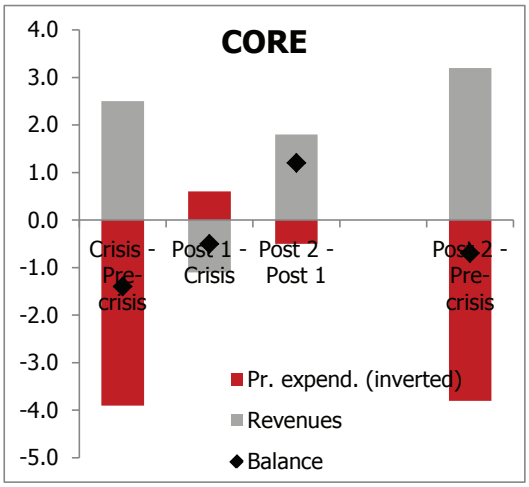
Appendix 2

Figure 1. Decomposition of changes in the cyclically adjusted primary balance across periods, by country groups









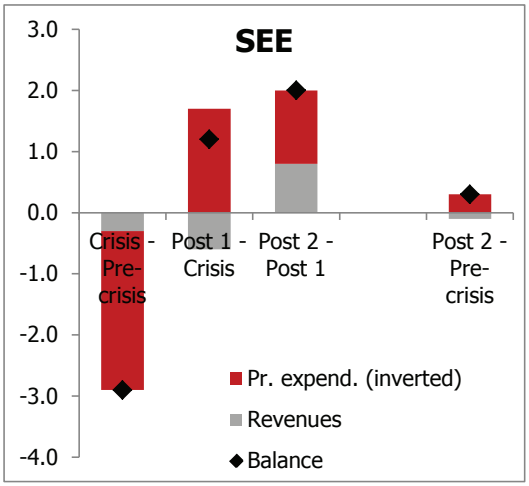
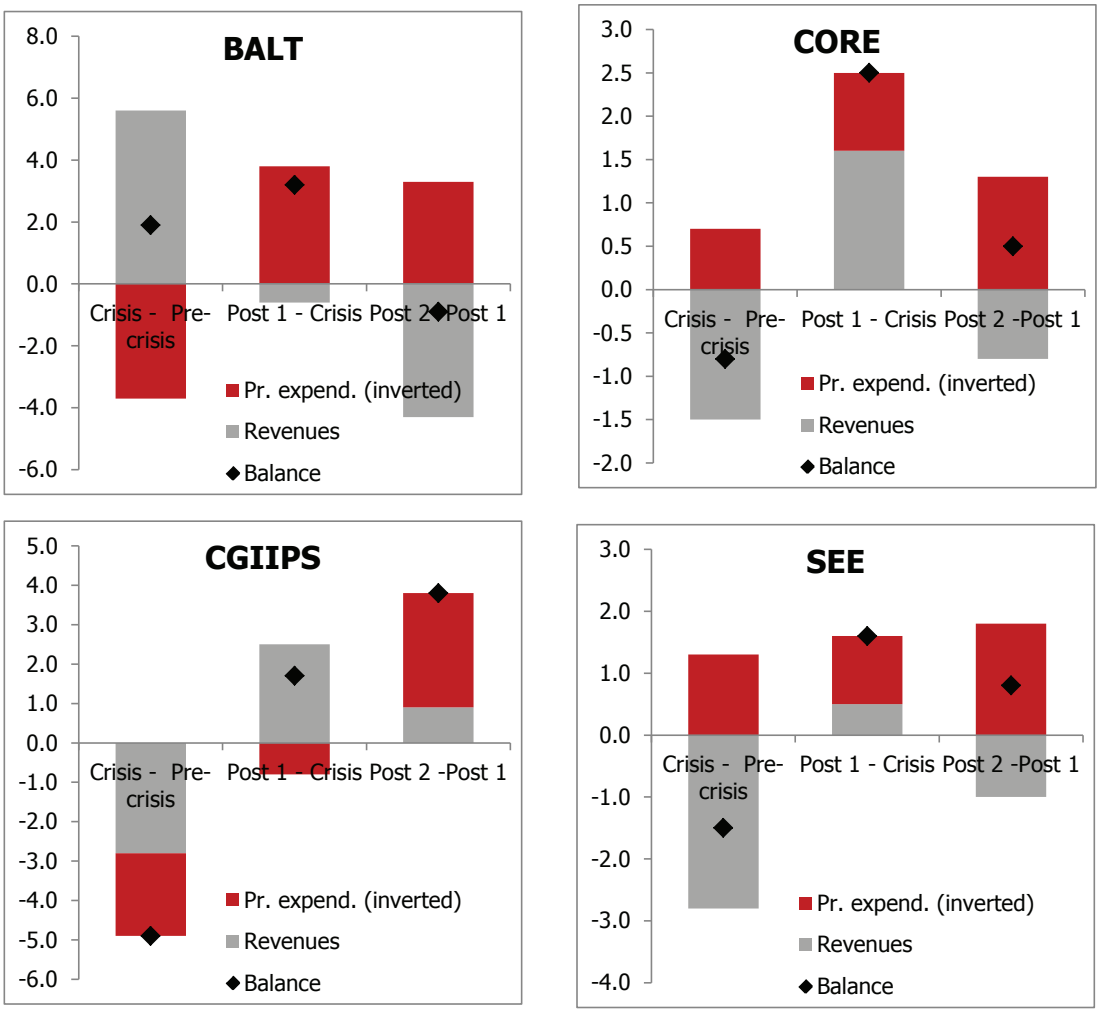


Figure 2. Decomposition of changes in the cyclically adjusted primary balance across periods, by country groups - difference-in-difference compared to the "core" group



NATIONAL BANK OF THE REPUBLIC OF MACEDONIA

PROGRAM

3rd Research Conference "Towards Recovery and Sustainable Growth in the Altered Global Environment"
28-29 April 2014, Skopje

Venue: Alexandar Palace Hotel

28 April 2014 (Monday)

9.00-11.15 Session I: Keynote Lectures and Panel Discussion

Chair: Saso Arsov, Board member, NBRM

9.00	Dimitar Bogov, Governor of the National Bank of the Republic of Macedonia, Opening speech
9.10	Erdem Başçi, Governor of the Central Bank of the Republic of Turkey, keynote lecture
9.40	Martine Guerguil, Deputy Director of Fiscal Affairs Department, International Monetary Fund, keynote lecture
10.10	Philip Turner, Deputy Head of Monetary and Economic Department, Bank for International Settlements, keynote lecture
10.40	Discussion
11.10	Announcement of the Annual Award of the NBRM for the best paper in macroeconomics by a young researcher
11.15	Coffee break

11.30 - 13.00 Session II: Bank Lending and Spillovers to the Real Sector

Chair: Anita Angelovska-Bezoska, Vice Governor, NBRM

11.30	Matija Lozej, Uroš Herman, Bank of Slovenia, The Effect of Loan Supply Shocks on Bank Lending and the Real Economy: Evidence from Slovenia
11.50	Péter Harasztosi, Marianna Endrész, Central Bank of Hungary, Corporate Foreign Currency Borrowing and Investment, the Case of Hungary
12.10	Gerti Shijaku, Bank of Albania, Foreign Currency Lending in Albania
12.30	Daniela Pulst, European Central Bank, Discussant
12.45	Discussion
13.00	**Lunch**

14.00 - 15.30 Session III: Private Sector Behavior and Its Financial and Macroeconomic Impacts

Chair: Maja Kadievska-Vojnovik, Vice Governor, NBRM

14.00 Ivana Rajković, Ranko Jelić, Branko Urošević, National Bank of Serbia, Dollarization of Deposits in Short and Long Run: Evidence from CESE Countries

14.20 Svilen Pachedzhiev, Zornitsa Vladova, Tania Karamisheva, Bulgarian National Bank, Analysis of the Deleveraging Process of Non-Financial Enterprises in Bulgaria

14.40 Şerife Genç, Osman Furkan Abbasoglu, Yasin Mimir,Istanbul School of Central Banking, Central Bank of the Republic of Turkey, Cross-Sectional Facts on Bank Balance Sheets over the Business Cycle

15.00 Mariya Hake, European Commission, Discussant

15.15 Discussion

15.30 Coffee break

15.45 - 17.00 Session IV: Measuring and Assessing Financial Stability

Chair: Milica Arnaudova Stojanovska, General Manager, NBRM

15.45 Mirna Dumičić, Croatian National Bank, Measuring Financial Stability – Systemic Risk Accumulation and Materialization vs. Financial System Resilience;

16.05 **Željka** Asanović, Central Bank of Montenegro, Early Warning Models for Systemic Banking Crisis in Montenegro;

16.25 Goran Petreski, Faculty of Economics Skopje, Discussant

16.40 Discussion

29 April 2014 (Tuesday)

9.30 - 11.00 Session V: Macroeconomic Issues in the Process of Global and Regional Recovery

Chair: Vít Bárta, Czech National Bank, Advisor of Governor

9.30 Kurmaş Akdoğan, Central Bank of the Republic of Turkey, Asymmetric Behaviour of Inflation around the Target in Inflation-Targeting Emerging Markets

9.50 Selena Begović, School of Economics and Business, University of Sarajevo, Bosnia and Herzegovina, The Effect of Currency Board Arrangements on Inflation Performance in European Transition Countries

10.10 Isabella Moder, Elisabeth Beckmann, National Bank of Austria, Households' Expectations and Macroeconomic Outcomes – Evidence from the Euro Survey

10.30 Peter Sanfey, European Bank for Reconstruction and Development, Discussant

10.45 Discussion

11.00 Coffee break

11.15 - 13.00 Session VI: Fiscal Consolidation and Public Debt Sustainability

Chair: Aneta Krstevska, Chief Economist, NBRM

11.15 Vivian Norambuena, Georgetown University Washington DC, Serial Defaulters: An Attempt to Account for the Unobservable

11.35 Rilind Kabashi, National Bank of the Republic of Macedonia, Effects of Fiscal Policy on the Post Crisis Recovery of European Economies

11.55 Branimir Jovanovik, National Bank of the Republic of Macedonia, Discussant

12.10 Discussion

12.25 Wrap up and closing of the conference

12.30 Lunch

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