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Central Bank Sterilization Policy:
The Experiences of Slovenia and Lessons for
Countries in Southeastern Europe[1]

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1. Introduction

It is well known that countries in the Southeastern European (SEE) region have experienced a substantial and gradually intensified inflow of foreign capital during the entire period of economic transition (Markievicz, 2006). Central banks in those countries had to adapt their monetary policy operations and exchange rate regimes to the changing conditions. Especially in those countries that responded by implementing a managed floating exchange rate regime, central banks had to find viable solutions in order to support the "consistency triangle" policy framework (Bofinger and Wollmershaeuser, 2001). Advocates of the "consistency triangle" policy framework claim that simultaneous determination of the optimum interest rate level and the optimum exchange rate path is possible. Effective sterilization procedures need to be activated by the central bank in order for the policy framework to be operational.

The experiences of some developing countries in the 1990s confirm the viability of sterilization as a key element of the central bank's monetary policy in circumstances of intensified inflow of foreign capital (Lee, 1996). However, certain limitations to this kind of strategy exist, which in most cases central banks need to address properly by developing alternative procedures and instruments instead of classical open-market operations. Namely, the use of classical open-market operations does not happen to be a feasible strategy in most countries, since

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money markets and money market instruments in developing/transition economies are usually underdeveloped.

In this paper we first review some sterilization practices and general characteristics of sterilization-based monetary policy approaches presented in the literature to date. The main objective of the paper is to elaborate sterilization practices implemented by Banka Slovenije in the period from the introduction of Slovenian tolar as the national currency at the beginning of the 1990s, till entry into the ERM2 mechanism and consequent adoption of the euro. The case of the Slovenian central bank is analysed in comparison to five central banks in countries of the SEE region, by using an approach based on decomposition of stylized central bank balance sheets. Some innovative approaches to sterilization operations conducted by Banka Slovenije could be employed in other countries in the SEE region, especially in those facing intensified foreign capital inflow.

The rest of the paper is structured as follows: first, we give a brief overview of the general findings published so far regarding central banks' sterilization practices in developing countries (section 2). In section 3 we discuss the relevance of sterilization policies for a select set comprising Slovenia and five SEE countries. This is followed by a more detailed presentation of Bank of Slovenia sterilization practices and lessons that can be drawn from Slovenian experiences (section 4). The paper concludes in section 5 with a summary of the main conclusions and findings.

2. The Role of Sterilization in Central Banks of Developing Countries

As long as the financial sector is relatively closed and dominated by commercial banks, central banks can exercise monetary control by the setting of two parameters: reserve requirements against demand deposits at commercial banks, and the discount rate on bank borrowing from the central bank (Van't Dack, 1999). Eastern European economies faced this kind of circumstances in the pre-transition period, while the beginning of the transition accelerated the opening of the economy and the development of the financial sector. Both processes decisively affected the operations of central banks in those countries, since central banks needed to make adjustments in their monetary policy frameworks and supporting operations.

Because of the high inflation environment and greater economic openness in most transition countries at the beginning of the 1990s, the choice of the exchange rate regime became of great significance for central banks in these countries. The so-called "inconsistency triangle" has traditionally provided a framework for analysis of the relevant arrangements in exchange rate policy. Following this framework, a country can choose between three different options (Bofinger and Wollmershaeuser, 2001):

- a fixed exchange rate without an autonomous interest rate policy and free capital mobility;
- an autonomous interest rate policy with a freely floating exchange rate and free capital mobility; or
- capital controls and a combination of fixed exchange rate and autonomous interest rate policy.

However, the inconsistency triangle framework is based on three-corner solutions, which involve only two diametrically opposed foreign exchange solutions: either completely fixed or completely flexible exchange rates. It does not say anything about the policy of managed floating, where the exchange rate is neither fixed nor flexible. Floating exchange rate arrangements mean that the exchange rate is targeted along an unannounced path and the central bank intervenes in order to keep the exchange rate close to the target path (Bofinger and Wollmershaeuser, 2001).

The concept of the floating exchange rate regime turns the "inconsistency triangle" framework into the "consistency triangle" framework. Advocates of the latter claim that simultaneous determination of the optimum interest rate level and the optimum exchange rate path is possible (Bofinger and Wollmershaeuser, 2001). The case of Central and Eastern European (CEE) countries shows that many transitional countries entered the transition process with pegged exchange rates, while during the 1990s many of them gradually opted for more flexible exchange rate strategies (Markiewicz, 2006). However, some countries (e.g. Slovenia and Romania) have stuck to managed floating exchange rate arrangements from the very beginning of the transition and have not altered exchange rate policies substantially.

In most transition economies, decisions on suitable foreign exchange rate regimes were tightly related to the external balance situations. Namely, considerable external imbalances due to substantial capital inflow and current account deficits made central banks concentrate heavily on foreign exchange policies. Capital inflow can become a serious threat to monetary stability, especially if a central bank decides to maintain a target rate that is higher than the equilibrium (market) rate, since the excess supply of foreign currency has to be purchased by the central bank in exchange for domestic currency. Consequently, the optimal level of domestic reserves in the banking sector can be exceeded, stimulating credit extension over the desired levels. As a result, the central bank needs to withdraw excess liquidity through the use of sterilization measures.

In principle, a central bank can operate to set policy with either *ex ante* shortages or surpluses. Generally central banks prefer to operate with *ex ante* reserve shortages, which means that they act in the market as net creditors. To the contrary, if central banks operate with *ex ante* reserve surpluses, they act in the market as net debtors. In a shortage situation, the central bank finds itself in a monopoly position as a lender to the market; as a monopoly supplier of reserves, it

is able to engage in credit transactions with counterparties as a price setter, thereby setting the marginal price of the commercial banks' liabilities (Ganley, 2002).

In the instance that the banking system experiences a surplus, the central bank intervenes to withdraw reserves. It can do this by running down its assets, and/or it may sell foreign currency or financial assets, such as central bank bills. These transactions impact the asset side of commercial bank balance sheets, and therefore the central bank can influence the yield on commercial bank assets, rather than the value of their liabilities.

The key difference between reserve shortage and reserve surplus situations is that in the case of the latter, the central bank is not a monopoly supplier of financial assets per se (Ganley, 2002). As a result, in a liquidity surplus situation, where commercial banks actually have improved liquidity, they are not compelled to participate in reserve absorption operations conducted by the central bank. Commercial banks have the option, but not the obligation, to purchase financial assets offered by the central bank. Therefore the participation of commercial banks in central bank absorption operations depends on the commercial banks' asset demand preferences, which also depend on alternative investment opportunities in the market and their returns. The central bank can raise the attractiveness of absorption operations either by offering higher returns on financial assets offered to the market, or by acting as an exclusive provider of specific financial assets demanded by commercial banks, usually as reserve assets. In this respect the central bank can typically act on the market as a monopoly supplier of risk-free assets, especially in environments with undeveloped money markets. If commercial banks see the central bank as a monopoly provider of risk-free assets, then it is much easier to get the banks to participate in liquidity withdrawal operations.

So, if a central bank decides in favour of managed floating exchange rate arrangements and at the same time operates in an environment of permanent external imbalances, especially characterized by a constant inflow of foreign capital, the implementation of efficient sterilization operations is an inevitable task.

The experience of some developing countries in the 1990s confirms the viability of sterilization as a key element of the central bank's monetary policy in the case of an increased inflow of foreign capital (Lee, 1996). The study made a detailed analysis of six developing countries (Chile, Colombia, Indonesia, Korea, Spain and Thailand) which faced severe surges in capital inflow back in the 1990s. The main findings can be summarized as follows:

- Sterilization instruments could not be applied continuously, as the outstanding stock of open-market bills rose sharply in most countries during the inflow episode.
- The size of open-market sales for sterilization purposes was limited by the absorptive capacity of the domestic economy and especially by the stage of development of local securities markets (thin and illiquid markets prevented

the continuous implementation of open-market operations as the main instrument of monetary policy).

- Operations proved to be extremely costly for central banks in terms of the loss of operating income.
- In some instances the implementation of sterilization procedures resulted in higher domestic interest rates, which attracted additional capital inflow.

Due to all the aforementioned reasons, most countries gradually stopped using open-market sales in their sterilization operations. Subsequently, the authorities in these countries began to supplement their initial response with changes in underlying policies, such as fiscal adjustment, easing of restrictions on capital outflows, acceleration of trade liberalization, and a more flexible exchange rate policy that allowed for nominal appreciation. Some countries introduced more novel sterilization measures, such as swap operations in the foreign exchange market (Indonesia) or adjustment of government deposits (Thailand). Many sought to combine the (first-best) indirect instruments of monetary policy with some direct controls on capital inflow, although other controls were more in indirect forms.

Studying the cases of the six developing countries, Lee (1996) further tries to find answers to two additional questions:

- What are the practical limits on the use of sterilization as a monetary policy strategy?
- Can the scope of sterilization be expanded or its costs reduced through new or unconventional instruments?

As regards practical limits on the use of sterilization, Lee (1996) identifies four key factors that limit the effective range of open-market sterilization procedures:

1. The ability to sterilize capital inflow is inversely related to the degree of international capital mobility. With increasing international capital mobility the effectiveness of sterilization operations can deteriorate, since sterilization efforts are usually quickly overwhelmed by continuing inflows. Lee (1996) even claims that in the extreme, when capital is perfectly mobile, sterilization is completely ineffective.

2. Sterilization policy fundamentally cannot work over an extended period of time when shocks are durable, because sterilization seeks to deal with the effects, rather than the underlying causes of shocks. So practically any particular sterilization can be useful as a temporary measure to be employed until the primary cause of the inflow can be identified and more fundamental policy measures curing the primary cause can be implemented.

3. Particularly in developing countries, the scope of classical open-market operations can be severely restricted by the underdeveloped state of financial markets and the fiscal costs which these operations entail. These restrictions can be summarized as follows:

    a. Sterilization instruments are usually not perfect substitutes for the financial assets which market participants (investors) wish to hold. As a result,

sterilization efforts may push up the interest rates on sterilization instruments, and thus also the required market rate of return.

b. Authorities' sterilization capacities are usually limited by an inadequate supply of marketable instruments, which means that the central bank needs to develop sterilization instruments.

c. The scale of sterilization operations can be limited by thin and segmented markets – conditions that usually accompany an inadequate supply of marketable instruments.

4. Heavy fiscal costs may eventually curtail sterilization operations. Lee (1996) divides fiscal costs into three categories: debt-service burden costs, possible operating losses at the central bank, and potential vulnerability to capital flow reversal.

Because of the aforementioned practical limits, it is desirable for monetary authorities to seek techniques and instruments which could expand the scope of effective sterilization operations. In practice it may be necessary to use classical open-market operations in combination with some supplementary sterilization measures (e.g. discount policy and direct lending, reserve requirements, government deposits, foreign exchange swap), or even with more direct controls on capital inflows, such as a variable deposit requirement on foreign borrowings or an interest equalization tax on certain capital transactions.

Before we turn to the case of Slovenia and the presentation of techniques and instruments employed by Banka Slovenije to provide effective sterilization, we shall examine some challenges to sterilization in selected SEE countries.

3. Relevance of Sterilization Issues in Selected SEE Countries

As the implementation of sterilization procedures, in terms of magnitude and structure, is tightly related to the issue of surplus reserves in the banking system, we need to understand the formation of the reserves position in the banking system in order to be able to discuss the implementation of adequate sterilization measures.

According to Ganley (2002), "A thorough appreciation of the workings of the central bank balance sheet is fundamental to an understanding of the way in which surplus reserves arise in practice." Regardless of the central banks' choice of operating target, each central bank relies on its ability to manage the balance sheet (Schaechter, 2001). Depending on the targeting approach, a central bank's balance sheet adjustments appear as endogenous or, alternatively, exogenous. Namely, when targeting interest rates, the adjustments on the balance sheet are only a reflection of the quantities needed to achieve a predetermined rate. Alternatively, when a central bank targets quantities, it determines and steers the quantity and accepts the resulting interest rate, which becomes endogenous (Schaechter, 2001). So, in the case of price targeting, changes in the central bank balance sheet become

endogenous, while they are exogenous in the case of quantity targeting (Ganley, 2002).

As a rule, central banks in transitional and/or emerging economies have to deal with surplus instead of deficit liquidity positions in the banking system, since these economies often attract a sizeable capital inflow as they open and undergo privatization (Ganley, 2002). Generally, two major types of changes on central bank balance sheets can be a source of surplus reserves in the banking sector:

1. increases in net foreign assets, which are linked to current account balance and exchange rate, and/or to capital account inflow; and
2. increases in net lending to the government, which are a direct consequence of the monetization of the fiscal deficit.

In the rest of this section, we shall try to identify developments in the net liquidity positions of central banks in Slovenia and five countries in the SEE region that could be considered prospective euro area members (Bulgaria, Romania, Croatia), or at least strong aspirants for such a status in the more distant future (Macedonia, Albania). Decomposition of central bank balance sheets is used as a tool for the detection of liquidity positions (surplus or deficit) and identification of approaches (instruments) used by central banks for the management of their liquidity positions.

The data presented later in this section clearly show that all central banks included in this study primarily need to deal with surplus liquidity positions, and therefore to employ instruments (approaches) for mopping up excess liquidity from the banking sector. To this end, they can use market-based or non-market approaches. Market-based approaches involve any financial transaction between a central bank and its counterparties which leads to the withdrawal of liquidity. Liquidity absorption transactions should create a regular shortage in the market, but in practice this is rarely achieved (Ganley, 2002). The non-market approach involves quantitative barriers, rules or restrictions on market activity, which try to keep potential injections of liquidity outside the banking system. The latter of the two approaches involves increases in reserve requirements as well. Of course neither of the approaches, non-market nor market-based, is likely in itself to remove the underlying causes of surplus reserves (Ganley, 2002).

In order to analyze the magnitude and dynamics of surplus reserves in the banking sectors of individual countries, we shall use a simple decomposition of central bank balance sheets. By using IFS statistics, we first try to construct a stylized central bank balance sheet for each country, as depicted in table 1.

Table 1: A Stylized Central Bank Balance Sheet

Assets	*Liabilities*
Net foreign assets (NFA)	Cash in public circulation (Cash)
Net lending to government (NLG)	Bank reserves
Net lending to banks (NLB)	–
Net other items	–

Source: Ganley (2002).

Based on the stylized balance sheet, we are able to calculate the "cumulative autonomous liquidity position"[2] for each country on a quarterly basis. The cumulative position depicts the historical activities of the central bank as they are reflected in individual central bank balance sheet items. So, for example, the stock of "net foreign assets" (NFA) reflects the cumulative injection (if "foreign assets" > "foreign liabilities") or cumulative withdrawal (if "foreign assets" < "foreign liabilities") of liquidity in the banking system to date. Similarly, the stock of "net lending to government" (NLG) reflects the cumulative injection (if "claims on government" > "government deposits") or cumulative withdrawal (if "claims on government" < "government deposits") of liquidity in the banking system to date.

Cumulative Autonomous position =

$$= (Foreign\ Assets - Foreign\ Liabilities) +$$
$$+ (Claims\ on\ Central\ Government - Central\ Government\ Deposits) +$$
$$+ (-Currency\ Outside\ Banks) +$$
$$+ / - Other\ Items\ (net)$$

Developments in the three main contributing factors (net foreign assets, net lending to government, cash in public circulation) to the cumulative autonomous position in selected countries are displayed in tables 2 and 3. All three contributing factors are expressed relatively in terms of GDP, so we can compare three different ratios: NFA to GDP, NLG to GDP, and cash to GDP.

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[2] Borio (1997) and Ganley (2002) define the autonomous liquidity position (ALP) as a result of changes in major sub-segments of the central bank balance sheet:

$$ALP = \Delta NFA + \Delta NLG + \Delta\ Other\ net\ items - \Delta\ Cash$$

Therefore we have chosen to denote the net positions calculated on the levels as cumulative net position.

Four major conclusions can be drawn by observing the ratios:
1. In all six countries the NFA to GDP ratio has increased dramatically in the period from the beginning of the 1990s to the end of 2005. With only a few exceptions (e.g. Albania and Romania in the first half of the 1990s), NFA positions have always been positive, meaning that the NFA continuously contributed to the injection of liquidity into the banking sectors of individual countries.
2. NFA positions strongly dominated NLG positions in all countries after the year 2000. These characteristics clearly indicate the crucial importance of foreign currency capital flows for domestic liquidity in all observed countries.
3. The NLG to GDP ratio has demonstrated quite different dynamics and directions of movement in different countries and different sub-periods. In some countries, NLG cumulatively provided an injection of additional liquidity into the system (e.g. Albania), while in other countries (e.g. Slovenia) the government cumulatively was a net depositor with the central bank and therefore did not increase the cumulative net liquidity position of the banking system.
4. The cash-in-circulation to GDP ratio as an important absorption factor has cumulatively increased in most of the countries, the only exception being Romania, although this growth has not been as strong as in the case of the NFA to GDP ratio.

Table 2: Autonomous Components of the Cumulative Autonomous Position Expressed as a Percent of GDP in Slovenia, Croatia and Macedonia

	Slovenia			Croatia			Macedonia		
Year	NFA/GDP	NLG/GDP	CASH/GDP	NFA/GDP	NLG/GDP	CASH/GDP	NFA/GDP	NLG/GDP	CASH/GDP
1992	4.4%	0.3%	-1.6%	0.1%	0.0%	-0.1%	0.0%	0.0%	0.0%
1995	9.2%	-0.7%	-2.2%	8.4%	-0.3%	-3.1%	4.1%	0.6%	-2.9%
2000	16.6%	-1.1%	-2.6%	16.5%	-0.6%	-3.9%	14.7%	-3.8%	-3.4%
2005	25.1%	-1.2%	-2.7%	23.7%	-0.3%	-5.4%	18.7%	-4.5%	-5.0%

Source: IFS and authors' calculations.

Table 3: Autonomous Components of the Cumulative Autonomous Position Expressed as a Percent of GDP in Albania, Bulgaria and Romania

	Albania			Bulgaria			Romania		
Year	NFA/GDP	NLG/GDP	CASH/GDP	NFA/GDP	NLG/GDP	CASH/GDP	NFA/GDP	NLG/GDP	CASH/GDP
1992	0.0%	0.0%	0.0%	3.2%	2.7%	-7.4%	-0.7%	0.1%	-5.3%
1995	-5.4%	18.4%	-15.2%	5.7%	4.2%	-5.7%	-0.2%	-1.2%	-3.9%
2000	11.1%	13.7%	-17.0%	14.7%	0.4%	-7.7%	6.0%	1.6%	-2.7%
2005	15.2%	7.0%	-16.6%	29.8%	-5.3%	-11.9%	20.3%	-1.9%	-3.5%

Source: IFS and authors' calculations.

Evidently, in all countries except Albania, NFAs strongly dominate NLG in their contribution to the cumulative liquidity position in the banking sector. Further inspection of data as they are presented in table 4 and chart 1 reveals the annual dynamics of contributing factors across countries. It is very obvious that in the Slovenian banking sector, net foreign exchange inflows have represented the heaviest burden for the national central bank relatively speaking, because the share of NFAs in the GDP has risen to more than 25%. Clearly Banka Slovenije was compelled to develop adequate offsetting operations enabling it to manage excess liquidity efficiently.

When observing NFA dynamics, the growth trend of the proportion of NFA in GDP can be clearly identified for all six countries in the sample. Likewise, one can easily recognize important differences across countries. So, for example, the NFA of Banka Slovenije amounted to 4.4% of GDP in the beginning of the observation period, while Albanian, Croatian, Romanian and Macedonian banks at the same time experienced NFA-to-GDP ratios close to zero. Only in the case of the Bulgarian central bank, with 3.2%, did the situation happen to be similar to that of Slovenia. In the first half of the 1990s, only the Slovenian and Croatian central banks experienced steady growth in the NFA-to-GDP ratio, which in the case of Banka Slovenije climbed to 10%, and in case of the Croatian National Bank to 9.7% by the end of the year 1996. In rest of the countries, including Bulgaria, the ratio stayed at levels close to 5% or substantially less.

Table 4: Proportion of NFA in GDP in Individual Countries for the Period 1992–2005

	SLO	ALB	BUL	CRO	ROM	MAC
1992	4.4%	0.0%	3.2%	0.1%	-0.7%	0.0%
1993	5.9%	0.0%	2.0%	2.2%	-1.2%	2.2%
1994	7.9%	-5.0%	1.6%	6.6%	0.2%	3.6%
1995	9.2%	-5.4%	5.7%	8.4%	-0.2%	4.1%
1996	10.0%	5.5%	0.8%	9.7%	-1.2%	4.6%
1997	15.4%	9.4%	11.2%	10.8%	2.4%	5.2%
1998	17.0%	8.8%	14.8%	11.2%	2.6%	6.3%
1999	16.3%	9.2%	14.0%	13.0%	3.3%	8.9%
2000	16.6%	11.1%	14.7%	16.5%	6.0%	14.7%
2001	19.7%	14.2%	15.1%	20.1%	9.7%	24.6%
2002	25.4%	15.1%	18.1%	22.4%	13.0%	19.6%
2003	28.0%	14.0%	21.8%	22.5%	13.0%	16.4%
2004	25.6%	14.0%	26.1%	22.9%	15.5%	15.8%
2005	25.1%	15.2%	29.8%	23.7%	20.3%	18.7%
Period 92-05	16.2%	7.6%	12.8%	13.6%	5.9%	10.3%

Source: International Financial Statistics.

Central banks confronted by surplus cumulative liquidity positions need to react adequately to those positions in order to equilibrate liquidity in the banking system. Again, the cumulative consequences of these reactions are always, directly or indirectly, reflected on the central bank balance sheet. In order to observe different types of central bank reactions, we shall again analyze stylized central bank balance sheets in the six selected countries.

Chart 1: Proportion of NFA in GDP in Individual Countries for the Period 1992–2005
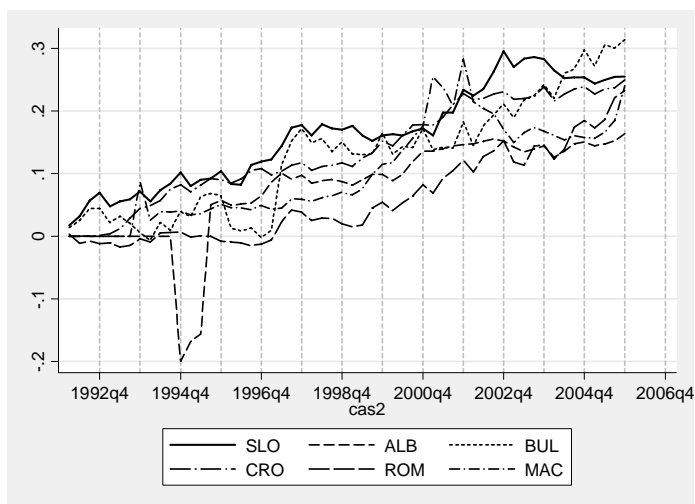
Source: IFS and authors' calculations

In tables 5 through 9 we can see cumulative autonomous liquidity positions expressed as a share of GDP.[3] Ratios are calculated across countries for each five years of the entire observation period. The size of the autonomous position actually determines the volume of the necessary offsetting sterilization measures. Namely, net foreign assets and net lending to government first need to be adjusted for the currency in circulation outside banks. Currency not possessed by deposit money banks is also considered to be an autonomous factor, and it usually works in just the opposite direction as NFAs or NLG. The resultant position can be considered a sterilization target for each central bank.

In all countries except Bulgaria and partially Albania, the share of the individual country's cumulative autonomous liquidity position in GDP has increased since the

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[3] The table for Romania is not displayed because of the unavailability of data on the autonomous position's offsetting factors. Proportions of the autonomous position in GDP are as follows: in 1992, –1.1%; in 1995, –3.7%; in 2000, 4.8%; and in 2005, 15.4%.

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beginning of 1990s, reaching its peak values after the year 2000. This kind of dynamics closely followed the dynamics of NFAs in individual countries, where accelerated privatization processes and intensified foreign investments were a reason for increased NFAs. The increase of cash outside banks as the most important offsetting factor obviously has not had a significant impact on movements in the total cumulative autonomous liquidity position.

A brief comparison of the cumulative autonomous liquidity positions across countries reveals that the Slovenian central bank had to confront the largest autonomous positions, which represented 20.9% of GDP at the year end 2005. Similarly, the autonomous position as a share in GDP was relatively high in the case of the Croatian National Bank (18.2% of GDP at the end of 2005) and somewhat lower in the case of the Romanian central bank (15.4% at the end of 2005) and the case of the Bulgarian central bank (10.8% at the end of 2005). In Albania and Macedonia, cumulative autonomous positions represented less than 10% of GDP at the end of 2005. Obviously the Slovenian central bank in particular was confronted with a most challenging situation as regards the need for sterilization of excess liquidity in the banking sector, stemming mostly from NFAs.

Data presented in tables 5 through 9 also describe the type and intensity of offsetting activities of the central banks, which had to react to the autonomous positions. Of course we need to be aware of all the limitations of comparisons, since the IFS data enabled us to construct only stylized central bank balance sheets, which means that not necessarily all peculiarities of specific central bank operations could be captured in their entirety.

Nevertheless, the information on deposit money bank reserves with the central bank is available for all central banks, and likewise the information on central banks' capital. Other central bank balance sheet items representing offsetting operations varied across the countries. In any case, we can detect the main characteristics of sterilization procedures in the selected central banks.

As in the case when we analyzed factors contributing to the formation of cumulative autonomous positions in central banks, we can again easily observe the very specific situation of the Slovenian central bank if compared to other central banks in the selected pool of countries. Banka Slovenije proved a unique case due to the relatively low proportion of commercial bank reserves in the total cumulative autonomous liquidity position, which amounted to only 9.9% in 2005 and was even negative at the beginning of the 1990s.[4] In the case of the Albanian central bank, the share of commercial bank reserves amounted to 87%, and in the case of the Croatian central bank, 87.5% of the cumulative autonomous liquidity position in the year 2005. These percentages were somewhat lower with the Bulgarian (61%) and Macedonian central banks (58.1%) at the end of 2005. These data clearly show

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[4] A negative sign indicates that the central bank was a net supplier of liquidity to the banking system through its lending operations.

that central banks in general rely to a large extent on reserve requirements as an instrument of excess liquidity reduction in the banking system.

On the other side, the specific situation of Banka Slovenije reveals a somewhat different approach, where central bank sterilization procedures rest on alternative instruments. In the particular case of the Slovenian central bank, securities issued by the central bank itself represent such an alternative instrument, which accounted for more than 75% of the cumulative autonomous liquidity position in the banking sector at the year end 2005. This proportion of the central bank's securities was even larger back in the 1990s, when it exceeded 80% of the cumulative autonomous liquidity position of the banking system.

Table 5: Autonomous Position of the Central Bank and Offsetting Factors: Slovenia

SLOVENIA (structure in %)	Autonomous position as % of GDP	Autonomous position	DMB's reserves w/ central bank	CB's securities	CB's capital
1992	3.0%	100.0%	-6.8%	81.9%	24.9%
1995	6.1%	100.0%	-1.4%	81.1%	20.4%
2000	12.7%	100.0%	14.6%	62.4%	23.0%
2005	20.9%	100.0%	9.9%	75.4%	14.6%

Source: Authors' calculations and IFS.

Table 6: Autonomous Position of the Central Bank and Offsetting Factors: Albania

ALBANIA (structure in %)	Autonomous position as % of GDP	Autonomous position	DMB's reserves w/ central bank	Other liabilities to banks	CB's capital
1994	3.4%	100.0%	43.6%	0.0%	56.4%
1995	9.7%	100.0%	45.0%	0.0%	55.1%
2000	8.8%	100.1%	46.2%	10.6%	43.4%
2005	6.5%	100.0%	87.0%	0.9%	12.1%

Source: Authors' calculations and IFS.

*Table 7: Autonomous Position of the Central Bank and Offsetting Factors: Croatia*

CROATIA (structure in %)	Autonomous position as % of GDP	Autonomous position	DMB's reserves w/ central bank	DMB's FX deposits	CB's securities	CB's capital
1992	0.0%	100.0%	-39.7%	0.0%	2.0%	137.7%
1995	4.8%	100.0%	59.1%	0.0%	3.2%	37.8%
2000	12.1%	127.9%	52.1%	27.9%	21.4%	26.5%
2005	18.2%	131.5%	87.5%	31.5%	0.0%	12.5%

Source: Authors' calculations and IFS.

Table 8: Autonomous Position of the Central Bank and Offsetting Factors: Bulgaria

BULGARIA (structure in %)	Autonomous position as % of GDP	Autonomous position	DMB's reserves w/ central bank	Other liabilities to banks	CB's capital
1992	8.5%	100.0%	24.7%	0.0%	75.3%
1995	16.6%	100.0%	17.4%	16.3%	66.3%
2000	7.1%	100.0%	41.8%	0.0%	58.2%
2005	10.8%	100.0%	61.0%	0.0%	39.0%

Source: Authors' calculations and IFS.

Table 9: Autonomous Position of the Central Bank and Offsetting Factors: FYR Macedonia

MACEDONIA (structure in %)	Autonomous position as % of GDP	Autonomous position	DMB's reserves w/ central bank	CB's capital
1993	1.7%	96.4%	-20.3%	116.7%
1995	2.1%	100.0%	-85.5%	185.5%
2000	6.6%	100.0%	44.9%	55.1%
2005	7.9%	100.0%	58.1%	41.9%

Source: Authors' calculations and IFS.

Other countries' central banks have relied much less on alternative instruments for the withdrawal of liquidity out of the banking system. However, IFS data and stylized central bank balance sheets indicate the use of such instruments in Albania, Croatia and Bulgaria, while the stylized balance sheets for Romania and Macedonia do not disclose the implementation of any instruments that would be

recorded on the balance sheets of those central banks. In any case, alternative instruments in the form of "other liabilities to banks" (Albania, Bulgaria) and "foreign exchange deposits" and "central bank securities" (Croatia) have not been used to a large extent, and besides that their employment was restricted to limited sub-periods (e.g. in the case of Bulgaria, before the introduction of the currency board).

Chart 2: Proportion of Deposit Money Bank Reserves in GDP in Six Countries in the Period 1992–2006
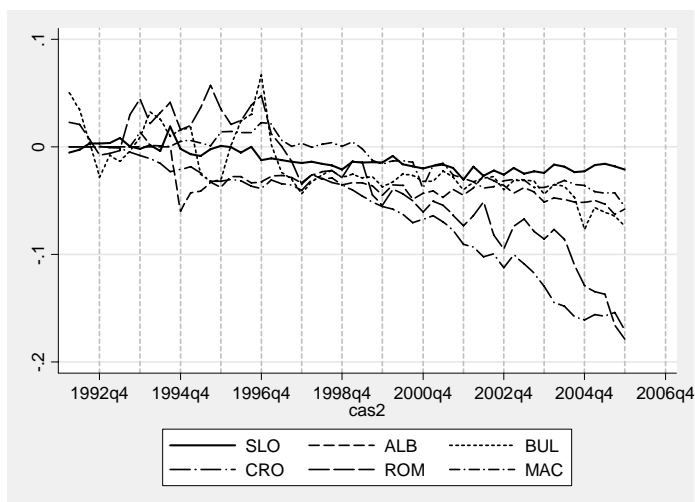
Source: IFS and authors' calculations.

Chart 3: Proportion of Deposit Money Bank Reserves in Cumulative Autonomous Liquidity Positions in Individual Countries in the Period 1992–2006
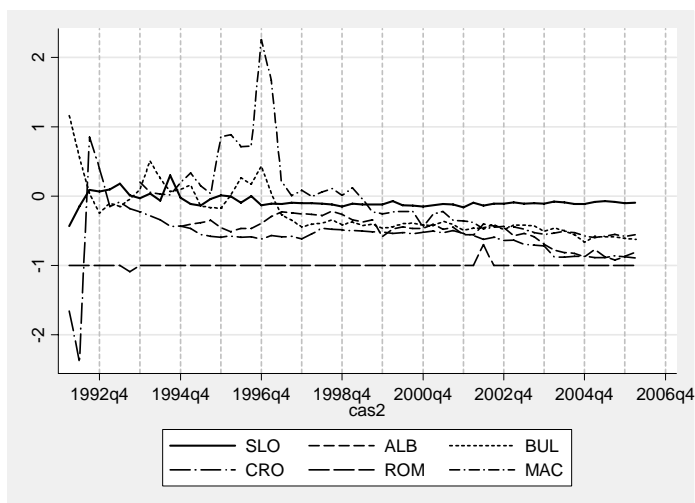
Source: IFS and authors' calculations.

Charts 2 and 3 graphically summarize one of the main features of sterilization policies in the selected set of six countries. Both figures disclose the prevalent role of reserve requirement instruments in most of the countries except Slovenia, where Banka Slovenije evidently has not used mandatory reserves as an essential sterilization instrument. This fact also indicates the early decision of Banka Slovenije to minimize the role of non-market instruments and to lean on instruments that could be classified as market-based instruments, thereby also supporting the development of the money market and its accompanying instruments.

4. Effective Sterilization: the Case of Slovenia and Lessons for Other Countries in the Region

4.1 Historical Development of Banka Slovenije's Sterilization Instruments

In the period between 1992 and 2005, Slovenia was exposed to net foreign exchange inflows of different sources and intensity. Before we introduce the

different instruments used for the purpose of sterilization, we shall try to split the whole period into sub-periods.

In the first three years (period I: 1992–1994), the net foreign exchange inflow originated from the surplus in the current account and to small extent also from borrowing abroad. It is also related to privatization in the housing sector financed by foreign currency savings in cash.

In the next three-year period (period II: 1995–1997) the current account was almost balanced and borrowing, together with direct and portfolio investments by non-residents, intensified. At the end of the rehabilitation process of the two biggest Slovenian banks, the NFA of the central bank also increased due to liquidity provisioning to the banks based on purchase of their foreign assets.

In the period of the Russian and Asian crisis (period III: 1998–2000) the supply of foreign financing diminished substantially. At the same time, due to the introduction of VAT and the appreciation of the tolar, the current account was temporarily in deficit. These years served as "breathing" period before the next wave of foreign exchange inflow.

In the remaining years (period IV: 2001–2005), the final steps of financial liberalisation were made. In these years financial outflow neutralised a large portion of financial inflow. Nevertheless, NFAs as a proportion of GDP increased by another ten percentage points, mainly due to foreign direct investment, banks raising loans abroad and the inflow of DEM cash into banks when euro banknotes and coins were introduced in 12 EU Member States.

In the previous section, the important role of central bank securities was put forward in the case of Slovenia as a way to drain excess liquidity from the banking sector. In this section, in the following paragraphs the most important financial instruments offered by Banka Slovenije shall be presented.

Foreign currency bills were transferable, registered non-series securities (i.e. certificates of deposit), available as a standing facility to banks and via banks to other legal entities, with a maturity between two months and 360 days. The main purpose of the instrument being offered was to drain excess foreign exchange from the foreign exchange market. The instrument was effective for two reasons. Banks were obliged to hold minimum reserves in foreign exchange (a part of it in foreign currency bills as a less risky investment) against the foreign currency deposits of households. The second reason lays in the fact that enterprises (mostly those importing and exporting goods and services) invested in foreign currency bills as a substitute for foreign currency claims on banks. Foreign currency deposits for enterprises previously had not been allowed. This instrument was introduced in January 1992, at first denominated only in German marks and later available also in US-dollars. From the year 2000 on, when foreign currency deposits were allowed for enterprises, foreign exchange bills were sold to banks only. This facility was available until the very end of the tolar monetary policy. Foreign currency bills served banks as eligible collateral for almost any kind of Bank of

Slovenia loans (lombard, liquidity and short-term loans, and also for repurchase operations).

Twin bills were short-term transferable securities issued to the bearer in hard copy. They comprised a tolar part, the face value being indexed by inflation, and a foreign currency part, denominated in DEM. Both parts were sold for tolars at a discount, each part at a different discount rate. At maturity one part was redeemed in tolars and the second part in DEM. Subscription was available to banks and via banks to households and enterprises. On the secondary market, each of the two parts could be traded separately. By introduction of this instrument in the second half of 1992, Banka Slovenije offered safe investment opportunities to non-banks as well. Through this instrument, the demand for foreign exchange by households and enterprises was satisfied to some extent. It also served as a learning opportunity to compare yields on tolar- and DEM-denominated investments in a period of a high level of "dollarization" in the banking sector. In fact, banks slowly experienced a sizable restructuring of deposits in favour of tolar-denominated deposits. The final (12th) issue of twin bills took place in April 1999, with redemption in March 2000.

One of the most structured instruments ever designed by Banka Slovenije was the bill with warrants. These bills were transferable securities issued to the bearer, at first in hard copy and later on as dematerialized book-entry securities. In the year 1994, financial instruments were still widely indexed or denominated in foreign currencies. So Banka Slovenije decided to offer short-term securities with a maturity of six months, which were sold at a discount calculated in relation to the nominal interest rate. One to five warrants were attached to the tolar bill, depending on the duration of the investment (one warrant for each month until maturity). Each warrant acted as a hedge against higher inflation or a smaller rate of tolar depreciation than projected by the terms of the issued series of security. In this way inflation and nominal depreciation targeting was performed publicly, and owners of warrants were rewarded by extra discounts in the case of different results than projected. Bills with warrants were sold at auction, which served as a good basis for testing expectations about the accuracy of the central bank's projections, as well as for raising interest among investors for developments in the inflation and exchange rate. In the months when inflation was higher than projected (as a monthly average), holders of warrants could realize a bonus by buying tolar bills (without warrants) at an extra discount. Furthermore, in the months when tolar depreciation was smaller than projected, holders of warrants could realize an extra discount by purchasing foreign currency bills with a maturity of 180 days or more. In the period between June 1994 and December 1999, 14 series of bills with warrants were issued (the last issue was a bill without warrants; it served only for the purpose of realizing possible discounts based on previously issued warrants).

By the year 2001 central bank securities became available only to the banking sector, and they were transferable only among domestic banks. There were two

major reasons for such a change in policy: the bank interest rate margin normalized, and under financial liberalization it was difficult to prevent new foreign investments in central bank securities. To drain excess liquidity from banks, central bank tolar bills with a maturity of 60 days were offered regularly to banks as a standing facility. Bills with 270 days of maturity were offered at weekly auctions. For a limited period of time (at the time of the major takeover of one Slovenian pharmaceutical company by a foreign company), 360-day tolar bills were offered only to the banks which participated in an agreement concerning foreign exchange market intervention. For the reinvestment of proceeds paid out at maturity of the 360-day bills, Banka Slovenije offered long-term floating rate deposit with maturity falling into the year 2007, after the date of the planned introduction of the euro. The same long-term deposit also was used to drain excess liquidity which followed the reduction of the rate of reserve requirement.

For the proceeds of the state's 34% stake in the biggest Slovenian bank, sold to KBC bank in 2002's privatization process, the Ministry of Finance and Banka Slovenije agreed on a time deposit under the same conditions as offered to the banks by the 270-day bills. Based on these financial resources, in the environment of lower long-term interest rates the Ministry of Finance began the process of restructuring existing government bonds originally issued with a call option, effectively resulting in savings for the government in terms of lower costs of debt financing. Finally, the time deposit of the Ministry of Finance was used to repay euro bonds at the date of maturity in May 2005, with a net neutral effect on the foreign exchange market by the two transactions at different times.

Banka Slovenije signed an agreement with the Ministry of Finance in April 2001 stipulating coordination between the two institutions on developing the money market. One measure for the development of the money market was the introduction of a one-month Treasury bill, issued by the Ministry of Finance in co-operation with Banka Slovenije. The proceeds of the subscription were deposited by Ministry of Finance at Banka Slovenije in a cost-neutral way. The overall bonus of the instrument was to provide a regular weekly indication of the one-month interest rate of the money market. The bonus for the Ministry of Finance was in having liquidity facility at hand when needed (based on the rules of forecasting requirements), and the bonus for Banka Slovenije was in broadening its capacity to sterilize. This instrument was abolished in November 2005, well after the stability of the exchange rate was safely established within ERM 2.

Chart 4: Liquidity Absorbing Instruments of Banka Slovenije in the Period 1995–2005, Expressed as Percent of the Bank's Total Assets
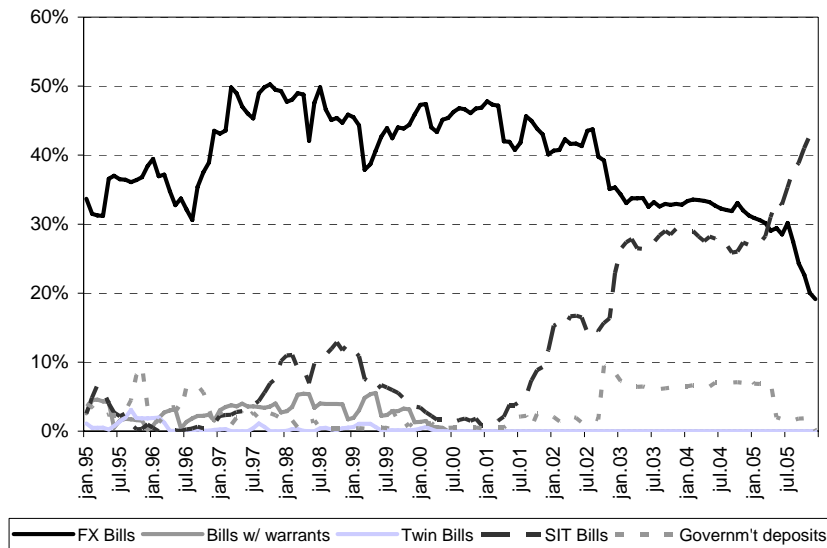
Source: Banka Slovenije and authors' calculations.

The evolution of relative importance of the major groups of liquidity absorbing instruments is depicted in chart 4. As already previously explained in this section, foreign exchange bills represented relatively the most important sterilization instrument throughout the observed period and amounted to even as much as 50 % of Banka Slovenije's total assets in some sub-periods. Bank of Slovenia's bills denominated in Slovenian tolars on the other hand represented analogous sterilization instrument that has gradually gained its relative importance after year 2001 and remained in use till the adoption of euro. The rest of the sterilization instruments, although important due to their specific design (e.g. twin bills, bills with warrants), usually represented up to 5% or mostly up to 10% of Banka Slovenije's total assets and their implementation used to be concentrated in specific sub-periods.

4.2 Responses of Banka Slovenije to Practical Sterilization Limits

It is desirable to consider how the four key obstacles that limit the effectiveness of open-market sterilization procedures (elaborated in section 2) could be circumvented in practice, taking into account the Slovenian experience. As stated

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by Lee (1996), these limitations should be taken into account in selecting and designing supplementary instruments and techniques to deal with financial inflows and their consequences.

First of all, the question arises of whether alternative kinds of operations compared to open-market operations are available. For open-market operations it is characteristic that monetary policy instruments are offered to counterparties – banks – through auctions. There are two possible alternate paths: to offer instruments (for sterilization purposes, we mean central bank liabilities such as central bank bills) to non-bank investors (e.g. enterprises and households), or to sell them as standing facilities.

Related to the four limitations brought forward in section 2, some stylized lessons from the case of Slovenia would be the following:

a) The ability to sterilize capital inflow is inversely related to the degree of international capital mobility.

Undesirable consequences of capital inflow can be avoided not only by sterilization efforts on the one hand, but also by reducing the mobility of capital with a form of indirect capital controls on the other hand. By the beginning of 1995 in Slovenia, banks and enterprises had to deposit at the central bank without interest 40% of loans raised abroad if the maturity was less than 5 years (at a later stage, less than 7 years). Another measure in a kind of tax with the effect of an extra cost on foreign financing was introduced by February 1997 on portfolio investments. The first capital control measure was abolished in 1999, and the second in 2001.

b) Sterilization policies cannot work for long when shocks are durable, because sterilization deals with the effects rather than the underlying causes of shocks.

The answer to this kind of limitation could be a very simple one: those countries that are more persistent in sterilization efforts are more likely to experience changes in shocks all at once. This was exactly the case in Slovenia when it came to the Asian and Russian crisis in 1998 and 1999. The effect of lower capital inflow occurred in exactly the same year as Banka Slovenije encountered the liquidity impact of sterilization costs that exceeded the potential growth of base money. This means that sterilization would also be needed for the portion of returns paid to investors for sterilization instruments. In the period of the Asian and Russian financial crisis, the need for sterilization diminished relatively due to the lower foreign capital supply.

c) The scope of classical open-market operations can be severely restricted by the underdeveloped state of financial markets and by fiscal costs.

It is true that less-developed financial markets make sterilization more difficult and more costly. On the other hand, in previous decades in completely different circumstances (compared to today's infrastructure) financial institutions and investors also dealt with securities. So it is possible. The first issues of Bank of Slovenia bills were issued in hard copy; they were sold to banks, and also to

households and enterprises through the banks as intermediaries. The main reason to make banks compete with the non-banking sector was the fact that the interest rate margin in the banking sector was well over five p.p. By deciding to compete with banks for savings on the retail deposit market, Banka Slovenije did not affect the lending rates of banks and it avoided extra costs due to bank inefficiency.

d) Heavy fiscal costs may eventually curtail sterilization operations. These costs may also lead to operating losses at the central bank, which can have a negative effect on the independence of the central bank in monetary policy.

During the whole period between 1992 and 2005, Banka Slovenije was only once faced with an operating loss. That was in the year 1998, at the end of the second consecutive period of substantial growth of the NFA item on its balance sheet. This loss could easily be covered by accumulated general reserves from the previous large growth of NFAs, and consequently also with adequate sterilization challenges. In this period of time, the mix of monetary policy operations was designed to cope with the high costs of the sterilization operations. Three pillars of monetary policy operations were agreed with the vast majority of the banks on a voluntary basis. The first pillar enabled Banka Slovenije to signal the exchange rate at which banks would set deals on the retail foreign exchange market during a limited period of intervention (if so decided by the central bank). According to the second pillar, Banka Slovenije provided tolar liquidity mostly by purchasing foreign currency temporarily (instead of outright) by means of seven-days swaps offered to the banks (only those that had agreed to be parties to the agreement) as a standing facility. Central bank bills offered only to banks for the purpose of the sterilization of excess liquidity represented the third pillar. The difference between such an arrangement and classical outright foreign currency intervention could be summarized as follows:

- Short-term currency swaps allowed banks to manage their liquidity comfortably, but restrained them from extending long-term loans on the basis of very short-term funds.

- The use of foreign currency swaps enabled Banka Slovenije to compensate for a great deal of sterilization costs. The interest rate on the swap instrument was set according to the uncovered interest parity (UIP) principle: the rate was set taking into account the interest rate differential adjusted for the desired pace of depreciation and for the country's risk premium. The main refinancing rate of Banka Slovenije was consequently the sum of the swap interest rate and the main refinancing rate of the ECB (as a proxy for EURIBOR).

- The short-term nature of the swap instrument and its flexible pricing deterred potential arbitrage and restrained the emergence of interest rate-sensitive capital inflow on one hand and, on the other, still provided some flexibility for Banka Slovenije's own monetary policy needs.

5. Conclusions

The economic transition processes in Central and Eastern European countries have been characterized by the sizeable internal and external imbalances these economies had to deal with. Central banks in these economies had to adopt monetary policy strategies suitable to such vacillating economic conditions. One of the most controversial decisions all central banks in transition economies had to make was a decision on the appropriate foreign exchange rate regime. The existent theory was very much based on the so-called "consistency triangle" framework. This particular framework, which advocates three-corner solutions involving only two diametrically opposed foreign exchange solutions (either completely fixed or completely flexible exchange rates) turned out to be incompatible with policy solutions adopted by some central banks in developing/transition economies. Namely, contrary to the theoretical suggestions, some central banks relatively successfully opted for managed floating foreign exchange rate regimes. Lee (1996) elaborates experiences of such practices in six developing countries around the world.

In transition economies, only a few central banks decided to implement a managed floating exchange rate regime (e.g. Romania and Slovenia) at the very beginning of the transition. However, current account imbalances and especially intensified foreign capital inflow in most of these countries led their central banks to different conclusions regarding their foreign exchange policies. Any economy that opted for any form of managed floating exchange rate regime had to cope with rising net foreign assets on its central bank's balance sheet.

Analysis of stylized central bank balance sheets in six countries (Slovenia, Croatia, Bulgaria, Romania, Albania and Macedonia) reveals the tremendous importance of net foreign assets as a main contributing factor to the cumulative autonomous liquidity position of the banking sector in each of the observed countries. Central banks must respond to increasing autonomous liquidity positions by the implementation of adequate sterilization measures. The case of Banka Slovenije and its sterilization practices are further elaborated in this paper.

The analysis of practical limits on the use of sterilization as a monetary policy strategy is based on the example of Banka Slovenije. The past experience of the Slovenian central bank proves that it is possible to design a sterilization strategy which can work for longer periods of time. However, Banka Slovenije with its sterilization instruments had to compensate for a relatively underdeveloped financial market and the absence of risk-free securities suitable for sterilization operations traditionally known in financially more developed economies. So, at least in some sub-periods, the Slovenian central bank was compelled to combine market-based instruments with indirect capital controls. Additionally, Banka Slovenije decided to issue its own securities, which were offered not only to commercial banks as typical central bank counterparties, but also to non-financial

companies and in some instances even to individual investors. By designing a more complex mix of monetary operations based on three pillars (exchange rate signalling, introduction of seven-days swaps, central bank bills), Banka Slovenije was capable of coping with the relatively high costs of sterilization operations. In many respects the rich experience of Banka Slovenije in the field of sterilization operations can be very instructive for central banks in the SEE region as well, especially if it proves necessary for countries in this region to deal with continuing foreign capital inflow.

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Appendix 1

Table 1: Classification of Exchange Rate Regimes in Sample Countries

Exchange rate regime	Slovenia	Albania	Bulgaria	Croatia	FYR Macedonia	Romania
Currency board arrangements			**X** (since July 1997)			
Other conventional fixed peg arrangements (against a single currency)					**X** peg to EUR (before 1999, DEM)	
Pegged exchange rates w/in horizontal bands	**X** (from Jul 2004 till Jan 2007					
Managed floating with no predetermined path for the exchange rate	**X** (till 28 Jul 2004)			**X**		**X**
Independently floating		**X**				

Source: IMF, De Facto Classification of Exchange Rate Regimes and Monetary Policy Framework.

Appendix 2

Graphical Presentation of Factors that Determine the Autonomous Liquidity Positions of Central Banks in Individual Countries
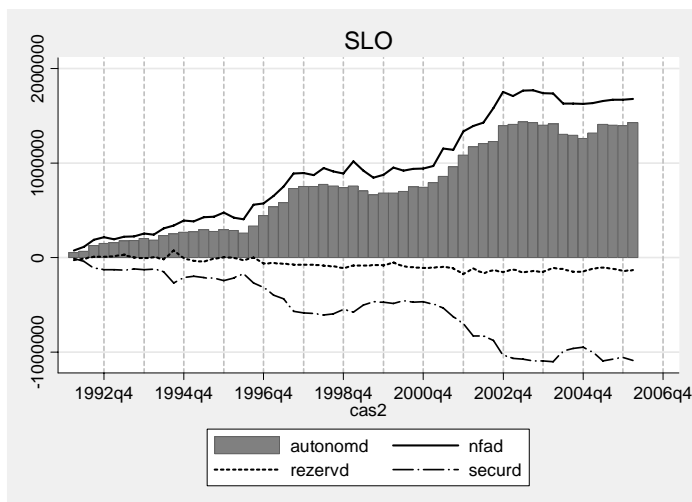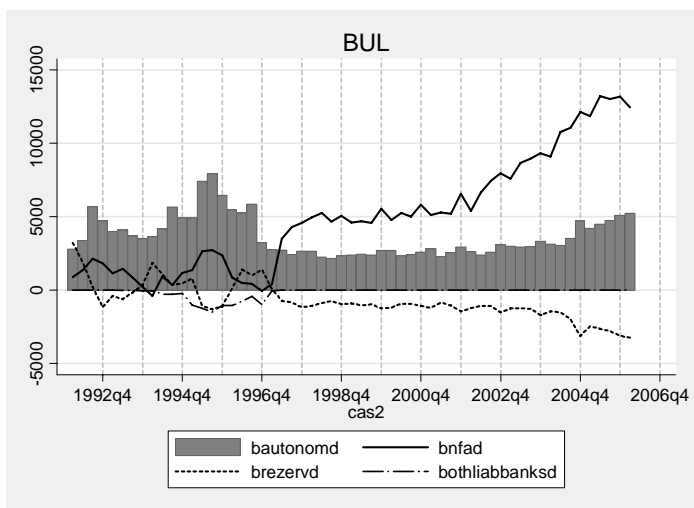

Abbreviations: autonomd – autonomous factors; nfad – net foreign assets; rezervd – reserves; securd – securities.
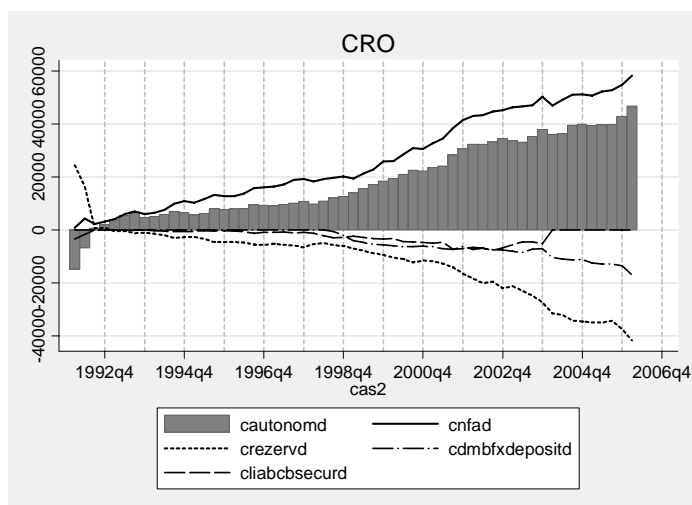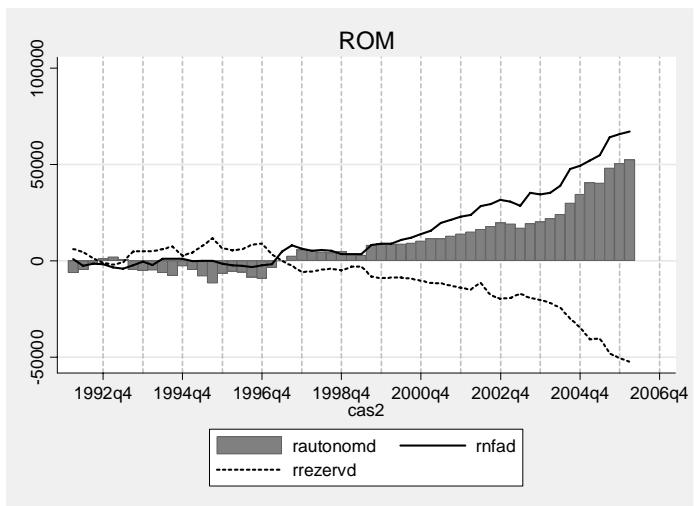

Abbreviations: cautonomd – autonomous factors; cnfad – net foreign assets; crezervd – reserves; cdmfxdepositd – domestic banks' FX deposits; cliabcbsecurd – central bank's securities (liabilities).
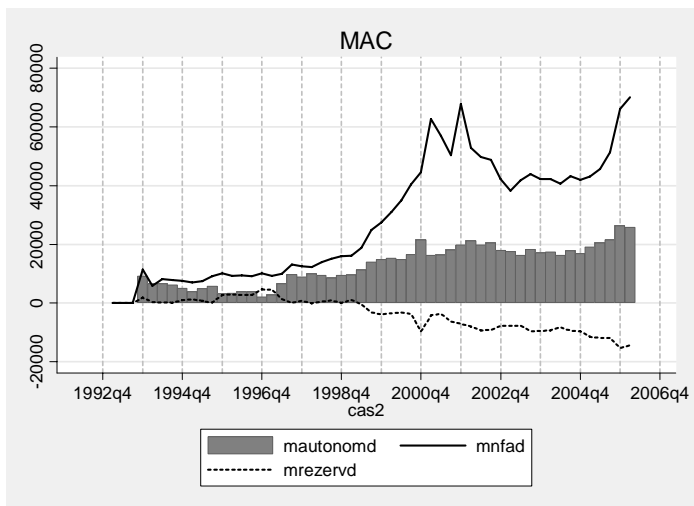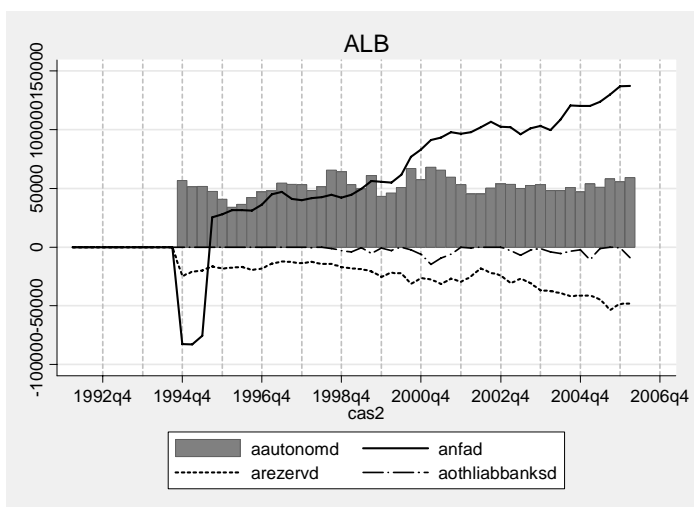
Abbreviations: mautonomd – autonomous factors; mnfad – net foreign assets; mrezervd – reserves.

Abbreviations: bautonomd – autonomous factors; bnfad – net foreign assets; brezervd – reserves; bothliabbanksd
– other liabilities to banking institutions.

Abbreviations: rautonomd – autonomous factors; rnfad – net foreign assets; rrezervd – reserves.

Abbreviations: aautonomd – autonomous factors; anfad – net foreign assets; arezervd – reserves; aothliabbanksd – other liabilities to banks.