CONTENTS

Introduction

Estonia has had a currency board arrangement (CBA) for more than nine years. Due to the successful performance of Estonian economy under CBA, the maintaining of current exchange rate regime until the full participation in the EMU, *inter alia*, during Estonia's participation in ERM 2 looks as the optimal option.

The main aim of the paper is to examine different aspects of the sustainability of Estonian CBA. For this purpose the paper gives an overview of CBA in general, describes the rationale for the choice of the CBA in Estonia and uses model simulations to assess its sustainability. It also analyses whether the preconditions for the successful performance of the CBA are in place in Estonia and discusses the compatibility of Estonian CBA to the EMU and ERM 2.

The objective of the first three Sections of the paper is to give an overview of the features of the CBA in general and the Estonian CBA in particular. We mainly focus on the issue of the credibility of the CBA and on the nature of the adjustment process under this exchange rate regime. We also discuss the reasons why CBA was chosen in Estonia.

The main idea of the second part of the paper (Sections 4–6) is to use model simulation to assess the sustainability of Estonian CBA. For this purpose the main channels of transmission are studied first.

In the fifth Section we perform a comparative analysis of CBA vs other exchange rate regimes. The aim of the comparative analysis is to determine the performance of the CBA in comparison with the situation where another exchange rate arrangement and monetary rule would have been used in Estonia. Freely floating and pegged exchange rate regimes as alternatives to CBA are analysed. We also compare CBA with the monetary policy rule targeting inflation and/or output gap and/or exchange rate and using interest rate as the instrument.

In the following Section we study the sustainability of the CBA by using model simulation to assess the impact of external shocks (both permanent and temporary). Specifically, we try to analyse post-shock adjustment in the economy (ie whether shocks cause the divergence or convergence in the Estonian economy and how long it takes for the economy to converge to the long-term path after a shock).

The following three Sections complement previous analysis by directly examining whether the preconditions for the successful performance of the CBA are in place. First, we analyse the resilience of the banking sector by analysing its performance during external shocks deriving from the Asian and Russian crisis. This is done by the analysis of the events in forward market and the changes in interest rates and money supply. Secondly, we examine the fiscal policy stance after the introduction of the currency board with special emphasis on the period strongly influenced by external shocks (1997–1999). Thirdly, we discuss the flexibility of the real sector of the economy. For this purpose the flexibility of wage setting, movements in the real exchange rate and changes in foreign trade are covered.

In the last three Sections of the paper we examine the sustainability of Estonian CBA in the light of the accession to the EU and full participation in the euro zone. In this part we discuss the compatibility of the CBA to ERM 2, examine the legal and institutional aspects of joining the EMU and shortly discuss problems related to the EMU.

We finish the paper with conclusions regarding the sustainability of the CBA. Our analysis shows that CBA is a suitable exchange rate regime for Estonia. We argue that the preconditions for a well-functioning CBA – resilient financial sector, flexible wage and employment system and prudent fiscal policy – are in place. The sustainability of the CBA is also supported by model simulations, which show that shocks hitting Estonian economy do not cause convergence of Estonian economy from the long-run path. Based on the above-mentioned results we conclude that the currency board arrangement is the best exchange rate regime for Estonia before the full participation in the third stage of the EMU.

1. Currency Board Arrangement in Estonia

Currency reform started on June 20, 1992 in Estonia and was backed up by basic legislation which determined the nature of the reform (The Currency Act, Foreign Currency Act, Act of the Republic of Estonia on the Security of the Estonian Kroon adopted in the Supreme Council of the Republic of Estonia on May 20, 1992). With the reform the currency board (CBA) system was introduced.

CBA is a monetary regime based on an explicit legislative commitment to exchange domestic currency for a specified foreign currency at a fixed exchange rate combined with restrictions on the issuing authority – the CBA – to ensure the fulfilment of its legal obligation (IMF (1996)).

CBA is restricted by a legal barrier to change the exchange rate. The fact that the exchange rate can be changed with great difficulties only adds to the CBA's credibility. The backing rule eliminates (or strictly limits) the scope for issuing unbacked monetary liabilities ensuring that the CBA does not run out of foreign reserves to maintain the parity (IMF (1996)).

The main characteristic of the CBA system is that the board stands ready to exchange domestic currency for the foreign reserve currency at a specified and fixed rate (Walters, Hanke (1992)). In case of the CBA the money supply is endogenous consisting in exchanging domestic currency at a fixed exchange rate to the currency that forms the reserve.

The CBA bears certain resemblance (though in a completely modified context) with gold standard principles. It could be considered as a 'surrogate' for the automatism and the rules of the gold standard. In some sense it is a return to the goals' hierarchy of the gold standard and to the corresponding adjustment mechanisms. Both systems aim to subordinate money supply to simple, effective and transparent rules. They affect macroeconomic policy by imposing the strongest discipline – that of capital movements and the markets. (Avramov (1999))

The principal features of the Estonian CBA are 100% backing of base money, fixed exchange rate regime and complete convertibility of Estonian kroon. Under the terms of the Act on the Security of the Estonian Kroon, the currency issue is fully backed by the gold and convertible foreign exchange reserves of the Bank of Estonia (Eesti Pank). The Bank may change the amount of Estonian kroons in circulation only in accordance with changes in its gold and foreign exchange reserves (Clauses 1 and 4 of the above Act).

CBAs are principally required to hold realisable financial assets in the reserve currency at least equal to the value of domestic currency outstanding (Walters, Hanke (1992)). Actually, claims against CBA and the backing by reserves can be broader or narrower. For instance, Argentina adopted a quasi-CBA arrangement in which only newly issued domestic currency, but not the whole outstanding stock, is 100 per cent backed by foreign reserves with all currency convertible at a fixed exchange rate. (Osband, Villaneuva (1992))

According to the rules of Estonian CBA, the deposits of commercial banks (required and excess reserves) with Eesti Pank are backed in the same way as cash. This solution was conditioned by practical considerations. In Estonia there was no effective system of interbank clearing outside the central bank. Therefore banks had to keep their accounts in Eesti Pank. In the moment of kroon‘s issue it was crucial to create and support confidence in newly issued currency as well as in the monetary system as a whole. For this purpose, it was decided that obligations of the central bank to commercial banks would be backed.

A broader than usual CBA backing became possible due to sufficient reserves. Gold reserves became available to the Estonian central bank following the agreement to repatriate gold deposited by Estonia with the Bank of England before the occupation of the country in 1940 (Saavalainen (1995)). Thus, at the moment of the currency reform in June 1992, 90% of the obligations of the currency board were backed with reserves. The rest of the initial reserves were formed from subsequent restitution by Swedish government and the Bank for International Settlements. By mid-July, the CB had already excess reserves compared to the obligations.

Since June 20, 1992 the exchange rate regime has been a fixed rate against the German mark of 8 EEK = 1 DEM. From the beginning of 1999, the Estonian kroon is also fixed to the euro (15,6466 EEK = 1EUR).

According to the legislation, the Bank of Estonia has no power to devalue the Estonian kroon. Any change in the exchange rate of the kroon leading to devaluation against the German mark must first be approved by the Parliament.

Considering the convertibility, there are no restrictions on current account transactions of balance of payments. With the effect from August 15, 1994 Estonia has accepted the obligations of Article VIII of the IMF Articles of Agreement, under which members undertake to refrain from imposing restrictions on the making of payments and transfers for current international transactions or from engaging in discriminatory currency arrangements or multiple-currency practices without IMF approval.

The only valid restriction for capital account transactions is connected with the purchase of land by non-residents (the permission of the Government or local authority is needed). There are no further restrictions on capital account transactions. Although Eesti Pank cannot conduct a discretionary monetary policy, it has implemented several measures aimed at improving the monetary policy operational framework to enhance the sustainability of the financial system.

2. Features of CBA

2.1. Credibility

CBA provides credibility while even the possibility of discretionary policy may raise inflationary expectations.[1] CBA is an extreme/special form of fixed/pegged exchange rate systems whereby irreversibility of commitment is guaranteed by a legally fixed parity between the national currency and the reserve currency. Thus the currency board is capable of enhancing confidence, reducing the risk of attack against the national currency and imposing the stricter discipline rules of fixed exchange rate regimes. (Avramov (1999))

By eliminating or strictly limiting monetary authorities' ability to monetise fiscal deficits, or lend to banks, CBA can rapidly strengthen credibility. In principle, CBAs would be expected to be more effective than conventional fixed pegs when the monetary authorities' reputation has been weakened by the history of lax fiscal policy, accommodative monetary policy, and failed stabilisation attempts or when the authorities lack an established track record (as in Estonia and Lithuania). By providing clear signals about policy intentions of the authorities, and ensuring monetary independence from the government, CBAs facilitate an adjustment of expectations and promote wage and price discipline, thereby lessening potential inflation biases. (IMF (1996))

Under fixed exchange rates and perfect capital mobility, a country cannot pursue an independent monetary policy. In the case of CBA there are legal restrictions on the use of policy tools. (IMF (1996)) Under the currency board, the central bank would lose its discretion to act, and inflation and real interest rates would drop towards the levels of those in the country issuing the anchor currency. The more credible policy environment would provide a better framework for stability and growth. (Gulde (1999))

2.2. Adjustment Process

In accordance with the CBA principle, liquidity management of the banking system is the responsibility of commercial banks themselves, ie of the market. Due to the lack of instruments (or their inefficiency), CBA is characterised by the non-discretionary monetary policy and non-intervention. Endogenous money supply is directly linked to automatic **"**sterilisation" of excess liquidity. Sterilisation of excess liquidity is engineered through the increase of foreign assets of commercial banks. In other words, banks tend to increase their foreign assets if there is no demand (acceptable by banks) for their domestic assets. The opposite process is also possible, meaning that banks increase their domestic assets by decreasing their foreign assets. [2] The above-

[1] CBA is but one of the elements of the stabilisation programme. Although it will, if properly designed, contribute to eliminating macroeconomic imbalances, its long-term survival depends equally on the implementations of appropriate supporting measures (Gulde (1999))

[2] The referred process is the main mitigating remedy for one of the CB potential key problems – the restrictive effect. This criticism assumed that the only way to increase the currency supply under the CB arrangement was by means of a current account surplus (Fischer (1982)). Yet bank credit was capable of expansion. As deposits expanded, the public's currency-deposit ratio fell, as did also bank's excess reserves and their reserve-deposit ratio. The money supply could grow even in the absence of current account surpluses. Moreover, international capital inflows were also available to increase the currency supply. A secular rise in output did not necessarily betoken a falling price level.

mentioned sterilisation brings money supply into accordance with demand and eliminates excessive money supply in the long run.

The adjustment mechanism works through interest rate arbitrage. Under the specie flow process, an outflow of capital, as a result of doubts about the exchange rate, would lead to the contraction of money supply. Interest rates then go up, and a counter-flow of funds is induced. The series of event would take place automatically and speedily, so that the exchange rate can be "fixed" without government intervention.[3] (Tsang (1998))

According to Tsang such logic seems a bit shaky. Under normal circumstances, interest rate hikes may contribute towards the stabilisation of a currency. But if the exchange rate is itself fluctuating and looks insecure, higher interest rates will not necessarily induce a counter-flow of capital. In this sense, the specie flow process is not a reliable mechanism in fixing an exchange rate. Therefore, there is the need for the second mechanism of CBA: currency arbitrage (alternatively known as exchange rate arbitrage) that directly binds the exchange rate. Given the board's 100% foreign reserves for cash in circulation, cash arbitrage can be carried out. In case the market exchange rate weakens from the official rate, people can convert their bank deposits into cash, go to the currency board to exchange cash into foreign currency at the stronger official rate, and then sell the foreign currency in the market. This arbitrage activity will yield a non-risky profit, and the selling pressure on the foreign currency will bring the market exchange rate back to the official level. (Tsang (1998))

3. The Rationale for the Choice of CBA

Estonia's choice of CBA reflected the search for high credibility and transparency of monetary policy as well as a firm ground for economic reforms.

3.1 Institutional Underdevelopment

An important reason for choosing CBA in 1992 was the limited central banking expertise. Although Eesti Pank was re-established in 1989, it did not have any control over monetary policy until the monetary reform in 1992. Due to the lack of any expertise in implementing independent monetary policy, CBA was partially chosen for its simplicity. In line with this argument, the IMF has also concluded that due to its simplicity CBA is particularly attractive for post-chaos countries and/or for small countries that have recently attained independence and that wish to have their own currency for motives of seigniorage as well as national identity.

In addition to the lack of central banking expertise at the time of the monetary reform the implementation of an effective discretionary monetary policy under different exchange rate arrangements was severely constrained by the lack of statistical data. This problem was accentuated by the fact that, also during the first years after the monetary reform, the quality of the available statistical data was low. Therefore the

[3] Gulde, Kähkonen and Keller (2000) stress that this is essentially the same mechanism that also operates under other fixed exchange rate arrangements. However, the lesser room for discretionary monetary policy and the correspondingly stronger exchange rate guarantee implied by the CBA suggest that the necessary interest rate changes and the associated costs for the economy could be comparatively lower.

lack (and later the low quality) of statistical data hindered the creation of a model for the Estonian economy. Without a model describing the monetary transmission, the use of discretionary monetary policy and the targeting of economic policy could not have been feasible.

It is clear that the creation and evaluation of models requires observations and time. Even if we believe that Estonian (and foreign) economists had in mind "the right" model (which considering the past is a very strong assumption[4]), one need to have waited until 1996 to estimate the model. As it was only then that the minimum length of time series was available for estimation. But even if the model had been compiled at that time, the reliability of that model would have been low. This stems from the fact that the confidence interval of the econometric model that is estimated on that short time series is so wide that the model-based policy recommendations cannot be reliable. The use of the model in 1997–98 would have also been hampered by the impact of the Asian and Russian crises which caused significant structural changes in the economy. Therefore, the model should have been re-estimated to take into account these structural changes. Accordingly, an adequate model could have been constructed only in 1999 or 2000 (as was the case).

To summarise, Keller (2000) has argued that an effective anti-cyclical monetary policy is difficult enough to pursue in developed, large and therefore relatively closed economies. In transition countries, with rapid structural transformations, the knowledge of our profession regarding the exact transmission channels and relevant time lags is clearly less deep. Therefore, the balance of risk appears to favour small transition economies with fixed exchange rates to maintain their exchange rate policy.

3.2. Part of Stabilisation Package

The implementation of the CBA was a crucial part of the stabilisation package. An important reason for choosing CBA arrangement was the need to gain credibility. In addition to that, the implementation of the CBA was to provide a solid nominal anchor for both stabilisation and restructuring. CBA arrangement seemed to be a feasible solution for achieving stable monetary environment and a basis for stable economic relations in a short period of time.

One of the major goals of the economic stabilisation in 1992 was the need to lower inflation. As an important feature of the CBA is its non-inflationary nature, the implementation of CBA was considered as a way of bringing down the inflation.[5] As a result of the monetary reform, money supply became endogenously determined and inflation triggering excess money supply disappeared. Inflation rate started to fall: in the first quarter of 1992 monthly CPI was close to 30%; in December 1992 monthly CPI had decelerated to 3.3%. At the beginning of 1993, most of the open sector prices

[4] The main problem in the determination of the model is the shaping of the long-term component. On the basis of a time series consisting of a couple of years it is impossible to do adequately. In that respect, the underlying inflation could be characteristic of that – each additional year changed radically the vision of underlying inflation (see Sepp-Vesilind-Kaasik (2000)).

[5] The non-inflationary nature of the CBA stems from the fact that, under this arrangement, money supply is restricted. Devaluation is eliminated as a possible source of increasing the nominal money stock. Furthermore, money supply is strictly constrained by eliminating one of its sources. Under the classical two-tier banking system, the central bank issues money against both foreign and domestic assets. In this case it performs issuing functions by increasing its monetary liabilities against lending to government (budget financing) or commercial banks (refinancing or lender of the last resort). Manipulation of domestic sources of reserve money underlies monetary policy and, in a sense, is the *raison d'etre* for central bank existence. However, if manipulation is exercised beyond certain sound limits and under governmental pressure it starts to generate inflation. (Avramov (1999))

had reached the new equilibrium level. The disinflation process was quite smooth and the fluctuations of the monthly indices reflect mainly administrative steps, including tax measures (see Figure 1).[6]

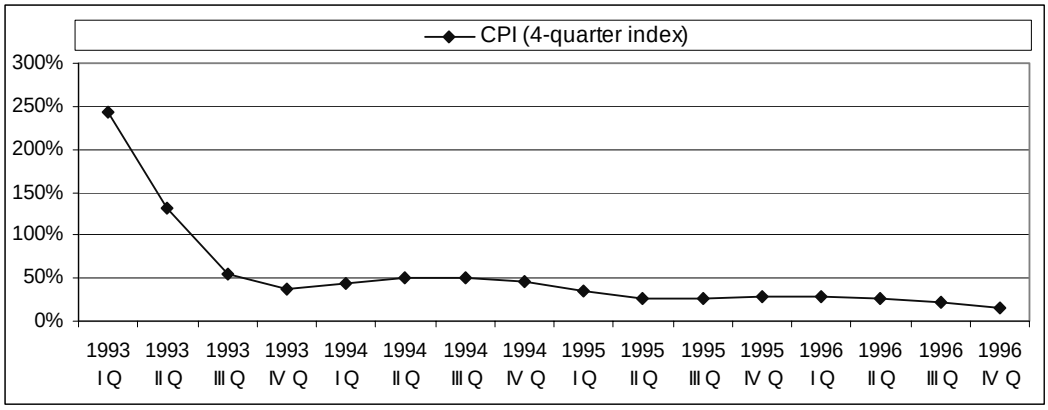


Figure 1. The dynamics of CPI in 1993–96

The introduction of CBA helped to increase fiscal commitment. In order to avoid jeopardising the target of lower inflation and keeping the external balance "on track," special fiscal targets were set for every year.[7] In the period from mid-1993 to the end of 1994, for example, the government targeted a financial deficit about 1–2% of GDP. These ceilings helped to keep public debt on a low level: since 1997 government debt has not exceeded the 7% level of GDP.

The economic policy choices made during the monetary reform attained strong confidence in Estonian economy, and creditworthiness of the private sector (including the banking sector) improved considerably during the first couple of years after the monetary reform. Bearing this in mind, financial deficit as a fiscal target was replaced by fiscal (overall) deficit, which *de facto* marks a return to tighter fiscal policies. By setting low ceilings to fiscal deficits, the government aimed at dampening domestic demand and keeping domestic economy from overshooting.

4. Channels of Transmission

According to Leitemo and Roisland (1999), it is practical to model monetary transmission with a two-sector model. In the two-sector model, there are basically two explicit channels for the transmission of shocks – interest rate and exchange rate channels. It seems plausible that the tradable sector output is more sensitive to changes in the real exchange rate, whereas the non-tradable sector output is more affected by the real interest rate through domestic demand.

[6] For a comprehensive discussion of inflation in Estonia in the first half of the 1990s see Sepp-Viilmann (1995)

[7] Ghosh, Gulde and Wolf (1998) have argued that the fixed exchange rates lead to better fiscal results. This is largely determined by the fact that fiscal policy under these currency regimes is subordinated to maintaining the fixed exchange rate. There is an essential difference between the intermediate regimes of a fixed exchange rate and the currency board (which is a further manifestation of the advantage of the stringent commitment of a currency board). While the first retains the possibility for monetary authorities to hold domestic assets, with currency boards this possibility is eliminated. Therefore, the possibility that overly expansionary fiscal policy will cause a currency crisis under CBA is strongly reduced.

Below, we will look at both channels, assuming different impacts of interest and exchange rates to the sectors. Alas, it is done by a one-sector model, because till now we lack a two-sector model of Estonian economy. As for the interest rate, we use nominal rate, because so far there is no empirically confirmed evidence that the real rate has an impact. Leaving aside speculative attacks, one might say that it is not a big mistake: in the absence of exchange rate risk, the nominal interest rate is a good proxy for investment yield/prices.

And one more clarification: although CBA is a fixed rate regime and by the definition the dynamics of nominal exchange rate is excluded, we study the effect of the nominal rate. It is due to the fact that in some episodes the NEER of kroon depends crucially on appreciation/depreciation of the currencies unpegged to DEM or to EUR.

One may say that the credit channel has a role to play in Estonian economy, though in modelling we were unable to establish that, both in the case of loan channel and the balance sheet channel. The terms that characterise the latter - adverse selection and moral hazard – were at least in 1997–98 during the turmoil of the Asian and the Russian crises the keywords in describing the behaviour of Estonian economic agents.

4.1. Interest Rate Channel [8]

The model includes both short- and long-term rates. Long-term interest rate depends on the short rate and inflation expectations. The system could be reduced to look at only one interest rate, but the distinction between short and long rate is useful in order to analyse shocks caused by speculative attacks (see Section 5).

The direct effect of the nominal interest rate is characterised by considerable restrictive impact. Regarding GDP it is a well documented puzzling negative correlation between real output and the short term nominal interest rate (Fuhrer–Moore (1995)). In case of Estonia, a one percentage-point rise in the short-term rate (see Figure 2) impacts domestic demand: SHORT LENDING RATE↑→ OUTPUT GAP↓. At the same time this transmission includes a kind of adjustment mechanism – as the money supply in the model is determined solely by transaction motive, and money supply has negative effect on the interest rate, then OUTPUT GAP↓→ M2↓→ LENDING RATE↑.

In addition to the effect on domestic demand there exists also a marginal supply side effect, which is indicated by the decline of export. As capital (and therefore investments) is explanatory variables of export in the long-run, and investments are negatively related to interest rate, then LENDING RATE↑→ CREDIT↓→ INVESTMENTS↓→ REAL CAPITAL↓→ EXPORT↓

EXPORT converges with the pre-shock trajectory as the impact of the error correction process becomes prevailing in late stages of adjustment and GDP↑→ CREDIT↑→ INVESTMENTS↑→ REAL CAPITAL↑→ EXPORT↑. [9]

[8] The interest rate channel of our model does not actually include the interest rate arbitrage. The reason comes from the fact that we failed to model international financial flows.

[9] This scheme contrasts the transmission logic of Leitemo and Roisland's two-sector model. Using their argumentation, one could assume that the effect of interest rate is expressed in the decline of output in domestic non-tradable sector, which assumedly lowers inflation rate. Declining inflation and depreciation of domestic currency raises competitiveness and export.

Due to the output gap, the rise in interest rate has a small impact on inflation as well (see Figure 2 and 3).

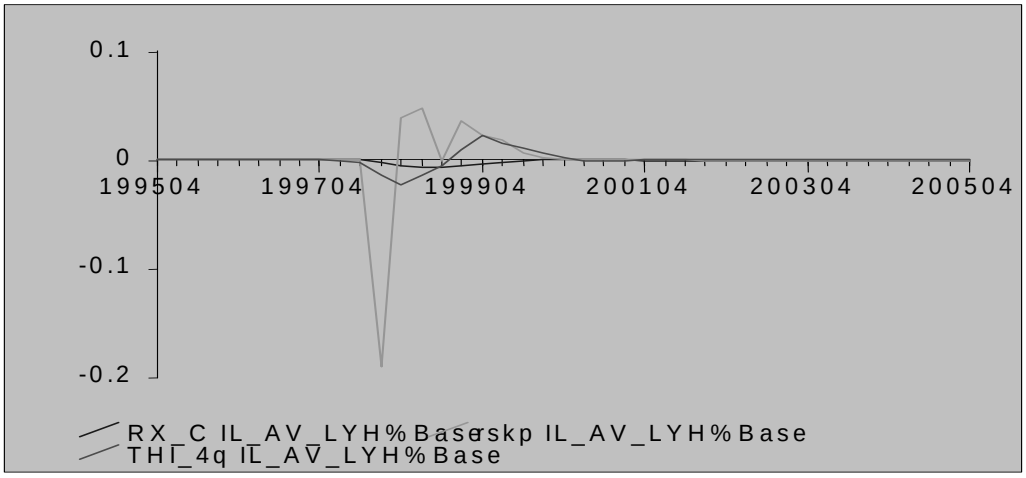


Figure 2. Interest rate shock in percentage points from the baseline (RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI)

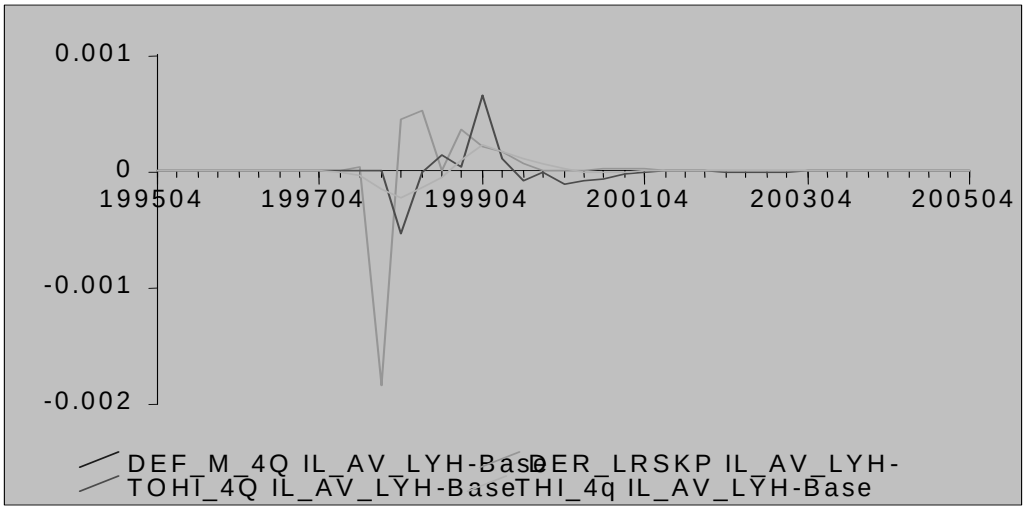


Figure 3. Interest rate shock absolute deviation from the baseline (DEF_M_4Q is annualised import deflator, DER_LRSKP is output gap, TOHI_4Q is annualised PPI, THI_4Q is annualised CPI)

4.2. Exchange Rate Channel

The importance of exchange rate channel comes from the openness of Estonian economy. This channel transmits impacts of nominal as well as real exchange rates. According to the restrictions of the fixed exchange rate regime, it is understandable that the real rate channel is particularly effective.

4.2.1. Real Exchange Rate (REER)

As mentioned above, the real exchange rate operates as a factor of export in the long run. The dynamics of real rate in (transition) economy with fixed exchange rate is primarily determined by domestic inflation, which depends on the convergence of price level and of relative prices. The appreciation of real rate means, *ceteris paribus,* declining (price) competitiveness and slower growth of export. In our simulations the permanent shock in the real effective exchange rate (one percentage point appreciation) has constant effect on real variables. Appreciation leads to lower long-term level of growth because of the decreased competitiveness (see Figure 4).

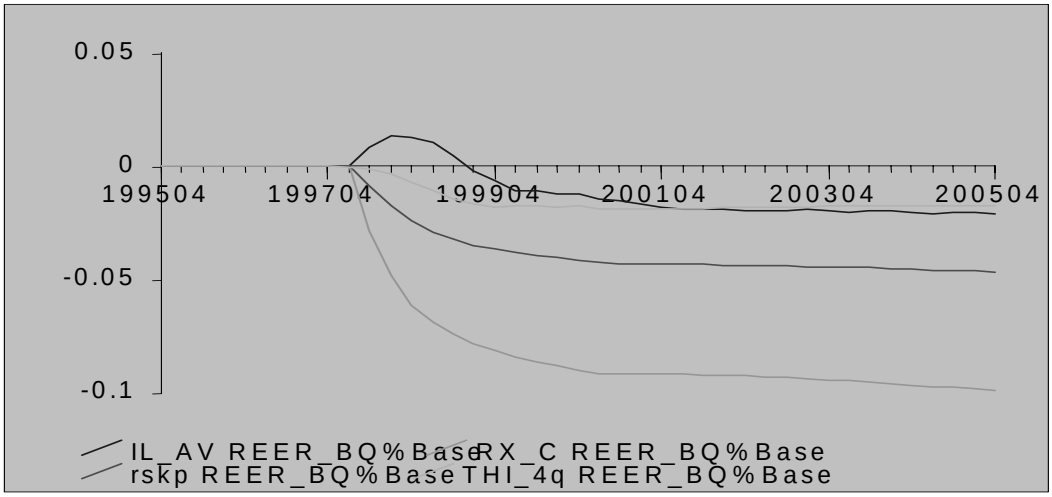


Figure 4. Shock of REER in percentage points from the baseline (RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualised CPI)

4.2.2. Nominal Exchange Rate (USD)

USD and SEK are on the trade bases principal floating currencies with respect to the Estonian kroon. Looking at Figure 5, one may follow the adjustment after the nominal appreciation of USD by 1%. It can be concluded that the effect of the appreciation of dollar on real indicators is rather significant, and in total, positive. This is due to favorable reaction of real exchange rate.

The nominal depreciation of kroon affects economy through several variables. The increasing competitiveness raises export and GDP.

On the other hand, the appreciation of USD causes domestic inflation by the increase of import prices (see Figure 6). Inflation is supported also by the increase of exports, which creates some extra demand pressure. However, it is evident, that the overall effect of USD appreciation is positive. The real depreciation of kroon due to its nominal depreciation is bigger than the real appreciation caused by inflation (see Figure 7).

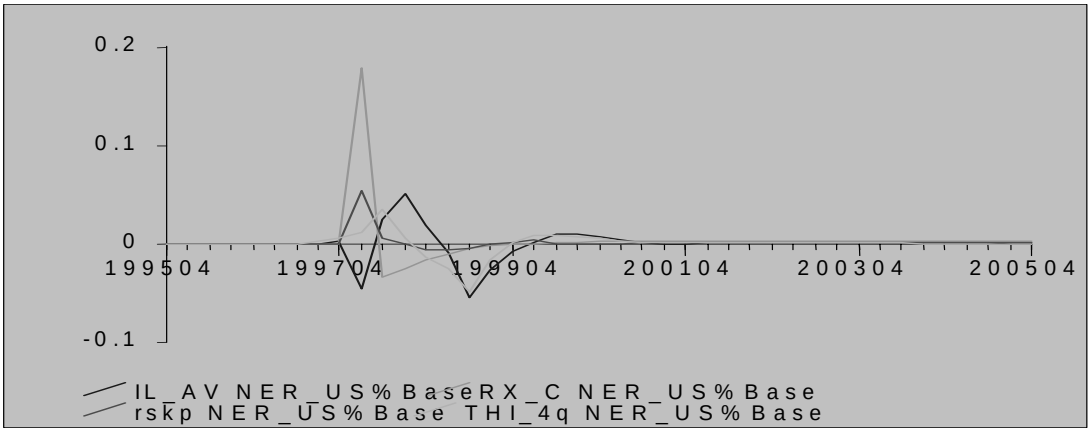


Figure 5. USD shock in percentage points from the baseline (RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI)

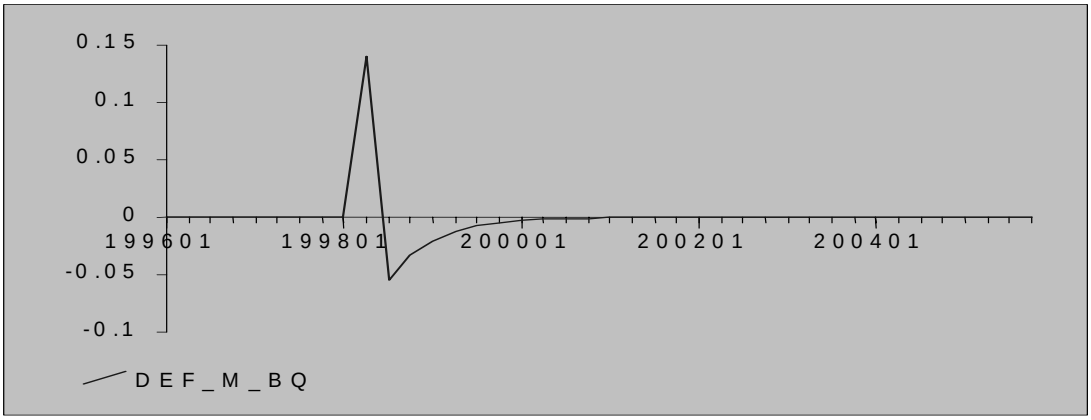


Figure 6. USD shock as absolute deviation from the baseline (DEF_M_BQ is import deflator as base index)

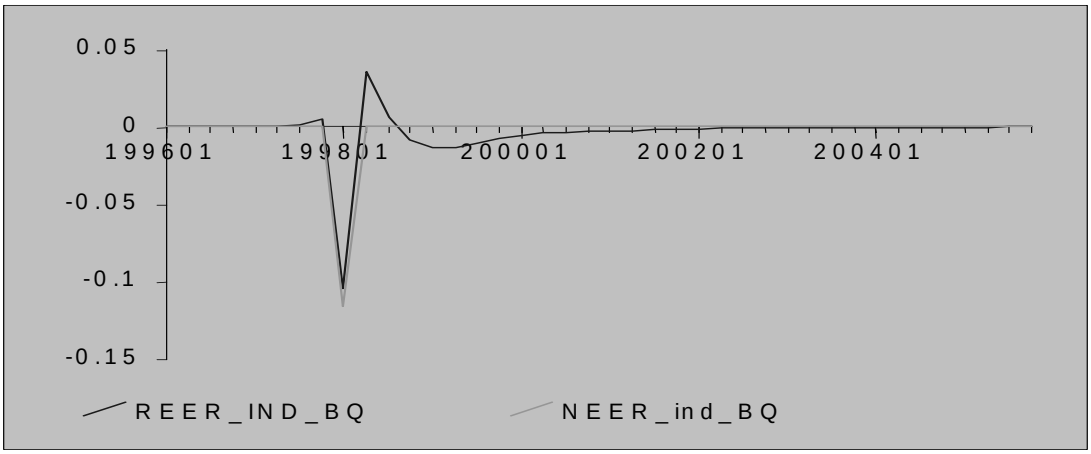


Figure 7. USD shock as absolute deviation from the baseline (REER_IND_BQ is REER of Estonian kroon regarding industrial countries, base index; NEER_IND_BQ is NEER of Estonian kroon

4.3. Significance of Transmission Channels

Looking at the variation of the key variables, it is clear that the exchange rate channel is somewhat more influential.

This outcome is logical within the framework of a two-sector economy paradigm, and it is also intuitive, based on the realities of the Estonian economy. Taking into account the openness of Estonian economy, one should expect the exchange rate channel to prevail. The interest rate channel reacts primarily through the demand for non-tradable, which gives only a minor contribution to GDP. Therefore the impact of interest rates on aggregate measures (including GDP) should be minor as well. On the other hand, the exchange rate is an influential determinant of the tradable sector output. As the tradable sector is dominant in Estonia, then, of course, one would conclude that the impact of the exchange rate is crucial also for the development of the whole economy.

5. Comparative Analysis: CBA vs Alternative Policy Rules in Estonia [10]

The aim of the comparative analysis is to determine the performance of a CBA in comparison with the situation where another exchange rate arrangement and monetary rule would have been used in Estonia. Freely floating and pegged exchange rate regimes as alternatives to the CBA are analysed. In the future (keeping in mind the importance of the ERM 2 framework) one could also consider the performance of exchange rate target zones (eg using Garber-Svensson's (1995) extensions to Krugman's target zone model). CBA has been compared with the monetary policy rule targeting inflation and/or output gap and/or exchange rate and using interest rate as the instrument.

5.1. Alternative Regimes

When comparing CBA with alternative exchange rate regimes one has to introduce at least two central hypotheses regarding (a) the formation of market exchange rate and (b) the behaviour of monetary authority.

The exchange rate formation in our experiments is based on the conventional approach in analysing interrelations of monetary policy rules and exchange rate regimes – on uncovered interest parity with risk premium (see for example Leitemo-Söderström (2001)). As regards the agents' expectations towards changes in the exchange rate the model incorporates both rational and adaptive expectations.[11] Rational expectations are model consistent. As the first approximation, which could be elaborated in the future, we assigned equal weights to adaptive and rational expectations.

Regarding the operation of the monetary authority, monetary rule(s) should be determined. In our simulations the CBA has been compared with a monetary rule including interest rate as the instrument. We excluded open market operations, as

[10] The model used for the comparative analysis is described in Appendix 7.
[11] The idea of combining different types of expectations is suggested by Leitemo and Söderstren (2000).

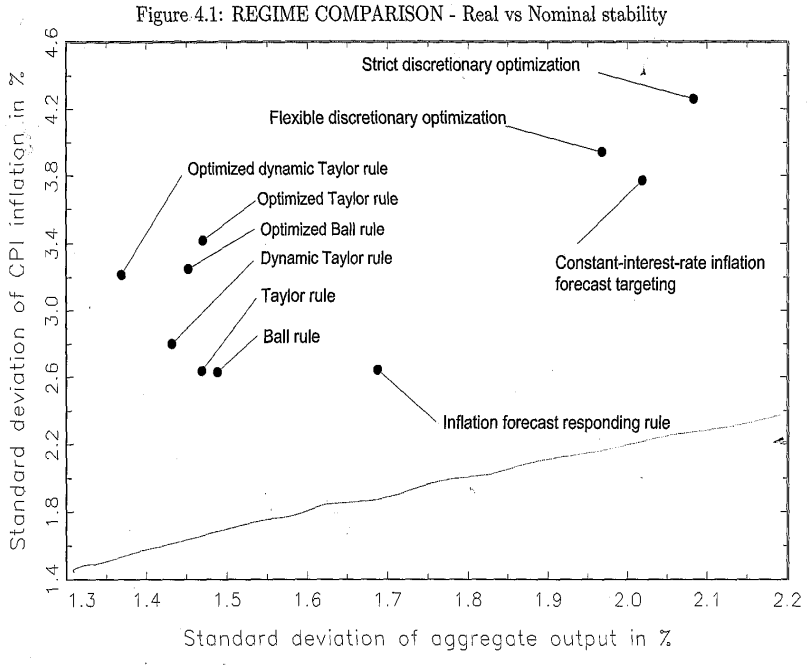
these operations are not actually used in Estonia. Therefore, we assumed that the main monetary policy instrument is the hypothetical refinancing rate,[12] which is the sum of the Euribor, the country's risk premium[13] and a conventional error-correcting feedback component. As the refinancing rate depends also on the level of the Euribor it is only partially exogenous due to the fact that the Estonian commercial banks are able to attract significant amounts of foreign funds.

We assumed that the monetary authority is targeting (underlying) inflation or/and output gap or/and exchange rate. Obviously the central bank could in principle target one of the above-mentioned targets or a combination of them. The first two (inflation and output gap) are more or less typical targets in the case of an interest rate based rule. The last target – exchange rate – is sometimes incorporated with interest rate to form a synthetic instrument. For example, Ball (2000) has studied the monetary condition index as a policy instrument. Meanwhile, exchange rate can be treated as a target as well. For example, Ball (2000) and Benigno-Benigno (2001) have included exchange rate into the right hand side of the rule.

There is some evidence that simple monetary rules might outperform more complex optimal rules (see Figure 4.1 from Leitemo-Roisland (1999)). For this reason simple monetary policy rules were used in this analysis.

The reaction parameters of the rule were found by simple experimenting which consisted of calibration of parameters. The aim of calibration was to find a value that would enable one to achieve the target with the least variation in the interest rate.

Figure 4.1: REGIME COMPARISON - Real vs Nominal stability



[12] Due to the CBA, Eesti Pank does not have a refinancing rate.
[13] The sum of the Euribor and the country's risk premium is equal to the price of foreign funds to Estonian commercial banks (as a proxy for that the interest rate of Estonian commercial bank loans was used).

5.2. Historic Simulations

Provisional results of historical deterministic simulations show that under the simplifying assumption of perfect information of monetary authority[14], rules that target only one variable – either output gap or inflation – formally outperform the CBA. However, it appears that output gap targeting increases interest rate volatility drastically. This is due to the fact that output gap makes up approximately three fourth of the loss function (ie total variation in the gap, inflation and interest rate). The rest of the total variation is divided more or less equally between inflation and the interest rate.

Figure 8 and 9 show a trade-off between the output gap and interest rate variation. It appears that if one uses interest rates for smoothing the gap, then interest rate variation becomes similar to the gap (actual) hyper-variation.

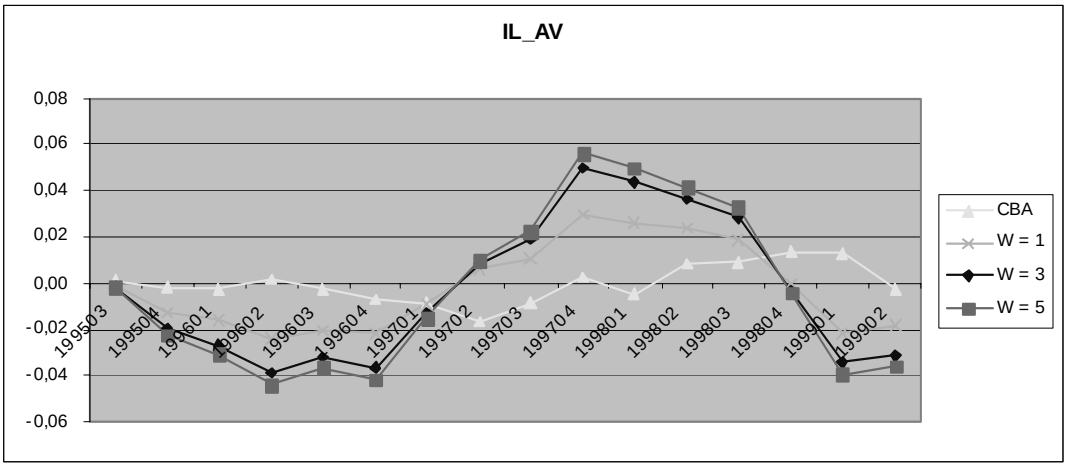


Figure 8. Simulated dynamics of interest rate in case of CBA and gap targeting (when the gap has weight equal to 1,3 or 5 in the monetary rule)

Due to the inclusion of the additional features of a small open economy in the model the results of the simulations somewhat changed the conclusions of the earlier version of the paper. Previously it was found that, in principle, it is possible (even if it is not reasonable when taking into account the resulting volatility of interest rates) to target output gap by using the refinancing rate. Now it turns out that even very large changes in the refinancing rate cannot close the output gap completely.

The reason for that is straightforward. The CBA simulations showed that due to the openness of Estonian economy, the output gap depends mostly on foreign demand and the role of domestic demand is marginal. Therefore the smoothing of the gap via

[14] In our experiments, monetary authority is assumed to know the true structure of the economy. The monetary authority understands the formation of private agents' expectations, and is able to use this knowledge to its advantage. The possession of perfect information entails two things – firstly, the central bank is competent to make 100 per cent adequate decisions. Secondly, the perfect information assumption allows to realise its decision precisely in accordance with expectations and intentions. The reality is certainly more complex than the above simplification. Svensson and Woodford state that a central bank operates under considerable uncertainty due to the circularity problem. Many important indicator variables for central banks are forward-looking variables, variables that depend on private-sector expectations of the future developments in the economy and future policy. However, these expectations, in turn, depend on an estimate of the current state of the economy, and that estimate in turn depends, to some extent, on observations of the current forward-looking variables (Svensson and Woodford (2000)).

domestic demand through interest rates is accompanied by irrational growth of interest rate variability.

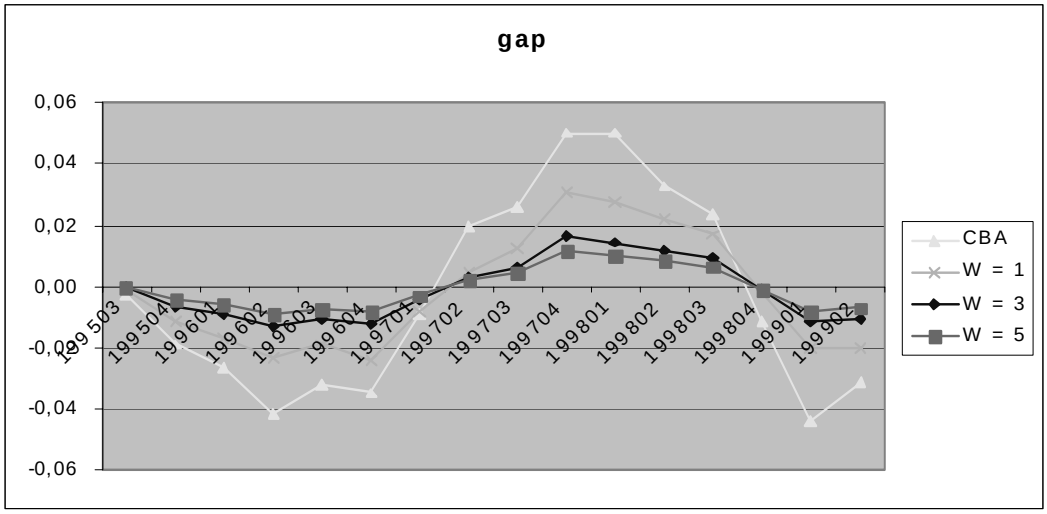


Figure 9. Simulated dynamics of gap in case of CBA and gap targeting (when the gap has weight equal to 1,3 or 5 in the monetary rule)

What actually matters for foreign demand and consequently for the gap is the exchange rate channel, which contains the real and nominal rates transmission channels. As simulations show interest rate as a policy instrument produces unfortunately rather problematic effects in the open economy context (see Figure 10).

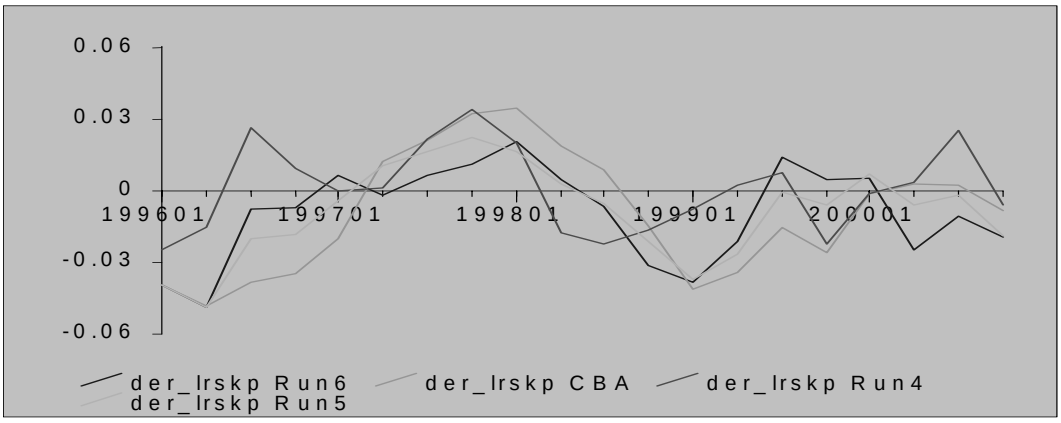


Figure 10. Simulated dynamics of output gap (DER_LRSKP) in case of CBA and gap targeting in the open economy context

The real exchange rate channel influences the output gap targeting in the following way:
gap → interest rates↑→ gap↓→ CPI↓→ REER↓→ X ↑→ gap↑→ and again from the beginning.

A positive output gap induces the central bank to raise its refinancing rate. This, in turn, lowers the output gap via its dampening effect on domestic demand. In the absence of strong nominal rigidities this causes a decline in inflation rate (possibly

even deflation when there are no downward rigidities) which induces real exchange rate depreciation. Depreciation of the real exchange rate improves Estonia's external competitiveness, which will lead to an increase in exports. A rise in exports causes a positive output gap etc.

In case of a floating exchange rate, the output gap targeting is also dependent on the nominal exchange rate channel in addition to the real exchange rate channel:
gap → interest rates ↑→ ER(=EEK/DEM)↑→ REER↓→ X ↑→ gap↑→ and again from the beginning.

Again, a positive output gap prompts the central bank to raise the refinancing rate. A rise in interest rates leads (due to the UIP) to weaker nominal exchange rate[15]. This will cause a depreciation of the REER, which will lead to higher exports. As in the case of the real exchange rate channel the rise in exports causes a positive output gap.

The described inefficiency of output gap targeting in Estonia is in line with conclusions about the efficiency of different monetary rules in a small open economy. Corsetti–Pesenti (2001) state that in an open economy a policy attempting to close the domestic output gap may induce excessive volatility in the exchange rate. Gali–Monacelli (2000) stress the same for the interest rate.

As was described above, the influence of the interest rate on the aggregate demand is not significant in Estonian economy. Therefore, one could suppose that inflation targeting is not effective if the interest rate has an impact only on domestic demand. This is evidenced by a model simulation, which is based on the assumption of a fixed/pegged exchange rate. In this case the changes in the refinancing rate do not influence the exchange rate and thereby have no effect on foreign demand.

Based on model simulations one could conclude that under exchange rate targeting the economic performance and dynamics of fundamentals are more or less the same as under the CBA (taking for granted that actual exchange rate will be close to the target). Of course, from the operational point of view there is a clear difference between the CBA and exchange rate targeting. If a central bank wishes to achieve the exchange rate target it has to foresee the exchange rate expectations (as well as speculative attacks). Therefore, a central bank cannot rely on a backward looking monetary policy rule when it uses the interest rate as an instrument. In this case the process is explosive: according to the rule the exchange rate gap produces a response in the interest rate, which in turn (due to the UIP) causes a shift in the exchange rate, etc.

The model simulations indicate that monetary rules that target more than one variable are not successful. It is intuitive – if mono-target rules are ineffective, there is no reason to hope that a combination of targets would be more successful. Due to different lags and transmission channels the situation is more complicated in the case of multi-target rules. The interest rate as a policy instrument becomes even less effective than under the mono-target regime and central bank is not able to achieve its targets simultaneously.

[15] Of course, UIP as the only hypothesis reflecting the exchange rate formation is a rather crucial simplification (when considering the possibility of interest rate arbitrage). Unfortunately our model does not include endogenous financial flows, thus it is not possible to simulate arbitrage.

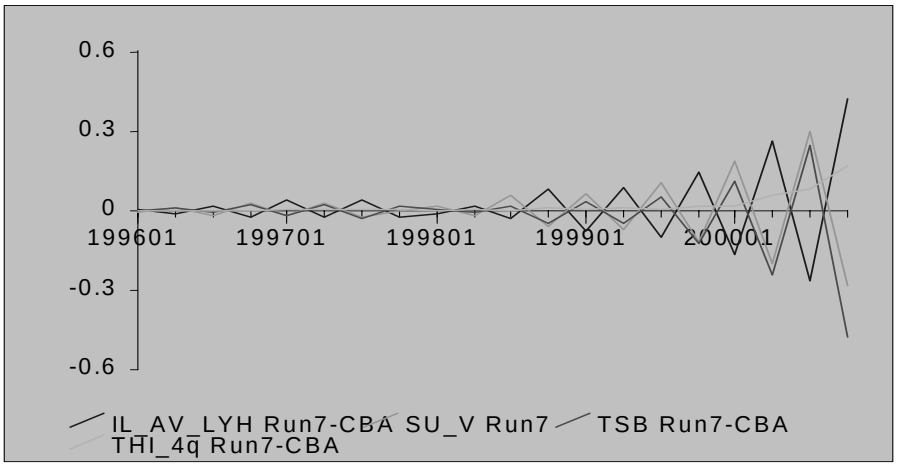


Figure 11. Explosive dynamics of backward looking exchange rate targeting (as compare to the baseline)

Policy Conclusion

Simulations prove that CBA is the most suitable monetary policy framework for Estonian economy.[16] Based on the above described simulations one may conclude that the interest rate (due to its inefficiency) is not a suitable monetary policy instrument in a small and very open economy like Estonia. Instead of the interest rate the central bank might use the exchange rate as an instrument. But practical realisation of this, at the first glance a good option in fine tuning, brings along serious problems regarding the confidence in the national currency and operations of the tradable sector. Therefore, we think that the CBA is still the best policy option.

The only hypothetical problem with the CBA is whether the actual level of the exchange rate is appropriate or not.[17] If there is large misalignment between the actual and equilibrium exchange rate, one might consider a free float for eliminating this misalignment. On the other hand, there are several serious problems with a free float. One of the main arguments against a free float is the possibility of drastic exchange rate volatility. As the exchange rate channel is highly important for the Estonian economy, the exchange rate volatility will lead to significant variation in real variables. This problem is compounded by the fact that Eesti Pank is not experienced in using instruments for affecting the exchange rate formation.

Fortunately there are no signs of serious misalignments exchange rate of kroon (see Section 9) and there is no reason to believe – considering the growth outlook for the Estonian economy and the economic policy set-up – that the kroon will be under- or overvalued in real terms.

[16] Obviously this conclusion applies only if the model reflects the Estonian economy adequately which is our hope.
[17] Fortunately there are no signs of a serious misalignment in the exchange rate (see Section 9) and there is no reason to believe – considering the growth outlook for the Estonian economy and the economic policy set-up – that the kroon will be under- or overvalued in real terms.

6. Sustainability of CBA

In addition to the legal and institutional factors that are the prerequisites and increase the sustainability of the CBA a range of economic factors have to be in place for a well-functioning CBA. In other words, the sustainability of the currency board also depends on the ability of the real economy to function reasonably well under such exchange rate regime.

One of the features of the CBA is the absence of an independent monetary policy. Therefore, an economy operating under the CBA principles needs greater flexibility of markets in order to cope with missing adjustment instruments of monetary policy and of the floating exchange rate. In fact, under currency board economic adjustment has to come through price and wage adjustments. Therefore, the sufficient flexibility of the labour and goods markets is especially important.[18]

Under a currency board the role of fiscal policy is also of great importance, as it is the main policy tool, which can be used for economic stabilization.[19]

A sound banking system is an essential condition for the stability of the CBA. This necessity arises from several reasons. First (in most cases) monetary authority under the CBA cannot act as a lender of last resort; secondly, as there is no automatic refinancing window at the central bank, the principal role in ensuring a stable liquidity system, has to be fulfilled, first and foremost by financial intermediaries themselves.[20]

6.1. Simulation of External Shocks

One way to analyse the sustainability of Estonian CBA is to look at the outcomes of the shock-simulations. So we studied the following external shocks, most relevant under the CBA (not to consider the speculative attacks):
1) nominal exchange rate shock (using the macromodel of Estonian economy, it is possible to simulate the impact change of exchange rate of USD (see Section 4.2.2), Swedish krona (see Appendix 2), Russian rouble and also NEER (see Appendix 3));
2) shock of foreign interest rate (Euribor 3M, see Appendix 4);
3) shock in import prices (see Appendix 5);
4) export shock (using the model it is possible to distinguish the impact of different factors of external demand - as of GDP of EU15, the Finnish GDP, the CPI of EU15,

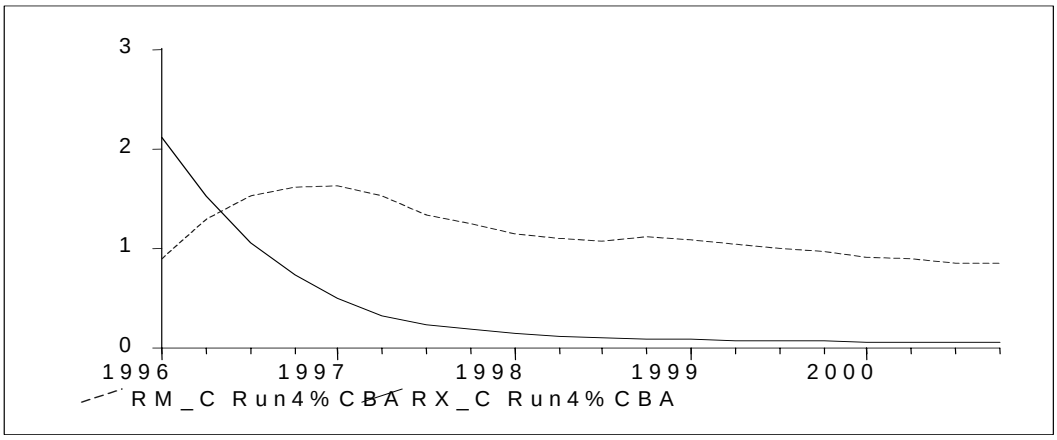
[18] The gain from the CBA derives from the flexibility of the economy. The flexibility, in turn, stems from the liberalisation and openness. Yet it is a one-sided conclusion, since it only reflects the short-term effect. In fact, CBA relevantly relates to the long-term aspect as well. The flexibility, liberal organisation and openness of the Estonian economy are partially also the results of the introduction of CBA (and the reforms initiated thereby). The structure of our economy is endogenous to monetary rule: CBA is most suitable because Estonia has developed a favourable environment for CBA through structural and institutional reforms.

[19] Avramov (1999) points out that an indirect threat for the system could come from political pressures for a withdrawal from the CBA through a change in the fixed exchange rate. The depression of the real sector and the restrictive financial conditions will decrease public support for maintaining the CBA.

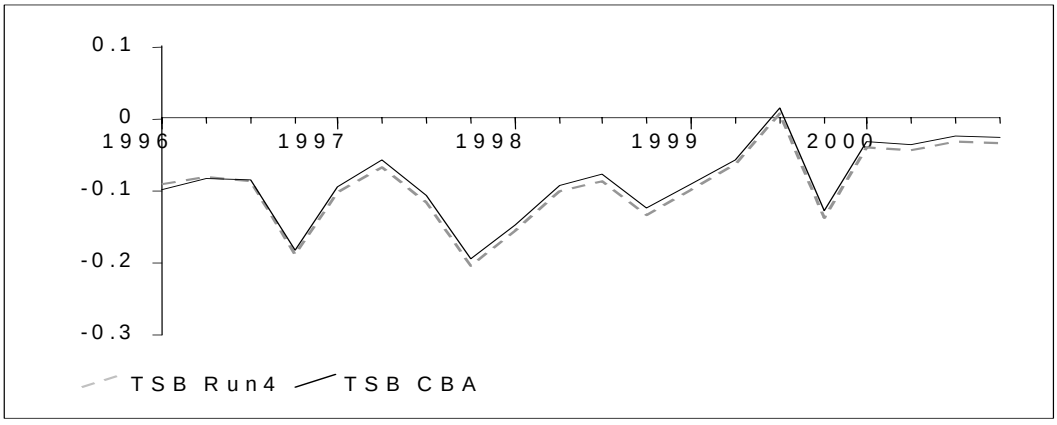
[20] Viable banking system is also important due to the intertwining of monetary and credit systems which creates a connection between exchange rate crises and bank crises. Stockam stresses that banking system crises can create speculative attacks on a pegged exchange rate. Crises in currency markets and credit markets can feed on each other. This interrelationship – the fact that we have the same set of institutions for the allocation of credit in an economy as we have for promoting transactions services – means that monetary arrangements, such as an exchange rate system, can affect the real economy through these credit channels. Importance of these credit channels remains controversial. Nevertheless, there is evidence to worry about those issues and to believe that they may be worse in countries with less-developed financial systems, business firms may depend even more heavily on the banking system (rather than direct acquisition of funds in capital markets) than in more developed countries. (Stockman, p 1495–9)

the Russian CPI, etc in our exercise the foreign demand shock is studied in the simple aggregate form (see Appendix 6)).

The main conceptual conclusion to be drawn is that temporary shocks do not cause the divergence of the Estonian economy from the long-run path. Or in other words, the adjustment of exogenous shocks leads to convergence with the long-run path. According to intuition, export shock proved to be the most effective exogenous shock. In addition, export shock has a slight long-lasting effect on the trade balance. In the short run, a positive export shock will cause an increase in GDP growth, a positive output gap and a rise in consumer price inflation. As regards GDP the positive export shock has a temporary impact. After a short-lived correction the GDP will converge to its long-term path. As external demand is the critical factor of output gap, a positive export shock produces higher inflation for approximately a year and a half, which in turn results in appreciation of the real exchange rate. Real exchange rate appreciation causes an increase in imports due to the substitution effect. [21] Therefore, the economy experiences a slight worsening of the trade balance. As regards other variables the impact of a positive export shock is not significant.



a) deviations of export and import from the baseline



b) goods and services balance (base line and shock simulation)
Figure 12. Export shock and external balance

[21] The real appreciation of exchange rate has a stronger impact on the imports than on the exports (as the appreciation does not result from the proportional decline of competitiveness).

In order to verify that convergence is not caused by the mutual compensation of shocks, the least favourable combination of the simultaneous shocks was studied. The most restrictive selection of the shocks includes the increase of the interest rate, decrease of demand resulting negative GDP gap, fall in money supply etc. Nevertheless, the conclusion made earlier holds true here as well – shocks adjustment leads onto the long-run path.

We studied also the permanent shocks. The conclusions were in accordance with intuition: adjustment after demand side shocks leads back to the previous growth trajectory relatively quickly. The main exception is adjustment of export shock. Due to the role of external demand for Estonian economy, the post-shock convergence is rather slow. As external demand is the critical factor of output gap, the positive export shock produces increasing inflation, which in turn results in appreciation of real exchange rate and in temporary decline of competitiveness.

The second exception of convergence is the Euribor shock, which has an essential impact on domestic interest rate. Interest rate has a direct effect on supply side through investments and on fixed capital (as capital formation is touched). The convergence is very slow: at the end of the period under the consideration (2005:04), the GDP deviation was still 0,0022% and export deviation 0,0044% from its baseline simulation.

The main conclusion of our simple exercises is that shocks adjust to the long-run path and in this aspect the Estonian currency board seems sustainable.

6.2. Actual Performance of CBA

The second way to analyse the sustainability of Estonian CBA is to look how the economy has actually coped with shocks. As the Asian and Russian crisis both had a clear impact on the Estonian economy, we will analyse how the Estonian economy reacted to the adverse conditions brought by these external shocks.

The two external shocks that hit Estonia in 1997–98 were of different magnitude and influenced Estonian economy through different channels. The common feature of the crisis was the fact that these shocks spread via contagion effects – both crises started with a speculative attack and were accompanied by difficulties in obtaining foreign financing.

The influence of the Asian crisis to Estonian economy was less severe. It started with a speculative attack and a decrease in foreign capital inflows, which resulted in the significant fall of the prices of financial assets and a temporary rise in money market rates.

The impact of the Russian crisis to the real sector was stronger. As a result, Estonia recorded four consecutive quarters of economic decline starting from the fourth quarter of 1998. The decline was steepest in the first half of 1999 when the output contracted by 3% as compared to the first half of 1998. Although in the second half of the year another growth phase started, the overall GDP growth remained negative for

the year 1999 (-1,1%). The decline in economic growth was mainly due to a sharp contraction in exports. For the 1999, as the whole export of goods declined by 5%, during the first half of the year the decline in exports amounted to 10%. Obviously the exports to CIS was the hardest hit – during that period exports to Russia decreased by 40%.

The influence of the Russian crisis was also felt in the financial sector. Immediately after the Russian crisis broke out there was a strong speculative attack on the Estonian kroon, significant increase in money market rates, subsequently both the growth in money supply and loans stopped. The speculative attack was triggered by the contagion effect of the Russian crisis. The strength of these effects was supported by the fact that Estonia had relatively strong trade relations with Russia. In addition to that Estonia was in a vulnerable position because of its high current account deficit which at the outbreak of the crisis was seen as a threat to the existing exchange rate arrangement.

In conclusion, the Russian crisis (to a lesser extent also Asian crisis) could be considered a good test of the sustainability of the CBA (particularly from the perspective of the viability of financial sector).

The two years starting from the second half of 1997 demonstrated the ability of Estonian financial system to cope with rapid changes in the environment. The financial sector proved its performance efficiency in the face of severe external shocks. It could be said that Estonian financial sector emerged stronger from this turmoil – the capitalisation and liquidity of the banks increased and the involvement of Nordic banking groups also increased the credibility of domestic banks. Therefore, one can conclude that the sustainability of Estonian financial sector has increased during last years, which upholds the argument that it is strongly supporting the sustainability of the CBA itself.

7. Case Study of the Speculative Attack: the Russian Crisis

7.1. Money Supply

The Russian crisis had also a strong effect on the money supply. For the first time since the beginning of 1993, the money supply (both M2 and M1) contracted in absolute terms in the second half of 1998. Broader money supply decreased from 28 billion EEK in the end of July 1998 to 25,5 billion EEK in the end of January 1999. The decline in broader money supply reflected a decrease in cash in circulation and demand and time deposits of Estonian kroon (see Figure 13). During the period from July 1998 to January 1999 cash in circulation decreased by 12%, demand deposits of EEK by 13% and time deposits of EEK by 17%. The only exception was the foreign currency deposits that increased by 10%.

The decline in money supply was due to several reasons. First of all, the Asian and Russian economic crises decreased the credibility of emerging economies which in turn triggered a decline of foreign capital inflows to those countries (including Estonia). These developments were also exacerbated by a slowdown in Estonian economy. As a result of these developments the foreign capital inflows decreased

from 11 billion EEK in 1997 to seven billion EEK in 1998. Secondly, the Russian crisis caused a strong slowdown in the growth rate of consumer incomes and corporate profits as well. It is reasonable to assume that private individuals used temporarily part of their deposits for consumption smoothing and enterprises used their cash balances to cushion the growing problems with external financing.

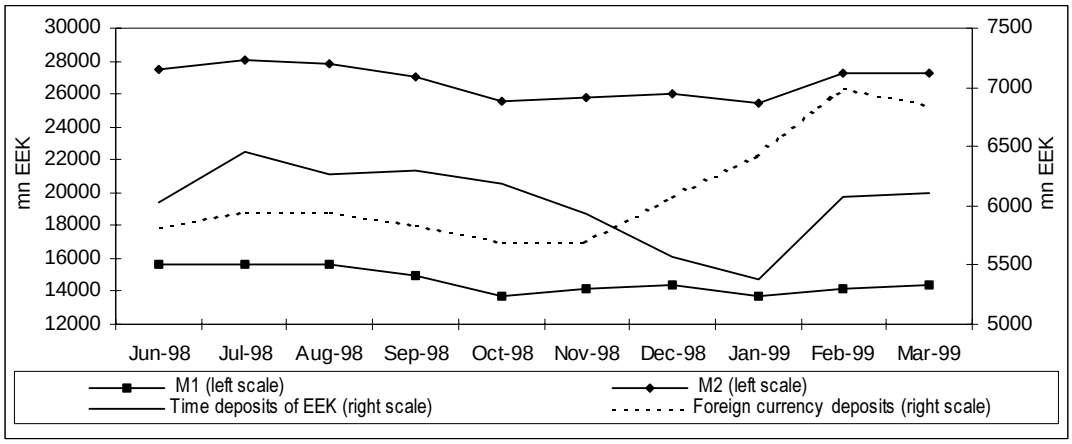


Figure 13. The dynamics of the components of money supply from June 1998 to March 1999

Also the Russian crisis roughly coincided with the bankruptcy of a medium-sized bank – *Eesti Maapank* (The Land Bank of Estonia) which decreased the credibility of Estonian banking sector. At that time it was widely assumed that the Russian crisis would increase strongly the amount of bad loans. Therefore, the decreased credibility of the banking sector and subsequent problems with two small banks – *ERA Pank* (ERA Bank) and *EVEA Pank* (EVEA Bank) in the autumn brought about a withdrawal of deposits from Estonian banks (especially from the smaller banks).

In addition to the above-mentioned factors, the Russian crisis also increased the probability of devaluation. This is evidenced by the fact that during the second half of 1998 Estonian private individuals and firms decreased their cash portfolios of Estonian kroons and their demand and time deposits in EEK. Against the background of decreasing banking sector credibility and economic hardships Estonian private individuals increased their foreign currency holdings in Estonian commercial banks. This could be seen as an evidence of fears of devaluation among Estonian economic agents. Simple correlation analysis shows that during July 1998 and March 1999 the interest rates of forward transactions and components of money supply exhibited a strong negative correlation. The correlation between interest rates of forward transactions and M1, M2, demand deposits of EEK and time deposits of EEK were –0.54, -0.76, -0.51 and –0.35, respectively (see also Figure 14).

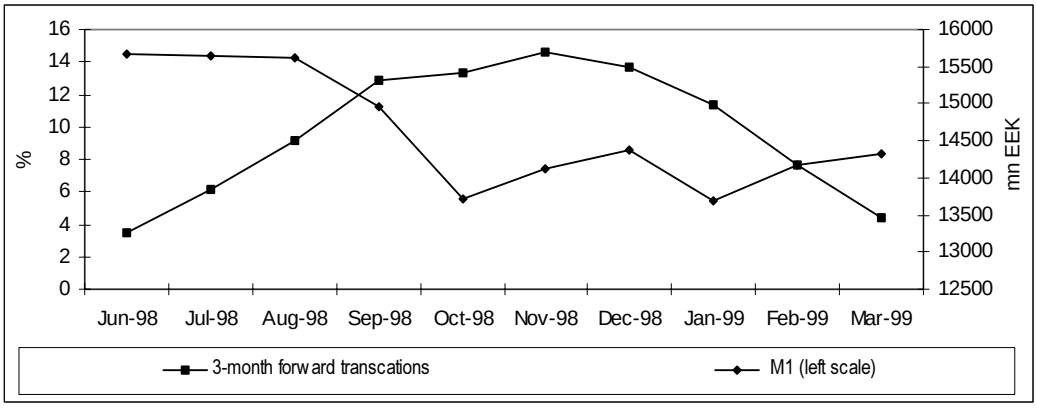


Figure 14. Interest rates of forward transactions and M1 from June 1998 to March 1999

7.2. Forward Market

Similarly to the Asian crisis, the first influences of the Russian crisis were felt in the financial sector (mainly in the forward market). During the second half-year the foreign currency forward market experienced a substantial rise in price quotations, which was related to the crisis in Russia. Before the Russian crisis the interest rate of DEM–EEK forward transactions ranged from 2% (one-month forward transactions) to 5% (one-year forward transactions) (see Figure 15). With the start of the Russian crisis the price quotations surged and peaked in December when the interest rates of these transactions amounted to nearly 15%. The reasons for this currency speculation were mainly based on the belief that Estonian economy is not able to withstand the adverse influence of the Russian economic crisis and in order to maintain its external competitiveness vis-à-vis Russian enterprises has to devalue its currency. Anecdotal evidence suggests that the currency speculation was launched by foreign financial intermediaries, both Estonian commercial banks and, to a lesser extent, Estonian corporate sector firms were betting on the stability of the exchange rate of EEK.

Unlike October 1997, the rise in quotations was not followed by a notable increase in trading volumes. In the third quarter the volume of DEM–EEK forward transactions undertaken by the banks amounted to 7.8 billion kroons, which was less than the record-breaking 9.5 billion kroons in November 1997. The difference between the behaviour of commercial banks in the forward market in the second half of 1997 and second half of 1998 can be seen in different dynamics of the price quotations (see Figure 15). While in the second half of 1997 the interest rates of forward transactions amounted to 8%, the corresponding figure in 1998 was twice as high. At the same time the difference between money market interest rates in the second half of 1997 as compared to the second half of 1998 were quite small. This, in turn, indicates that Estonian commercial banks were at that time less inclined to take risks. On the one hand, position-taking was restrained by the availability of bank funds and the fact that due to the involvement of foreign capital in the banking sector commercial banks took a cautious position which was evidenced by the reduced limits related to forward transactions. On the other hand, a huge bid-offer spread in foreign currencies and high interest levels made speculations expensive.

Because of the consolidation process in the banking sector and involvement of foreign capital, short positions of foreign banks in the Estonian kroons started to decrease on the forward market from November and with them also price quotations of Estonian kroon forwards. By December 1998, the situation in the forward market stabilised and returned to normal level.

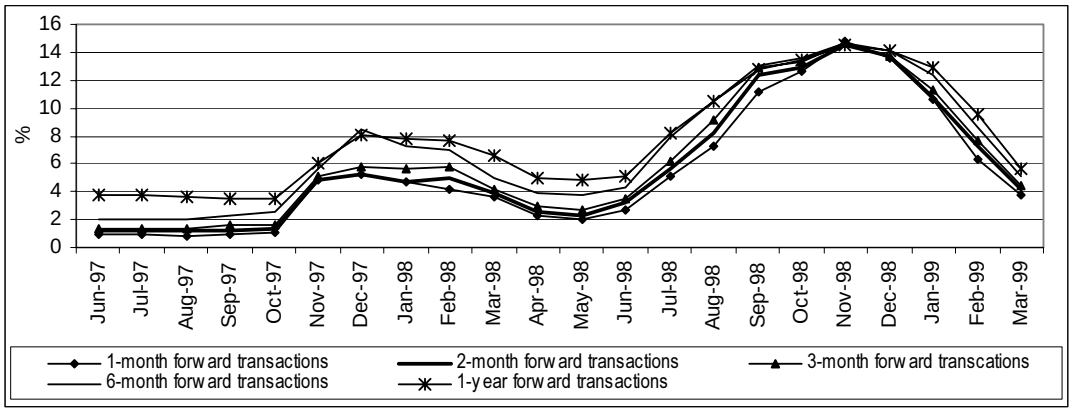


Figure 15. Interest rates of forward transactions (1-month to 1-year) in June 1997 to March 1999.

7.3. Interest Rates

In addition to the impact of the Russian crisis on forward market, the developments in Russia also influenced money and credit markets. Due to the increased instability related to the Russian crisis, the money market interest surged again in August and this increase stopped only in November. The money market interests rates peaked in November and December, but then started to decrease – between December 1998 and April 1999 the money market interest rates decreased from ~18 % to 6–7%. This strong decline was associated with the disappearance of the foreign speculative pressure and the involvement of strategic investors, which increased the capitalisation and liquidity of the banking sector.

In the credit markets the influence of the Russian crisis reinforced the already prevailing trend – the decline in credit growth (see Figure 16). In the fourth quarter of 1998, the credit to residents started to decline (this trend continued up to the third quarter of 1999). The decline in commercial banks loan portfolio in 1999 stemmed mainly from the Russian crisis. On the one hand, the Russian crisis decreased the investment demand of the corporate sector and there-by reduced the demand for loans; on the other hand, it caused the commercial banks to adopt a more conservative lending policy.

The above-mentioned increase in interest rates was the result of two processes. First of all, it reflected the increase in devaluation expectations (evidenced by strong speculative attack). Commercial banks tried to hedge this by increasing the interest rates of Estonian Kroon denominated loans. Secondly, the Russian crisis caused a decline in the money supply, which had a negative influence on the supply of bank loans. As it was mentioned earlier, the Russian crisis caused a strong slowdown of consumer incomes and corporate profits, which in turn increased at least temporarily

the demand for loans. These two developments – a decrease in the supply of loans and an increase in the demand for loans, were the second reason for a rise in interest rates. These two effects have been captured in the model without separation.

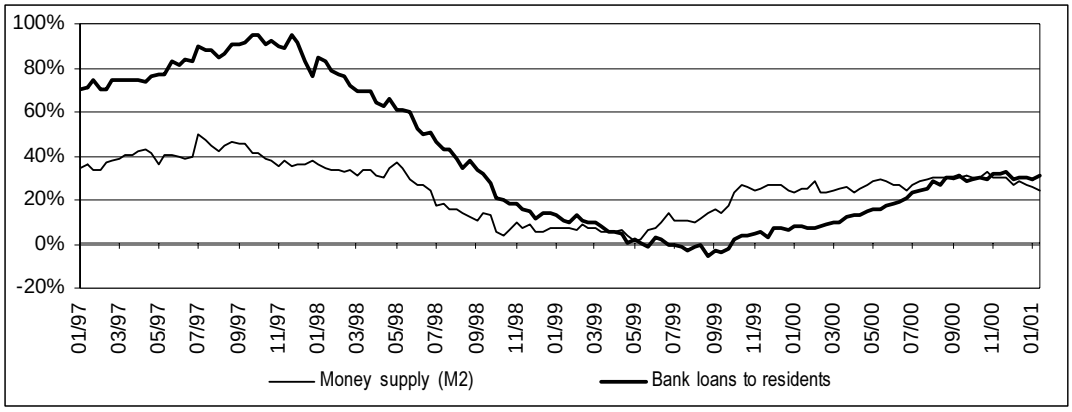


Figure 16. The growth of money supply and credit in 1997–2000

Model simulations indicate that an increase in forward points, which is caused by currency speculation, has a strong impact on Estonian short-term interest rates, its impact on long-term interest rates is modest.

The Russian crisis had also an effect on long-term interest rates (the average long-term interest rates increased from 12% in the third quarter of 1998 to 14% in the fourth quarter of 1998.

Figure 17 shows the effect of an increase in forward points that is equal to an increase in forward points in the third quarter of 1998 – during that period the interest rates of forward transactions increased ca 6 percentage points. As a result of this, shock short-term interest rates increase approximately by three percentage points. At the same time the influence of a temporary increase in forward points is short-lived.

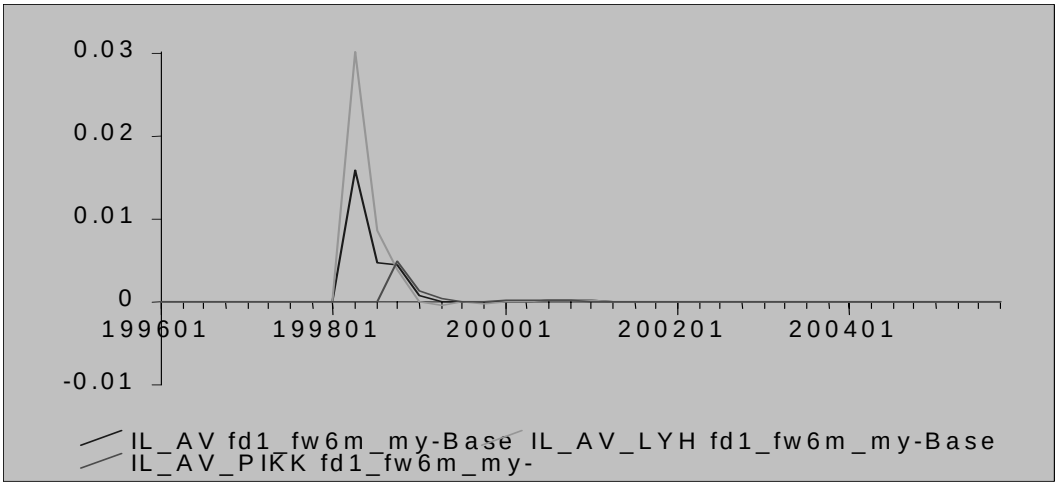


Figure 17. Effects of a speculative attack (increase in forward points) on interest rates (IL_AV is average lending rate, IL_AV_LY is short lending rate, IL_AV_PIKK is long lending rate).

7.4. Consequences of Crises

In addition to the effect of currency speculation on interest rates, it also has an impact on the price level and real variables (GDP, exports). Model simulations (see Figure 18 and 19) reveal that an increase in forward points has a relatively strong impact on Estonian GDP growth. Figure 18 shows that a temporary increase in forward points (equal to the increase in forward points in the third quarter of 1998) causes approximately 0,6% decline of GDP growth from baseline. On the other hand, the negative impact of this exogenous shock is temporary (one quarter) and GDP growth converges to its long-run path. The impact of an increase in forward points has a small impact on exports and price level.

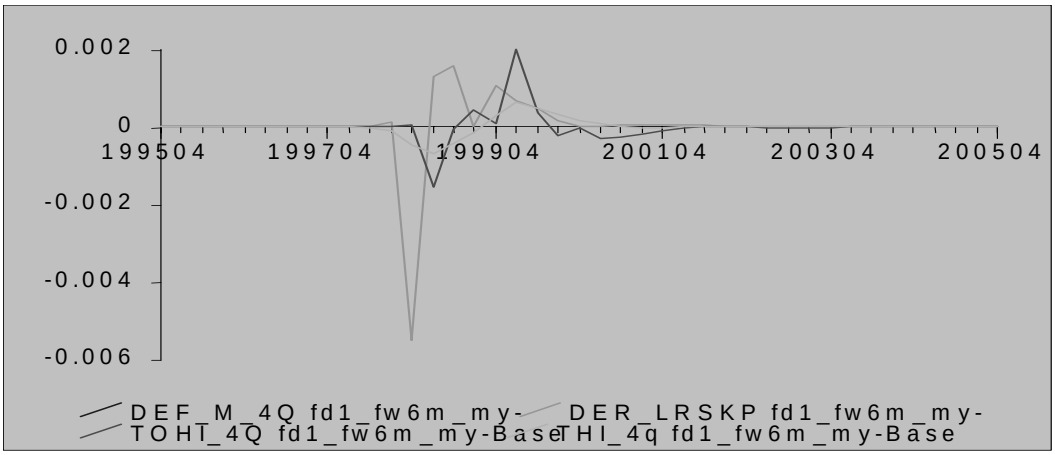


Figure 18. Effects of a speculative attack (increase in forward points) on exports, GDP and CPI (in percentage points from the baseline; RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI)

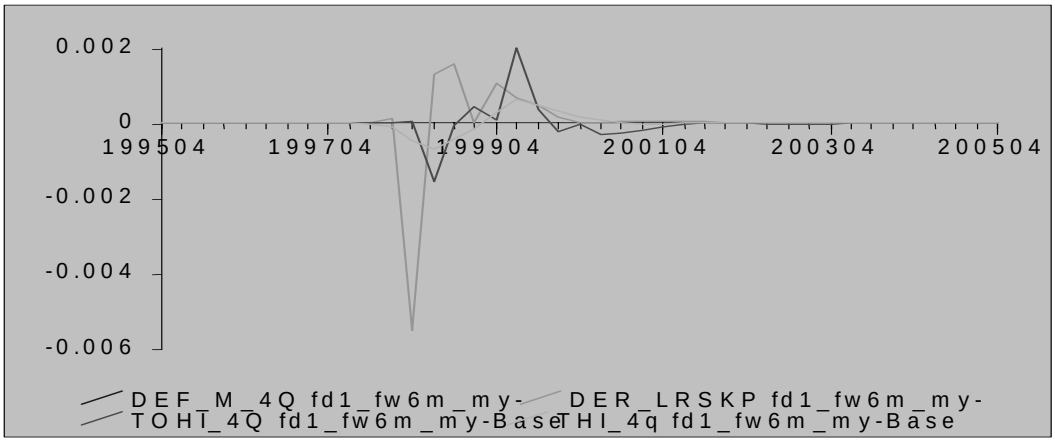


Figure 19. Effects of a speculative attack (increase in forward points) on import prices, GDP gap, CPI and PPI (as absolute deviation from the baseline, DEF_M_4Q is annualized import deflator, DER_LRSKP is output gap, TOHI_4Q is annualized PPI, THI_4Q is annualized CPI)

In addition to the influence of Asian and Russian crises on monetary aggregates and credit and money markets, they also quickened the pace of consolidation in the financial system. As under the CBA, the burden of adjustment remains with banks, two years of turbulence resulted in the second wave of consolidation of the banking system. The number of banks fell from 12 in 1997 to six in 1999. This dramatic fall did not involve remarkable loss for depositors or serious deterioration in asset quality. There were three mergers resulting in highly oligopolistic banking market – two leading banking groups possess more than 80% of total assets of the banking system. Third merger was more of a rescue operation, resulting in central bank ownership of the third largest bank (which was later sold to a foreign strategic investor). It is clear, that turbulence in international markets forced consolidation of the banking sector; also in end-1998, Scandinavian banks entered as strategic owners of the two largest banking groups. Due to the involvement of strategic investors and rapid consolidation, banking sector became highly capitalised and liquid.

8. Fiscal Policy Stance (1997–2000)

Fiscal discipline is an essential prerequisite for the sustainability of the CBA. As was argued in the second Section of the paper, the CBA eliminates or strictly limits monetary authorities' ability to monetise fiscal deficits. But there is still a possibility that the government could run irresponsible fiscal policy. This in turn might undermine the stability of the economy and create political pressures for abandoning the CBA, thereby increasing the risk of a currency crisis. Therefore the fiscal policy should be aimed at achieving a sustainable economic growth. This is underlined by the fact that under the CBA the central bank cannot implement an effective discretionary monetary policy – the primary policy tool for macroeconomic stabilisation is fiscal policy.

Since 1995 the deteriorating current account deficit became the main concern of the fiscal policy and the government started to target fiscal deficits (see Figure 20). By setting low ceilings to fiscal deficits the government aimed at dampening domestic demand and keeping domestic economy from "overshooting". The role of fiscal policy became crucial in 1997 mid-1998. By spring 1997 current account deficits exceeded 14% of GDP and the domestic credit growth was over 70% (year-on-year). Under these circumstances the government made a decision to raise public savings as much as possible. This brought along a drastic change: in the first quarter of 1997 the general government budget was practically balanced, reaching a surplus of 5% of GDP in the third quarter and more than 2% of GDP in the fourth quarter. The overall annual surplus of over 2% of GDP was generated in the second half of the year. During the period of surplus-generating fiscal policy the Stabilisation Reserve Fund was established. Investing the funds of the Stabilisation Reserve Fund abroad served the aim of reducing domestic demand and sustaining foreign investor confidence in economic policy.

The tight fiscal policy continued in the first half of 1998, helping not only to stop deterioration but also decrease current account deficit. With large capital inflows, restrictive fiscal policy helped to maintain foreign investor confidence, avoided the overheating of economy, as well as the balance of payment crisis and reduced volatility of capital flows.

Economic decline in the second half of 1998 and first half of 1999 had a negative impact on fiscal revenues: the general government accounts swung from a surplus of 2.2% of GDP at the end of June 1998 to a deficit of 0.2% of GDP for 1998. The 1999 draft budget was elaborated before the full extent of the slowdown and was based on too optimistic growth expectations. In addition, the draft was worked out and passed at the Parliament in a pre-election period. As a result**,** deficit increased even further in 1999, reaching over 6% of GDP in the first half of the year. The deficit was financed from the reserve built up during the years of fiscal surpluses.

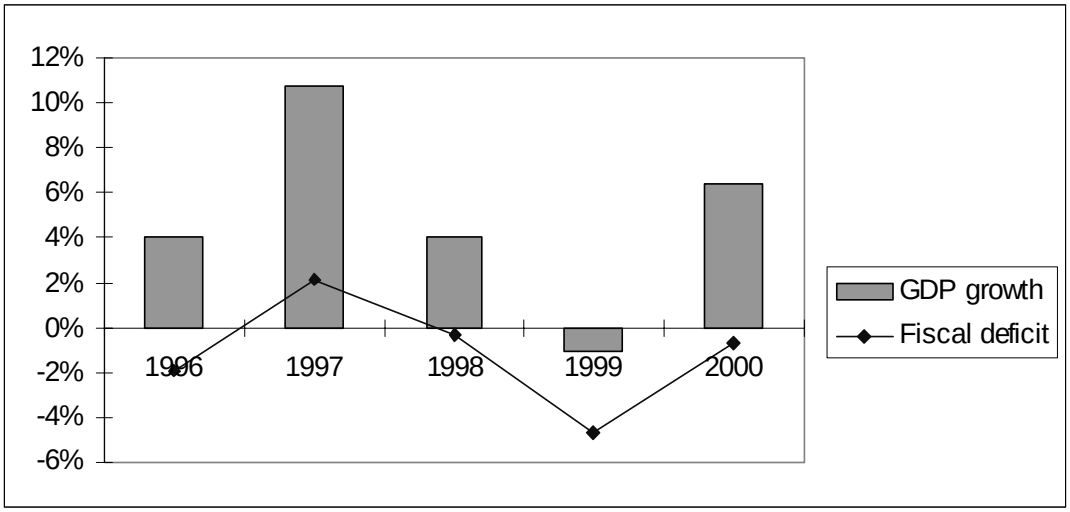


Figure 20. The dynamics of economic growth and fiscal deficits in 1996–2000

After the elections, the new government prepared a supplementary budget, which cut expenditures by about 1.2% of GDP and was adopted by the Parliament in June 1999. As a result the public sector deficit decreased somewhat in the second half of 1999, for the year as a whole the deficit was equal to 4,7% of GDP. In 2000 the authorities aimed to curb the deficit and succeeded to lower it to 0,7% of GDP.

Therefore it could be said that during the last four years fiscal policy has been used for stabilisation purposes – in 1997 and 1998 fiscal policy measures were implemented to avoid overheating of the economy. Taking into account that fiscal policy is the main policy tool for macroeconomic stabilisation, the fiscal policy this far has supported the sustainability of the CBA. At the same time authorities have managed to keep public sector deficits manageable and have swiftly reacted to avoid large fiscal deficits.

9. Flexibility of the Real Sector of Estonian Economy

Given the strict rule-based monetary framework, the real sector flexibility (especially labour market flexibility) is an important prerequisite for smooth adjustment to both external and internal shocks. As Estonia has set few restrictions and regulations to the labour market, this has created possibilities to develop a flexible wage and employment system.

Vesilind and Rell (2000) used the period 1996 – 1999 first half to estimate the flexibility of the wage setting in the economy. They found that wages were quite flexible in the tradable sector of the economy – the changes in the productivity had a strong impact on wages (see Figure 21). In the sheltered sector of the economy the relationship between productivity and wages was less evident. In public sector, however, the changes in the economic activity had a negligible effect on the wages of public sector employees (see Figure 22).

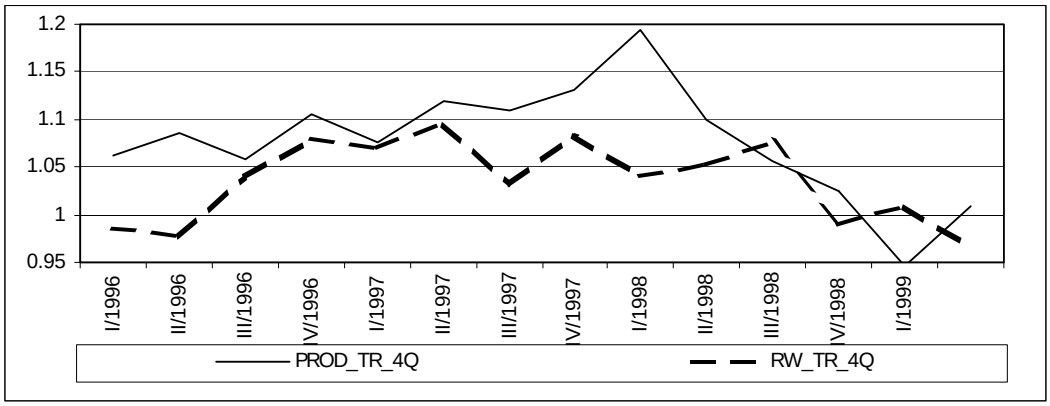


Figure 21. The real wage and productivity growth in tradeable sector in 1996–99

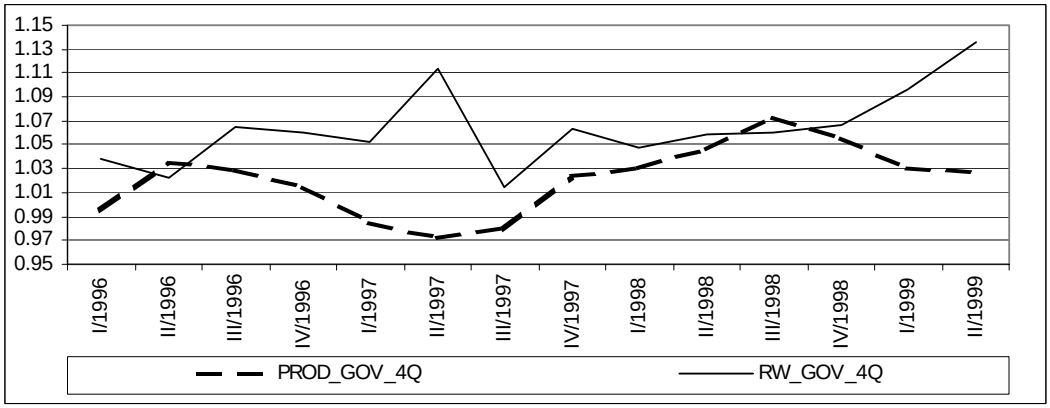


Figure 22. The real wage and productivity growth in public sector in 1996–99

In addition to analysing directly the flexibility of the labour and goods markets, the flexibility of Estonian economy can be assessed indirectly by looking at the deviations of the actual real effective exchange rate (REER) from the equilibrium level. By this way one can gain insight into the flexibility of the economy by looking whether the actual REER has deviated from the equilibrium level and how quickly the actual REER has returned to its equilibrium path. It could be said that the smaller the deviations are and the quicker the return of the actual REER to its equilibrium level is the higher the flexibility of the economy.

From 1992 the real effective exchange rate of the Estonian kroon has continued an appreciating trend. In particular in 1997 it showed a 5% appreciation, a 17% appreciation in 1998 (mainly due to the Russian crisis) and a 4% depreciation in both 1999 and 2000 (due to low CPI growth and the weakening of the euro) (see Figure 23). As the Estonian Kroon was clearly undervalued in the first years after the

monetary reform part of the appreciation is therefore just a normal path towards equilibrium, driven by the existing price differential with western partners. Calculations done in Eesti Pank (Filipozzi (2000)) suggest that in addition to the appreciation of the real effective exchange rate its equilibrium level appreciated as well (see Figure 24).[22] But the appreciation of the equilibrium REER has been slower than that of actual REER. For example, in 1993 the misalignment (the difference between actual and equilibrium REER) decreased from about 25% in 1993 to 7–8% right before the Russian crisis.

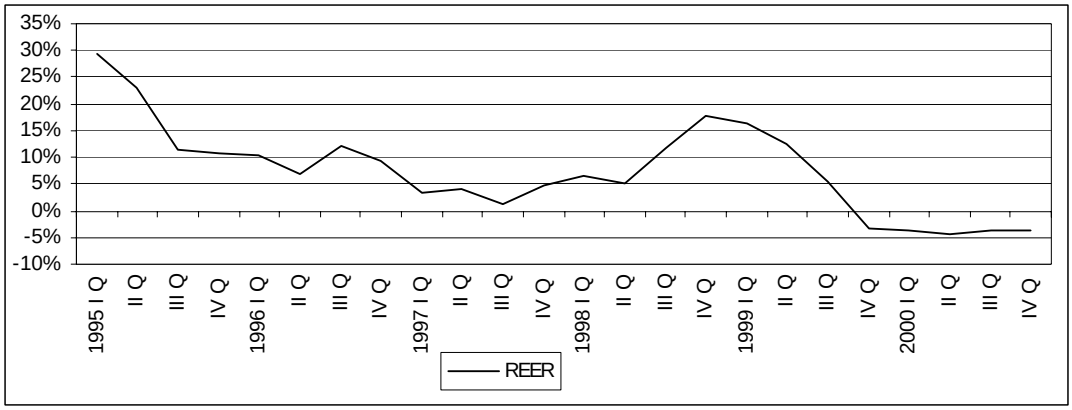


Figure 23. The dynamics of REER in 1995–2000

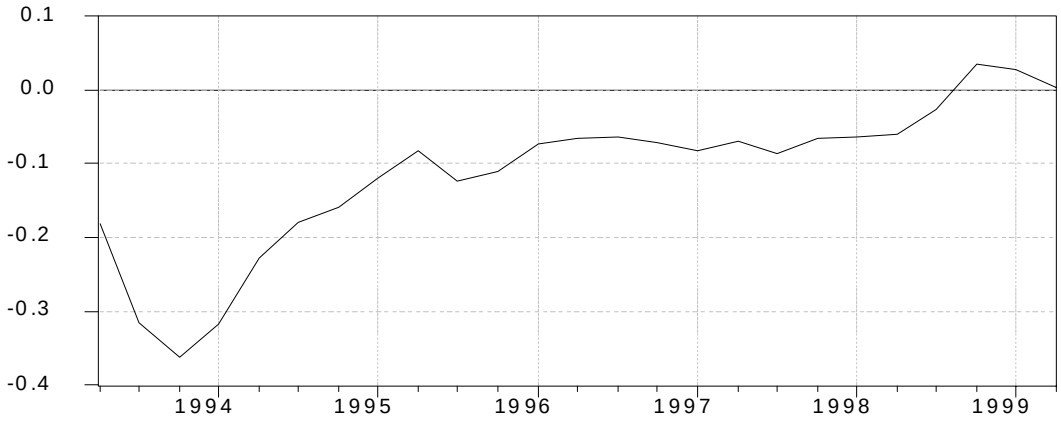


Figure 24. The difference between REER and equilibrium REER

The Russian crisis brought about a sudden jump in REER – therefore the actual REER exceeded the equilibrium REER by approximately 5%. But today the actual REER has fallen slightly below the equilibrium REER.

From this we can conclude that in the period 1997–2000 the REER of EEK was not overvalued. This conclusion can be affected by different hypotheses on the equilibrium or sustainable value of fundamentals that influence the equilibrium REER but the main message of our estimation remains unchanged. The appreciation of real exchange rate goes together with an appreciation of its equilibrium value, and this did not damage seriously the external competitiveness of Estonian economy and cause a

[22] In this estimation the equilibrium REER depended on the following variables: productivity differential between tradable and non-tradable sectors, investment share, resource balance and nominal effective exchange rate.

significant widening of current account deficit. The fact that during the last four years the equilibrium real exchange rate and actual exchange rate have not differed significantly for a longer period indirectly demonstrates the flexibility of the economy, which in turn increases the sustainability of the CBA.

The argument that the actual REER has not exceeded the equilibrium exchange rate level or put differently the actual REER has not been overvalued is also evidenced by the trends in Estonian foreign trade. In 1998–2000 the annual growth in exports has every year exceeded the growth rate in imports – during that period the average annual growth rate of exports was 23%, the corresponding figure for imports was 15% (see Figure 25). Therefore it could be argued that these foreign trade developments indicate that the continual real appreciation of the REER has not negatively affected Estonian competitiveness.

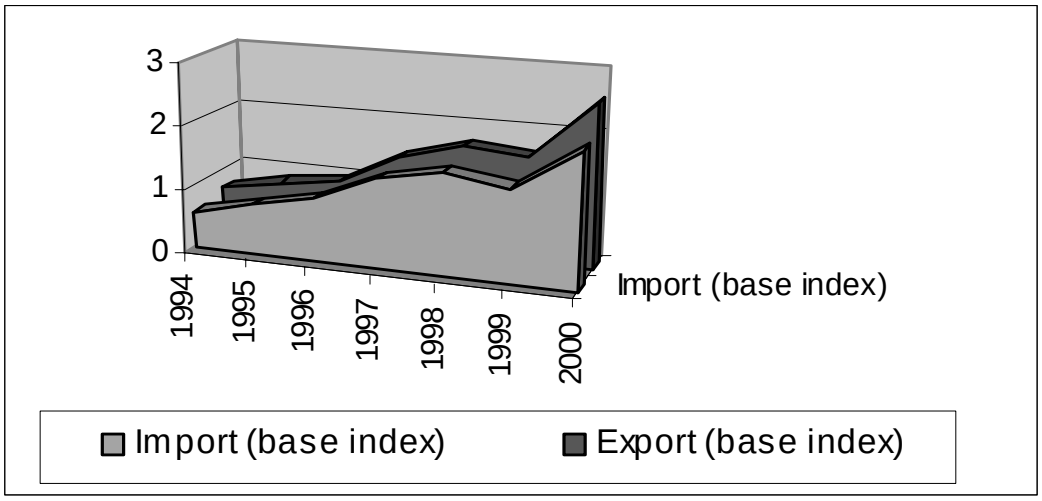


Figure 25. The export and import growth in 1994–2000

As it was said, the Russian crisis (in the third quarter of 1998) caused the actual REER to appreciate significantly and exceed the equilibrium level. According to the calculations by Filipozzi (2000), the actual REER returned to its equilibrium level already in the second quarter of 1999. In addition to the flexibility in the labour market, this was supported by the rapid reorientation of Estonian trade from CIS markets to Western – Europe. In 1997 the share of Estonian goods exports to Russia amounted to 14%, two years later (in 1999) it had decreased to only 5%. During the same period the share of exports to EU increased from 58% in 1997 to 70% in 1999. In addition to the increase of the share of Estonian exports to Western Europe, its growth was also strong (27% in 1998 and 6% in 1999). Together with the rapid reorientation of Estonian trade, there were also significant changes in the structure of the manufacturing and commodity structure of the exports. As a result of the Russian crisis the importance of food–processing industry declined considerably; at the same time against the background of overall decline there was fast growth in manufacture of machinery and equipment. These trends brought along also changes in the structure of foreign trade – the share of foodstuff in exports decreased from 16% in the first half of 1998 to 6% in the first half of 2000; the share of machinery and equipment increased during this period from 19% to 33%. This rapid reorientation of trade and

changes in the structure of the economy therefore points to the flexibility of the economy.

10. Compatibility of the Estonian CBA with the EMU and ERM 2

The process of acquiring the full participation in the EMU can be divided into three distinct stages:

- Estonia's economic and monetary policy preparations to accede to the European Union (from an applicant country to full EU membership)
- Estonia as a European Union Member State: period from the accession to the European Union to joining the euro area;
- Estonia joins the euro area: Estonia will participate in the formulation and implementation of the EU monetary policy (ie the central bank will implement ECB monetary policy guidelines and manage the circulation of the cash and account money in euro)

Estonia's official position is the maintenance of Estonia's currency board and fixed exchange rate peg until the full participation in the EMU, *inter alia*, during Estonia's participation in the exchange rate mechanism (ERM 2, the standard fluctuation band 0%).

The main reasons for maintaining CBA arrangement can be divided into two groups. First, Estonian economy has prerequisites for a successful CBA: quite flexible labour and goods markets, resilient financial sector and sustainable fiscal policy. Secondly, the Bank of Estonia wishes to avoid possible economic costs (increased uncertainty that might lower investments, reduced policy transparency and discipline and high exchange rate fluctuations) associated with a move from a CBA to a more flexible exchange rate arrangement.

Currently also the official position of the ECB and (un)official position of the IMF are similar to that of Eesti Pank – both the ECB and IMF have acknowledged that there are no fundamental reasons against maintaining CBA until the full participation in the EMU.

According to the official position of the ECB (2000) euro-based currency board arrangements cannot be regarded as acceptable substitutes for participation in ERM 2, but may in some circumstances constitute an appropriate unilateral commitment undertaking enhancing the commitment to exchange rate stability deriving from participation in ERM 2. It should be emphasised that their unilateral character implies that they would not impose additional obligations on the ECB, besides those deriving from the ERM 2 resolution.

ECB has noted that there do not seem to be fundamental reasons that would suggest that CBAs might be counterproductive in the run-up to accession, provided some preconditions are met. Notably among these are: sufficient international reserves to back up the CBA, a strong commitment to fiscal discipline, a sound financial system with proper regulation and supervision, and goods and labour markets with flexible prices and wages. While the nominal exchange rate is fixed, other prices adjust to

keep the real exchange rate at an appropriate level. CBAs have also reinforced candidate countries prudent attitude towards fiscal policy by forbidding the central bank to monetise fiscal deficits.

ECB has argued that CBAs are a proper policy choice for countries where a fixed exchange rate system is deemed appropriate, such as small, open economies with flexible input and output markets. The choice of an anchor is most important, as the anchor currency must not only enjoy the confidence of markets, but also be the currency of an entity which the CBA economy has close economic and trade relations.

At the same time ECB has acknowledged that during the transition and catching-up period, there are factors tending to produce an appreciation of the real exchange rate. Among these are price liberalisation, the Balassa-Samuelson effect, and implementation of community *acquis* having an impact on prices and price convergence to the EU. Under currency boards, there is no trade-off between prices and exchange rates, hence a nominal appreciation could not counter these factors, and there will be some resulting inflation, higher than EU-average. The ECB has concluded that this real appreciation should not necessarily have a negative impact on competitiveness because there are still economy-wide productivity gains to be achieved in transition economies, and there is a large scope for improvement in non-price competitiveness.

In addition to ECB the IMF (Keller (2000), Gulde, Kähkonen, Keller (2000)) has also endorsed the view that the CBA is compatible with the EMU an ERM 2 mechanism. Still, one has to keep in mind that this is not an official position of the IMF.

Keller(2000) has found that ECB decision that an euro-pegged CBA will be permitted under ERM 2 on a case-by-case basis provided that agreement is reached on the central rate vis-à-vis the euro is a most welcome decision as there does not appear to exist a solid economic argument against maintaining a well functioning CBA under ERM 2. However, Balassa-Samuelson effects or other reasons for equilibrium real exchange rate appreciation may make it difficult for a country with a CBA to meet inflation convergence criteria as defined above. Rough calculations suggest that the Balassa-Samuelson effect is perhaps equivalent to slightly more than the 1.5 percentage point inflation margin allowed under the Maastricht criteria. However, this would probably be less of a problem for countries using the wide band of ERM 2 as they could in principle allow their nominal exchange rates to appreciate. In the past (and most recently in the case of Greece) the EU has also deemed revaluations of central rates within the ERM to be consistent with the convergence process. And as also recently demonstrated, strategic tax cuts can help meet the Maastricht inflation target. There remains also the question whether it would not be appropriate to redefine the Maastricht criteria, so as to take into account, *inter alia*, the trend of real appreciation in the CEEC transition countries. It is clear that their circumstances differ from those countries that became the original euro-area members.

The above-mentioned authors have argued that the success of the Estonian currency board arrangement in weathering severe crises—prompted by banking failures (1992–1993), the emerging markets crisis (1997), and the Russian crisis (1998)—has reinforced the authorities' commitment to maintain the existing arrangement through EU accession and ERM 2. This should not be problematic for Estonia. First, the CBA

enjoys considerable credibility, which should reduce convergence play. While in the most recent crises (1997 and 1998), short-term domestic interest rates rose rapidly from about 5–6 per cent to over 15 per cent, they unwound relatively quickly and are currently at historically low and close to the euro area levels. Secondly, under the discipline of the CBA, the authorities have transformed their economy: in particular, the banking system has been consolidated, supervision strengthened and labour markets are quite flexible. Thirdly, very low level of public sector debt provides room for fiscal policy flexibility.

Keller (2000) has also concluded that the economic justification for allowing CBA in ERM 2 appears strong. With unfettered capital flows the appropriateness of the exchange rate parity can be inferred indirectly by the size of interest differentials and the durability of export and GDP growth. And provided that prices and wages are sufficiently flexible, real exchange rate flexibility can still be achieved under CBA. Moreover, moving from CBA to a more flexible exchange rate regime is unlikely to provide a clear indication about the long-term equilibrium exchange rate—if we look, for example, at the exchange rates between the euro and the US dollar—and could entail significant economic costs. During an intermediate period with a more flexible exchange rate regime, the exchange rate could be expected to fluctuate significantly as market participants speculate about the rate for the eurozone entry. In addition, abandoning a well-functioning and credible currency board could lead to reduced policy transparency and discipline, lower investment as a result of greater uncertainty, and the potential for households to shy away from local currency savings. Very importantly, there may be no obvious candidate for an alternative monetary policy framework since, following an extended period with CBA, it might be difficult to identify a stable quantitative framework linking policy instruments to inflation, while the range of available central bank instruments might also be inadequate.

11. Legal and Institutional Aspects of Joining the EMU

According to the official position of Estonia, Estonia is prepared to adopt and implement the *acquis* with respect to economic and monetary union in full on accession to the European Union. Estonia does not request any transitional period to the *acquis* in this chapter.

At present Estonian legislation is not fully in compliance with the EU *acquis* of the EMU; however, the basics are in place: capital movements are largely liberalised; the central bank is independent from the Government; and Estonian fiscal policy aims at budget balance. The remaining harmonisation of the respective legislation will be achieved by 2003, ie by the time we expect to join the EU (two key acts in this field are the Basic Budget Act and the Central Bank Act). This enables Estonia to participate in the EU as a non-euro area country. Eesti Pank accepts the position of EU that the EU and the euro area cannot be joined simultaneously, while Estonia will be granted the status of a member state with derogation upon accession to the EMU.

Estonia remains committed to align its policies with the EMU *acquis* and guarantees their effective implementation in accordance with the final objective of adopting the euro.

In addition to the harmonisation of the Estonian legislation there are also some institutional aspects that deserve attention in light of the accession and joining the EMU. Namely there is a need for the reform of the monetary policy operational framework.

The ongoing reform of monetary policy operational framework is targeted to the improvement of standing facilities, which form the core of any CBA. In the medium term the joining of the euro area is expected in line with EU enlargement. This gives rise to a specific question – how should a CBA be merged into single currency area in operational terms? What different scenarios can be under consideration? By and large, there seem to be at least two alternative ways to treat this issue:

- quick operational convergence with limited use of open market operations (as a CBA itself limits the scope for OMOs);
- stepwise operational convergence, which means improvement of standing facilities and creation of conditions for full-scale operational framework with, delayed implementation until joining the EMU.

As it is internationally recognised, CBA can be regarded a suitable exchange rate arrangement for nominal and real convergence towards single currency area – ie the euro area – in case of Estonia. Therefore the second option (ie step-wise operational convergence) has been chosen for the reform of the operational framework.

The ongoing reform of Estonian monetary policy operational framework has the following goals:

The first goal is the reorganisation of the required reserves system. This means lowering the rate of required reserves with the central bank (in national currency) with simultaneous rise of required reserves in high-rated liquid foreign assets (in the anchor currency). This reminds to some extent the liquidity requirement operational in Argentina. Here it is important to note that the ratio of the required reserve with the central banks was 13% in 2000 that is significantly higher than in the euro zone (2%).

The second major goal is the start of operational convergence towards the EMU. One of the central issues here is the introduction of high-rated liquid foreign assets (in anchor currency) which will serve as collateral for intra-day liquidity facility, which is necessary for starting the RTGS. This can also mean the possibility for creating marginal lending facility, collateralised by foreign assets. In the longer-run, extending the maturity of intra-day repo facility can be the way to converge to ECB type facilities (two-week repo, etc). If the foreign assets in question are high-rated (no less than AA for example) and euro denominated, this can be the way for operational convergence towards the eurozone standards in the medium term without undermining the credibility of the CBA in the short-term.

The final goal is the maintenance of the credibility of CBA in terms of financial independence. In terms of central bank expenditures this reform will not change much. As required reserves are remunerated in Estonia, the financial outcome of the reform depends on the difference of earnings rate on central bank's foreign assets (currency board cover) and required reserves remuneration rate. This feature also

limits the possibilities of the central bank to offer market rate remuneration on required reserves, as the central bank must cover its risks as well.

12. Economic Problems related to the EMU: the Conflict between Achieving Full Nominal and Real Convergence

It is widely accepted that the income and price level of a country are positively related. As it was also briefly mentioned ECB (2000) has acknowledged this tendency and has argued that real appreciation (which under fixed exchange rate regimes reveals via inflation differential, say between Estonia and EU) should not necessarily have a negative impact on competitiveness.

Although there is consensus in theoretical literature of the positive correlation between income and price level, it is quite difficult to quantify this. According to a recent IMF (2000) study that looked at the relationship between income and price level convergence in Central European (CE) countries, a one percentage point growth differential between the EU and CE will lead to 0.4% price level increase in these accession countries. Kravis (1986) and Hansson and Helliwell (1990) have found that a 1-% increase in income level will cause a 0.6–0.9 and 0.4% increases in price level, respectively.

The European Comparison Program (1996) has produced analogous results. It shows that there is a relatively strong correlation between price and income convergence in countries with income levels below 60-70% of the Austrian level, ie in the group of countries where Estonia belongs. On the other hand, countries with income levels above 80% of Austrian income do not have considerable positive correlation. Based on that one can conclude that the relationship between price and income convergence is stronger when the income level of a country is relatively low.

Simple calculations done in Eesti Pank show that a 1% increase in income level of transition countries will lead to a 0.5–0.7% increase in the price level of these countries. Assuming that the long-run (10–20 years) economic growth rate of Estonia is 5% and that of the EU is 2%, the inflation differential between Estonia and the EU would be approximately two percentage points. Naturally the inflation rate of a transition economy is strongly influenced by other factors specific to transition economies (price liberalisation, the influence of adopting community acquis on prices) as well as the usual supply- and demand-side factors. For example, the recession Estonia endured in1999 caused the price differential between Estonia and the EU to narrow by less than one percentage points. On the other hand, the strong rebound in 2000 and 2001 with the impact of the weakening of the euro will probably result in a widening of this inflation differential (to about three percentage points in 2001).

The relationship between price and income convergence indicates that in medium-term the inflation differential between Estonia and the EU will remain probably higher than stipulated in the Maastricht Treaty. Hopefully it will be acknowledged that the inflation differential between an accession country with a fixed exchange rate regime and the EU might not show worsening competitiveness of the accession

country. But the situation is just the opposite – higher inflation in accession country might be a response to increasing competitiveness in the latter.

Conclusions

The main result of our analysis is that currency board arrangement (as a monetary rule and an exchange rate regime) is suitable for Estonia. Model simulations support this conclusion.

Based on comparative simulations of different monetary rules and exchange rate regimes one may conclude that the interest rate (due to its inefficiency) is not a suitable monetary policy instrument in a small and very open economy like Estonia. Thus, conventional inflation and output (gap) targeting rules cannot be effective and consequently floating exchange rate regimes do not have advantages to compare with CBA.

Instead of the interest rate the central bank might use the exchange rate as an instrument. But practical realisation of this might bring along serious problems regarding the confidence in the national currency and operations of the tradable sector. Therefore we think that CBA is still the best policy option. The only hypothetical problem with the CBA is whether the actual level of the exchange rate is appropriate or not. Fortunately there are no clear signs of serious misalignments in the exchange rate of Estonian kroon.

Secondly, our analysis showed that the main preconditions for a well-functioning CBA are in place, and that the actual performance of Estonian economy demonstrates the sustainability of the CBA.

First, the developments in the financial sector support the argument that Estonia has a resilient financial sector. This was especially evident from the second half of 1997 to the second half of 1999. These two years demonstrated the ability of Estonian financial system to cope with rapid changes in the environment. The financial sector performance proved to be efficient in the face of severe external shocks. It could be said that Estonian financial sector emerged stronger from this turmoil – the capitalisation and liquidity of the banks increased and the involvement of Nordic banking groups also increased the credibility of domestic banks. Therefore one can conclude that the sustainability of the Estonian financial sector has increased during last years, which upholds the argument that it is strongly supporting the sustainability of the CBA itself.

In addition to the resilience of the banking sector fiscal policy has also increased the sustainability of the CBA. During the last four years fiscal policy has been used for stabilisation purposes – in 1997 and 1998 fiscal policy measures were implemented to avoid overheating of the economy. Taking into account that fiscal policy is the main policy tool for macroeconomic stabilisation, fiscal policy has this far supported the sustainability of the CBA. At the same time authorities have managed to keep public sector deficits manageable and have swiftly reacted to avoid large fiscal deficits.

We also found that due to the fact that there are few restrictions and regulations in the labour market, Estonia has developed a relatively flexible wage and employment system. The flexibility of the price and wage formation in Estonian economy is also supported by the trends in the real exchange rate. These suggest that during the period 1997–2000 despite of severe shocks the REER of the Estonian kroon was not overvalued.

In addition we also analysed the sustainability of the CBA by the use of shock simulations (both temporary and permanent shocks). The main conclusion to be drawn is that the shocks do not cause divergence of Estonian economy from the long-run path. Or in other words, the adjustment to shocks leads to convergence with the long-run path.

As

(1) Estonian economy has the prerequisites for a successful CBA: quite flexible labour and goods markets, resilient financial sector and sustainable fiscal policy;
(2) other monetary rules and exchange rate regimes do not have explicit advantages comparing with CBA;
(3) a shift from CBA to a more flexible exchange rate arrangement has possible economic costs (increased uncertainty that might lower investments, reduced policy transparency and discipline, and high exchange rate fluctuations)

we concluded that **CBA** is the best option for exchange rate arrangement before the full participation in the third stage of the EMU.

Currently also the official position of the European Central Bank and (un)official position of the International Monetary Fund are similar to that of presented above – both the ECB and the IMF have acknowledged that there are no fundamental reasons against maintaining a CBA until the full participation in the EMU given that the macroeconomic policy is supportive of this monetary regime.

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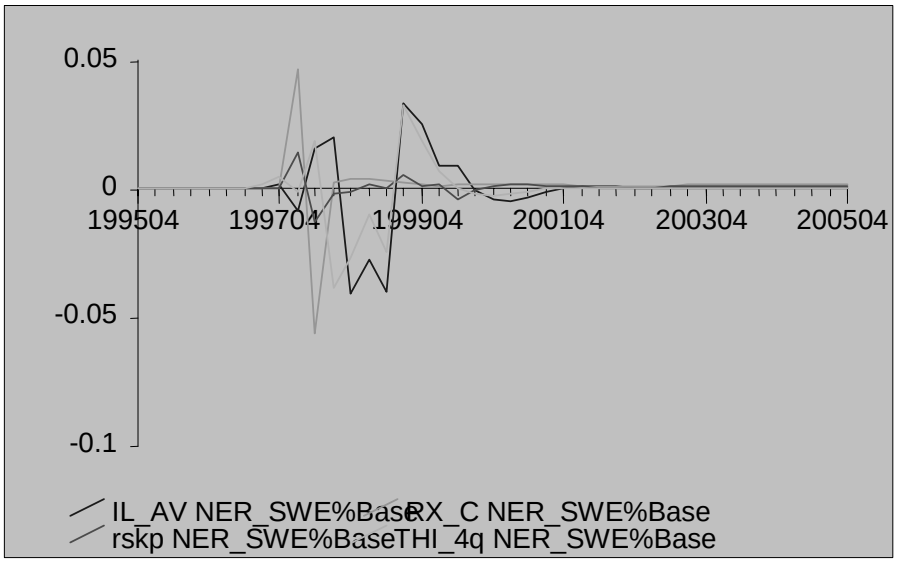
Appendixes

Appendix 1. Measures taken by Eesti Pank (EP) aimed at improving the monetary policy operational framework in changing internal and external environment

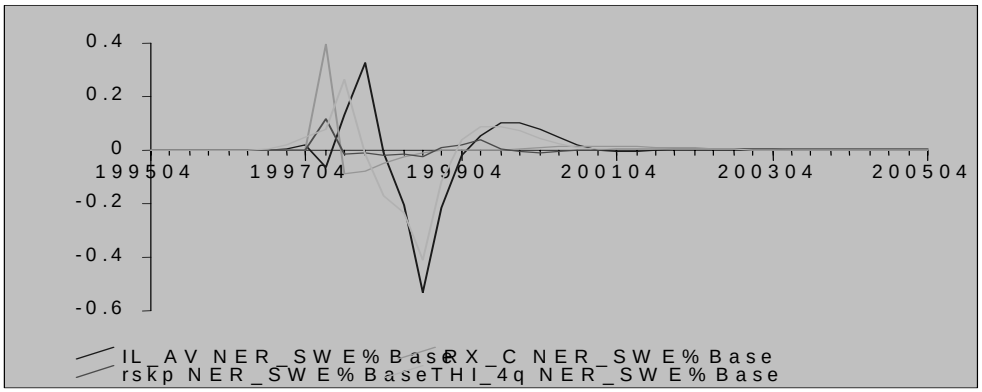
Measure	Date	Underlying causes	Impact on markets
Standing facility of buying/selling foreign currency to commercial banks ("forex window")			
Abolishing the spread in EEK/DEM (since 1.01.99. EEK/EUR and other EMU currencies) transactions between EP and domestic credit institutions	1.07. 96	• Promote the effective functioning of the forex market and facilitating short-term interest arbitrage	• Bigger banks have established an effective infrastructure for such "broader liquidity management" as well as strengthened their foreign liquidity buffers • Transactions between EP and commercial banks have simplified • Role of the domestic interbank forex market has gradually weakened • Lowered interest rate margin between the Estonian kroon and the euro due to missing capital controls • For liquidity management purposes the "forex window" could not be viewed as an alternative to required reserves in very short term (T+0)
Reserve requirement			
Introducing the monthly averaging principle in meeting the reserve requirement	1.07.96	• Provide for banks more flexible buffer for the short-term liquidity management in order to limit liquidity risks and stabilize the interbank money market interest rates	• The use of daily minimum requirement by banks decreased substantially • Assessment of the impact of introducing the averaging on the interest rate stability is complicated because of significant structural changes in the banking sector over the past three years. However, the interest rate level has been stable in normal times
Lowering of the cash deductibility in meeting the reserve requirement	1.07.96 (40%) 1.07.97 (30%) 19.06.98 (20%)	• Decrease actual cash demand • Increase liquidity buffers • Decrease of security risks of cash holdings	• In 1996–1997 banks have taken into account cash deductibility ratio in their cash holdings • In 1998 the impact of the decrease of cash component was insignificant
Adding net liabilities of credit institutions vis-à-vis foreign banks to the reserve requirement calculation base	1.07.97	• Diminish structural deviations caused by the massive foreign capital inflow • Eliminate "unjustified advantages" of credit supply based on foreign capital inflow • Limit credit expansion • Increase liquidity buffers	• Strong signal to banks about the risks of foreign liabilities based credit expansion • Banks' circumventing the requirement in various ways (over reporting cycle, over channelling capital inflow via other parts of banking group) • The size of foreign reserves of banks grew; at the same time the quality of foreign assets remained ambiguous
Increase in the penalty interest rate for non-compliance with the reserve requirement to 20%	1.11.97	• Ensure the meeting of the reserve requirement in a situation where the market interest rates tend to grow higher than penalty interest rate set by EP	• Created the "ceiling" for the money market interest rates • The penalty interest rate has been too high and rigid at normal times
Raising the daily minimum reserve requirement to 4% of the reserve base	1.11.97	• Force the banks to keep intra-day kroon liquidity reserves due to instability stemming from Asian crisis • Provide EP with some flexibility in the case of potential liquidity crisis	• Because of the relatively high (monthly averaged) reserve requirement the daily requirement did not play any important role, particularly for bigger banks
Extending the reserve requirement base: including financial guarantees into reserve base	1.08.98	• Avoid circumventing of "net liabilities against foreign banks" clause in reserve requirements over channelling the capital inflow via other parts of financial groups • For strengthening the liquidity buffers of the monetary system	• The volume of effective reserve requirement increased significantly • Rapid adjustment of banks: the amount of banks' guarantees to financial institutions and non-resident credit institutions diminished
Remuneration of required reserves	1.07.99	• Decrease distortions on financial market by reducing negative impact of the uncompensated reserve requirement • Decrease advantages of other financial market players (not subject to reserve requirement) over credit institutions	• Decrease in the structural deviations • Signalling effect: continuation of restrictive monetary policy in the conditions of expansive fiscal policy • Partial compensation for the restrictive monetary policy

		• Avoid reducing liquidity buffers, while reforming operational framework in a more market-oriented direction	
additional liquidity requirement (ALR)			
Establishing liquidity requirement	1.11.97	• Prevent banks from expanding their loan portfolios at the expense of liquidity buffers in the deteriorating financial environment • Enhance financial stability • Restrict credit expansion	• Considerable growth of banks' deposits held with EP • Most banks did not face any trouble meeting the requirement after its introduction • Strong positive signal in the middle of Asian financial crisis
Maintaining the liquidity requirement	1998	• Maintain adequate liquidity buffers and secure financial stability (precautionary measures in order to avoid the contagious effects of the Russian financial crisis)	
	1999	• Continue restrictive monetary policy in the conditions of the expansive fiscal policy • Maintain adequate liquidity buffers for potential Y2K problems	
Penalty for non-compliance with additional liquidity requirement	1.11.97	• Ensure the meeting of ALR	• Overwhelmingly correct meeting of ALR • Case by case penalty rule may cause moral hazard • Liquidity buffer at EP is in practice not operational (due to harsh penalty measures), thereby hindering smooth liquidity management
standing deposit facility			
Establishing standing deposit facility	1.07.96	Increase banks' incentives to maintain liquidity in domestic currency	• Assessment of the impact on reserve demand ambiguous • The instrument has supported smooth functioning of the liquidity management
certificates of deposits of Eesti Pank			
Central bank CD auctions	19.03.93	• Increase the efficiency of inter-bank money market • Smooth seasonal fluctuations in the cash demand cycles • The creation of an instrument based on domestic eligible security was meant to encourage domestic interbank market (via providing potential collateral)	• Does not function at turbulent times (if market rates are significantly higher than the yield offered by the central bank) • Is a divergence form the orthodox currency board as it changes money supply; hence the volumes have been kept very small and yield capped; hence its role diminished in line with deepening of financial intermediation

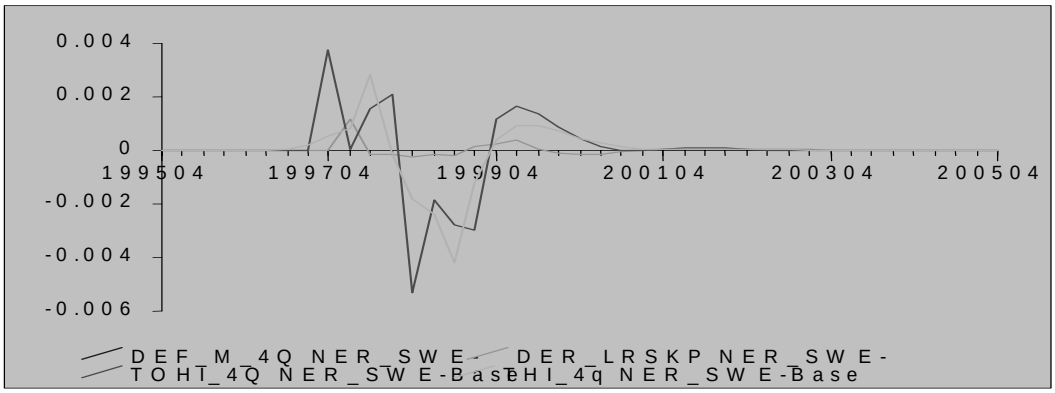
Appendix 2. Nominal appreciation of Swedish Krona



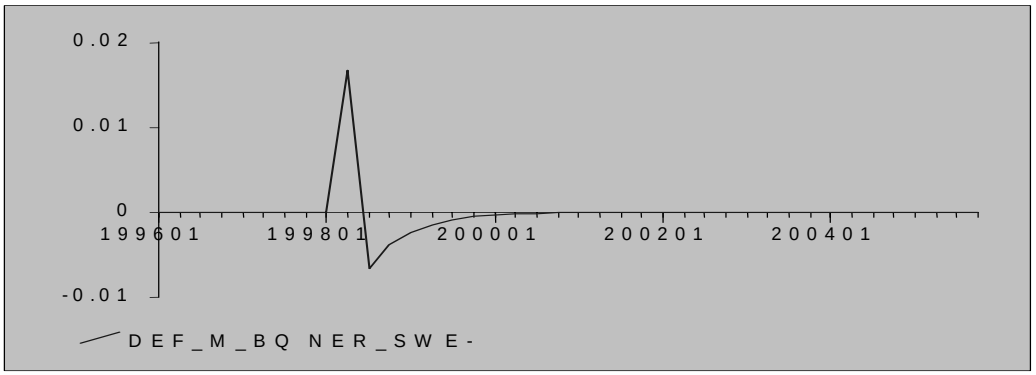
Temporary shock (+1% point in 1998–01 and -1% point in 1998–02) in percentage points from the baseline: RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI



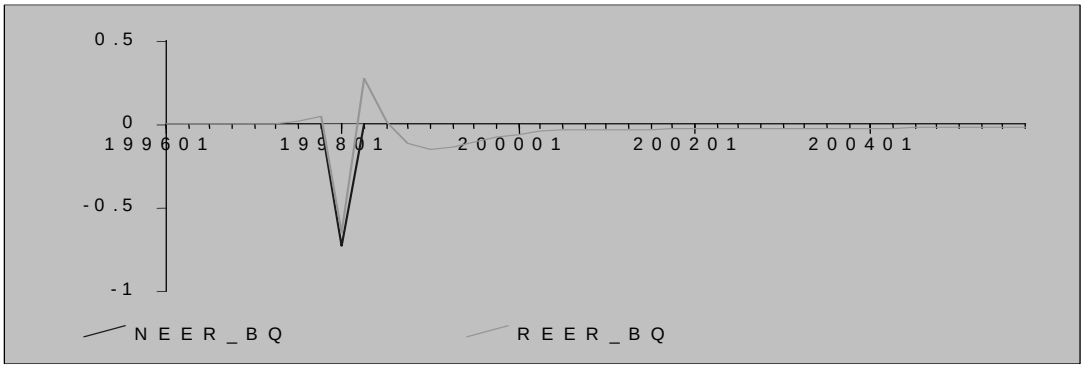
Permanent shock (+1% point in 1998–01) in percentage points from the baseline: RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI



as absolute deviation from the baseline: DEF_M_4Q is annualized import deflator, DER_LRSKP is output gap, TOHI_4Q is annualized PPI, THI_4Q is annualized CPI

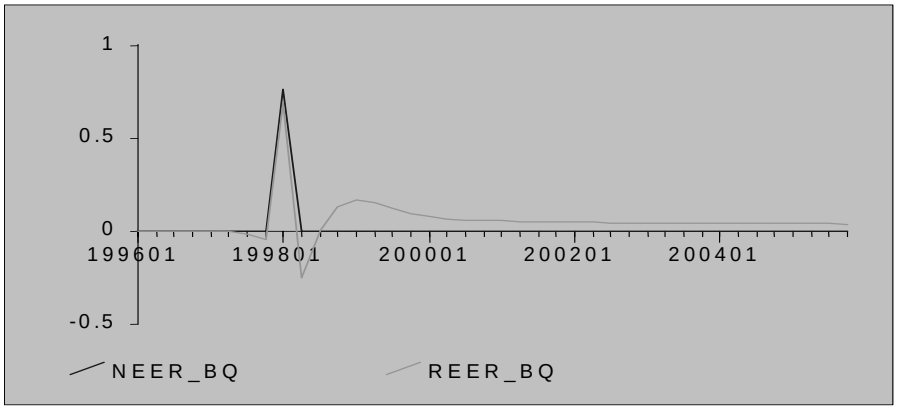


as absolute deviation from the baseline: DEF_M_4Q is annualized import deflator

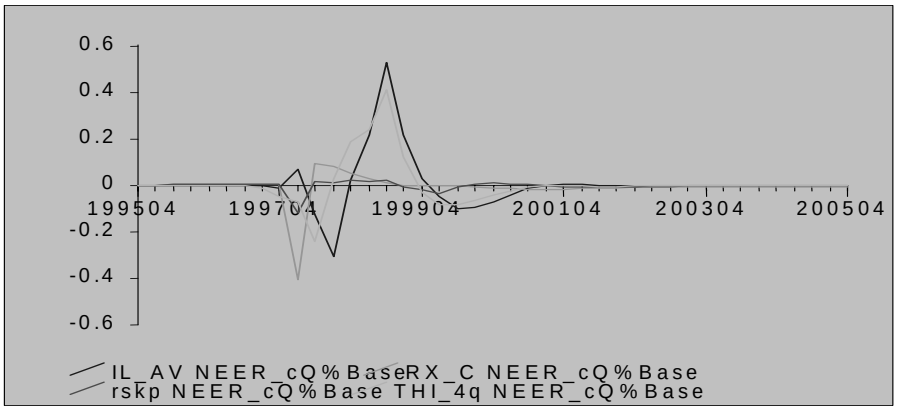


as absolute deviation from the baseline: REER_BQ is base index of real effective exchange rate of Estonian kroon, NEER _BQ is base index of nominal effective exchange rate of Estonian kroon.

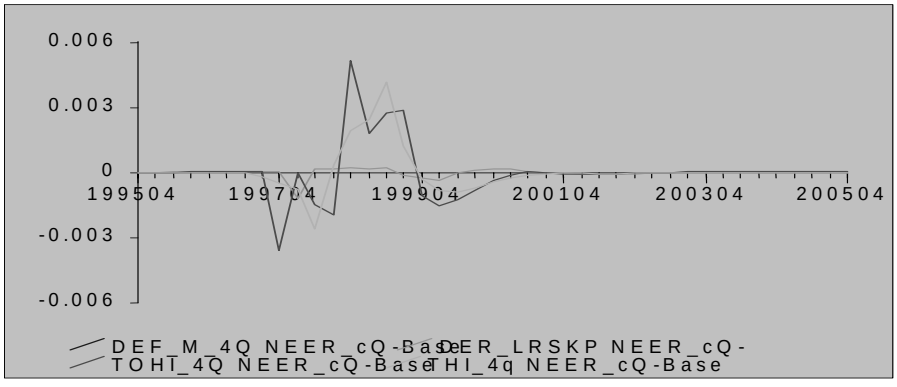
Appendix 3. Appreciation of NEER



as absolute deviation from the baseline: REER_BQ is base index of real effective exchange rate of Estonian kroon, NEER _BQ is base index of nominal effective exchange rate of Estonian kroon.



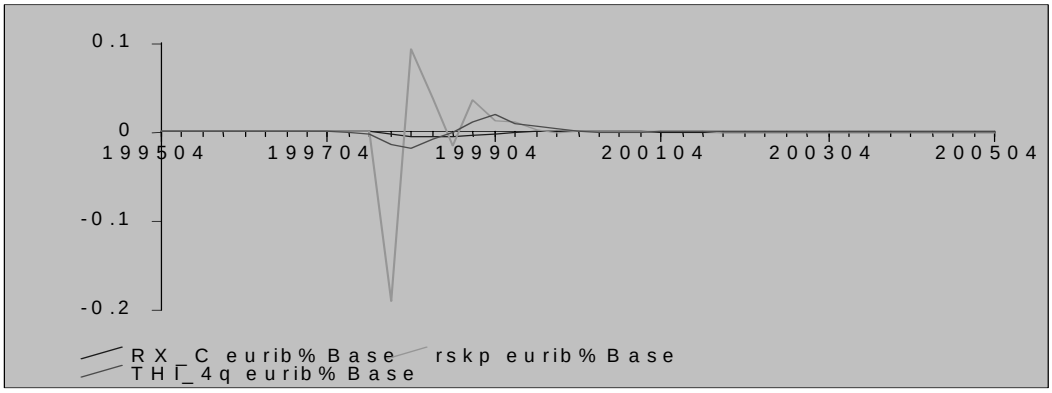
in percentage points from the baseline: RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI



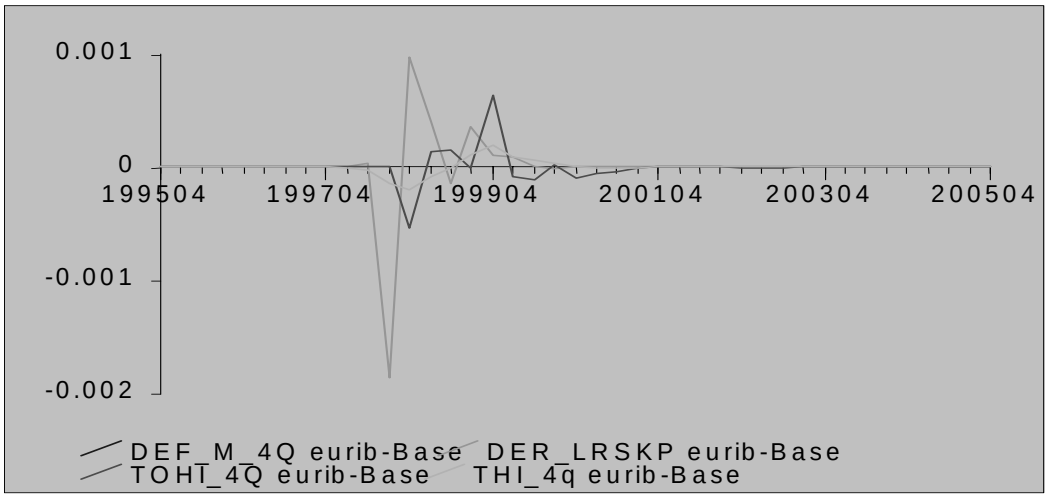
as absolute deviation from the baseline: DEF_M_4Q is annualized import deflator, DER_LRSKP is output gap, TOHI_4Q is annualized PPI, THI_4Q is annualized CPI

Appendix 4. 1%point increase of EURIBOR

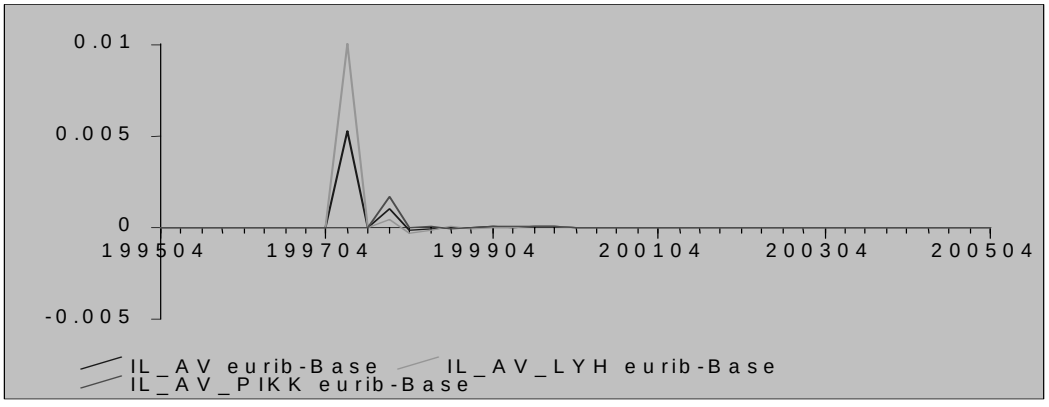
Temporary



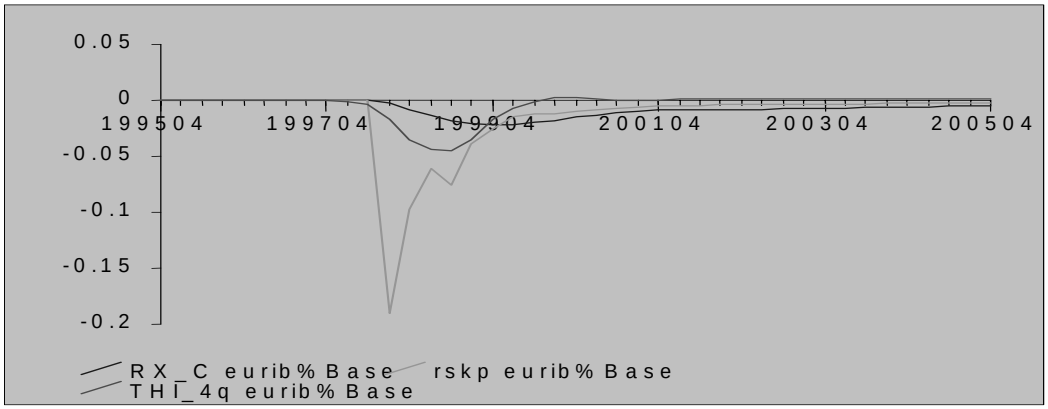
in percentage points from the baseline: RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI



as absolute deviation from the baseline: DEF_M_4Q is annualized import deflator, DER_LRSKP is output gap, TOHI_4Q is annualized PPI, THI_4Q is annualised CPI

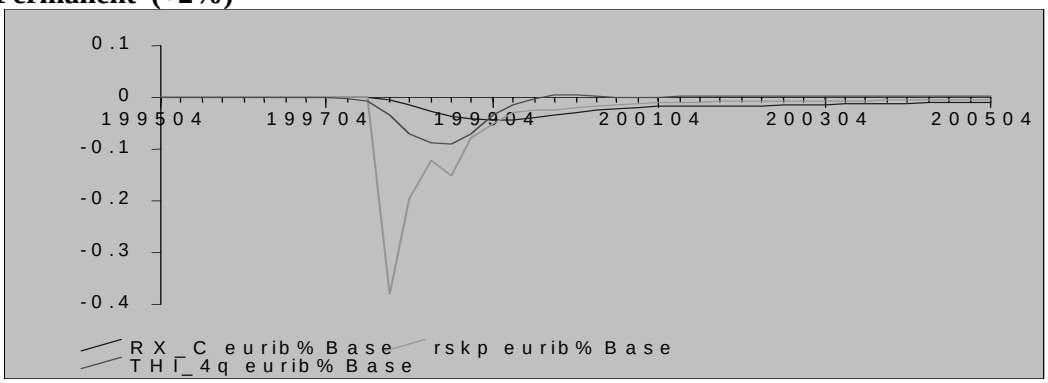


Permanent (+1%)

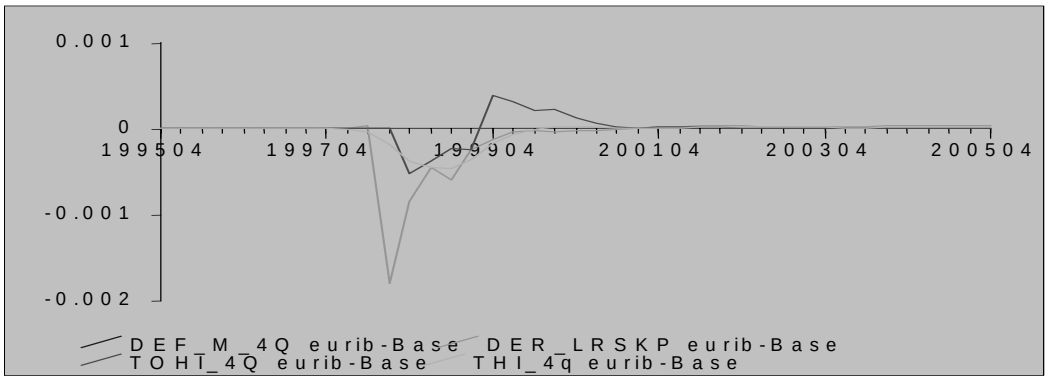


in percentage points from the baseline: RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI

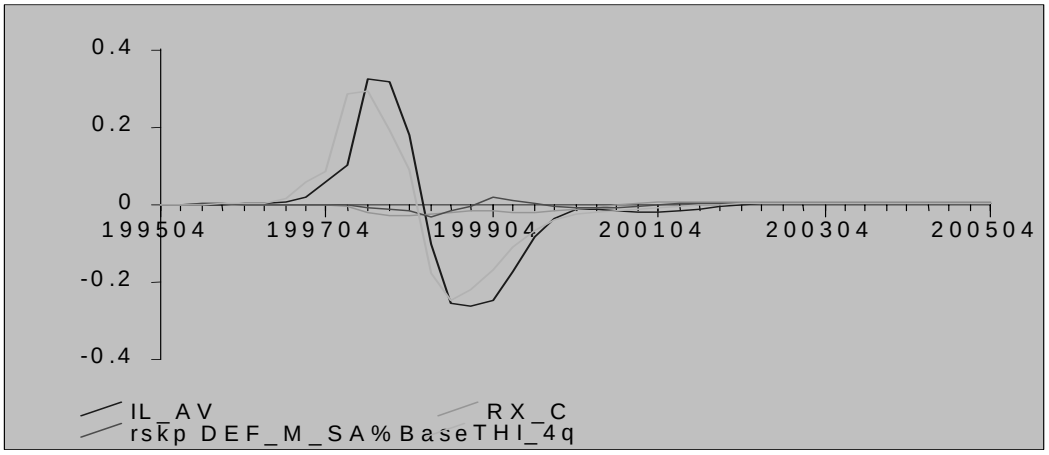
Permanent (+2%)



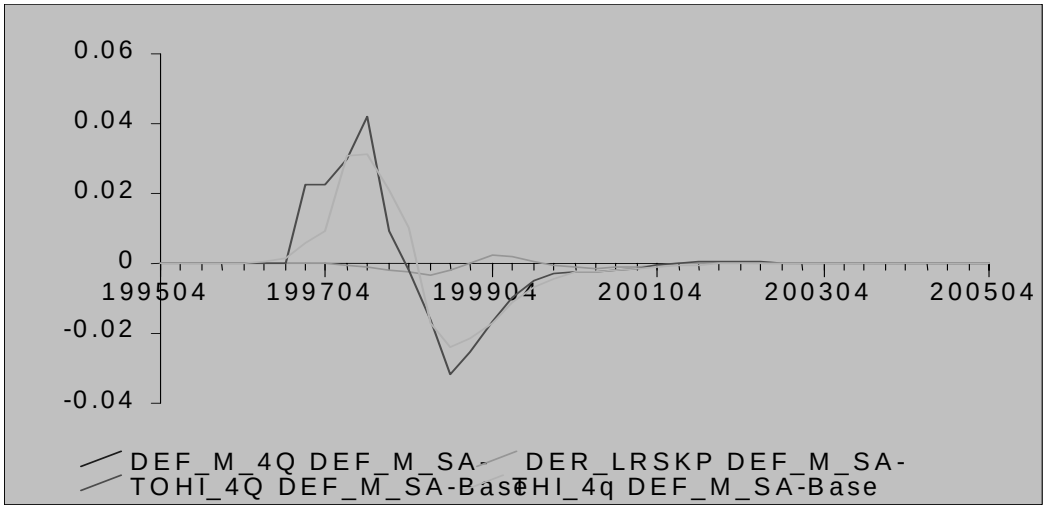
in percentage points from the baseline: RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI



Appendix 5. 1 percentage point increase of import prices



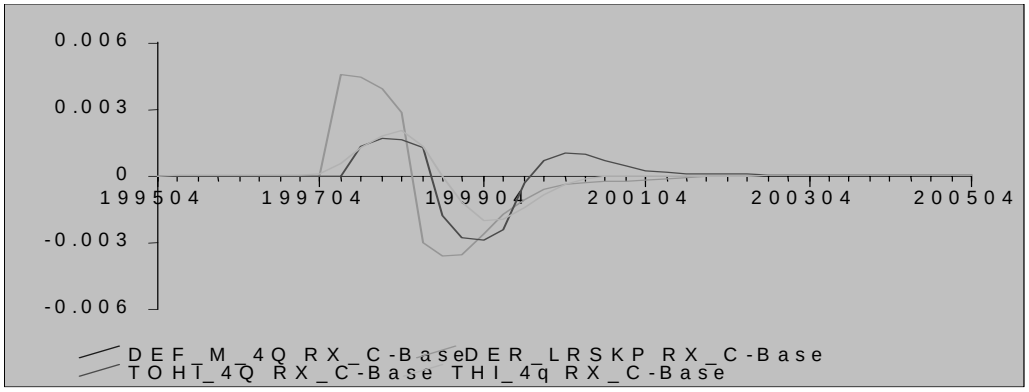
in percentage points from the baseline: RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI



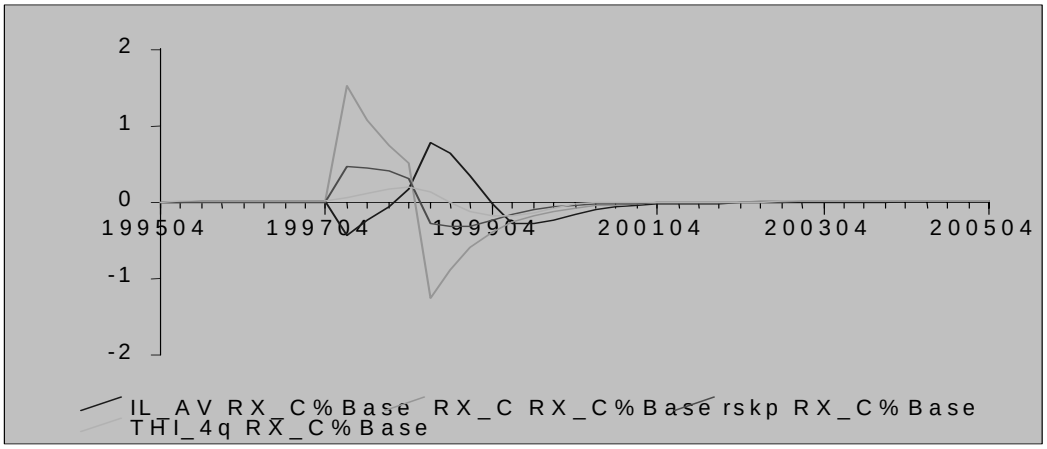
as absolute deviation from the baseline: DEF_M_4Q is annualized import deflator, DER_LRSKP is output gap, TOHI_4Q is annualized PPI, THI_4Q is annualized CPI

Appendix 6. Increase of exports (+1,5%)

Temporary

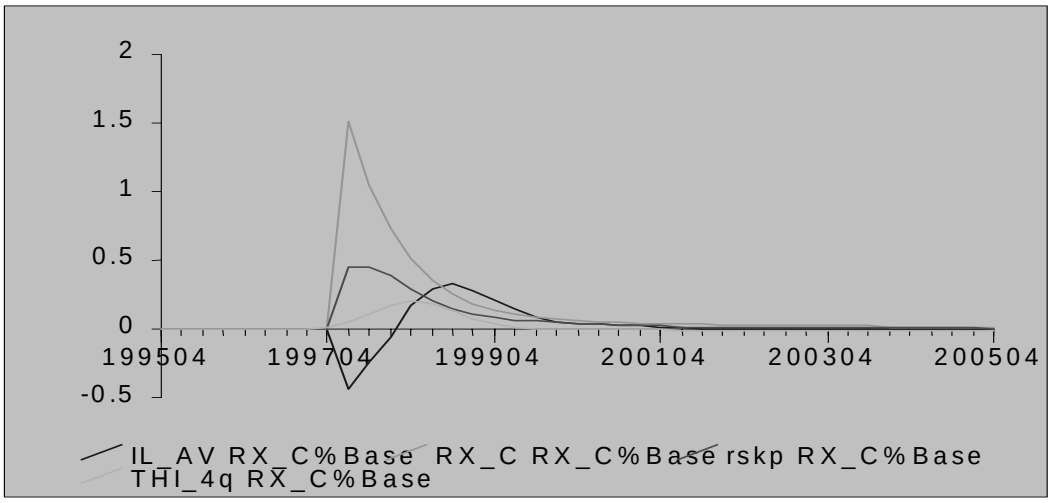


as absolute deviation from the baseline: DEF_M_4Q is annualized import deflator, DER_LRSKP is output gap, TOHI_4Q is annualized PPI, THI_4Q is annualized CPI

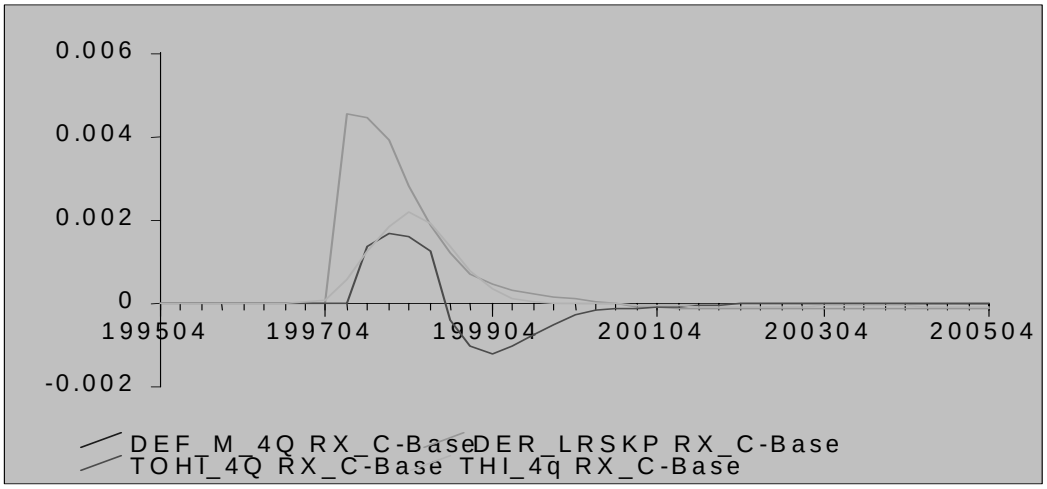


In percentage points from the baseline: RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI

Permanent



in percentage points from the baseline: RX_C is export in real terms, SKP is GDP in real terms, IL_AV_LYH is short lending rate, THI_4Q is annualized CPI



as absolute deviation from the baseline: DEF_M_4Q is annualized import deflator, DER_LRSKP is output gap, TOHI_4Q is annualized PPI, THI_4Q is annualized CPI

Appendix 7. The short-term core equations of the model

Interest rates

(1a) IL_AV_LYH = -0.7123*(IL_AV_LYH(-1) - EURIBOR_3M(-1) + 0.4540 - 1/time(199001)^.1800) - 0.2356*((LOG(RM2_US)/SA_LRM2_X*100) - (LOG(RM2_US(-1))/SA_LRM2_X(-1)*100)) + RFM + EURIBOR_3M- EURIBOR_3M(-1) + 0.0498*DM_9704+ 0.0049*FD1_FW6M_MY(-1) + IL_AV_LYH(-1);

The short-term market interest rate (see equation 1a)) depends on (1) EURIBOR, (2) hypothetical refinancing rate (see Section 5, RFM = 0 in the case of CBA) and (3) to other market factors such as money supply and devaluation expectations (the proxy for devaluation expectations are the forward points).

The long-run value of the interest rate (IL_LR = LIBOR_DEM_3M - 0.2967 + $1/TIME^{0.2693}$) is determined in accordance with the uncovered interest parity hypothesis combined with risk premium term. The risk premium is proxied using the time function – the risk declines in proportion to proceeding the stabilization, transition to the market economy and accession to EU. The devaluation expectations are presented with forward transaction points.

(1b) IL_AV_PIKK= -0.1507027707+ 0.1556437994*IL_AV_LYH(-2) + 0.2159906212*THI_BQ/THI_BQ(-4);

The long run interest rate (2a) is proxied by the short rate and inflation expectations which both are backward looking.

Monetary rule

Our monetary rule is based on the hypothetical refinancing rate, which is the sum of the EURIBOR, country's risk premium and a conventional error-correcting feedback component RFM. As the refinancing rate depends also on the level of the EURIBOR it is only partially exogenous due to the fact that Estonian commercial banks are able to attract significant amounts of foreign funds.

(1c) $RFM = \alpha*(DER\_CPI_{t-i}) + \beta2*(DER\_RGDP_{t-i}) + \gamma*(V_{t-i}-VT)$,

$i = \{0;1\}$

	Reaction parameters		
Monetary rule	α	β	γ
CBA	0	0	0
Targeting			
Inflation	0	2	0
Output gap	2	0	0
Exchange rate	0	0	0.12
Multi-targeting	2	2	0.12

Money supply

(2) RM2_US = SA_LRM2_X * exp(-.5*(LOG(RM2_US(-1)/SA_LRM2_X(-1)*100) +7.9757-1.8230*LOG(RSKPSA(-1)) - 0.0074*(TIME(199202)))+ LOG(RSKPSA)- LOG(RSKPSA(-1))- 0.0064*(FW6M_MY(-1)- FW6M_MY(-2)) + 0.0778*DM_9703 - 0.0420*DM_9601+ 0.0114 + LOG(RM2_US(-1)/SA_LRM2_X(-1)*100))/100;

Equation (2) characterizes money supply, which is determined by demand under the currency board arrangement. According to equation (2), the money demand is driven by the transaction motive. So the money supply is dependent on GDP. Money supply is also dependent on devaluation expectations (see Section 7)

Prices

(3) DER_LCPI= ω_{TR}*DER_CPI_TR + ω_{NT}* DER_CPI_NT
(3a) DER_CPI_TR = 0.2632*DER_DEF_M + 0.0677*DER_LRGDP + 0.2155*DER_PPI + 0.0098*DM_9503_9601 - 0.0056*DM_9603_9604 + 0.3971*DER_CPI_TR(-1) + 0.2268*DER_CPI_TR(1)

Equation (3) is a CPI equation, which according to Sepp-Vesilind-Kaasik (2000) is weighted average of tradable and non-tradable inflation.

According to the equation (3a) the deviation of tradable inflation from the long run (CPI_TR_LR=0.003016+67.755/TIME$^{2.4}$) depends on four main processes:
a) impact of demand, which is reflected by GDP gap;
b) external transmission of inflation through the supply-side price setting. Externally transmitted inflation is reflected by the deviation of producers' price index from the trend (DER_PPI) as the PPI depends basically on the import prices (see equation (5));
c) backward-looking adjustment process which is reflected by the two lagged components of the dependent variable;
d) forward-looking expectation formation which is a model consistent process.

(3b) DER_CPI_NT = 0.0342*(DUM_ADMIN)

The equation (3b) first of all reflects the impact of administrative price changes on the short-run non-tradable inflation. The reason for such impact is obvious. Goods with controlled prices form the major part of the non-tradable sector. The only way to bring the prices of the non-tradable into line with the change of the general price level (or with underlying non-tradable inflation CPI_NT_LR=0.003016+407.736/ TIME $^{2.7}$) is to apply administrative action.

(4) DLOG(PPI) = -0.7259*DER_PPI(-1) + 0.4824*DLOG(DEF_M) + 0.2858*DER_LRGDP(-1) + 0.3145*DLOG(DEF_M(1)) + 0.27776*DLOG(DEF_M(2))

The equation (4) shows that the dynamics of PPI is caused by
a) the demand which is reflected by the lagged GDP gap;

b) import prices, which affect producers price setting in forward-looking way;
c) very rapid error correction mechanism for restoring the long-run (which is determined by import prices LOG(PPI_LR) = LOG(DEF_M)+4.111604)

(5) LOG(DEF_M_SA)= -0.3920081917*(LOG(DEF_M_SA(-1))-0.3127*LOG(THI_EU15_BQ(-1)/sa_thieu15_x(-1)*100)+ 5.8646) -0.2099*(log(NEER_ind_BQ(-1))-log(NEER_ind_BQ(-2)))+LOG(DEF_M_SA(-1));

According to the equation (5), the dynamics of import prices is caused by
a) lagging adjustment of external inflation (which is proxied by the THI_EU15 ie the average quarterly inflation of EU15);
b) lagged effect of the change of the nominal effective exchange rate;
c) error correction mechanism for restoring the long-run (which is determined by the external inflation LOG(DEF_M_LR)= LOG(THI_EU15_BASE)+4.417392567)

(6) DEF_X_4Q=((0.0581 - 0.0581*(1/(NER_US_BQ/NER_US_BQ(-1)))
+ 0.9360* (sqrt(sqrt(tohi_bQ/tohi_bq(-4)))- (0.0030+4494.974/TIME(199002)^3.7)-1))+
(0.0030 +2477.5394/TIME(199002)^3.5)+1)^4;

According to the equation (6), the dynamics of export prices is caused by
long run path presented with 0.0030 +2477.5394/TIME(199002)^3.5);
deviations of PPI from its long run;
USD exchange rate.

Demand

(7) LOG(RSKPSA) = -0.5*RESID_LRSKP(-1) + .3*(LOG(RX_C/SA_RX_C)-LOG(RX_C(-1)/SA_RX_C(-1))) - 0.1894*(IL_AV_LYH(-2)- IL_AV_LYH(-3)) - 0.2886*(IL_AV_PIKK(-3)- IL_AV_PIKK(-4)) + log(RSKPSA(-1));

Equation (7) for the GDP includes the error-correction mechanism for the adjustment of gap. In the short run it reflects the leading role of export in economic growth. The restricting effect of interest rate on economic growth corresponds also to the intuition.

Trade

(8) LOG(RX_C)=-0.3*(LOG(RX_C(-1)/SA_RX_C(-1))
-(LOG(RGDP_EU15_SA(-1))+.8*LOG(RK(-1))-9.0064 -
0.0927*LOG(REER_BQ(-1)-1)+0.1242*DM_9702_9802(-1)))
+2.1097*DLOG(RGDP_FIN_SA(-2))+0.1098* ifeq(200001)
-0.5475*(LOG(NEER_BQ)- LOG(NEER_BQ(-1)))+ LOG(RX_C(-1)/SA_RX_C(-1))
+ LOG(SA_RX_C);

Export (excluding sub-contracting) is dependent in the long run on supply side factors (on investments and on the level of real exchange rate, although the latter has marginal effect)) as well as on demand (presented by EU15 real GDP). The short run dynamics of exports is caused by the error-correction mechanism, changes in effective nominal exchange rate and external demand (Findalnd's GDP).

(9) RM_C= exp(-0.2427*(LOG(RM_C(-1)) -0.9022*LOG(RSKP(-1)) -0.96063*LOG(REER_BQ(-1))) + 0.5180*(LOG(LAEN_J(1)/SKP(1))-LOG(LAEN_J/SKP))+ 0.8277*(LOG(RSKP)- LOG(RSKP(-1)))+log(RM_C(-1)));

Import (excluding sub-contracting) is dependent in the long run on income (real GDP) and price level (as the base index of REER). The short-run dynamics of exports is caused by the error-correction mechanism, income difference and change in relative credit level (in GDP).

D, L are operators of difference and logarithms;
DER_LCPI - deviation of CPI from its long-run path;
DER_LRGDP - GDP gap (deviation of real GDP from the trend determined with production function);
DER_CPI_TR is the deviation of the tradable inflation from its long-run path;
DER_DEF_M – deviation of import deflator from long-run path;
DM_… – dummies for elimination of the systematic component in the residuals;
DER_PPI - the deviation of the producers' price index from the long-run path;
DER_CPI_NT – the deviation of the non-tradable inflation from the long-run path;
DUM_ADMIN is the dummy variable to specify administrative price change, a key component of which is the increase in the housing tariffs and rates.
IL_AV_LYH - average short-run interest rate (less than one year)
EURIBOR_3M - 3-month EURIBOR
RM2 - real money supply (M2)
LRM2 - long-run money supply
RFM - monetary rule
FW6M_MY - forward points of 6 month forward transactions
IL_AV_PIKK - average long-term interest rate (one year and over)
THI_BQ - quarterly base index of CPI
IL_AV - average interest rate
RSKP - real GDP
L - number of employees
H - hours worked by a employee
RK - real capital stock
RX - real exports
DEF_M - import deflator
THI_EU15 - the CPI of 15 EU countries
NER_US - exchange rate of USD/EEK
TOHI - producer price index
TOHI_LR - long-run producer price index
DEF_X -export deflator
RGDP_EU15 - real GDP of 15 WU countries
REER - Kroons real effective exchange rate
RGDP_FIN - Finnish real GDP
RM - real imports
LAEN_J/SKP - the share of Estonian commercial banks loans to GDP
PPI_LR - long-run producer price index
PPI - producer price index
V - floating exchange rate
VT - fixed or pegged exchange rate