THESIS ON ECONOMICS H16

Monetary Policy Transmission Channels, Flexibility of the Economy and Future Prospects of the Estonian Monetary System

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Declaration:

Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for any academic degree.

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VÄITEKIRI MAJANDUSTEADUSES H16

Rahapoliitika ülekandekanalid, majanduse paindlikkus ja Eesti rahasüsteemi tulevikuväljavaated

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INTRODUCTION

One of the outstanding features of the Estonian economy has been the stability of its monetary system. For more than 16 years Estonian monetary system has been based on a currency board arrangement (CBA). A currency board arrangement is a fixed exchange rate arrangement governed by strict rules, including an explicit commitment to a fixed exchange rate and the requirement that domestic currency is issued only against foreign currency. Therefore, a currency board arrangement has to stand ready to exchange domestic currency for the reserve currency at a specified and fixed exchange rate, and all issued currency has to be backed by foreign currency reserves or gold. As a result the Estonian domestic currency, the Estonian kroon, has been fixed to the Deutsche Mark (from June 1992 to January 1999) and later to the euro.

The stability of the Estonian monetary system and the fixed exchange rate for such a long period is rather an exception than a rule. In most of the other Central and Eastern European (CEE) countries, there have been several significant changes in the exchange rate and monetary policies. In the beginning of the transition (in the first half of the 1990s), most of the CEE countries opted for some kind of a fixed exchange rate regime. Afterwards the larger CEE countries moved towards more flexible arrangements. Lately, as several new European Union member countries have started the preparations for joining the euro area, this trend is likely to reverse again.

In addition to the lack of significant changes in Estonia's exchange rate and monetary policies, there have been few tensions in the monetary system since the adoption of the currency board arrangement in 1992. The first noteworthy example is the period of 1997-98, when the economic and financial crises in Asia and Russia tested the resilience of the Estonian monetary system. As a result of lower confidence in emerging countries, there were several strong speculative attacks against the Estonian kroon. However, these were short-lived, and due to the currency board, there was no impact on the nominal exchange rate. They did not force the authorities and the general public to seriously consider changes to the monetary arrangement. On the contrary, these events were seen by many as a proof of the stability of the exchange rate regime.

Due to the currency board arrangement the scope for independent discretionary monetary policy is severely limited in Estonia. The Estonian central bank has the possibility to use the compulsory reserve requirement to influence the monetary base and its excess reserves for discretionary policy measures. However, due to the integration of the Estonian financial sector with the financial markets of the European Union, it has been acknowledged that using the required reserves as a frequent policy instrument would be ineffective. As the amount of excess reserves at the central bank is small compared to the domestic financial sector, the frequent use of this instrument would also be ineffective. Therefore these tools have not been used for active monetary policy. These aspects highlight an important characteristic of the Estonian monetary regime: without an independent

discretionary monetary policy all the necessary adjustments are left to the market, under the anchoring role of the nominal exchange rate.

Already since the start of the official accession negotiations with the European Union in 1997, the Estonian authorities have maintained the position that Estonia should join the euro area as soon as possible. This was the reason for Estonia to join ERM II already in June 2004 – just two months after joining the European Union. It is noteworthy that Estonia is participating in ERM II with the standard +/- 15 % band but has unilaterally taken the obligation to guarantee a zero percent fluctuation margin of the Estonian kroon and to maintain the currency board arrangement until the adoption of the euro.

These features – the stability and the resilience of the monetary regime, the absence of a discretionary monetary policy (the currency board arrangement) and the plan to adopt the euro – raise two key questions about the Estonian economy: how has the economy with its fixed exchange rate regime managed to adjust to various shocks and how will it cope with shocks under similar monetary arrangements in the future. Analysing these issues is the main aim of the thesis.

In general the success of an economy under a fixed exchange rate is determined by the confidence in and effective functioning of the monetary arrangement and its ability to deal with shocks. The ability to deal with different shocks is strongly dependent on the flexibility of the economy. Due to the absence of a discretionary monetary policy, the economy will adjust via changes in product, labour and financial markets. The importance of these adjustment channels is also highlighted by the fact that due to the high level of openness of the Estonian economy, the effectiveness of discretionary fiscal policy is constrained. The significance of flexibility will remain important in the future as Estonia will maintain the present monetary arrangement until the planned adoption of the euro.

Therefore in the thesis we will (i) review the flexibility of the economy, (ii) analyse in depth one of its most important aspects – the price flexibility, and (iii) assess the impact and relevance of the main (monetary) transmission channels in the Estonian economy. As mentioned, the success of the economy under fixed exchange rate is determined by the confidence in the monetary system and its effective functioning. For that purpose we will review the main aspects of the Estonian monetary set-up, the depth and structure of the financial sector, the relationship between the financial and real sector and evaluate the Estonian strategy to join the euro area.

The above-mentioned topics are covered in the following three published articles:

(1) "Monetary Policy in Estonia: The Transmission Mechanism" (2004), co-authored by Raoul Lättemäe and Urmas Sepp and published in *The Euro Area and the New EU Member States,* edited by Lucio Vinhas de Souza and Bas van Aarle; Palgrave MacMillan; pp. 130-163.

(2) "Comparison of Pricing Behaviour of Firms in the Euro Area and Estonia" (2009), co-authored by Aurelijus Dabušinskas and published in

Microfoundations of Economic Success: Lessons from Estonia, edited by David Mayes; Edward Elgar, pp. 19-76.

(3) "Monetary Policy and EMU Enlargement: Issues Regarding ERM II and Adoption of the Euro in Estonia" (2004), co-authored by Raoul Lättemäe and published in *Atlantic Economic Journal*. Volume 32, No. 4, pp. 293-301.

In the first paper "Monetary Policy in Estonia: The Transmission Mechanism" we will review the main aspects of the Estonian monetary set-up, the depth and structure of the financial sector, the relationship between the financial and real sector, the main transmission channels and assess the impact and relevance of those channels. For the latter we use a small-scale macroeconomic model for Estonia. The contribution of the author of the thesis in this article is the construction of the macro model and the evaluation of different (monetary) transmission channels. The original contribution of the paper lies in the fact that whereas there is a huge literature on monetary transmission in general, research on the monetary transmission under a currency board arrangement is very limited. Parts or preliminary versions of the article have been published in Lättemäe, Randveer, Sepp (2002) and Randveer, Sepp (2002) and presented at the 53rd International Atlantic Economic Conference held in March, 2002 in Paris, France and at Scientific Conference on Economic Policy held in June 2002 in Värska-Tartu, Estonia.

In the second paper "Comparison of Pricing Behaviour of Firms in the Euro Area and Estonia" we will analyze the flexibility of the price setting of the Estonian firms. Specifically we compare the flexibility of the pricing behaviour of the Estonian firms with the euro area by looking how firms review and change their prices, how quickly they adjust their prices to different shocks and what are the reasons for price stickiness. The contribution of the author of the thesis in this article is in the design of the survey questionnaire, data analysis and the review of the reasons of price stickiness. As far as we know, this is the first survey-based investigation of price-setting behaviour of a new European Union member country. Parts or preliminary versions of the article have been published in Dabušinskas, Randveer (2006) and Dabušinskas, Randveer (2008) and presented at COPE Annual Conference held in July 2006 in Beijing, China; at the 62nd International Atlantic Economic Conference held in October 2006 in Philadelphia, United States; at the 3rd International Conference "Baltic Business and Socio-Economic Development" held in June 2007 in Tallinn, Estonia; and at the 3rd Annual Conference of Estonian Economic Association held in January 2008 in Pärnu, Estonia.

In the third paper "Monetary Policy and EMU Enlargement: Issues Regarding ERM II and Adoption of the Euro in Estonia" the main aim is to analyse Estonia's entry to ERM II and the adoption of the euro. For that purpose the article describes the official position of the Estonian authorities regarding entry into ERM II and the adoption of the euro, explains the rationale for the early entry into ERM II, and

presents the reasons for maintaining the currency board arrangement until full membership in the European Economic and Monetary Union (EMU). In addition we discuss one of the challenges of the adoption of the euro – a possible overvaluation of the Estonian kroon. The contribution of the author of the thesis in this article is the review of the flexibility of the Estonian economy and the discussion of the possible misalignment of the nominal exchange rate of Estonian kroon. Parts or preliminary versions of the article have been presented at the 57th International Atlantic Economic Conference, held in March 2004 in Lisbon, Portugal, and at ISSEI Conference held in August 2004 in Pamplona, Spain.

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1. MONETARY POLICY TRANSMISSION IN ESTONIA

One of the key issues in assessing the ability of the economy to cope with various shocks is the analysis of the monetary transmission mechanism (MTM). This will help to determine how the changes in the monetary conditions (interest rates, exchange rate and credit) affect the economy. In addition of gaining knowledge about the impact of these shocks, this will show the functioning of the main transmission channels.

This mechanism is influenced by several factors – the set-up and consistency of macroeconomic policy, including the choice of monetary regime and the structure of economy – especially the financial sector –, and the intra-sector linkages. The effectiveness of different transmission channels is highly dependent on the evolution of financial systems and market structures and its evaluation is a challenging task even in advanced economies.

In Estonia, the monetary system is founded on a euro-based currency board arrangement. The features of the currency board arrangement are an important aspect of the monetary transmission mechanism in Estonia. There is no active monetary policy. Price stability in Estonia is linked to the anchoring role of the exchange rate, and all the necessary adjustments are left to the market.

Under a fixed exchange rate and free capital mobility, Estonian monetary conditions are therefore closely linked to the monetary policy in the EU: in addition to the changes in Estonian risk premium, the interest and exchange rate

developments in Europe – and therefore also the monetary policy actions of the European Central Bank – directly influence the Estonian monetary environment. The continuously increasing integration of the Estonian financial sector with foreign markets during the last ten years, as well as the particular set-up of the Estonian monetary framework, has strengthened those links substantially. In fact, foreign money markets are more important for liquidity management in Estonia than domestic money markets. As a result, the transmission from EU interest rates into Estonian money market and retail rates is strong.

The effects of those monetary signals to Estonian enterprises and households are analysed using a small-scale macro model. The model is a typical small-scale macro model with the standard features – a Keynesian short run and a neoclassical long run. The model contains price setting rigidities (partly due to market imperfections, which allows staggered price setting) and open economy features. The model incorporates a number of other relevant features of the Estonian economy. First of all, the Estonian economy is very open and small. Therefore it is strongly influenced by the external environment. This dependence is also reflected in the model: economic activity is, to a large extent, determined by foreign demand, and domestic inflation is a function of imported inflation. Secondly, as the economic liberalisation was completed already by the mid-1990s, the processes in the Estonian economy are essentially market-driven. Thirdly, the development of the Estonian economy is strongly influenced by the convergence process towards the EU. This is evident in nominal (inflation, interest rates) as well as real variables (income level). Keeping in mind the specific nature of the Estonian monetary arrangement and its importance to the whole economic system, it was essential to model the monetary system in a way that incorporates the main elements of the CBA. However, in this respect we made a typical simplification – the CBA is modelled as a completely credible fixed exchange rate regime. In this way we omitted the political and institutional considerations that in fact distinguish a CBA from a credible fixed exchange rate regime.

The final aim was to construct a macro model whose simulations would adequately reproduce past developments of the Estonian economy, while, on the other hand, the behaviour of its variables (including transmission schemes) should also correspond to intuitive views on the inner workings of the Estonian economy.

The first link in the monetary transmission mechanism – the transmission of monetary signals within the financial sector – is broadly determined by the depth of financial intermediation and by the structure of the financial sector. However, in Estonia, this issue cannot be analysed in the narrow context of the domestic financial markets. The Estonian financial sector's short-term borrowing and lending include also foreign exchange markets and foreign markets-related activities.

Domestic money markets in Estonia are small and closely linked to foreign markets. As under a CBA, monetary policy signals are external to the system (not set by the central bank), the role of foreign monetary signals is dominant. This is clearly shown by the Estonian interbank money market rates that most of the times

closely follow the Euribor rates.

Reliance on the external signals allows us to model the short-term interest rate as an uncovered interest rate parity condition with a risk premium. The dynamics of the short-term interest rate is split into short-run components and a long-term convergence term, which are linked by an error correction mechanism. The short-run component is specified by the uncovered interest rate parity condition. In addition, the short-run dynamics of the interest rate is influenced by the money supply. The long run component is equal to the foreign interest rate plus the domestic risk premium. The risk premium is approximated by a declining function of time.

It is important to note that the currency risk component of the domestic risk premium is typically lower under CBA, as the arrangement is by definition 'the ultimate fix'. On the other hand, this proposition is valid only when market participants believe in the arrangement. If the credibility of macroeconomic policies is low, the domestic risk premium can be high and volatile. Moreover, when markets are not perfect, domestic liquidity conditions and term structure, as well as regional or global risks, can affect domestic risk premium or imply devaluation expectations. Therefore, the interest rate is conditional on the speculative pressure. The devaluation expectations in the model are approximated by the foreign exchange market forward points, which show the difference between the spot and forward exchange rates. Under ordinary conditions (i.e. with a forward point difference below two standard deviations), the exchange rate expectations do not have a direct impact on the interest rate in the equation. During a speculative attack, the devaluation expectations have a definite effect on the interest rate.

Money supply is modelled as being dependent on demand and capital flows. Firstly, it is assumed that money demand is mainly driven by the transaction motive and money supply is dependent on GDP. The trend in the long-run equation reflects a rate of 'natural' financial deepening. In addition, the money supply is dependent on devaluation expectations and interest rate arbitrage conditions. If the interest rate differential (i.e. the difference between the domestic and foreign interest rates) is higher than the devaluation expectations, then, according to the interest rate arbitrage condition, there will be a capital inflow and increase in money supply. In the opposite case, the capital outflow decreases the money supply.

As the Estonian economy is very open and small, real sector developments are strongly influenced by the external environment. This dependence is reflected also in the model, as aggregate demand is to a large extent determined by foreign effective demand. The equation for aggregate demand is a modification of a traditional IS curve for the open economy, where domestic demand is driven by exports both in the short-run and long-run. In the short run, it is dependent on the lagged impact of short-term and long-term interest rates.

The equation for exports is an extension of an imperfect substitutes model. The short-run dynamics of exports is modelled by the changes in the effective nominal exchange rate and external income, which is approximated by the Finnish GDP.

The long-run relationship includes both demand-side and supply-side factors. The main supply-side variable is the capital stock, which is dependent on investments. This marks the fact that in the long run, exports are constrained by the production and technological capacity of the economy. Exports are also determined in the long run by demand-side factors, namely by the real effective exchange rate and by EU (EU-15) demand. Similarly to exports, the basis for import equation is the imperfect substitutes model. Accordingly, imports are determined by income (proxied by the GDP) and by the real effective exchange rate.

The main representation of the supply side is given by a Cobb-Douglas production function. Output is explained by three exogenous processes: employment, a restructuring parameter (h),[1] and the Hicks-neutral technical progress. The only endogenous explanatory variable for the supply is capital, which is dependent on investments.

Investments are positively related to the output and the growth rate of the stock of loans. The output level indicates the range of investment possibilities, while the stock of loans reflects the availability of resources for financing investment projects. In addition, the changes in output are positively related to expectations – a rise in expected growth in turn increases investments. Therefore, the change in the stock of loans in the model has both a short-term as well as a long-term impact on the economy.

The price level is strongly influenced by import prices. In the model we assume that the inflation will remain somewhat higher in Estonia as compared to the advanced economies. The main driving force of that is higher productivity growth in Estonia.

The import deflator is the main channel for the transmission of the external price signals in the model and import prices are predominantly relevant in domestic price formation. The transmission scheme is simple – the import price deflator, which is dependent on foreign prices as well as on the exchange rate, influences the producer price inflation (due to the imported production inputs). The latter affects the tradables inflation and thus the consumer price inflation (CPI). Demand pressures enter into the model through the output gap from the producer price inflation.

The monetary policy transmission channels are typically divided into three groups: (1) interest rate channel, (2) asset price channel (i.e. exchange rate and equity prices) and (3) credit channel.[2] Our model incorporates three channels: the

[1]The indicator h is added to the production function in order to describe the total productivity change generated from labour reallocation. This indicator increases when labour moves into more productive sectors. According to Rõõm (2001), the inclusion of this indicator helps to correct the general measure of employment, expressing the labour augmenting technological progress, generated from sectoral restructuring.

[2]For a discussion about standard approaches to monetary transmission see for instance Mishkin (1996), Benhabib and Farmer (1999), Romer and Romer (1990), Bernanke and Gertler (1995), Bernanke and Blinder (1998) and Kashyap and Stein (1993). For transition economies, see BIS (1996).

interest rate, credit and exchange rate channel, but not asset prices directly.

According to model simulations, the impact of the interest rate channel is the following. A rise in short-term interest rate will cause a decrease in domestic demand. In addition to the effect on domestic demand there also exists a marginal supply side-effect in the model, which is indicated by the decline in exports. This effect exists as capital stock (and therefore investments) is one explanatory variable for exports in the long run, and investments are negatively related to interest rate. Exports converge to the pre-shock trajectory as the impact of the error correction process becomes prevailing in later stages. The disinflationary effect of the interest rate shock is limited. This is due to the fact that in the model, inflation depends predominantly on import prices, which are determined by the producer currency pricing. The interest rate has also a small impact on the foreign trade balance due to changes in real effective exchange rate (REER). The effect on other variables is insignificant.

The impact of the credit channel is similar to the interest rate channel. The increase in banks' loan portfolio will temporarily increase real exports and GDP. Both shocks – in interest rates and in the stock of credit – run partly through the supply side, as they have an effect on the investment level, thus on the capital stock. Credit growth will increase investment, and thus capital formation. The increase in the capital stock will have effects through the supply and foreign trade channels. This increase in the capital stock will shift the production potential. The rise in potential GDP has also a disinflationary impact. In the long run, however, the impact of the increase in bank's loan portfolio does not have permanent effects on the growth rates of real variables. The increase in the capital stock is also reflected in the rise of exports, and this, in turn, supports GDP growth and increases the demand and causes inflationary pressures. All together, the rise in the bank's loan portfolio decreases the inflation rate through the credit channel. The impact of the credit on nominal variables (short-term interest rates and CPI inflation) is negligible.

The exchange rate channel can be described with an example of the depreciation of the nominal exchange rate of the kroon. The nominal depreciation of kroon affects the economy through several variables. The nominal depreciation directly supports exports by increased price competitiveness. The export growth will in turn boost GDP that creates demand pressure and inflation, but its impact is small. Due to the relatively high exchange rate pass-through, the depreciation will increase import prices, thereby accelerating domestic inflation. This effect is also marginal. In addition, nominal depreciation will cause a real depreciation (in spite of the inflationary effects of the nominal depreciation). The depreciation of the real effective exchange rate means, *ceteris paribus,* increased (price) competitiveness and higher export growth. In the long run, however, the impact of change in the nominal exchange rate does not have permanent effects on the growth rates of the real variables.

Our analysis showed that the exchange rate channel was the most influential in Estonia during the model estimation period. Considering the smallness and

openness of Estonia, this result seems reasonable. However, as a consequence of substantial structural changes, the relative relevance of the exchange rate channel has most likely been decreasing. There are several factors that point to such a shift. Firstly, the reorientation of trade towards EU markets that decreased the relevance of the US dollar as a trading currency. Secondly it is related with the adoption of the euro in 1999.

The impact of the interest rate channel is more modest than the impact of the exchange rate channel. However, the relative importance of the interest rate channel has substantially increased during the last years, as several factors have diminished the relevance of the exchange rate channel. The lower impact of the interest rate channel in the estimations stems also from the fairly low level of financial intermediation and negative real interest rates at the beginning of the estimation period. In addition, the model does not account for the indirect impact of foreign interest rates on Estonian economic activity through external demand. As the Estonian economic growth is mainly export-determined, changes in foreign interest rates may have strong indirect impacts through changes in external demand, in addition to direct impacts through Estonian interest rates.

Finally, according to our simulations, the credit channel has clear effects on the economic activity in Estonia, while its impact on inflation is negligible. The credit channel has similar effects as the interest rate channel. Both shocks run partly through the supply side, as they have an impact on the level of investments and on capital stock. However, the credit channel has been mostly important during the Asian and Russian crises, when Estonian banks faced constraints in obtaining additional capital from foreign markets. During other periods, its relevance has not been as clear.

2. PRICE SETTING AND FLEXIBILITY OF PRICES IN ESTONIA

The ability to deal with different shocks is strongly dependent on the flexibility of the economy. Due to the absence of a discretionary monetary policy, Estonian economy will adjust via changes in product, labour and financial markets. In the following section we will concentrate on the product markets in general and the price flexibility in particular. In the economic analysis price flexibility is usually considered to be one of the most important aspects of flexibility of the economy.

The methodology of studying price setting by a means of business interviews has been initiated by Blinder (1991) and Blinder et al. (1998) who applied it for analysing price setting in the US. The potential of this approach has prompted similar studies in other countries, e.g. the UK (Hall et al., 2000), Sweden (Apel et al., 2005), Canada (Amirault et al., 2004) and, most recently, the nine euro area countries, where price setting surveys were carried out in the framework of the Inflation Persistence Network (IPN). Since we were particularly interested in comparing the price setting of Estonian firms with that of the euro area, we designed the survey drawing heavily on the questionnaires used by the IPN

participant countries.[3]

The survey of price setting in Estonia was conducted via the Internet by the Estonian Institute of Economic Research (EKI) in September 2005. Our contract with the Institute foresaw that the Institute would deliver at least 200 responses and that the sample would cover the goods sector, the trade sector and the services sector in approximately equal proportions. Since the response rate was low, the Institute had to send the questionnaire out to more than 1,000 firms. The final sample consisted of 208 responses and it covered the main sectors in approximately equal proportions. It has to be noted that both in the euro area and Estonia the samples were biased toward industry (manufacturing) and larger firms.

One important decision that had to be made when designing the survey was choosing the definition of the *main product*, the product that firms had to focus on in their responses. The individual surveys of the IPN varied somewhat in this respect, since some defined the main product as the one generating the biggest turnover in total sales, while others concentrated on the dominant product in domestic sales (Fabiani et al., 2005). Given that ultimately we were interested in gaining more understanding about inflation in Estonia, we decided to concentrate on price setting in the domestic market and defined the main product with reference to sales in Estonia.

We inquired about a number of important characteristics of the markets firms operate in, for which our results can be compared with those documented in the IPN surveys, namely, the distribution of customers by customer type (firms, consumers or the public sector), the distribution of customers by the type of firm-customer relationship (occasional and regular customers), and the degree of perceived competition in the main market. About 60 percent of the demand faced by our sample firm's is attributed to firms; the remaining 40 percent — to consumers. Hence, even though according to this measure, our survey describes predominantly producer prices, the bias toward producer prices is not as strong as in the case of the IPN surveys, in which firms accounted for 75 percent of the customer base on average.

Our surveys are quite similar in terms of the reported nature of firm-customer relationships. Specifically, the share of regular customers is approximately 70 percent in the sample of the euro area as well as our sample.[4]

In addition we asked about the degree of competition that the firms face. To make the comparison of our results with those of the IPN possible, we also measure the degree of competition indirectly, by looking at the importance that

[3] See Fabiani et al. (2005) and country-specific studies: Austria (Kwapil et al., 2005), Belgium (Aucremanne and Druant, 2005), France (Loupias and Ricart, 2004), Italy (Fabiani et al., 2004), Luxembourg (Lünnemann and Mathä, 2005), the Netherlands (Hoeberichts and Stokman, 2005), Portugal (Martins, 2005), and Spain (Alvarez and Hernando, 2005).

[4] As in IPN surveys, our questionnaire did not provide a precise definition of a regular customer, allowing firms to decide this on their own. In contrast, Hall et al. (2000) defined long-term customers as those dealing with the firm for at least five years.

firms assign to competitors' prices when setting their own price. If compared with similar measures reported by the IPN for the euro area, our findings suggest that competition is more widespread in Estonia.

Price setting can be thought of as a two-stage process. Firstly, necessary information is collected and processed in order to determine the optimal price. This is the so-called price review stage of price setting. The second phase involves making a decision whether to set the actual price at the newly determined optimal price level or not. Since the latter decision can be negative because the actual price may turn out to be equal to the optimal one or because of some other reason that prevents price adjustment, having information only about actual price changes, i.e. only about the realized outcomes of the second stage of the price setting process, may be insufficient to identify the behavioural patterns necessary to understand price setting adequately. In such a situation, the survey methodology comes in particularly handy as it enables one to address the two different stages of price setting separately (Blinder et al., 1998).

In assessing the flexibility of prices, it is useful to know whether firms undertake price reviews mostly in response to certain sufficiently significant shocks or reassess prices on a regular basis. In the literature, these modes of behaviour are referred to as state-dependent and time-dependent pricing, respectively. It is said that time-dependent price reviewing is likely to introduce more sluggishness in the process of price adjustments than state-dependent pricing, since the timing of action is not synchronised with the occurrence of a shock (Apel et al., 2005).

According to the survey, 27 percent of Estonian firms say that they review prices regularly. This share does not appear to be very different from those found by the IPN in other European countries, even though it is somewhat lower than the (GDP weighted) average share of 34 percent calculated for the euro area as a whole. From this point of view, the finding that the incidence of firms with time-dependent price reviewing is on average lower in our sample than in IPN surveys suggests that there is a case for less price rigidity in Estonia than in the euro area.

About 60 percent of Estonian firms make pricing decisions predominantly on the basis of past and present information, whereas the remaining 40 percent of them decide about prices in the present/future context. The predominance of backward-looking firms in our sample is in contrast to the corresponding results reported by Fabiani et al. (2005). They conclude that in the euro area as a whole, the proportion of firms practicing mostly backward-looking pricing to those making pricing decisions in the present/future context is about the reverse of what we have found in our sample. As backward-looking behaviour is considered to increase the price stickiness, this is our survey's only indication of lower price flexibility in Estonia.

The frequency of price changes is another characteristic of price flexibility. Other things equal, the higher is the frequency of price changes, the lower is price stickiness. The frequency of price changes is influenced by the price-setting rules the firms use. These in turn are dependent on the competitive pressures in the markets where they operate. Specifically, we inquired whether firms practice mark-up pricing or mostly follow competitors' prices and essentially take prices as given

by the market. This information should shed some light on how important imperfect competition is in the economy. To cross-check the results and see if they are consistent, we also look at whether mark-up pricing is more likely when the degree of perceived competition is lower. In addition we investigate the incidence of price discrimination in pricing. This is yet another, somewhat indirect way of learning about firms' market power and the mode of competition in the market.

We find that similarly to the euro area, mark-up pricing is a predominant price setting practice in Estonia. We confirm that this pricing method is used more frequently in the markets where the level of perceived competition is low. The incidence of prices being shaped mainly by competitors' prices is higher in our sample (45 percent) than in any other euro area country for which such data are provided by the IPN. This higher incidence of price taking behaviour suggests that everything else being equal, there is a smaller case for price rigidity in Estonia.

The evidence that price discrimination is a common practice in Estonia is broadly in line with the results for the euro area. However, the share of firms practicing price discrimination in Estonia (70 percent) is slightly lower than that in the euro area on average (almost 80 percent). This difference can be interpreted as implying that in Estonia, firms are somewhat more constrained by competitive market forces than in most euro area countries.

We find that the frequency of price changes is somewhat higher in Estonia than in the euro area countries. That is especially evident if we consider the incidence of firms that change prices less often than once a year. The share of such firms in the euro area is 27 percent but only 14 percent in Estonia. In addition, we find that price changes are less frequent than price reviews. Given that the incidence of price reviews is not binding for the frequency of price changes on average, the latter are relatively infrequent either because some price reviews show that price changes are unnecessary or because there are additional reasons that make firms unwilling to change prices.

There exist many theories that aim to explain nominal price rigidity. However, assessing the empirical validity and relevance of different theories in this research area has proved to be particularly difficult. This is due to the fact that some theories are observationally equivalent, and some of the explanations are often based on the behaviour of certain variables that we cannot observe and measure. As an alternative, Blinder (1991) proposed using business surveys as a means to investigate price stickiness and even to inquire about the empirical relevance of respective economic theories.

In our survey we asked the firms to assess the relevance of the following nine hypothesis of price stickiness: (1) explicit contracts, (2) implicit contracts, (3) cost-based pricing, (4) coordination failure, (5) judging quality by price, (6) change non-price factors, (7) menu cost, (8) costly information and (9) pricing thresholds. According to the survey results, Estonian firms consider the existence of explicit and implicit contracts, cost-based pricing and coordination failure, the main reasons for price stickiness. This is similar to the results of the euro area survey. The first two explanations support the view that price stickiness largely results

from customers' preference for stable nominal prices, and that the four top-ranking explanations taken together imply that the main reasons preventing more frequent price adjustment are related to the price change stage rather than the price review stage of the price setting process.

Another measure of price flexibility is the speed of price adjustment, measured by the amount of time it takes for firms to change their prices in response to a shock. We asked the firms to consider four different shocks — higher demand, lower demand, higher costs, and lower costs — that are significant enough to make them willing to change the price, and inquired how much time, on average, it would normally take them to actually change their prices.

Estonian firms would change prices considerably quicker than in the reference euro area countries. Even if we compare the implied speed of price adjustment in Estonia and in Luxembourg, the country where the price adjustment is arguably the fastest among the sample of euro area countries, the case for less price stickiness in Estonia carries through strongly. In particular, more than 60 percent of firms in our sample say they would adjust prices to changes in demand within one month (for firms in Luxembourg this is only 35–40 percent).Therefore we can conclude that the share of firms that would change prices within one month after the occurrence of a shock is about twice larger in Estonia than in the euro area. We interpret this finding as a direct indication of relatively higher price flexibility in Estonia.

The same conclusion can be reached even more easily if we consider an alternative way to compare the nature of price adjustment to shocks across different countries, namely, by contrasting the incidence of firms that say they would not adjust their prices at all. Surprisingly or not, the proportions of firms that choose this option as an answer are usually non-trivial. The share of firms that would not adjust prices in response to a demand or cost shock is systematically and considerably (about three times) lower in Estonia than in the reference euro area countries. Again, we take this as direct evidence of a relatively higher flexibility of prices in Estonia.

3. ENTRY TO ERM II AND THE ADOPTION OF THE EURO

The aim of this part of the analysis is to assess Estonia's entry to ERM II and adoption of the euro. For that purpose we explain the rationale for the early entry to ERM II and the euro area, present the reasons for maintaining the currency board arrangement until the full membership in EMU and discuss the challenges of the adoption of the euro. Although this analysis was completed at a time of Estonia's entry to ERM II, most of the issues discussed – (1) rationale for early entry into the euro area, (2) maintenance of the CBA until euro adoption and (3) the challenges of becoming a full member of EMU – are currently as significant as they were then. We also believe that the main conclusions of the analysis are relevant today.

Estonian authorities have declared that Estonia seeks to join the European Economic and Monetary Union as soon as possible. Estonia participates in the

ERM II with the standard fluctuation band and by maintaining unilaterally the currency board arrangement. The latter implies that the Estonian authorities unilaterally guarantee a zero percent fluctuation margin of the Estonian kroon.

The main motive for an early entry of Estonia to ERM II is to reap the benefits of the monetary union as soon as possible. The latter include: (1) the maintenance of strong fiscal policy discipline, (2) an increase of the economic and financial integration of the Estonian economy with the euro area, (3) a reduction of the transaction costs related to the currency conversion and (4) a decrease in the interest rates via an elimination of the exchange rate risk premium. All of these in turn should intensify trade, foster economic growth and real convergence.

Usually, premature participation in ERM II is deemed to entail the potential costs in other areas, such as short-term costs of fiscal consolidation and the cost of giving up independent monetary policy and flexible exchange rates as stabilisation tools. Those costs are practically non-existent in case of Estonia, as the ERM II and later full participation in the euro area do not call for major adjustments in Estonia's macroeconomic policies.

Fiscal discipline has been strongly entrenched in the political culture of Estonia since the adoption of the kroon. Estonia has maintained one of the most prudent fiscal policies among the acceding countries. Throughout this period the budget deficit has exceeded the Maastricht three per cent limit only once, in 1999 (due to economic adjustments after the Asian and Russian crises that coincided with the election cycle). The general government budget has recorded a surplus since 2001. As a result both governments' gross and net debt is the lowest among EU member countries. Therefore, joining the monetary union does not entail any significant change for the fiscal policy.

The costs related to possible loss of independent monetary policy are non-existent, as Estonia has operated a successful currency board vis-à-vis the euro/Deutsche Mark for over a decade, and therefore has not been able to pursue independent discretionary monetary policy. The currency board with its limited discretion is usually perceived to be the closest monetary regime to a full monetary union. Thus, Estonia has been practically in quasi-monetary union with the euro area core countries since the introduction of the kroon. Participation in the ERM II and entrance into the euro area are therefore steps that do not entail giving up monetary independence, but reduce remaining transaction costs and risk premiums, whereas adjustment and transmission mechanisms that are currently in place will remain largely unaltered after the entrance.

The rationale for the maintenance of the CBA (implying the absence of the independent discretionary monetary policy) until the adoption of the euro is based on the sufficient degree of nominal convergence and exchange rate stability, the flexibility of the markets and the strong integration of the Estonian economy to the euro area countries.

The nominal exchange rate of the Estonian kroon has been kept unchanged since 1992. During that period the incidence of speculative attacks has been rare (1997, 1998). The stability of the exchange rate has been strongly entrenched, evidenced

by the fact that the public has not seriously questioned the current monetary regime and the level of the nominal exchange rate. As a result the nominal interest rates in Estonia have converged to the level in the euro area and since 1998 the inflation rate on average has not been significantly higher than in the euro area countries.

Estonia is a highly open economy. It has close trade relations with the EU, its main trading partner. The Estonian economy is most closely connected to the economies of Finland and Sweden. Similarly to trade links, strong financial links should also reduce the exposure to asymmetric shocks, as they should smooth the impact of asymmetric shocks by cross-border flows of capital and by convergence of financial structures (Mongelli, 2002). The EU, especially the Nordic countries, plays an important role as a source of FDI inflows, as well as in the Estonian financial sector.

Comparable economic structures decrease the danger of asymmetric economic shocks and increase the similarity of shocks within a monetary union (Tavlas, 1994). The structure of the Estonian economy (both in terms of value added and employment) disaggregated into three main sectors, has practically converged to the economic structure of the present EU. At a more disaggregated level some differences remain.

The economic symmetries in Estonia should be higher vis-à-vis the Nordic countries than vis-à-vis the larger EMU members, as trade and investment links are stronger with this region. Indeed, some studies show that the Estonian business cycle is closely synchronized with Finland's business cycle (Danilov 2003, Kaasik et al., 2003). Therefore, possible economic asymmetries in Estonia vis-à-vis the euro area as a whole depend also on possible asymmetries between the Nordic countries (especially Finland) and the other EMU economies. Thus, the business cycle synchronization between Estonia and EMU "core" members might remain smaller than in central European countries, as the synchronisation of the business cycle of the Nordic countries with the euro area is not very high.

The need for nominal exchange rate adjustments is lower if wages and prices are flexible (especially downwards). It should be stressed that in spite of relatively weak economic ties with Germany in the early and mid-1990s, when the currency board was introduced, Estonia's growth and export performance has been favourable. As this has occurred under rigidly fixed exchange rate regime, the latter indirectly points to the flexibility of the real sector to cope with asymmetric shocks without the need for a more flexible exchange rate policy.

This is confirmed by the fact that incidences of exchange rate pressures have been rare throughout these years, save for only some contagion episodes during the Asian and Russian crises in 1997-98. While the Estonian economy experienced considerable output volatility in 1998-1999, the subsequent quick recovery from a strong external shock is a sign that the currency board provides fast and credible signals for the economy to react to changes in the global environment. As a result, the periods of restructuring have been fairly short.

Most studies have concluded that in international comparison Estonian labour markets appear to be relatively flexible and the labour market has been able to

absorb asymmetric shocks by adjusting the labour costs and employment levels to new market conditions. The structure of the Estonian employment has changed considerably during the 1990s. The labour force has been mobile across sectors and job tenure has been rather short. Labour flows between sectors in Estonia have been large compared to OECD countries as well as the other acceding countries (Faggio, Konings (1999), Haltivanger, Vodopivec, Gross (1999) and Eamets (2001)). Firing restrictions are comparable to those of an average EU country in terms of their strictness (according to OECD data).

The institutional framework underpins the labour market flexibility. Wages are mostly bargained at the individual firm level. At the country level, for example, the contracts do not include direct increase in wages, but concentrate on minimum wages, unemployment benefits and other basic questions of income policy. Ex-ante indexation has no role in the Estonian wage setting system. Under these conditions wages in Estonia demonstrated downward real (in the tradable sector even nominal) flexibility during the adverse shock of the Russian crisis in 1998-99. The means-tested character of the social safety net has also supported the flexibility of the labour market.

In spite of the high degree of exchange rate stability, nominal convergence, integration with euro area countries and the flexibility of the economy, there are challenges related to the adoption of the euro. One of the most important challenges is the current account sustainability. The possible excessiveness of the current account deficit is commonly analysed as a reflection of real sector competitiveness or relative price developments. The main aim is to benchmark current account deficit against some economic "fundamentals" or actual real effective exchange rate against fundamental real effective exchange rate.

Several studies have tried to assess the sustainability of the current account deficit in Estonia (see Haas et al. (2003), Burgess et al. (2003)). The general conclusion from these studies is that some amount of current account deficit may be justified in the medium term, as far as the competitiveness developments continue to be favourable. The estimates for "equilibrium" current account deficit in Estonia range around 5-8% of GDP. For example, the IMF has estimated that non-excessive current account deficit, which is sustainable and solvent in the medium term, is around 7.5% of GDP, whereas long-run "equilibrium" current account deficit is estimated to be around 5% of GDP in the Baltic countries (Haas et al., 2003). Those results are also in line with the Bank of Estonia estimates.

The widening of the current account deficit could be attributed to several factors. The standard explanations for the increase in the current account deficit have been intensified inflow of foreign capital due to EU accession combined with sustained domestic demand. However, in the context of the entry to ERM II and the adoption of the euro, the issue of the possible misalignment of the real exchange rate also requires careful examination.

In general, the dynamics of different REER indices has been relatively stable since the mid-1990s, with one rather strong incident of appreciation (about 12-16%) during the Russian crisis in 1998 due to the nominal appreciation of the

Estonian kroon/Russian ruble exchange rate. The sharp appreciation of the REER in 1998 was followed by gradual depreciation of REER during 1999-2000.

It should be noted that the changes in the real exchange rate of the Estonian kroon from mid-1990s have crucially depended on the price/cost index – the unit labour cost based, producer price index based REER and terms of trade have exhibited neither strong depreciation nor appreciation; the consumer price index, GDP deflator and internal REER have shown various degrees of trend appreciation. The differences in the longer-run dynamics of various REER indices stem from the fact that the domestic inflation in non-tradable goods and services has been much higher than in the tradable sector. Therefore the indices that include a significant share of non-tradable goods and services exhibit a stronger appreciation than the indices with a lower share of non-tradable goods and services.

The relative stability of REER developments after the Russian crisis reflects the fact that a considerable share of Estonia's exports is directed towards the EU. Moderate appreciating trends in the CPI-based REER in recent years can, therefore, be connected to the Balassa-Samuelson effect rather than to loss of competitiveness. Trend real appreciation due to the Balassa-Samuelson effect has been estimated at 1.5 - 2% annually. Other factors that had contributed to strong real appreciations in the early years of transition have, to varying degrees, dissipated (Burgess et al., 2003).

Due to difficulties in interpreting the REER indices, equilibrium REER concept is sometimes used to assess possible exchange rate misalignments. The equilibrium REER concept presumes that there exists an equilibrium real exchange rate, which refers to REER that would prevail if the economy would be simultaneously in internal and external balance. This concept indicates that exchange rates can get seriously misaligned with economic fundamentals, thereby creating substantial macroeconomic imbalances. Moreover, misalignments can be a consequence of inappropriate macroeconomic policies and thus indicate the necessity of a shift in monetary or fiscal policy. Therefore, several studies have attempted to estimate the equilibrium level of the real exchange rate of the Estonian kroon.

Although the Estonian REER has to some extent appreciated over the last decade, relevant literature has not found much evidence of misalignment of the Estonian kroon. The equilibrium REER estimates obtained from the different approaches indicate that the initial position in 1992 ranges from a 15% undervaluation to a small overvaluation of the kroon, depending on the model used. The initial undervaluation, found in several models, turned into a temporary 5-10% overvaluation in 1998 (due to adjustments related to both the Russian crisis as well as contagion effects). The deviation in 1998 was short-lived. At the end of the estimation period the actual real exchange rate was found to be close to the equilibrium in most studies.

Most assessments based on a broad range of indicators suggest no clear evidence of exchange rate misalignment that would call into question the underlying competitiveness of the Estonian economy. According to most calculations, the actual real exchange rate has not deviated significantly from its estimated

"equilibrium" value throughout the period.

In addition, the estimates of trade elasticity vis-à-vis exchange rate in those studies indicate that the impact of the REER or NEER on trade flows is limited. This result seems to be robust across different methods and specifications of the models employed, implying a secondary role for the exchange rate in achieving a sustainable position of external balance. The latter is also reflected by the fact that the dynamics of REER and current account are rather different, which suggests that trade flows have been determined primarily by income or supply factors rather than by movements in relative prices.

The weak relationship between the current account deficit and the real exchange rate is also evident by the dynamics of the components of the current account deficit. In this decade the deficit of the income balance have explained nearly half of the current account deficit. The size of the deficit of the income balance depends on the stock of foreign investments in Estonia and the profitability of the foreign-owned firms[5]; the latter is loosely related to the level of the real exchange rate.

CONCLUSIONS

The main aim of the thesis was to assess how the Estonian economy with its fixed exchange rate regime has managed to adjust to various shocks and how will it cope with such shocks under a similar monetary arrangement in the future.

The analysis demonstrates that the successful operation of the Estonian economy under a fixed exchange rate regime has been the result of relatively high price and wage flexibility, strong trade and financial integration with the other EU member countries, fiscal policy discipline and resilient monetary regime and financial sector. As there are no indications that these features of the economy will change, we argue that it is suitable for Estonia to maintain the fixed exchange rate regime – i.e. maintain the currency board arrangement until the adoption of the euro.

In the thesis most of the conclusions relate to (1) price flexibility, (2) financial integration and (3) the resilience of the monetary regime and the financial sector. Compared to the euro area member countries, Estonian price setting is more flexible. This conclusion rests on the following main conclusions of the thesis. Firstly, the share of firms using mainly time-dependent pricing rules is lower in Estonia than in most of the euro area countries, suggesting that in the event of a shock, prices would be more flexible in Estonia. Secondly, compared to the euro area countries for which data is available, the share of firms that set their prices according to their competitors (i.e. take prices essentially as given) is the highest in Estonia. These results are in line with the finding that the perceived competition in Estonia is considerably higher than in the euro area. Thirdly, the frequency of price changes in Estonia is higher than in the euro area. It is especially evident in the share of firms that change their prices less than once a year: in Estonia, the share of

[5] As most of the profits of foreign-owned firms are reinvested they are simultaneously recorded in the current account and financial account of the balance of payments.

such firms is twice lower than in the euro area. Fourthly, the speed of price adjustment after shocks is higher and the share of firms not changing prices in case of shocks is lower in Estonia than in the euro area. The only result that points in the direction of higher price stickiness in Estonia is the finding that the share of firms setting prices in a forward-looking manner (as indicated by the information set they use) is lower in Estonia than in the euro area countries.

Under a fixed exchange rate and free capital mobility, Estonian monetary conditions are closely linked to the monetary policy in the EU. The interest and exchange rate developments in Europe – and therefore also the monetary policy actions of the European Central Bank – directly influence the Estonian monetary environment. The continuously increasing integration of the Estonian financial sector with foreign markets during the last ten years, as well as the particular set-up of Estonian monetary framework, has strengthened those links substantially. In fact, the role of foreign money markets is more important for liquidity management in Estonia than domestic money markets. As a result, the transmission from EU interest rates into the Estonian money market and retail rates is evidently strong.

The effects of those monetary signals in Estonian enterprises and households depend on several aspects. To illustrate this, we presented a set of simulations using a small-scale macro model. Our analysis showed that the exchange rate channel was the most influential one in Estonia during the model estimation period. However, as a consequence of substantial structural changes, the relative relevance of the exchange rate channel has most likely been decreasing and the relative importance of the interest rate channel has substantially increased during the last years.

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Appendix 1

Monetary Policy in Estonia: The Transmission Mechanism

Urmas Sepp, Martti Randveer and Raoul Lättemäe

1 Introduction

The main aim of this chapter is to present a stylised review of the aspects that influence the monetary transmission mechanism (MTM) in Estonia. In addition, the different transmission channels are analysed with a small-scale macro model.

The MTM identifies the channels by which monetary policy measures, such as changes in money supply or central bank interest rates, influence domestic demand and inflation. The traditional view is that the monetary policy affects liquidity and interest rates in financial markets and these ultimately influence the real sector via their impact on consumption and investment decisions. Understanding those mechanisms is essential for understanding the impact of a monetary authority decisions and actions on the economy. However, there is no consensus about exactly how monetary policy transmits from central bank instruments to monetary policy targets. The reason is that the MTM consists of many different and partially overlapping channels that are difficult to separate empirically. In addition, unobservable expectations play an important role in private decisions, thus affecting the way equilibrium is reached in financial markets.

Whereas there exists a huge literature on monetary transmission in general, research on the MTM under a currency board is rather limited. This chapter reports the results of research conducted at the Bank of Estonia that attempts to fill this gap, in the context of the Estonian currency board. In particular, this paper reviews different aspects of Estonian monetary system and transmission mechanism (see also Lättemäe *et al*., 2002; Sepp and Randveer, 2002b; Lättemäe, 2001). In addition, a small-scale macro model that has been recently built to study different aspects of the Estonian monetary regime is reviewed in full here (see Sepp and Randveer, 2002a, 2002b). Some additional conclusions are drawn from the monetary transmission model compiled by Pikkani (2001) and also from different versions of the Bank of Estonia's macroeconomic models (Basdevant and Kaasik, 2002; Sepp *et al*., 1999).

The first part of the chapter gives a short overview of the Estonian monetary regime – the fixed exchange rate that is supported by the currency board arrangement (CBA). The second part overviews some stylised aspects that can influence the monetary transmission process in Estonia. Those are the depth of the markets, the financial structure and the relationships between financial and real sectors. Additionally, a small empirical macro-model, used to analyse the transmission mechanism in Estonia, is presented in detail. Finally, the third part presents some empirical results, based on this model, as well as on prior research. The main aim of this final part is to explain the impact and relevance of the various transmission channels in the Estonian economy.

2 Main features of the Estonian monetary regime

2.1 Currency board arrangement

For a decade, Estonian monetary policy has been based on a CBA. This is a specific type of fixed exchange rate arrangement, governed by strict rules. Those rules include a strong, explicit (usually written into law) commitment to a fixed exchange rate and the requirement that domestic currency is issued only against foreign exchange (IMF, 1996). Therefore, a CBA has to stand ready to exchange domestic currency for the reserve currency at a specified and fixed exchange rate, and all issued currency has to be backed by foreign reserves or gold.

Those strict rules constrain the scope for issuing unbacked monetary liabilities, ensuring that the board does not run out of foreign reserves to maintain the parity (IMF, 1996). A CBA, therefore, sets clear constraints on an independent monetary policy. In addition, the currency board cannot extend credit to the fiscal authorities. The fiscal regime, therefore, is subordinated to the monetary regime, and a hard budget constraint is imposed on the politicians (Hanke, 2002).

In Estonia, the CBA was introduced together with the monetary reform in 1992, after independence from the former Soviet Union. The so called 'Law on the Security for the Estonian kroon' sets the legal framework for the CBA principles:

i) Kroon exchange rate fixed with respect to the DEM[6];
ii) Prohibition to devalue the Estonian kroon;
iii) Requirement for full backing of issued kroons (i.e. currency in circulation and deposits in the Bank of Estonia) with convertible foreign currencies and gold;
iv) Guarantee for full convertibility of kroons at the official rate;
v) Requirement that the Bank of Estonia issues kroons only against corresponding change in foreign reserves.

As we can see, the 'Law on the Security for the Estonian kroon' enforces the CBA in a quite orthodox way. However, the currency board is not separated institutionally from the central bank. According to the 'Central Bank Law', the Bank of Estonia is responsible for typical central bank duties, i.e. maintaining the stability of the legal tender, conducting banking and monetary policy (as long as it does not contradict the above-mentioned principles), promoting financial stability, implementing banking supervision (only until 2002), collecting statistics, conducting research, and so on.

In our view, the institutional unification of the CBA principles and other central bank duties does not weaken the enforcement of the CBA principles in Estonia, as the most fundamental ones are guaranteed by the law. In implementing its tasks, the Bank of Estonia is independent of all governmental agencies. Any lending to the government by the Bank of Estonia is prohibited and the Bank is not liable for

[6]The exact exchange rate of the kroon (1DEM = 8EEK) was set by a separate decree. Since 1999, the kroon has been fixed to the euro (1 EUR = 15,6466 EEK).

the state's financial obligations.

Although the scope for possible discretionary monetary policy is limited only by the amount of excess reserves of the central bank, the Bank of Estonia has followed the rather orthodox rules-based principles of the Estonian CBA in practice. Most of the time, the only channel for base money issuance are transactions at the central bank forex window, ensuring that money supply adjusts only according to changes in its foreign reserves (see Figure 7.1). The few rare exceptions, when the central bank has injected additional liquidity into financial sector, have taken place in specific situations, and were carried out to avoid excessive systemic risk in the Estonian financial system. So there is no active monetary policy in Estonia, but discretionary actions in extreme situations are not explicitly ruled out either.

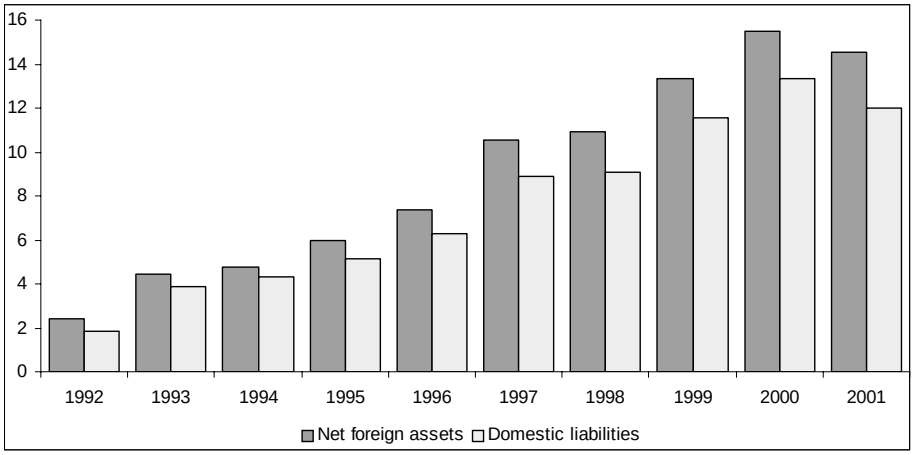

Figure 7.1 CBA cover (NFA and domestic liabilities of Eesti Pank, bn EEK)

Source: Eesti Pank.

There is no central bank policy rate or other operational monetary policy targets in Estonia. Therefore, there exists neither discretionary monetary policy instruments (albeit during 1993-2000 the Bank of Estonia issued small amounts of central bank CDs) nor any explicit lender of last resort (LoLR) facility. The only relevant monetary instrument, in addition to the forex window, has been reserve requirement for banks. Those have been somewhat higher in Estonia (currently standing at 13 per cent), compared to other Central European, 'transition' countries, in order to promote stronger financial discipline, strengthen the financial sector and compensate for the lacking LoLR facility (see Section 2.2. for a longer discussion on the evolution of the Estonian monetary framework).

This highlights an important characteristic of the Estonian monetary regime: *all the necessary adjustments are left to the market, under the anchoring role of the exchange rate*. Both market interest rates and liquidity adjust according to economic developments, external financing and arbitrage conditions. Conse-

quently, the key role in achieving and maintaining sufficient liquidity buffers rests with the financial system itself.

2.2 Main developments of the monetary policy framework, 1992-2001

The CBA principles were laid down through the unlimited forex window facility in 1992 (the bid-ask spreads were set at 0.5 per cent). In addition, a compulsory (non-averaged, non-remunerated) reserve requirement of 10 per cent of the liabilities of the banking sector was established. The then unsophisticated financial system and the simplicity of the CBA features permitted maintaining the monetary policy framework largely unchanged during the following four years. The only important development was the introduction of Bank of Estonia's CDs in the spring of 1993: however, the main aim of this instrument was to foster the development of the money market, and not to move towards discretion.

The first major set of reforms in the monetary policy operational framework was carried out in 1996, when the averaging of reserve requirements was introduced, the spreads in the forex window on DEM transactions were abolished and remuneration of excess reserves was introduced (the latter is also called 'the deposit facility' in the Estonian framework). These steps aimed to improve liquidity management in the banking sector, as well as accommodate market-based principles into the framework.

The next set of changes was carried out as early as 1997, caused by concerns about excessive monetary developments. More concretely, the increasing capital inflows, as well as financial sector over-borrowing from foreign markets during 1996-97, fostered domestic demand, which led to a rapidly deteriorating current account deficit. As the CBA sets clear limits on using monetary tools for implementing restrictive policies, the "stabilization package" contained not only an increase in the compulsory reserves, but also greater prudential capital adequacy requirements, and also the creation of a 'Stabilisation Reserve Fund' from fiscal surplus. In the monetary framework, this meant the widening of the reserve base and the increase in banks' reserve balances with the Bank of Estonia from 10 to 13 percent, through the introduction of those additional liquidity requirements.

During 1999-2000 the concerns about possible distortions caused by relatively high and uncompensated reserve requirements, as well as the need to start preparing the operational convergence of the Estonian monetary framework towards the eurosystem, led to new major changes in the monetary framework, through the further development of the Bank of Estonia's rules-based facilities. As a first step, the remuneration of required reserves was introduced in 1999. This aimed to decrease structural deviations from the eurosystem, as well as to signal that higher liquidity buffers in the financial system were still a prerequisite to cope with possible volatility.

As a next major step among these changes, the partial fulfilling of reserve requirements with high quality (at least with the AA-/Aa3 credit rating), euro-denominated foreign securities of national governments of advanced western

countries and of supranational institutions was allowed in January 2001 (initially up to 25% per cent of the reserve requirement, and from July up to 50 per cent). That meant lowering the rate of required reserves with the central bank (in national currency), while simultaneously rising required reserves in high-rated liquid foreign assets (in anchor currency). Such treatment of eligible assets in fulfilling reserve requirements allows the banking system to use its liquid assets more efficiently, as well as ensuring that there are sufficient liquidity buffers in the financial system. This reform is also forward-looking, as it induces the banking system to start accumulating and operating with the assets which form the basis for the eurosystem's monetary operations (it is important to note that all permitted securities belong to so-called 'Tier 1' assets of the eurosystem).

3 The core features of the Estonian economy

The structure of the financial system and the linkages between the financial and real sectors are important aspects in evaluating how monetary signals affect the real economy. The first determines the transmission from monetary indicators carrying the signals to other financial sector variables, especially into longer-term retail rates and into assets prices. The second determines the relationship between financial sector variables and the spending decisions of households and firms.

In this section we give an overview of the different structural aspects that influence the transmission mechanism in Estonia. In addition, we will present a small-scale macro-model that has been used in Sepp and Randveer (2002a, 2002b) to study different aspects of the Estonian monetary regime. Some additional conclusions are drawn from the monetary transmission model by Pikkani (2001), and also from different versions of the Bank of Estonia's macro-models (Basdevant and Kaasik 2002; Sepp *et al*., 1999). The model that is used here is a typical small-scale macro-model with the standard features – a Keynesian short run and a neoclassical long run. The model also contains price setting rigidities (partly due to market imperfection, which allows staggered price setting) and open economy features.

The model also incorporates relevant features of the Estonian economy. First of all, the Estonian economy is very open and small (see Table 7.1). Therefore it is strongly influenced by the external environment. This dependence is also reflected in the model – economic growth is, to a large extent, determined by foreign demand, and domestic inflation is a function of imported inflation. Second, as economic liberalization was already complete by the mid-1990s, the processes in the Estonian economy are essentially market-driven. Third, the development of the Estonian economy is strongly influenced by the convergence process towards the EU. This is evident in nominal (inflation, interest rates) and real variables (income level).

Table 7.1 Selected indicators of the Estonian economy, 1992-2001

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Real GDP growth (%)	-14.2	-9.0	-2.0	4.6	4.0	10.4	5.0	-0.7	6.9	5.4
GDP PPP compared to EU average			30	32	34	37	38	37	38	40
CPI	1076	89.8	47.7	29.0	23.1	11.2	8.2	3.3	4.0	5.8
Cur. acc. balance (% of GDP)		1.3	-7.2	-4.4	-9.2	-12.1	-9.2	-4.7	-6.0	-6.2
Exports (% of GDP)	55.4	69.6	75.3	72.0	67.1	78.4	79.7	77.2	95.4	91.7
Banking sector assets (% of GDP)	19	29.3	34.8	38.0	43.8	63.4	55.7	61.7	67.7	72.0
Fiscal deficit (% of GDP)		-0.7	+1.3	-1.3	-1.9	+2.2	-0.3	-4.7	-0.4	+0.4
Interest rates of real sector loans[7]		*32.6*	*23.2*	*17.2*	*13.1*	11.9	13.1	10.8	9.5	8.7
Unemployment (%)		6.5	7.6	9.7	10.0	9.7	9.9	12.3	13.7	12.6
Central Gov. debt (% of GDP)	2.2	5.6	5.0	5.2	6.2	5.2	4.3	4.6	3.2	2.7

Keeping in mind the specific nature of the Estonian monetary arrangement and its importance to the whole economic system (see Lättemäe *et al*. 2002), it was important to model the monetary system so as to incorporate the main elements of the CBA. However, in this respect we made a typical simplification – the CBA is modelled as a completely credible fixed exchange rate regime. In this way we omitted the political and institutional considerations that in fact distinguish a CBA from a completely credible regime (in principle it is possible that there are nominal exchange rate changes even under a CBA: see Batiz and Sy, 2000).

The model's parameters are a result of a mixed procedure of statistical estimation (for 1995-2000) and the calibration of selected values. The equations are estimated individually. The final aim was to construct a macro model whose simulations would adequately reproduce past developments of the Estonian economy, while, on the other hand, the behaviour of its variables (including transmission schemes) should also correspond to intuitive views of the inner workings of the Estonian economy.

3.1 Money markets and short-term interest rates

The first link in the MTM – the transmission of monetary signals within the financial sector – is broadly determined by the depth of financial intermediation and by the structure of the financial sector. However, in Estonia, this question cannot be analysed in the narrow context of domestic financial markets alone. The Estonian financial sector short-term borrowing and lending also include foreign

[7] Before1996 figures also reflect loans to financial institutions.

exchange markets and foreign-market-related activities.

According to the CBA principles, the Bank of Estonia offers to credit institutions unlimited forex purchase and sale facilities for all major currencies. This facility is the key element of the liquidity system. Moreover, as there are no bid-offer spreads for euro transactions, the credit institutions are free to move their liquidity across borders without transaction costs. Consequently, the most active market segment in short-term finance is the forex market, which in Estonia is more liquid than the domestic money market[8] and so the transaction volumes are larger (see Figure 7.2).

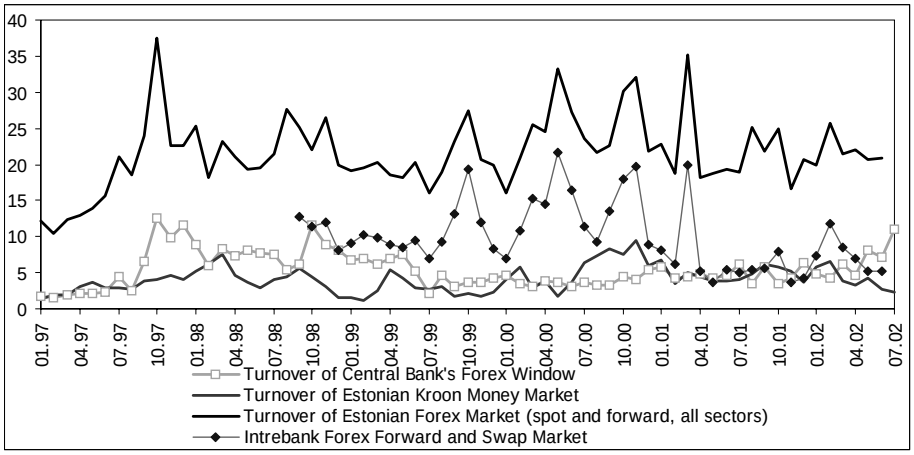

Figure 7.2 Volume of EEK money market, CB's forex window and market (bn. EEK)

This particular set-up has linked the liquidity management of the Estonian financial sector to the much deeper euromoney and capital markets. This has been a deliberate policy, as it is impossible (or at least not cost-effective) to build up full-scale, sophisticated financial markets in such a small economy as Estonia. In addition, the financial sector in Estonia is highly concentrated, with a couple of larger institutions making up the majority of the sector, which also hinders the development of deep domestic money markets.

Domestic money markets in Estonia are therefore rather small and closely linked to foreign markets. As under a CBA, monetary policy signals are external to the system (and not set by the central bank) and the role of foreign monetary signals is dominant. This is clearly shown by the Estonian interbank money market rates, as they closely follow the EURIBOR rates, except during the turbulent 1997-98 period (see Figure 7.3)[9].

[8]The Estonian kroon money market comprises short-term interbank deposits/loans, corporate debt securities and forex forwards and swaps instruments. No treasury bills are issued by the state.

[9]Except during the Asian and Russian crisis, when the domestic risk-premium increased.

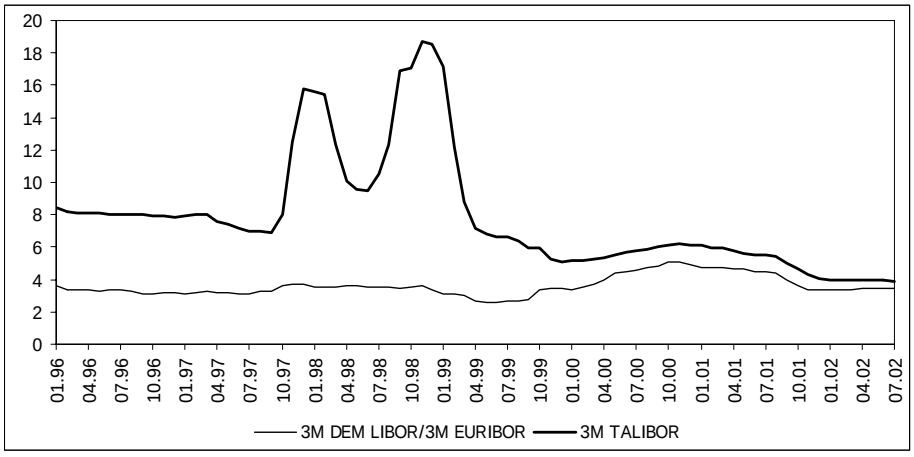

Figure 7.3 Money market rates in Estonia and in the Euroarea

Source: Eesti Pank.

The dependence on foreign financial markets allows us to model the *short-term interest rates* as a UIP condition with a risk premium (see equation 7.1):

$$d(i_S) = \alpha_1 ECM_{1,t-1} + \alpha_2 d(rm2) + \alpha_3 d(i^*) + \beta_1 \alpha_4 d(E_{t-1,t+j-1}(e)^{FW}), \qquad (7.1)$$

where $ECM_1=(i_S - i^* + f_1(t))$; $\alpha_1, f'_1(t)<0$; $\alpha_2, \alpha_3>0$; $\beta_1=1$, if $d(E_{t-1,t+j-1}(e)^{FW})>2SD^{FW}$, otherwise $\beta_1=0$.[10]

The dynamics of the short-term interest rates (i_s) is split into its short-run components and a long-term convergence term, which are linked by the error correction mechanism (ECM). The short-run component is specified by the UIP ($\alpha_3 d(i^*)+\beta_1\alpha_4 d(E_{t-1,t+j-1}(e)^{FW})$), were e^{FW} is the forward nominal exchange rate. In addition, the short-run dynamics of the interest rates is influenced by the money supply (*rm2*). The inclusion of this in equation (7.1) is based on the conventional specification of the LM curve (were money supply is negatively related to the interest rate).

The long-run component ($i^* + f_1(t)$) is equal to the foreign interest rate i^* plus the domestic risk premium. In the model, the foreign interest rate is specified as three-month EURIBOR. The risk premium is approximated by a *declining* function of time. This approximation is not standard one, as the representation of the risk premium as a random walk would be more conventional. However, our approach is supported by developments in the Estonian money market: during the last ten years the domestic risk premium has steadily decreased (Pikkani, 2001), which marks the

[10] In equation (7.1), Greek letters denote parameters, Latin ones denote variables, and the small cap letters denote values in logarithms (except the interest rate). d(•) is the difference operator.

progress in stabilization, transition to a market economy and accession to the EU. As alternative proxies, real sector indebtedness and the share of foreign ownership in the financial sector are used in some models as indicators for the long-run risk premium in Estonia.

It is important to note that the currency risk component of the domestic risk premium is typically lower under CBA, as the arrangement is by definition 'the ultimate fix'. On the other hand, this proposition is valid only when market participants believe in the arrangement. If the credibility in macroeconomic policies is low, then the domestic risk premium can still be high and volatile. Moreover, when markets are not perfect, domestic liquidity conditions and term structure, as well as regional or global risks, can affect the domestic risk premium or imply devaluation expectations.

For example, during the Asian and Russian crisis, the interest rate equation above was conditional on the speculative pressure.[11] The speculative pressure against the kroon in 1997-98 reflected a growing uncertainty among foreign investors with regard to the sustainability of the fixed exchange rate policy. This was caused by the deepening uncertainty about emerging markets in general and by the economic situation in Estonia in particular. The corresponding increase in Estonian interest rates was an automatic response of the CBA to speculative attacks and deteriorating capital flows, as the monetary authority did not intervene in the money or forex markets.

Therefore, the interest rate in equation (7.1) is conditional on the speculative pressure. The devaluation expectations in the model are approximated by the forex market forward points, which show the difference between the spot and the forward exchange rates. Under ordinary conditions (i.e., with a forward point difference below two standard deviations, SDs), the exchange rate expectations do not have a direct impact on the interest rate in the equation, so $\beta_1=0$. During the speculative attack, the devaluation expectations have a definite effect on the interest rate and $\beta_1=1$.

[11]The Asian crisis in 1997 resulted in a sharp increase in the speculative positions in foreign currency swap and forward markets in Estonia (see Lättemäe *et al*., 2002; Lepik, 1999). As a result, forward quotations grew, also pulling the money market rates. The foreign currency swap and forward markets also experienced a similar rise during the Russian crisis in 1998. However, unlike October 1997, the 1998 episode was not followed by a notable increase in trading volumes, as the speculative pressures were smaller. Therefore, pressure on the currency was felt mainly through high forward rates (Lepik, 1999).

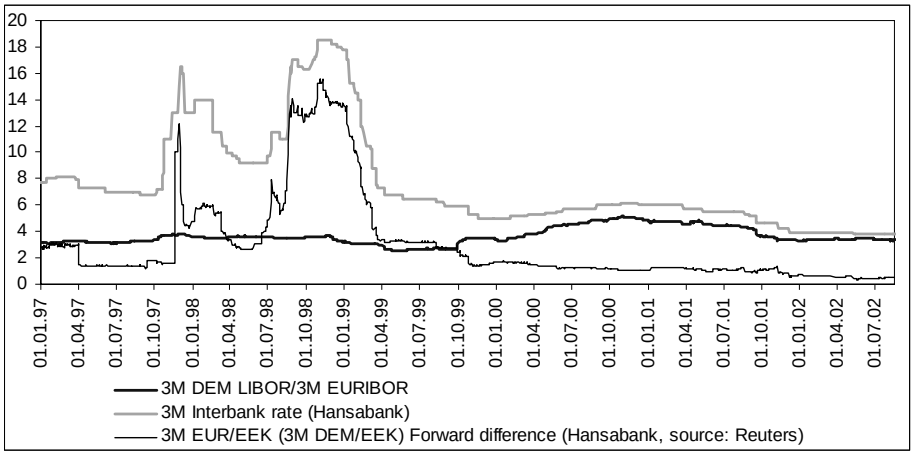

Figure 7.4 Forex forward difference and interbank rates (Hansabank quotes)

Source: Reuters

In the model, the structure of the – forward-looking – *exchange rate expectations* follows the logic of the so-called 'first generation' models of speculative attacks (see equation 7.2). In those models, countries suffer attacks when they run unsustainable monetary and fiscal policies (Peria, 2002). Therefore, it is assumed that a significant decrease in foreign demand worsens the current account balance and may cause a balance of payments problem. This, in turn, increases the possibility that the authorities may have to devalue, in order to improve the current account balance. More specifically, the expected changes in the foreign effective demand[12] ($E_{t,t+j}(d^X)$) determine the devaluation expectations in the model. In addition, exchange rate expectations also include some inertia, as lagged expectations ($E_{t-1,t}(e)^{FW}$) are also included in this equation.

$$E_{t,t+1}(e)^{FW} = 2 + \beta_2 (\Sigma_{j=0,1}\alpha_5 E_{t,t+j}(d^X) + \alpha_6 E_{t-1,t}(e)^{FW}) + \\ + (1-\beta_2) (\Sigma_{j=0,1}\alpha_7 E_{t,t+j}(d^X) + \alpha_8 E_{t-1,t}(e)^{FW}), \quad (7.2)$$

where $\alpha_5, \alpha_7 < 0$; $\alpha_6, \alpha_8 > 0$; $\beta_2 = 1$, if $E_{t,t+1}(d^X) < -SD^{dX}$, otherwise $\beta_2 = 0$.

Similarly to the interest rate equation (7.1), the specification of the exchange rate expectations is conditional. In accordance with the empirics, the break-point for switching the nature of expectations is a decrease in effective foreign demand by more than one standard deviation of that variable, SD^{dX}. In this case $\beta_2 = 1$ and $\alpha_6 \approx \alpha_8 + 1$. In this case, the impact of the change in external demand on the exchange rate expectations is considerable. If the drop in foreign demand is smaller, then $\beta_2 = 0$, and the impact is minor.

[12]Foreign effective demand is here the trade-weighted average GDP of Estonia's main trade partners.

3.2 Foreign capital flows and money supply

Estonian banks have been active in international markets since the early times of the CBA. Initially, those activities covered mainly depositing (i.e., creating foreign assets as additional liquidity buffer, given the missing LoLR facility: Lepik 1999). Since 1995-96, borrowing by banks from foreign capital markets increased significantly, as markets' risk perceptions of Estonia lowered.[13] An early full liberalization of capital flows (in 1994) not only provided external competition, but also speeded up the integration of the banking sector with the international financial system.

If we exclude the turbulent periods from the Asian and Russian crisis in 1997-98, the banks' foreign borrowing has become a clear substitute for domestic deposits, when the domestic credit demand is high (see Figure 7.5). The opposite is also possible – banks' foreign reserves and foreign investments (i.e., NFA) are the main way to absorb excess liquidity, when growth in deposits exceeds credit demand. This is exactly in line with a CBA's adjustment mechanism, which ensures that market forces determine and limit the expansion of the money supply through foreign capital flows (Hanke and Schuler, 1994).

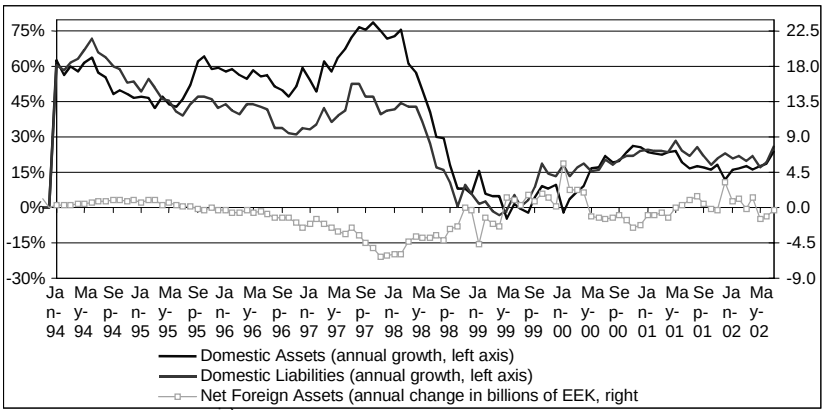

Figure 7.5 Annual growth of Estonian banking sector domestic assets and liabilities vs. annual change in banking sector NFA

To characterise those CBA features, *money supply* is modelled as demand and capital flows determined (equation 7.3). First, it is assumed that money demand is mainly driven by the transaction motive and money supply is dependent on GDP

[13]Long-term foreign capital has mostly been attracted to subordinated liabilities, issued long-term securities or as long-term borrowing in DEM or euros, where the interest rate has usually been indexed to three-six month DEM LIBOR or three-six month EURIBOR (plus risk-premium).

(y).[14] The trend $f_2(t)$ in the long-run equation reflects a rate of 'natural' financial deepening.

$$d(rm2) = \alpha_9 ECM_{2,t-1} + d(y) + \alpha_{10} d(MG(-1)) \qquad (7.3)$$

where $ECM_2 = rm2 - (y + f_2(t))$; $f_2'(t)>0$; $\alpha_9<0$; $MG = i - i^* - E_{t,t+j}(e)^{FW}$.

In addition, the money supply in equation (7.3) is dependent on devaluation expectations and interest rate arbitrage conditions. If the interest rate differential (i.e. the difference between the domestic and foreign interest rates) is higher than the devaluation expectations ($MG>0$), then, according to the interest rate arbitrage condition, there will be a capital inflow and increase in money supply. In the opposite case ($MG<0$), which is typical for the speculative pressure, the capital outflow reduces the money supply. This is in line with the above-mentioned adjustment mechanism, which ensures that the arbitrage conditions and foreign capital flows determine changes in the money supply.

3.3 Longer-term interest rates

The developments in the financial sector highlight that foreign interest rates signals transmit widely into Estonian retail rates (see Figure 7.6). Moreover, this effect has become increasingly evident since 1999-2000. This trend is consistent with the role of foreign markets and foreign capital flows under the Estonian CBA.

However, one of the most critical questions in the Estonian transmission process lies in the relative role of domestic and foreign money markets in determining the retail rates in Estonia. That is, it determines to what extent the transmission from foreign rates into longer-term interest rates takes place conventionally through the domestic money market or directly from foreign markets to retail rates.

[14]The empirical research in this field has not been able to identify other motives (e.g. speculative demand) for money demand.

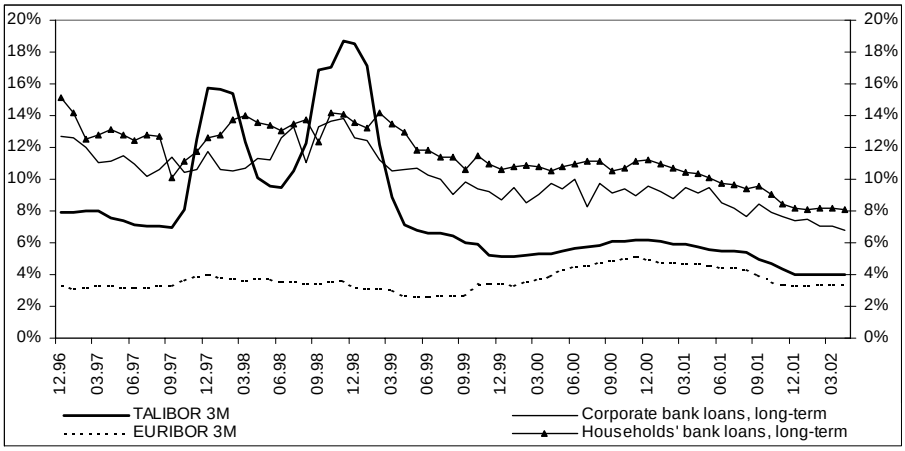

Figure 7.6 Short-term interest rates and retail rates, Estonia

Source: Eesti Pank.

This question arises because foreign money markets are more important for liquidity management in Estonia than domestic money markets. The direct impact from foreign interest rates into banks' retail rates is presumably also due to the close substitutability between domestic retail deposits and foreign borrowing as funds for banks' lending. On the other hand, the short-run interest rate arbitrage evidently takes place via the money market, whereas the arbitrage between longer-term interest rates is less clear – the capitalization of the bond market is too low in Estonia to allow extensive arbitrage through longer maturities in the bond market[15].

In addition, the small size of the domestic financial markets and lack of government securities evidently translate into the lack of a typical yield curve and well-established term structure – the relevant maturities in Estonian money markets are short-term (less than three months) and there is practically no trading in longer maturities. Hence the direct transmission from domestic money market rates to other domestic financial prices is difficult to capture, as the information chain can be slightly different from the traditional one. A factor that adds to these difficulties is the absence of government securities market, which usually provides a benchmark for the domestic yield curve. Partly due to restrictions imposed by the currency board, but even more due to successful economic reforms, Estonian fiscal deficits and government lending over the last ten years have remained modest by European standards. Consequently, there has been no need to develop a domestic government bond market, and against this background a government securities market would probably stay thin.

[15]Although it is interesting to note that the difference between Estonian and Euro-area nominal retail rates for corporate borrowing is currently about 2 per cent, which is close to the differences at the inflation rates: hence the real rates are similar.

Given the key role of the financial sector in financial intermediation, a representative yield curve may, for example, be derived from bank lending rates (see Bank of Estonia, 2001). Empirical analysis shows that the Estonian credit curve dynamics (e.g. the changes in the spread of long- and short-term rates), particularly on a sector level, include some information about *ex ante* developments in the real sector. However, the interpretation of these 'credit curve' signals is somewhat complicated, as shifts in the credit curve are subject to a variety of demand- and supply-related factors (e.g. changes in risk assessments, cost of funds, competition etc.).

In spite of this, we have modelled longer-term interest rates in a conventional way, with long-term rates determined by the domestic short-term interest rates (see Fuhrer and Moore, 1995). As an alternative, it is possible to reduce the model to one interest rate, as was done in prior models of monetary transmission in Estonia: Pikkani (2001) used only the general average retail interest rate, and assumed that the transmission from foreign rates into Estonian retail rates takes place rather *directly* into the entire spectrum of Estonian interest rates. Here, a distinction between short-term and long-term rates was assumed in order to reflect shocks caused by speculative pressures and to separate the particular impact of different interest rates on demand.

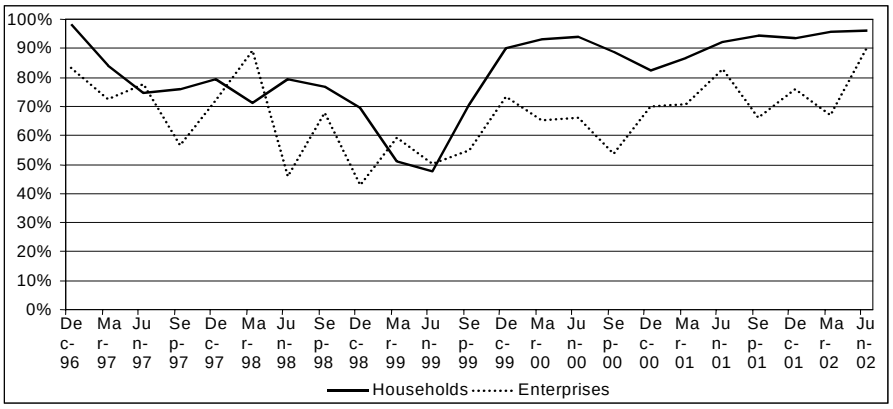

Figure 7.7 Estimated share of indexed loans in long-term loans to real sector, Estonia

In addition to the mechanisms referred to, foreign rates have considerable impact on real sector credit rates, due to the extensive use of interest rate indexing in Estonia (see Figure 7.7). The long-term retail credit rates are usually linked to the six-month EURIBOR or 6-month DEM LIBOR, as the latter reflects changes in the price of financial sector credit resources. Thus, at least to some extent, foreign interest rate signals are automatically passed into the Estonian real sector.

3.4 Aggregate demand and supply

As the Estonian economy is very open and small, real sector developments are strongly influenced by the external environment. Exports represent more than 100 per cent of GDP and are the basis of Estonian economic growth (see Figure 7.8).

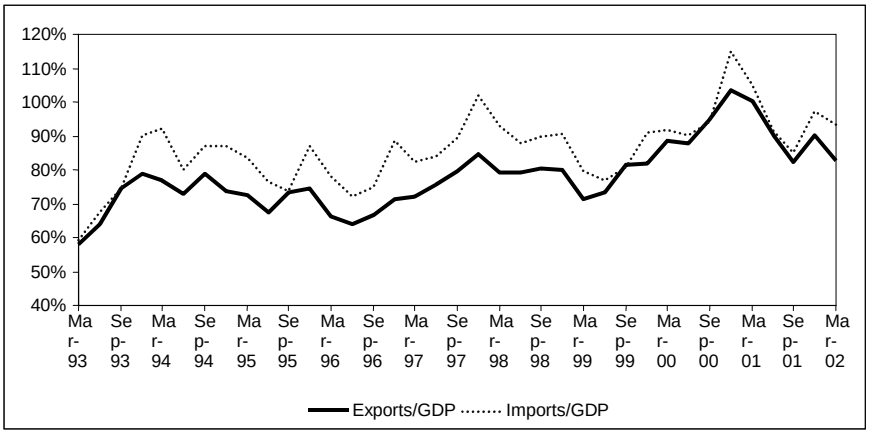

Figure 7.8 Openness of the Estonian economy

This dependence is also reflected in the model, as economic growth is to a large extent determined by foreign effective demand. The equation for domestic demand, which is equal to the GDP (*y*), is a modification of a traditional *IS curve* for the open economy, where domestic demand is driven by exports (*rx*, as a proxy for income from export activities) both in the short and in the long-run (see equation 7.4). Similar elements are applied on the IS curve on all the Bank of Estonia's different macro-models (see Basdevant and Kaasik, 2002; Sepp *et al*., 1999).

$$d(y) = \alpha_{11}ECM_{3,t-1} + \alpha_{12}d(rx) + \alpha_{13}i_{s,t-2} + \alpha_{14}i_{t-3}^{long}, \qquad (7.4)$$

where $ECM_3 = y - (\alpha_{15}\, rx + \alpha_{16})$; $\alpha_{11}, \alpha_{13}, \alpha_{14}<0$; $\alpha_{12}, \alpha_{15}, \alpha_{16}>0$.

The dynamic part of the equation includes an error-correction mechanism as well as the lagged impact of short- and long-term interest rates (correspondingly i_s and i^{long}).[16]

The equation for *exports* is an extension of an imperfect substitutes model (see equation 7.5). The short-run dynamics of exports is modelled by the changes in effective nominal exchange rate (*NEER*) and external income, which is

[16]It should be noted that, given the difficulties with the proper estimation of inflation expectations, we use nominal interest rates rather than real interest rates in our IS-curve specification. Such an approach is supported both by prior practice in Estonian macro-models (see Sepp *et al*., 1999), and by difficulties in estimating real interest rates (Rell, 1999).

approximated by Finnish GDP (y^{FIN}). The ECM in the export specification reflects convergence to the long-run equilibrium.

$$d(rx) = \alpha_{17}ECM_{4,t-1} + \alpha_{18}d(y^{FIN}) + \alpha_{19}d(NEER), \qquad (7.5)$$

where $ECM_4 = rx - (y^{EU}+\alpha_{20}rk+\alpha_{21}REER)$; $\alpha_{17},\alpha_{21}<0$; $\alpha_{18},\alpha_{19},\alpha_{20}>0$.

The use of Finnish GDP as a proxy for external demand in the short run is due to the fact that Finland is, by far, the most important trading partner for Estonia (see Figure 7.9).

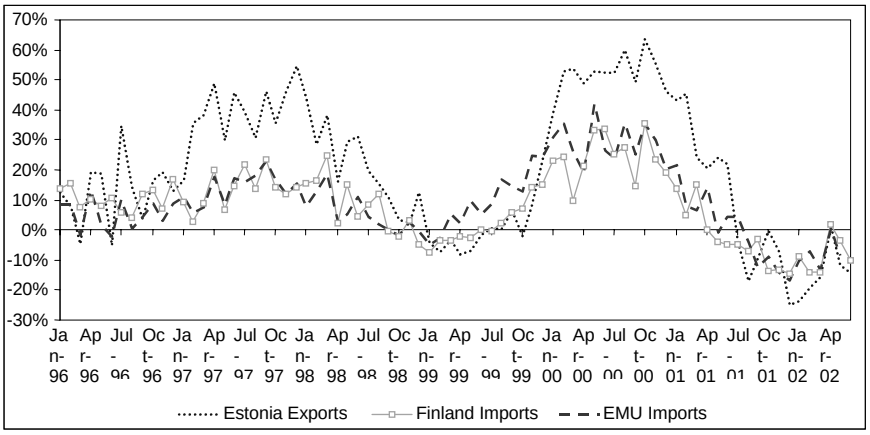

Figure 7.9 Annual growth of Estonian exports and Finnish and EMU imports

The proximity and strong trade relations are main reasons for the quick and dynamic response of Estonian exports to Finnish demand. This argument is supported by Kaasik *et al*. (2002), who found that the relatively high correlation between the business cycles in Finland and in Estonia (higher than the correlation between Estonia and the EU) is the result of close trade relations. Therefore, in the long run the foreign demand is reflected by the EU aggregate, while in the short run the demand dynamics are approximated with the Finnish GDP.

The long-run relationship of equation (7.5) includes both demand-side and the supply-side factors. The main supply-side variable in the equation, affecting export growth, is the capital stock (*rk*), which is dependent on investments. This marks the fact that, in the long run, exports are constrained by the production and technological capacity of the economy. In addition, FDI in the export sector has generated positive externalities (e.g. technological spillovers, managerial and marketing know-how etc.) and increased the competitiveness of the export sector (and the economy). FDI has also helped in reorienting exports from the unstable CIS countries to Western markets, underpinning sustainable growth.

On the other hand, exports are also determined in the long run by demand-side factors, namely by the real effective exchange rate (REER) and by EU demand. The REER is here as a proxy for the price competitiveness – REER appreciation

means a decline in competitiveness. This is consistent with Randveer and Rell (2002), who show that the REER is an influential determinant of Estonian exports. From the income side, the GDP of EU (y^{EU}) is used as the export demand factor, as nearly two-thirds of Estonian exports are directed into the European Union.

Similarly to the export, the specification of the *import equation* (7.6) is in line with the conventional set-up. The basis for the specification is the imperfect substitutes model:

$$d(rm) = \alpha_{22}ECM_{5,t-1} + \alpha_{23}d(y), \tag{7.6}$$

where $ECM_5 = rm - (\alpha_{24}y + \alpha_{25}REER)$; $\alpha_{22}>0$; $\alpha_{23},\alpha_{24},\alpha_{25}>0$.

Accordingly, imports (*rm*) are determined by the income (proxied by the GDP, *y*) and by the REER. The REER impact contains two aspects. First and indirectly, the real appreciation, in the case of a fixed exchange rate in a developing economy, often reflects an increase in income and the subsequent increase in consumption. It is reasonable to assume that the income growth will shift the demand to more sophisticated goods. In these segments, imports have a strong market position, and as a result, the growth of imports outpaces the rise of income. Second, the real appreciation produces a substitution effect. A real appreciation reduces the price competitiveness of the domestic goods. As a result, imports will replace part of them. However, in practice the magnitude of substitution is restricted. Due to the smallness of the Estonian economy, the range of goods that are produced for the domestic market is limited, and thus the possibility for such substitution is constrained.

In equation (7.6), the income elasticity in the long run is smaller than the income effect in the short-run. This effect is related to the cyclical development of the economy, as well as to the fact that, due to subcontracting, a significant proportion of Estonian exports are very import-intensive. This means that export-led GDP increase also sharply increases imports. Additionally, a rise in GDP is usually accompanied by an increase in bank lending, which tends to fuel investment-related imports. The joint effect of these factors is that the variation of imports is larger than that of income.

The main representation of the supply side is given by a Cobb-Douglas *production function* (7.7) with conventional properties, which has been drawn from Rõõm (2001):

$$y^S = \alpha_{26} + \alpha_{27}(l+h) + (1-\alpha_{27})rk + f_3(t), \tag{7.7}$$

where α_{26},α_{27}, $f'_3(t)>0$. Rõõm (2001) shows that such a Cobb-Douglas production function reflects the supply side of the Estonian economy quite adequately.

The use of Cobb-Douglas production function is also justified on the grounds of its simplicity, which is crucial in the case of short time series. According to equation (7.7) output is explained by three exogenous processes: employment (*l*), a

restructuring parameter (h),[17] and the Hicks-neutral technical progress ($f_3(t)$). The only endogenous explanatory variable for the supply is capital (rk), which is dependent on investment. *Investments* (rn, see equation 7.8), on the other hand, are positively related to the output and the growth rate of the stock of loans:

$$d(rn) = \alpha_{28}ECM_{6,t-1} + \alpha_{29}d^2(rl), \quad (7.8)$$

where $ECM_6 = rn - (\alpha_{30}d(rl) + \alpha_{31}y + \alpha_{32})$, $\alpha_{28}<0$; α_{29}, α_{30}, $\alpha_{31}>0$.

The output level (y) indicates the range of investment possibilities, while the stock of loans (rl) reflects the availability of resources for financing investment projects. In addition, the changes in output are positively related to expectations – a rise in expected growth in turn increases investments. Therefore, the change in the stock of loans in the model has both a short-term as well as a long-term impact on the economy.

3.5 Inflation

As Estonia is a small and open economy, its price level is strongly influenced by import prices. It is important to note that the inflation will remain somewhat higher in Estonia as compared to the advanced economies. The main reason for this is higher productivity growth in Estonia due to the *real* convergence, which also yields convergence of the structure and price level. This effect is believed to cause a one and a half to two and a half percentage points differential, when compared to inflation in advanced economies (Randveer, 2000).

The import deflator is the main channel for the transmission of the external price signals in the model, and import prices are predominantly relevant in domestic price formation. The transmission scheme is simple – the import price deflator, which is dependent on foreign prices as well as on the exchange rate, influences the producer price inflation (due to the imported production inputs). The latter affects the tradables inflation and thus the CPI. Formally the CPI is a weighted average of tradables and non-tradables inflation. Demand pressures enter into the model through the output gap from the producer price inflation.

The *import price deflator* (π^M in equation 7.9) is a function of NEER changes and income convergence (y^R)[18]. Import prices are set following a pricing-to-market behaviour in the model:

$$d(\pi^M) = \alpha_{33}\, ECM_{7,t-1} + \alpha_{34}\, d(NEER), \quad (7.9)$$

[17]The indicator h is added to the production function in order to describe the total productivity change generated from labour reallocation. h is higher, when labour moves into more productive sectors. According to Rõõm (2001), the inclusion of h helps to correct the general measure of employment, expressing the labour-augmenting technological progress generated from sectoral restructuring.

[18]The relationship between income and price level is estimated in IMF, World Economic Outlook (2000), Kravis (1986), Hansson and Helliwell (1990) and Randveer (2000).

where $ECM_7 = \pi^M - (y^R + NEER + \alpha_{35})$; $\alpha_{33}<0$; $\alpha_{34}, \alpha_{35}>0$.

Prices depend on the income level and on income convergence. On the other hand, the long-run import deflator depends on the exchange rate pass-through, which is also in line with conventional belief. The coefficients for exchange rate pass-through are roughly in line with Campa and Goldberg`s (2000) study of a large sample of OECD countries. They report about a 60 per cent pass-through in the short run and over 80 per cent in the long run, whereas the elasticities in our model are about 50 and 100 respectively. Slightly higher pass-through can be explained, given the higher share of energy and raw materials in Estonian imports, as imported energy and materials have pass-through elasticities close to one. Also Calvo and Reinhard (2000) claim that in 'transition' economies the pass-through from the exchange rate to inflation is generally higher than in more developed countries.

Due to the openness, import prices determine *producer price inflation* (PPI) in Estonia (π^P, see equation 7.10). In addition, Sepp and Rell (2001) showed that producer prices in Estonia are primarily influenced by supply-side behaviour. Also, producer prices are partially driven by demand, which is proxied by the lagged output gap ($\hat{y}$):

$$d(\pi^P) = \alpha_{36} ECM_{8,t-1} + \Sigma_{j=0,}\alpha_{37+j} E_{t,t+j}(d(\pi^M)) + \alpha_{38}\hat{y}_{t-1}, \quad (7.10)$$

where $ECM_8 = \pi^P - \pi^M$; $\alpha_{36}<0$; $\alpha_{37}, \alpha_{38}>0$.

This equation, taken from Sepp and Rell (2001), is basically a 'new hybrid Phillips curve'. The import prices affect producer price via expectations ($E_{t,t+i}(d(\pi^M))$). Producers tend to slightly overreact to expected imported inflation, as the estimated value for $\Sigma_{j=0}\alpha_{37} = 1.08 > 1$, i.e., a marginal inflation bias. The long-run relation here is determined by import prices: a fast convergence towards the long run in the equation obviously dampens the imported inflation bias.

The import and producer prices determine the *tradables inflation* (π^{TR}, see equation 7.11). This set-up is also consistent with Sepp and Rell (2001):

$$d(\pi^{TR}) = \alpha_{39}ECM_{9,t-1} + \alpha_{40}d(\pi^M) + (1-\alpha_{40})d(\pi^P), \quad (7.11)$$

where $ECM_{9,t-1} = \pi^{TR} - \alpha_{41}\pi^P$; $\alpha_{39}< 0$; $\alpha_{40}, \alpha_{41}>0$.

Tradables prices are based on producer prices in the long-run. This reflects the supply-side price formation, typical for imperfect markets. The significance of the supply side is underlined by the fact that the tradables inflation is higher than producer price inflation, as $\alpha_{41}>1$. In the short run the tradables inflation is a weighted average of PPI and import price deflator. The interpretation of PPI's role is the same in the long run: the import deflator represents the direct contribution of imported goods due to their share in the consumption bundle.

Due to technical reasons, the *non-tradables inflation* (π^{NT}, equation 7.12) reflects first of all the impact of administrative price changes (dummy D^A). The reason for such an impact is obvious, as regulated prices form the major part of the non-tradables:

$$d(\pi^{NT}) = \alpha_{42}D^{A} + f_4(t), \quad (7.12)$$

where $\alpha_{42} > 0$, $f'_4(t) < 0$.

The only way to bring the prices of the non-tradables into line with the common price level (or with the underlying non-tradable inflation $f_3(t)$)[19] is to apply administrative action. Although this process is in fact an error correction process, it cannot be included to the model as an econometric component. This is because the correction of 'errors', or occurrence of administrative measures, depends on the political circumstances (among others, on the election cycle). In some cases the error correction might be significantly delayed. Therefore the timing of the administrative 'error correction' process is in principle different from the logic of an ECM, according to which the deviations in the previous period are adjusted.

4 The MTM in Estonia

The monetary policy transmission channels are typically divided into three groups: (i) interest rate, (ii) asset price (i.e. exchange rate and equity prices) and (iii) credit channels.[20]

Our model incorporates three channels: interest rate, credit and exchange rate. The model allows for several simplifications regarding these, which will be explained below. This is mostly due to the fact that the previous work on the monetary transmission channels in Estonia is rather limited, and we were unable to estimate several transmission channels.

To explain transmission, we study exogenous shocks to variables that work through concrete channels. We are interested in the impacts of the transmission processes as well as in the comparative effectiveness of the different channels. The size of the studied shocks was one standard deviation of first-differenced series for the period 1995:1–2000:4.

4.1 The interest rate channel

The traditional interest rate channel is supposed to work through real interest rates, influencing consumers' and investors' decisions. However, extracting information from market yields can be extremely difficult when the financial markets are shallow and the usual yield-curve instruments are non-existent, as in Estonia. Moreover, the determination of real interest rates in a 'transition' country with a high and volatile inflation is a complicated issue, as the link between inflation expectations and actual inflation is obscure and changing. Therefore, it is

[19] See Sepp *et al*. (2000).

[20] For a discussion on standard approaches to monetary transmission see Mishkin (1996), Benhabib and Farmer (1999), Romer and Romer (1990), Bernanke and Gertler (1995), Bernanke and Blinder (1998) and Kashyap and Stein (1993), to name a few. For 'transition' economies, see BIS (1996).

empirically rather difficult to distinguish the explicit effects of real rates on economic activity. In addition, until 1997, inflation substantially exceeded the level of nominal interest rates, so that *ex post* real interest rates were clearly negative. Assuming that inflation expectations are in line with realized inflation, one would conclude that the *ex ante* real rates were also negative. On the other hand, an estimate using a structural VAR (see St-Amant, 1996), shows that most of the interest rate volatility is caused by nominal variation in expectations, whereas real interest rates have been very stable during the 90s (Lättemäe, 2002). Such outcomes make modelling a plausible link between interest rate movements and real sector behaviour rather difficult.

Here it is important to notice that, considering the behaviour of inflation expectations, there is only slight evidence of the existence of forward-looking 'rationality' in Estonian inflation expectations (Sepp and Rell, 2001). This type of 'rationality' is only found in the corporate sector, whereas Sepp and Rell (2001) did not find any evidence of a rational, forward-looking behaviour in household, survey-based, inflation expectations. According to them, backward-looking future inflation rate expectations described households' expectations best, whereas the *actual* headline inflation declined from almost 80 per cent to below 10 per cent

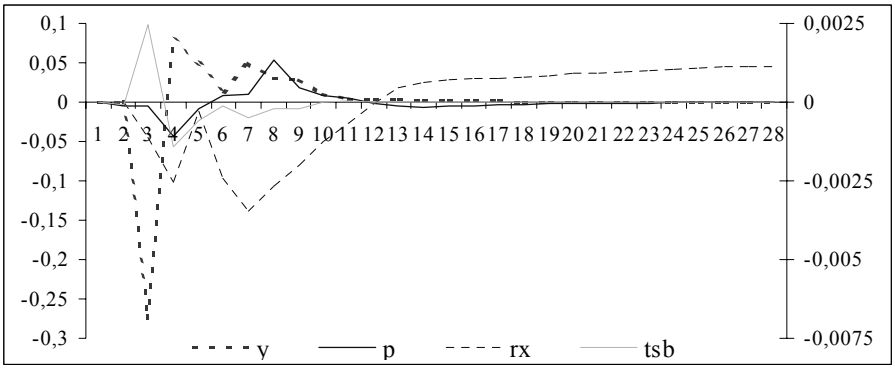

Figure 7.10 The interest rate channel: adjustments after the shock, Estonia

Notes: π and tsb: change from base; y and rx as: percentage change from base; y and π on the left axes and tsb and rx on the right axes.[21]

According to our model simulations, the effect of the interest rate channel is conventional. A rise in short-term rate starts a usual Keynesian-type restrictive transmission ($i^S\uparrow \rightarrow y\downarrow \rightarrow \hat{y}\downarrow$: see Figure 7.10). In addition to the effect on domestic demand there is also a marginal supply side-effect in the model, which is indicated by the decline of exports. This effect exists as capital stock (and therefore investments) is one explanatory variable for exports in the long run, and

[21] π is annualised inflation, *y* is real GDP, *rx* is real exports and *tsb* is current account balance.

investments are negatively related to interest rate. Exports converge to the pre-shock trajectory as the impact of the error correction process begins to prevail in later stages.

As can also be seen from Figure 7.10, the disinflationary effect of the interest rate shock is limited. This is due to the fact that in the model, inflation depends predominantly on import prices, which are determined by the producer currency pricing (and thus, by the changes in NEER). The interest rate also has a marginal impact on the foreign trade balance, due to REER changes. The effect on other variables is insignificant. Those results are also broadly in line with prior findings (see Pikkani, 2001).

However, those results should be treated with some caution, as the model is based on historical figures. In addition, there have been several structural shifts during the sample period that may make the results less plausible for today's environment. Due to the continuous increase in financial intermediation, as well as to the increased relevance of the euro in Estonians trade flows, the importance of the interest rate channel has grown during recent years. One must also note that the model does not incorporate possible indirect impacts from foreign interest rates. As, again, Estonia is a very small and open economy, its economic growth is mainly export-driven. Changes in foreign interest rates, therefore, may have strong indirect impacts through changes in external demand.

It is also important to note that the impacts of the shocks to foreign and domestic interest rates show, to some extent, different adjustment paths in our estimations. The reason is the different dynamics of the interest rate margin (*MG*). In the case of a domestic shock, MG will change; a move in foreign interest rates, however, does not affect it significantly. A change in MG causes interest rate arbitrage and, consequently, capital inflow or outflow, with corresponding moves in the money supply (see Section 3). However, the adjustment to foreign and domestic shocks is not fundamentally diverse.

4.2 The credit channel

The credit channel emphasizes informational problems in financial markets. Credit channel effects can appear as a change in the external finance premium or as a change in credit availability for the real sector. There are two basic transmission channels that arise as a result of informational problems – the balance-sheet and the bank-lending channels (Mishkin, 1996). The balance-sheet channel works due to the effects of monetary policy on firms' and households' balance sheets, which cause moral hazard and adverse selection problems in the retail borrowing market. The bank lending channel stresses the fact that banks are financial intermediaries designed to solve informational problems in credit markets.

Unfortunately, we do not have data on individual loan-contracts or data series of real sector balance sheets to explicitly identify the possible credit channel effects in Estonia. Instead, we specified assumptions that underpin the bank-lending channel and tested their relevance for Estonia.

The bank loan channel is supposed to work when bank loans are not perfectly substitutable with some alternative form of external financing, or when the banking sector is vastly dependent on domestic liabilities.[22]

Considering first the former, the only significant competitor for banks' intermediated finance is direct borrowing from foreign capital markets. The domestic corporate bond markets and equity markets are too small and shallow to be relevant. In addition, the domestic leasing companies are almost fully owned and financed by the banking sector. The amount of real sector foreign borrowing (i.e., equity-related capital is excluded) makes up about one-third of the total domestic credit into the real sector (see Figure 7.11). There is also some evidence from the period of the Russian crisis that a decrease in domestic bank lending after the crisis was partly compensated with foreign financing (Vesilind and Liiv, 2001).

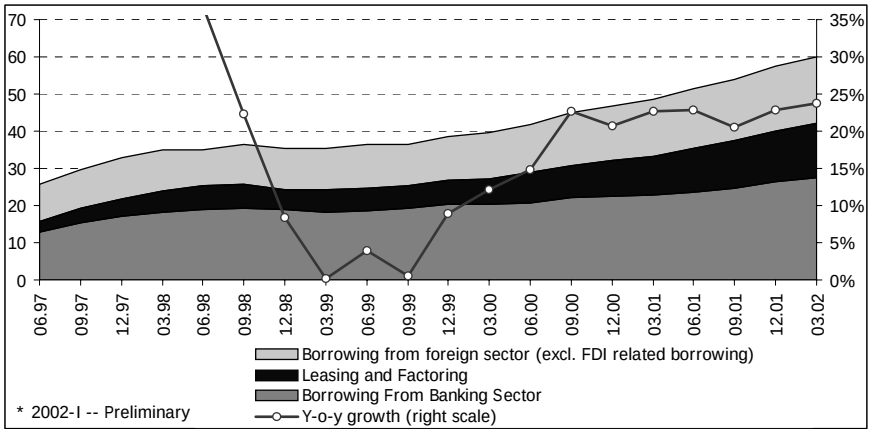

Figure 7.11 The structure of real sector borrowing, Estonia (bn EEK)

However, foreign capital markets are accessible to a limited group of larger enterprises, but the majority of the companies in Estonia are rather small. Those enterprises are more dependent on the banking sector in financing their activities. This means that they have a limited ability to substitute bank financing with other sources of credit, when the domestic credit supply is restricted. The bank-lending effects can, therefore, be present for smaller enterprises and for households.

On the other hand, the ability of the Estonian banking sector under a CBA to attract funds from abroad means that, when the foreign (re-)financing conditions are loose, domestic credit supply may follow the credit demand at the given interest rate level. Thus a contraction in domestic deposits does not necessarily lead to a contraction in credit supply in Estonia, as banks can attract foreign liabilities (or, in

[22]There are two different views of the credit channel. The first suggests that banks are dependent on deposits, and any contraction in deposits will prompt banks to shrink their balance sheets. The second suggests that there are significant numbers of bank-dependent firms that cannot replace bank lending with other sources of finance (Cecchetti, 1999).

the short term, use their foreign reserves) instead of domestic deposits to fulfil the credit demand. However, a tightening in the overall monetary environment or deteriorating capital flows may still mean that credit rationing effects can be present from the bank lending side. This conclusion is also supported by Pikkani (2001), who finds evidence of strong credit rationing effects in Estonia during the Asian and Russian crisis.

The functioning of the credit channel has been approximated in a very simplified way. First of all, the balance-sheet channel, which works through changes in firms` net worth, has been left aside. Second, bank lending was modelled as a function of credit demand and money supply. We did not take into account possible changes in the bank's behaviour (e.g. credit rationing). Therefore, we have explicitly modelled the bank credits as a stock of *real sector loans* (i.e. the central and local government loans and financial institutions loans are not included in the loan stock: see equation 7.13):

$$d(rl) = \alpha_{43}ECM_{10,t-1} + \alpha_{44}d(il) + \alpha_{45}d(rm2) + \alpha_{46}d(y_{t-1}) + \alpha_{47}d(rl)_{t-1}, \quad (7.13)$$

where $ECM_{10} = rl - (rm2 + \alpha_{48})$; $\alpha_{43},\alpha_{45},\alpha_{46},\alpha_{47}>0$; $\alpha_{44}<0$.

This equation is similar to the model used by Pikkani (2001). To capture the effect of the credit demand, the average lending rate (*il*) and real GDP (*y*) are used. *il* reflects the price of credit, real GDP (*y*) proxies the growth expectations in the backward-looking mode. The effect of the credit supply is given by money supply: this ties credit extension to base money. As the money supply is dependent on capital flows (which result from interest rate arbitrage), bank lending is also influenced by international capital flows.

Lättemäe (2001) and Pikkani (2001) found that the credit channel has a relevant role in Estonia. They argue that during the Asian and Russian crisis banks did not raise interest rates as much as could have been expected, but rather used credit rationing. Therefore, the impact from the increase in banks' loan portfolio is also simulated.

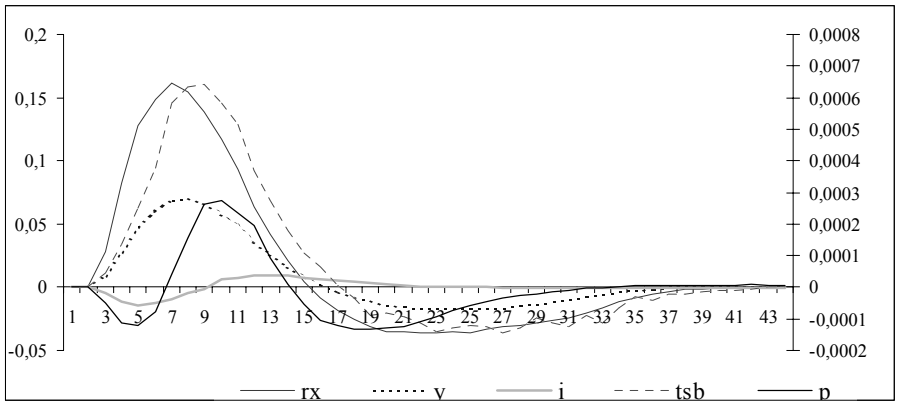

Figure 7.12 The credit channel: adjustment after the shock, Estonia

Note: rx and y on the left axis; tsb, π and i on the right axis.

As can be seen from Figure 7.12, the increase in banks' loan portfolio will temporarily increase *real* exports and GDP. Therefore, the credit channel has a similar effect to the interest rate channel. Both shocks – in interest rates and in the stock of credit – run partly through the supply-side, as they have an effect on the investment level, and thus on the capital stock. Credit growth will increase investment, and hence capital formation. The increase in the capital stock will have effects through the supply and foreign trade channels. This increase in the capital stock will shift the production potential and the long-run growth path. The rise in GDP also has a disinflationary impact through the price channel. In the long run the impact of the increase in bank's loan portfolio does not have permanent effects on real variables.

The increase in the capital stock is also reflected in the rise of exports, and this, in turn, supports GDP growth, and through the domestic income channel, increases the demand and inflationary pressures. Altogether, the rise in the bank's loan portfolio reduces the inflation rate through the credit channel. The impact of the credits on nominal variables (short-term interest rates and CPI inflation) is negligible. Among the nominal variables the highest variation is in the trade balance: this is due to the credit extension impact through the REER channel.

4.3 The exchange rate channel

According to the classification of Mishkin (1996), the exchange rate channel is part of the assets prices channel. It works mainly through exchange rate effects on net exports. Additionally, the exchange rate channel may include interest rate effects, as the exchange and interest rates are linked through interest rate parity.

In addition to exchange rate, equity prices also belong to assets prices channel. The equity price channel affects the real sector through two processes, the wealth effect and Tobin's q. However, we have not included equity prices in our model.

This is due to the fact that Estonian financial markets are shallow, and therefore bank deposits are still the most common savings instruments in Estonia. A reliable estimation of the assets prices channel in Estonia is also difficult to produce.

The importance of exchange rate channel in Estonia comes from the openness of the Estonian economy. The exchange rate channel transmits the impact of both nominal and real exchange rates. Of course, one could argue that a CBA is an extreme form of fixed exchange rate regime, and, therefore, by definition the nominal exchange rate dynamics are excluded. In fact, in some episodes the kroon NEER depends crucially on appreciation/depreciation of the currencies unpegged to the kroon's anchor currency (DEM, now the euro); hence exchange rate fluctuations stem from the fluctuations of the anchor currency. On a trade basis, the most important such floating currencies for Estonia are the USD and the SEK (the Swedish kronor). It is still important to note that the relevance of euro as trading currency has increased substantially – currently about 70 per cent of all foreign trade is carried out in euros, while in the mid-1990s DEM-based trade flows made up only about 20-30 per cent of the total.

With the use of our model it is possible to simulate the impact of exchange rate fluctuations of all the main unpegged currencies used in external transactions. Here we present the results of a change in the EUR/USD exchange rate, as, after the introduction of euro, the USD is the most important floating currency in Estonian foreign trade. The model simulation of a 1 per cent appreciation of the USD shows that, for a fixed regime, the nominal exchange rate channel is highly influential (Figure 7.13).

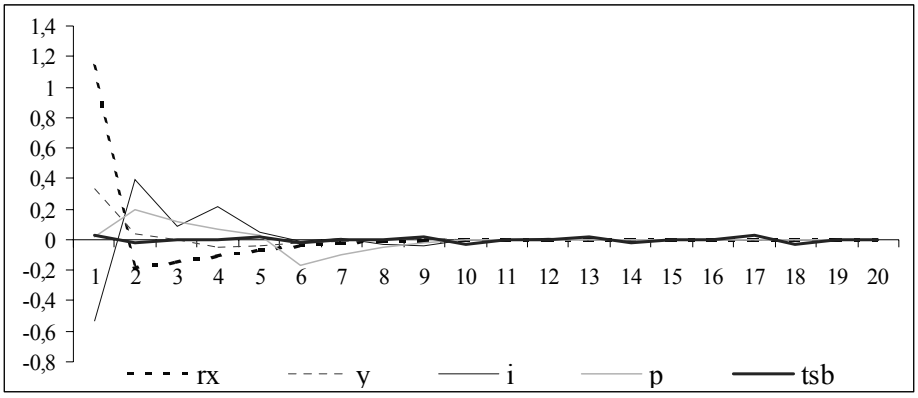

Figure 7.13 The exchange rate channel:(adjustment after the shock, Estonia

Note: π, *i* and *tsb* as the change from base; *y* and *rx* as percentage change from base.

The nominal depreciation of the kroon affects the economy through several variables, and its impact in the model matches this intuition. First, the nominal depreciation directly supports exports by increased price competitiveness. The export growth will in turn boost GDP, which starts the domestic income channel. Growing income creates some extra demand pressure and inflation, but this effect

is minor. Depreciation has also another channel to increase inflation: due to the relatively high exchange rate pass-through, depreciation has an impact on import prices, accelerating domestic inflation. This effect is also marginal. On the other hand, nominal depreciation will cause a *real* depreciation (in spite of the inflationary effects of the nominal depreciation) and start the real exchange rate channel. An REER depreciation means, *ceteris paribus,* improved (price) competitiveness and higher export growth.

All in all, the final effect of a USD appreciation (or kroon depreciation) is positive. The extent of the nominal depreciation of the Estonian kroon outweighs the impact of higher inflation, leading to a real exchange rate depreciation. This is consistent with Randveer and Rell (2002), who show that the REER is an influential determinant of Estonian exports. From the income side, the EU GDP (y^{EU}) is the main factor, as nearly two-thirds of Estonian exports are directed to the EU.

4.4 The relative importance of the channels

Comparing the performance of transmission channels, one could conclude that the exchange rate channel outperforms the others (see Table 7.2). This result is similar to that of other 'transition' countries (for Slovakia, Kuijs, 2002 shows that there is a strong impact of the exchange rate on *prices*, and virtually no effect from interest rates: in Chapter 6, a similar conclusion was reached for Slovenia).

Table 7.2. GDP and CPI elasticities (in %) for temporary shock,.[23]Estonia

		Impact elasticity	**Total elasticity**
Interest rate	GDP	0.03	0.06
	CPI	0.01	0.03
Exchange rate	GDP	0.16	0.28
	CPI	0.13	0.46
Credits	GDP	0.04	0.16
	CPI	0.00	0.05

23 Impact elasticity describes the direct and immediate effect; total elasticity reflects the overall impact of the shock during adjustment.

The outcome is also logical within the framework of a two-sector economy paradigm[24], and it is also intuitive, based on the realities of the Estonian economy. Taking into account its openness, one should expect the exchange rate channel to prevail. The interest rate channel acts primarily through the demand for non-tradables, and as the size of the non-tradables sector is relatively small, the impact of interest rates on aggregate measures (as GDP) should be limited. On the other hand, the exchange rate is an influential determinant of the tradables sector output. As the tradables sector is relatively large in Estonia, one would expect the impact of the exchange rate to be crucial also for the development of the whole economy.

The prominence of the exchange rate channel is also determined by the price-setting process and its consequences. Inflation in Estonia is predominantly influenced by import prices, while the role of demand pressure is secondary. Due to the prevailing producer currency pricing, import prices are crucially influenced by the nominal exchange rate. In addition, aggregate demand includes substantial exchange rate effects, as the aggregate demand for Estonian goods and services is directly related to the foreign demand, which is sensitive to the NEER.

The effectiveness of the interest rate channel stems from the institutional structure and fairly low levels of financial intermediation in Estonia during the estimation period. According to Kangur *et al*. (1999) corporate sector investments are mostly financed by internal sources and FDI. The share of domestic external financing (e.g. bank loans) has been of secondary importance. During 1994-98, bank loans to the corporate sector amounted to about 20 per cent of their investments. Additionally, as already mentioned, foreign interest rates may have some indirect impacts on Estonia through foreign demand.

Another factor that may influence the transmission of monetary signals into the real sector is that the degree of financial intermediation was relatively low at the beginning of 'transition' and is still relatively low, when compared to advanced economies. Further convergence of financial deepening towards advanced countries' levels implies several structural changes in real sector financing schemes. Those changes, affecting real sector balance sheets (increased freedom to borrow – in other words, to expand the liabilities' side of their balance sheets), may have been more relevant in such 'transition' countries than changes in interest rates (Kamin *et al*., 1998). This proposition can also hold when we consider real sector saving decisions. In low-income economies, households' propensity to save can be more dependent on the income and wealth effects than on the interest rates.

However, these results should be treated with some caution, as the model estimates are based on historical figures. The comparative relevance of different

[24] According to Leitemo and Roisland (1999), the significance of the monetary policy transmission channels are different for traded and non-traded sectors. In a 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 tradables sector output is more sensitive to REER changes, whereas the non-tradables sector output is more affected by the real interest rate, through domestic demand.

channels has been almost continuously shifting in favour of the interest rate channel. This process has been particularly intensive during the last years, for several reasons.

First, the 1998 Russian crisis fostered the reorientation of trade towards Western countries, while reducing the relevance of USD as trading currency. Moreover, our sample period includes figures from 1998 onwards, when the Russian rouble was devalued, causing problems in some sectors of the Estonian economy (especially parts of the food industry, whose exports were then more Russian-oriented). In addition, the initial introduction of the euro in 1999 reduced further the share of floating currencies in the currency composition of Estonian foreign trade, hence naturally reducing the relevance of exchange rate fluctuations.

Second, the relevance of interest rates has increased during the years, as financial intermediation has continuously deepened. For example, bank lending to residents accounted to about 15 per cent of GDP in 1995, whereas in 2001 it had increased to more than 45 per cent. Therefore, recent empirical results have found stronger links between interest rates and real sector behaviour than prior works.

The credit channel is, according to model estimates, also less effective, if compared to the exchange rate channel. In a way, the credit channel has the same effects as the interest rate channel. Both shocks - in interest rates and in the stock of credits – run partly through the supply channel. But unlike interest rates, the credit channel has clear GDP effects, while its impact on inflation is negligible. As mentioned previously, the credit channel was important during the Asian and Russian crisis, but in other periods its importance has not been that clear.

5 Conclusions

One of the key issues in assessing monetary policy is the analysis of the MTM. This mechanism is influenced by several factors – the set-up and consistency of macroeconomic policy, including the choice of monetary regime and the structure of economy – especially the financial sector- and the intra-sector linkages are just a few of them. The effectiveness of different transmission channels is highly dependent on the evolution of financial systems and market structures and its evaluation is a challenging task even in advanced economies.

In Estonia, the monetary system is based on a CBA whose anchor currency is the euro. The features of this CBA are an important aspect of the MTM in Estonia. There is no active monetary policy. Price stability in Estonia is linked to the anchoring role of the exchange rate, and all the necessary adjustments are left to the market. Furthermore, although the Estonian CBA is sometimes regarded as a *CBA-like* system, its set-up is rather orthodox.

Under a fixed exchange rate and free capital mobility, Estonian monetary conditions are therefore closely linked to the monetary policy in the EU: in addition to the changes in the Estonian risk-premium, the interest and exchange rate developments in Europe – and therefore also the monetary policy actions of the ECB – directly influence the Estonian monetary environment. The continuously

increasing integration of the Estonian financial sector with foreign markets during the last ten years, as well as the particular set-up of the Estonian monetary framework, has strengthened those links substantially. In fact, the role of foreign money and forex forward and swap markets, are more important for liquidity management in Estonia than domestic money markets. As a result, the transmission from EU interest rates into Estonian money market and retail rates is evidently strong.

The effects of those monetary signals in Estonian enterprises and households depend on several aspects, from the substantial structural changes in Estonia during the last decade to specific factors influencing households' and enterprises' everyday decisions. To illustrate this, we presented a set of simulations using a small-scale macro-model. There are several important aspects to be kept in mind when discussing those results. Namely, they are based on *ex post* data, i.e., they do not take into account structural changes that have taken place in the economic environment in recent years.

Our analysis showed that the exchange rate channel was the most relevant in Estonia during the model estimation period (1995-2000). Considering the smallness and openness of Estonia, this result seems reasonable. However, as a consequence of substantial structural changes, the relative relevance of the exchange rate channel has most probably been decreasing. Several factors point to such a shift. First, the reorientation of trade towards EU markets that reduced the relevance of USD as trading currency and second, the initial introduction of the euro in 1999.

The estimated effects of the interest rate channel are conventional: a deteriorating domestic demand and disinflationary pressures. According to the estimations, its impact is more modest than the impact of the exchange rate channel. However, the relative importance of the interest rate channel has substantially increased during the last years, as several factors have diminished the relevance of the exchange rate channel. The lower impact of the interest rate channel in the estimations stems also from the fairly low levels of financial intermediation and negative real interest rates at the beginning of the estimation period. In addition, the model does not account for the indirect impact of foreign interest rates on Estonian economic activity through external demand. As the Estonian economic growth is mainly export-determined, changes in foreign interest rates may have strong indirect impacts through changes in external demand, in addition to direct impacts through Estonian interest rates.

Finally, according to our simulations, the credit channel has clear effects on the economic activity in Estonia, while its impact on inflation is negligible. The credit channel has similar effects as the interest rate channel. Both shocks run partly through the supply side, as they have an impact on the level of investments and on the capital stock. However, the credit channel has been most important during the Asian and Russian crisis, when Estonian banks faced constraints on obtaining additional capital from foreign markets. During other periods, its relevance has not been that clear.

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Appendix 2

Comparison of Pricing Behaviour of Firms in the Euro Area and Estonia

Aurelijus Dabušinskas, Martti Randveer

In this chapter, we provide a broad overview of the price setting survey of Estonian firms and compare our findings with the results of analogous research for the eurozone summarised by Fabiani *et al*. (2005). In 2003 and 2004, nine central banks of the European System of Central Banks carried out price setting surveys in the framework of the Inflation persistence network (IPN), a joint research project on inflation persistence in the euro area and its member countries.[25] Although the national surveys were prepared largely in a decentralised way, the degree of coordination among the researchers was sufficient to make the surveys comparable in terms of a number of common issues investigated. On this basis, Fabiani *et al*. (2005) derived twelve stylised facts that generalise the key characteristics of price setting behaviour and price stickiness in the euro area. In the present chapter, we use these stylised facts as a set of landmarks for introducing the most important results from the survey of price setting by firms in Estonia. Among other things, we are particularly interested in whether our findings are in line with the stylised facts. Since most survey-based inference on price setting and price stickiness to date is based on research in more developed and mature economies than Estonia, we deem the comparison to be of interest. At the same time, given the wealth of empirical evidence provided by the IPN on price setting in the euro area, this seems to be the first survey-based investigation of price setting behaviour in a new member state, a future candidate of the euro club.

The methodology of studying price setting by a means of business interviews has been popularised by Blinder (1991) and Blinder *et al*. (1998) who applied it for analysing price setting in the US. The potential of this approach has prompted similar studies in other countries, e.g. the UK (Hall *et al*., 2000), Sweden (Apel *et al*., 2005), Canada (Amirault *et al*., 2004) and, most recently, the nine euro area countries covered by the IPN. Since we were particularly interested in making our survey comparable to the latter, we designed the survey drawing heavily on the

We thank the staff of the Estonian Institute of Economic Research (EKI) for helping to design the questionnaire and conducting the survey. We are particularly grateful to Evelin Ahermaa and Marje Josing as well as Kiira Martens, Aet Vanamölder, Lia Lepane, Viivika Savina, Annika Hansman, Merje Kelgo, Bruno Pulver, and Mati Reiman. We also thank Karsten Staehr and Eesti Pank's public seminar and Baltic States Central Banks' seminar participants for their comments and suggestions. The views expressed are those of the authors and do not necessarily represent the official views of Eesti Pank.

[25] The nine countries were Austria, Belgium, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain.

questionnaires used by the IPN participant countries.[26] In principle, the breadth and nature of the collected information are sufficient for a country-specific study of price setting similar to those undertaken by the IPN. However, given that the primary objective of the present chapter is to compare our results with the stylised facts drawn by Fabiani et al. (2005), we will consider only the most general characteristics of the data. Our equivalent of a more detailed study of the price setting behaviour of Estonian firms is the subject of current research.

The survey of price setting in Estonia was conducted via the Internet by the Estonian Institute of Economic Research (EKI) in September 2005. Our contract with the Institute foresaw that the Institute would deliver at least 200 responses and that the sample would cover the goods sector, the trade sector and the services sector in approximately equal proportions. Since the response rate was low, the Institute had to send the questionnaire out to more than 1,000 firms. To increase the response rate, all firms were contacted by telephone at least once; in a number of cases it was done more than once. The final sample consists of 208 responses.

The chapter is organised as follows. The next section overviews the introductory part of the questionnaire, which was designed to provide some general information about the firm and its market. The following two sections investigate the characteristics of the two stages of the price setting process, price reviews and price changes, respectively. The relative importance of various explanations for price stickiness is examined in the fourth section. The fifth section, in turn, ranks a number of price determinants according to their relevance in causing price increases and declines. The final section summarises the main points of the chapter and provides some conclusions. In addition, the chapter includes two appendices. Appendix A lists the stylised facts of price setting behaviour in the euro area discussed by Fabiani et al. (2005). Appendix B sets out our questionnaire.

General information about the firm and its market

We start by discussing the first two sections of our questionnaire which inquired about the basic characteristics of firms and their markets, respectively.[27] Among other things, the first set of questions provides information about the distribution of sample firms by sector and size, and thus tells us about the representativeness of our sample of the Estonian economy. The second set focuses on characterising the market structure that firms operate in, since that is likely to have important implications for their pricing strategies.

As mentioned in the introduction, our sample was designed to cover three sectors of the economy — industry, trade and services — in approximately equal

[26] See Fabiani et al. (2005) and country-specific studies: Austria (Kwapil et al., 2005), Belgium (Aucremanne and Druant, 2005), France (Loupias and Ricart, 2004), Italy (Fabiani et al., 2004), Luxembourg (Lünnemann and Mathä, 2005), the Netherlands (Hoeberichts and Stokman, 2005), Portugal (Martins, 2005), and Spain (Alvarez and Hernando, 2005).

[27] Specifically, we refer to sections ‘General information’ and ‘Market structure’ of the questionnaire, see Appendix B.

proportions. We decided to exclude the construction sector on the grounds that it would be especially difficult for construction firms to define their main product and/or fit the way they set or change their prices into the stylised framework that the questionnaire offered.[28] The sectoral composition of our sample and, for comparison, the sectoral coverage of the IPN surveys are described in Table 2.1. In terms of its absolute size, our sample of 208 firms is the smallest, but that is not the case if we compare the number of surveyed firms by sector.[29] As acknowledged by Fabiani et al. (2005), the majority of IPN surveys were clearly biased toward industry (manufacturing), but since this particular bias is far less prominent in our sample, the difference in sectoral coverage should certainly be kept in mind when comparing our and IPN results.[30]

If we look at the sectoral distribution of samples by country, ours is quite similar to the Spanish one but differs very much from the German and French surveys, which cover only manufacturing. For this reason, it might seem that the comparison of our findings with those of individual IPN countries should be done at the sectoral rather than the aggregate level. However, for basically all the major characteristics of price setting and price stickiness considered in their paper, Fabiani et al. (2005) report the corresponding GDP-weighted average measures that they interpret as describing the typical pricing behaviour in the euro area as a whole. Since we are certainly interested in reflecting this aspect of their message in our comparison, we proceed as follows. In the series of tables below, we present our results for Estonia next to the corresponding characteristics of price setting for the euro area as a whole and its constituent countries as reported by Fabiani et al. (2005). When considering aggregate measures, we focus mostly on the comparison of the figures for Estonia and the euro area and pay less attention to the pair-wise comparison of the Estonian indicators vis-à-vis those of individual euro area countries. At the cost of completely ignoring the small versus large economy dimension in such comparisons, we let the aggregation of the intra euro area figures alleviate the issue of different sectoral coverage in IPN samples and average-out other country-specific influences. On the other hand, whenever the data are available, we present and discuss the characteristics of price setting and price rigidity at the sectoral level. Since the problem of disparity in sectoral coverage basically disappears in such cases, the pair-wise cross-country comparison of various indicators becomes more appropriate.

Next, we compare the composition of our and IPN samples in terms of firm size. In addition to being an important criterion for cross-checking the representativeness

[28] The same argument applies in the case of providers of financial services, which were not covered by our survey either.

[29] For example, the number of trade firms in our sample is larger than in the samples of Italy and Luxembourg; the number of service firms is the same in our and the Italian sample.

[30] According to the Estonian Business Registry data for 2002, manufacturing firms constituted 14.2, services firms (excluding electricity, water and gas supply) 35.0 and trade firms 31.3 percent of all firms. Hence, in terms of the number of firms by sector, our sample overstates the significance of manufacturing but not as much as some national IPN surveys.

of a given sample, the distribution of firms by their size may have some influence on the calculated average characteristics of pricing behaviour.[31] In Table 2.2, the size of firms is measured by the number of employees, and for comparison purposes, the distribution of this variable is presented in terms of three size intervals: from one to 49, from 50 to 199 and, finally, 200 or more employees. Although Table 2.2 indicates that we have relatively fewer respondents in the category of firms with 200 or more employees compared to the synthetic sample of the euro area, in general our sample is quite similar to the majority of samples investigated by the IPN. In sum, we feel we can conclude that there are no significant comparability problems in terms of this dimension.[32]

Table 2.1. Sectoral coverage, percentages (*number of firms in brackets*)

	BE	DE	ES	FR	IT	LU	NL	AT	PT	EAa	EE
Industry	38	100	45	100	65	18	18	76	85	62	35
	[753]	[1228]	[833]	[1662]	[215]	[41]	[219]	[661]	[999]	[6611]	[73]
Trade	24		25		14	21	22			12	32
	[478]		[467]		[46]	[48]	[271]			[1310]	[67]
Services	18		30		20	38	60	24	15	21	33
	[364]		[557]		[68]	[89]	[756]	[212]	[174]	[2220]	[68]
Construction	20				1	23				4	
	[384]				[4]	[54]				[442]	
Total	100	100	100	100	100	100	100	100	100	100	100
	[1979]	[1228]	[1857]	[1662]	[333]	[232]	[1246]	[873]	[1173]	[10583]	[208]

Notes: BE=Belgium, DE=Germany, ES=Spain, FR=France, IT=Italy, LU=Luxembourg,

NL=Netherlands, AT=Austria, PT=Portugal, EA=euro area, EE=Estonia

a. Percentages for the euro area are computed on the basis of the absolute figures reported

[31] For example, in Spain and Luxembourg, large firms tend to give more importance to expectations about future conditions when assessing their prices than smaller firms (Fabiani et al., 2005). In addition, Alvarez and Hernando (2005) note that large Spanish firms conduct price reviews more often than smaller firms.

[32] This is not to say that the sample distribution of firms by size adequately characterises the population of all firms in Estonia. Masso et al. (2004) describe the distribution of all Estonian firms by the number of employees using the Estonian Business Registry data from 1995 to 2001. According to their Table A1 (and after adjusting the figures provided in it for the firms with zero or not reported number of employees), we find that the first size category — from 1 to 49 employees — accounts for 93.5 percent of all firms. The population share of the second size category cannot be calculated from this table exactly, but we can infer that firms with 50–249 employees account for 5.8 percent in the population of all firms. Clearly, our sample is significantly biased toward larger firms, but since the same seems to be true for most of the IPN samples (perhaps with the exception of Belgium and the Netherlands), the bias should not matter very much for our comparison exercise as such.

in brackets, which are the sum of the firms in each category over the nine countries

Table 2.2. Firm size, based on the number of employees, percent

	BE	DE	ES	FR	IT	LU	NL[a]	AT	PT	EA[b]	EE
1 - 49	75	29	43	18	-	41	81	53	38	47	53
50 - 199	17	35	23	43	39	47	19	28	37	29	36
≥200	8	36	34	39	61	12		19	25	24	11

Note: See also Table 2.1 for country definitions

a. In the Netherlands, the size classes are defined as follows: 1 - 49; ≥50

b. Percentages for the euro are are computed on the basis of absolute figures, which are the sum of the firms in each category over the nine countries

One important decision that had to be made when designing the survey was choosing the definition of the main product, the product that firms had to focus on in their responses. The individual surveys of the IPN varied somewhat in this respect, since some defined the main product as the one generating the biggest turnover in total sales, while others concentrated on the dominant product in domestic sales (Fabiani et al., 2005). Given that ultimately we were interested in gaining more understanding about inflation in Estonia, we decided to concentrate on price setting in the domestic market and defined the main product with reference to sales in Estonia.[33] To avoid confusion, we also declined asking firms about the distribution of their sales of the main product between the national and foreign markets. For this reason, we are not able to measure the degree of 'openness' in the sales of firms in our sample and compare this characteristic of Estonian firms with the corresponding results reported by Fabiani et al. (2005), although we nevertheless present their findings in the top panel of Table 2.3.

On the other hand, we inquired about a number of other important characteristics of the markets firms operate in, for which our results can be compared with those documented in the IPN surveys, namely, the distribution of customers by customer type (firms, consumers or the public sector), the distribution of customers by the type of firm-customer relationship (occasional and regular customers), and the degree of perceived competition in the main market. As Table 2.3 shows, about 60 percent of the demand faced by our sample firms is attributed to firms; the remaining 40 percent — to consumers. Hence, even though according to this measure, our survey describes predominantly producer prices, the bias toward producer prices is not as strong as in the case of the IPN surveys, in which firms accounted for 75 percent of the customer base on average. Note also, that the weight of producer prices in some national IPN surveys, e.g. 89 percent in Germany and 84

[33] In the questionnaire, we suggested (but did not insist) that the main product would be the one generating the highest turnover in the Estonian market. We also suggested that the good should correspond to something that is considered to be one category in the decision making of the firm with regard to pricing.

percent in Austria and Portugal, exceeded this average considerably. Since there can be some important differences between producer and consumer price setting, the fact that our sample is not as skewed toward producer prices as some IPN surveys is worth keeping in mind when comparing our results with individual IPN surveys, although the issue seems to be less relevant if the synthetic IPN sample for the euro area as a whole is used as a benchmark.[34]

Table 2.3. Market structure, percent[a]

	BE	DE	ES	FR	IT	LU	NL	AT	PT	EA[b]	EE
Main market for the main product (in industry)[c]:											
- domestic	55	78	82	64	73	63	72	69	67	72	-
- foreign	45	22	18	36	27	37	28	31	33	28	-
Main customer:											
- other firms	56	89	62	66	73	-	-	84	84	75	61
- consumers	40	7	36	30	25	-	-	9	12	21	39
- public sector	4	4	2	4	2	-	-	7	4	3	-
Firm-customer relationships[d]:											
- long term	78	57	86	54	98	84	-	81	84	70	67f
- occasional	22	43	14	46	2	16	-	19	16	30	33
Perceived competition[e]:											
- very low	18	19	26	19	10	17	5	20	8	17	2
- low	22	23	19	17	25	17	25	18	21	21	12
- high	30	34	24	38	37	34	49	30	38	35	43
- very high	30	24	30	25	29	32	22	32	32	26	34

Notes: See notes to Table 2.1 for country definitions
a. Re-scaled figures excluding non-responses.
b. Weighted averages (GDP weights.
c. Only the information under item 1 of the table refers to the industrial sector; the other three samples refer to the whole sample in each national survey.
d. In the case of Belgium, France and Italy, this refers to relationships with other firms.
e. Measured by the importance a firm gives to competitors' prices when considering

[34] The effect of the customer type on price setting behaviour is not always clear. Consider the frequency of price changes, for example. On the basis of the micro prices underlying the CPI and PPI indexes in Portugal, Dias et al. (2004) conclude that consumer prices are changed more frequently than producer prices. However, using analogous micro price data for Spain, Alvarez et al. (2005a) conclude just the opposite. Interestingly, there is no stylised fact comparing the frequency of price adjustment between consumer and producer prices in Alvarez et al. (2005b), the paper summarising the new micro evidence on price stickiness obtained by the IPN. Instead, the paper emphasises the presence of (a certain pattern of) heterogeneous flexibility within consumer and producer prices but not between them.

reducing its own prices.
f. Firms in trade excluded.

According to Table 2.3, IPN and our surveys are quite similar in terms of the reported nature of firm-customer relationships. Specifically, the share of regular customers is approximately 70 percent in the synthetic sample of the euro area as well as our sample.[35] It is important to note, however, that we did not ask trade firms to answer this question. We did so after being warned[36] that these firms would interpret it as asking about the number of customers holding the so-called 'client cards'. Since such an interpretation of the question was indicative of a very specific understanding of the issue, we decided to drop this question from the questionnaire designed for trade firms.[37] This exception notwithstanding, the responses reveal that in our sample of firms, as much as 67 percent of customers are perceived to be regular and only 33 percent of them are considered to be occasional.

Finally, the bottom panel of Table 2.3 provides information on the strength of competition in the main market. To make the comparison of our results with those of the IPN possible, we also measure the degree of competition indirectly, by looking at the importance that firms assign to competitors' prices when setting their own price. In particular, we asked the respondents to evaluate the following statement: 'The market is very competitive; therefore, we set our price in accordance with the market price level.'[38] The set of possible qualitative answers included 'irrelevant', 'of little importance', 'important' and 'very important', which we map into the assessment of the degree of competition as 'very low', 'low', 'high' and 'very high', respectively. It turns out that the main market has very low

or low degree of competition in the case of only 14 percent of firms, while the remaining firms split equally between those that operate in the markets with high and very high competitive pressure. If compared with similar measures reported by the IPN for the euro area, our findings strongly suggest that competition is more widespread in Estonia. This result is the first in a set of other indications revealed by the survey that price setting is on average more flexible in Estonia than in the euro area.[39]

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[35] As in IPN surveys, our questionnaire did not provide a precise definition of a regular customer, allowing firms to decide this on their own. In contrast, Hall et al. (2000) defined long-term customers as those dealing with the firm for at least five years.

[36] By the analysts of EKI involved in organising the survey.

[37] To our knowledge, such customer cards are issued mostly by big retail chains. In that case, the narrow interpretation of the question would have biased our results.

[38] See Q14, Appendix B.

[39] We also inquired about the degree of perceived competition directly, requesting the firms to choose one of the four descriptions of competition in their main market: 'very low', 'low', 'average', 'high', and 'very high'. Only 4 percent of firms indicated that competition is very low or low; 65 percent of them described it as average and high, and 30 percent as very high. These assessments are more subjective, but they reinforce the results based on the interpretation of responses about the importance of competitors' price.

Price reviews

Having reviewed the main characteristics of sample firms and their markets, we turn to the analysis of questions focusing on firms' pricing behaviour. Conceptually, price setting can be thought of as a two-stage process. First, necessary information is collected and processed in order to determine the optimal price. This is the so-called price review stage of price setting. The second phase involves making a decision whether to set the actual price at the newly determined optimal price level or not. Since the latter decision can be negative because the actual price may turn out to be equal to the optimal one or because of some other reason that prevents price adjustment, having information only about actual price changes, i.e. only about the realised outcomes of the second stage of the price setting process, may be insufficient to identify the behavioural patterns necessary to understand price setting adequately. In such a situation, the survey methodology comes in particularly handy as it enables one to address the two different stages of price setting separately (Blinder et al., 1998). In this section, we focus on price reviewing and address such issues as the circumstances under which price reviews are made, the frequency of price reviewing and the scope of information that is used in the process. In addition, we look into whether firms determine their prices according to the mark-up rule, as the pricing theory of imperfect competition would generally predict, or align them with the price level dictated by the market, as would be the case under perfect competition. Issues surrounding price changes will be discussed in the next section.

Similarly to the case of nominal price rigidity in general, we have limited understanding of the reasons that make firms review prices relatively infrequently. Ball and Mankiw (1994) suggested that frequent price reviewing may be undesirable because gathering information is costly. When trying to provide support for their sticky information model, Mankiw and Reis (2002) argued that infrequent re-optimisation could be due to costs of acquiring information, 'the cost of thinking' or some reasons related to bounded rationality.[40] Given the nature of the hypothesised impediments to more frequent price reviewing, they are difficult to investigate by the survey like ours. Hence, although we will return to the information costs hypothesis, when we discuss the results of the surveyed firms' evaluation of different explanations for price stickiness, we do not attempt to infer about the reasons for 'information stickiness' beyond this. Instead, we follow the earlier literature and seek a number of descriptive characteristics of the price reviewing process.

Whatever the reason(s) for discontinuous price revisions, it is useful to know whether firms undertake price reviews mostly in response to certain sufficiently significant shocks or reassess prices on a regular basis. In the literature, these modes of behaviour are referred to as state-dependent and time-dependent pricing, respectively, acknowledging that in the real world, firms may practice both

[40] In their model, all firms change prices in every period but they undertake re-optimisation on the basis of updated information infrequently (at randomly distributed intervals). Hence, price reviewing has a somewhat different interpretation in Mankiw and Reis (2002) than in this chapter.

approaches simultaneously.[41] For example, firms may use the time-dependent approach to approximate the state-dependent behaviour in relatively tranquil times but switch to the state-dependent pricing when some important factor changes significantly.[42]

The questionnaire asked firms if their practice of price reviewing is mostly time-dependent, state-dependent or a mixture of both. Table 2.4 provides information about the share of firms that described their price reviewing as time-dependent. As before, the table allows us to compare our survey results with those reported by the IPN. For the whole sample, 27 percent of Estonian firms say that they review prices regularly. This share does not appear to be very different from those found by the IPN in other European countries, even though it is somewhat lower than the (GDP weighted) average share of 34 percent calculated for the euro area as a whole. It is sometimes said that time-dependent price reviewing is likely to introduce more sluggishness in the process of price adjustments than state-dependent pricing, since the timing of action is not synchronised with the occurrence of a shock (Apel et al., 2005). In fact, money can be neutral in some models with state-dependent pricing.[43] From this point of view, the finding that the incidence of firms with time-dependent price reviewing is on average lower in our sample than in IPN surveys suggests that there is a case for less nominal rigidity in Estonia than in the euro area.

In general, it is unclear whether there are differences in the incidence of time-dependent price reviewing across sectors. Five IPN surveys could provide information on the sectoral distribution of price review strategies but the results were quite mixed (see Table 2.4). In our sample, the share of firms reviewing prices on a regular basis is higher in trade than in the goods sector and in services compared to trade. A similar pattern can be observed in three out of five IPN countries with sectoral results: Belgium, Spain and the Netherlands. Perhaps because this result was not very general, the IPN research team appears to have emphasised a slightly weaker form of it, the more commonly observed tendency for the share of time-dependent price reviewers to be higher in services than in the goods sector (Fabiani et al., 2005). This tendency is more noticeable in the case of Estonia as well: the share of firms reviewing prices on a regular basis is 35 percent in services but only 20 percent in the goods sector. Following the same reasoning as before, we may take this as an indication that price adjustment is likely to be more sluggish in services than in the goods sector.

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[41] See Taylor (1999) for a survey of models of sticky prices in macroeconomics.

[42] To justify this idea, Fabiani et al. (2005) refer to Sheshinski and Weiss (1977), who consider a model featuring costly price adjustment and show that in a constant inflation environment, the resulting optimal price adjustment policy for a monopolistic firm has a (s, S) form. The model is deterministic, however, so the behaviour implied by the (s, S) rule under constant inflation implies regular adjustment of prices.

[43] A famous example is Caplin and Spulber (1987). See Taylor (1999) for a more general discussion.

Table 2.4. Firms following mainly time-dependent rules, percent [a]

	Total	Sector		
		goods	trade	services
BE	26	22	29	24
FR	39	39		
DE	26	26		
ES	33	29	32	40
IT	40	40	35	45
LU	18	23	16	14
NL	36	26	34	40
AT	41	37		44
PT	35	32		63
EA[b]	34	32		
EE	27	20	25	35

Notes: See notes to Table 2.1 for country definitions.
a. Re-scaled figures exluding non-responses.
b. Weighted averages (GDP weights).

At the risk of creating an obvious attractor among the possible answers with regard to the timing of price reviews, we included an option specifying that the practice of price reviewing has both time and (perhaps only occasionally) state-dependent features. The availability of the option encompassing both pricing strategies certainly increased the flexibility of the question to match the complexity of pricing behaviour in the real world. At the same time, the presence of such an option must have strengthened the potential of this question to segregate those firms that follow purely time-dependent price reviewing. Indeed, the 27 percent of firms that opted for describing themselves as time-dependent price reviewers did so in spite of the fact that the mixed-policy option was present among possible answers.

Information about the share of firms that characterise their price reviewing as both time and state-dependent is provided in Table 2.5. On average, half of Estonian firms belong to this category, and although this result seems to be very similar to the average share of 46 percent reported by Fabiani et al. (2005) for the euro area, the Estonian figure is relatively high if we consider only those countries that had broader survey samples (and thus could report the responses by sector). Furthermore, we find that the mixed price-review policy is the most popular in the trade sector, where as many as 62 percent of firms engage in both time and state-dependent price reviewing. The mixed option is the least popular among the services firms (38 percent); as it happens, each price review policy is selected by approximately the same number of firms in this sector.

Table 2.5. Firms following both time and state-dependent rules, percent [a]

	Total	Sector		
		goods	trade	services
BE	40	42	36	48
FR	55	55		
DE	55	55		
ES	28	25	24	34
IT	46	45	62	26
LU	32	27	39	32
NL	18	19	21	16
AT	32	36		29
PT	19	23		17
EA[b]	46	46		
EE	50	50	62	38

Notes: See notes to Table 2.1 for country definitions.

a. Re-scaled figures excluding non-responses.

b. Weighted averages (GDP weights).

Thus, in accordance with Stylised fact 1 proposed by Fabiani et al. (2005),[44] we find that both time and state-dependent pricing strategies are used by Estonian firms, and that the state-dependent pricing behaviour or some elements of it is characteristic of about two-thirds of all firms. The share of firms using mainly time-dependent pricing is somewhat lower in Estonia (27 percent) than in the euro area (34 percent), suggesting that in the presence of shocks, prices can be slightly more flexible in Estonia. Finally, we also confirm the observation that time-dependent pricing is less common in the goods sector than in the services sector, indicating that prices are likely to respond to shocks more quickly in the former than in the latter.

When constructing a question about the information that firms use to determine the price of their main product, we decided to focus on the issue that we deemed to be particularly important in this context, namely, whether firms' behaviour is shaped by the information referring mainly to the present and the past or the present and the future. Hence, unlike the Austrian questionnaire, our survey did not include an option allowing for an encompassing answer 'Past, present, and future

[44] For convenience, the list of stylised facts is provided in Appendix A.

information'.[45] Moreover, in order to distinguish between the past and future perspectives on pricing more clearly, we decided to exclude the 'rule of thumb' alternative as well, since it largely describes backward-looking decision making.

Table 2.6. Information used in pricing decisions, percent

	BE	ES	IT	LU	AT	PT	EA[a]	EE
Rule of thumb	37	33	n.a.	30	n.a.	23		
Past/present context	29	39	32	26	37	29	32	59
Present/future context	34	28	68	44	12	48	55	41
Past, present and future	n.a.	n.a.	n.a.	n.a.	51	n.a.		

Notes: See notes to Table 2.1 for country definitions.
a. Weighted averages (GDP weights).

According to Table 2.6, about 60 percent of Estonian firms make pricing decisions predominantly on the basis of past and present information, whereas the remaining 40 percent of them decide about prices in the present/future context. The predominance of backward-looking firms in our sample clearly contrasts with the corresponding results reported by Fabiani et al. (2005), who conclude that in the euro area as a whole, the proportion of firms practising mostly backward-looking pricing to those making pricing decisions in the present/future context is about the reverse of what we have found in our sample. However, it is easy to notice that there is a substantial degree of variation in the results across individual countries of the euro area (see Table 2.6). For example, the share of firms making pricing decisions in the present/future context was found to be relatively low in Belgium (34 percent) and Luxembourg (43 percent).

To shed more light on these results, Table 2.7 compares the proportions of firms that make their pricing decisions using either mostly 'backward-looking' or 'forward-looking' information sets in the goods, trade and services sectors separately. In the case of the goods sector, our results appear to be quite in line with the findings for the eurozone: the share of firms making pricing decisions in

[45] In our opinion, the issue of whether firms use mainly historical data or predictions about future economic conditions when setting their prices is somewhat more specific and easier to address than trying to inquire whether firms behave optimally or sub-optimally on the basis of how broad, as in 'Past, present, future', or narrow – say, only 'Present, future' – their information set is.

the present/future context is 50 percent in the euro area and 53 percent in Estonia.[46] The outcome that there are more firms setting prices on the basis of mostly past information in the whole sample of Estonian firms is therefore determined by the responses of firms in the trade and particularly the services sector: the share of such firms is 60 and 68 percent in the trade sector and services, respectively. This differs from the corresponding summary figures for the euro area, where the average shares of firms setting prices on the basis of past and present information in the trade and services sector are only 38 and 29 percent, respectively. Interestingly, our findings are not as different if we compare them with the results of some individual country surveys and treat the 'Rule of thumb' option in the case of the latter as a form of backward-looking behaviour in pricing. Then, at least in the services sector, the ratio of firms setting prices using the present/past and present/future context is approximately 2:1 not only in Estonia but also in Belgium, Spain, Luxembourg, and Portugal.[47] In general, however, the tendency for Estonian trade and services firms to limit the information set they use when determining prices to mainly historical data is one of a very few survey results that can be interpreted as pointing toward relatively less flexible pricing behaviour in Estonia.

The importance of the finding that relatively more Estonian firms set prices on the basis of historical information is likely to depend on the frequency of price reviews. For example, backward-looking price setting should matter more for inflation persistence if prices are reviewed (and changed) infrequently. Another reason for investigating the frequency of price reviews is that it should help identify whether nominal rigidities are mostly associated with the price review or the price change phase of the price setting process.

[46] Again, there are considerable differences in the shares of forward-looking price setters among euro area countries, say, Spain (29 percent) and Italy (69 percent). All in all, however, the Estonian goods sector does not appear to be more backward-looking in its price setting than the goods sectors of most other euro area countries, as was the impression comparing the aggregate results.

[47] The share of forward-looking firms is clearly higher in Italy and Austria. The result that about 70 percent of Italian firms are forward looking appears to stand out even among the IPN surveys. In the case of Austria, the comparison of results is complicated by the fact that the Austrian questionnaire included an encompassing option 'Past, present and future'.

Table 2.7. Information used in pricing decisions by sector, percent

	BE	ES	IT	LU	AT	PT	EA[a]	EE
Goods								
Rule of thumb	29	29		28		20		
Past/present context	27	42	31	18	33	32	34	47
Present/future context	45	29	69	54	13	48	50	53
Past, present and future					55			
Trade								
Rule of thumb	35	33		21				
Past/present context	35	49	33	28			38	60
Present/future context	30	18	67	51			47	40
Past, present and future								
Services:								
Rule of thumb	46	37		40		42		
Past/present context	23	30	29	25	35	21	29	68
Present/future context	31	33	71	35	15	38	55	32
Past, present and future					53			

Notes: See notes to Table 2.1 for country definitions.
a. Weighted averages (GDP weights).

Table 2.8 describes the frequency of price reviews in the whole sample of Estonian firms and compares it with the corresponding results reported by the IPN for euro area countries (Fabiani et al., 2005). The table shows the distribution of firms over the following ranges of price review frequencies: twelve or more price reviews, between four and eleven price reviews and three or fewer price reviews per year. In addition, the last row of the table reports the median number of price reviews per year. At the aggregate level, the price review frequency in Estonia turns out to be very similar to that in the euro area as a whole: the share of firms reviewing prices on a monthly basis or more often is 24 percent in Estonia compared to 27 percent in the eurozone, the share of firms reviewing prices between 4 and 11 times a year is 16 percent in both, and, finally, the share of firms that review prices at most three times a year is 61 percent in Estonia and 57 percent in the monetary union. Although there are some exceptions, a similar pattern of frequency distribution can be observed in the majority of euro area countries, so the

synthetic summary measure for the eurozone appears to be quite representative. Given that our results also match the pattern, we can conclude that typically about a quarter of firms review prices on a monthly basis or more often, and about 60 percent of firms do that at most three times a year. Interestingly, the Estonian median of 2 price reviews per year is basically a midpoint in the range of medians reported by Fabiani et al. (2005).

Table 2.8. Frequency of price reviews per year, percent [a]

	BE	DE	ES	FR	IT	LU	NL	AT	PT	EA[b]	EE
≥12	4	30	7	31	28	26	37	29	5	26	24
4 - 11	8	17	7	22	14	20	19	25	26	17	16
≤3	88	53	86	47	57	54	44	46	69	57	61
Median	1	3	1	4	1	4	4	4	2		2

Notes: See notes to Table 2.1 for country definitions.

a. Re-scaled figures excluding non-responses.

b. Weighted averages (GDP weights).

A similar comparison of the frequency of price reviews in Estonia and the euro area by sectors reveals some differences in the case of the goods and trade sectors (Table 2.9). In the goods sector, Estonian firms review prices less frequently. For example, the share of firms reviewing prices at least quarterly is 42 percent in the euro area but only 26 percent in Estonia. The median number of price reviews in this sector in Estonia is one, whereas three out of seven IPN countries for which this measure is reported by Fabiani et al. (2005) have the median equal to four.

In contrast, trade firms review prices more frequently in Estonia than in the euro area. The share of firms reviewing prices on average at least quarterly is 63 percent in Estonia compared to only 44 percent in the eurozone. The fact that prices are reviewed more frequently in the trade sector than in the goods sector is also reflected by a higher median frequency, which is four reviews per year.

Table 2.9. Frequency of price reviews per year by sector, percent [a]

	BE	DE	ES	FR	IT	LU	NL	AT	PT	EA[b]	EE
Goods											
≥12	7	30	5	31	30	11	39	35	20	26	13
4 - 11	12	19	6	22	15	21	19	29	15	16	13
≤3	81	51	90	47	55	68	42	37	65	58	74
Median	1		1	4		2	4	4	2		1
Trade											
≥12	2		17		32	44	56			29	40
4 - 11	4		12		19	11	16			15	23
≤3	94		72		49	44	28			56	37
Median	1		1			4	12				4
Services											
≥12	3		2		20	13	24	24	9	15	16
4 - 11	5		5		11	21	21	22	6	11	11
≤3	92		92		70	67	55	53	85	74	74
Median	1		1			2	1	2	2		2

Notes: See notes to Table 2.1 for country definitions.

a.- Re-scaled figures excluding non-responses.

b. Weighted averages (GDP weights).

Finally, relatively infrequent price reviewing is reported by the firms in the services sector, and here the IPN and our surveys provide very similar results. In particular, only 26 percent of firms in both Estonia and the euro area review prices at least four times a year, while the remaining 74 percent of firms do that less frequently. The finding that price reviewing in the services sector is relatively infrequent was documented by most of the IPN country studies and was presented as one of the stylised facts of pricing behaviour of firms in the euro area. According to our results, however, the frequency of price reviewing in the services sector is not much different from that in the goods sector in Estonia. If anything, the median price reviewing frequency of 2 in services is even higher than the median frequency in the goods sector. In this context, it seems to be more appropriate to stress the fact that it is the trade sector that stands out as reviewing prices more often, perhaps because of the very nature of this business.

This completes our broad overview of the main characteristics of the price review process among Estonian firms. Next, we look into the practices that firms follow when they set and change their prices.

Price changes

The main reason we address reviewing and changing prices separately is that a price review must always accompany a price change but not necessarily result in one. The frequency of price reviews and actual price changes can therefore be quite different. Characterising the frequency of price changes and comparing it with the frequency of price reviews is one of the issues we investigate in this section. Before that, however, we look into the way firms determine the prices they want to set; for example, we inquire whether they practice mark-up pricing or mostly follow competitors' prices and essentially take prices as given by the market. This information should shed some light on how important imperfect competition is in the economy. To cross-check the results and see if they are consistent, we also look at whether mark-up pricing is more likely when the degree of perceived competition is lower. The last question we investigate before turning to discuss the frequency of price changes is the incidence of price discrimination in pricing. This is yet another, somewhat indirect way of learning about firms' market power and the mode of competition in the market.

As can be seen from Table 2.10, the share of firms that have chosen to describe their pricing as a mark-up rule is 53 percent, which is remarkably close to the euro area average of 54 percent. On the other hand, the share of firms that set prices in accordance with competitors' price is 46 percent in Estonia but only 27 in the eurozone. The remaining 20 percent of firms in the IPN surveys have found none of the above two options to be satisfactorily close to their pricing practice and chose the 'Other' option as an answer. Interestingly, only 2 percent of all firms in our sample have followed suit. This leads us to the conclusion that the incidence of mark-up pricing in Estonia is essentially the same as in the euro area, but the share of price taking firms is considerably higher. Note that the latter finding agrees with the earlier observation that the perceived level of competition is also higher in Estonia than on average in the EMU.

Table 2.10. Price setting rules, percent[a]

	BE	DE[b]			ES	FR	IT	NL[b]			PT[c]	EA[d]		EE[e]
		all	con	var				all	con	var		unwa	wa	
Mark-up	46	73	4	69	52	40	42	56	27	30	65	54	54	53
Competitors' price	36	17			27	38	32	22			13	26	27	46
Other	18	10			21	22	26	21			22	20	18	2

Notes: See notes to Table 2.1 for country definitions.

a. Re-scaled figures excluding non-responses.

b. Germany and the Netherlands distinguished between constant (con) and variable (var) mark-ups; 'all' includes both.

c. In the case of Portugal, the issue was not addressed directly; the information reported in the table has been estimated on the basis of the answers to other questions.

d. Reports unweighted (unwa) and weighted (wa) averages.

e. In the case of Estonia, firms were asked to assess the relevance of different price setting rules – the results in the table refer to the most relevant rule chosen.

Table 2.11. Price setting rules by sector, percent [a]

	BE	DE	ES	FR	IT	NL	PT[b]	EA[c]	EE
Weight, %	3.7	29.8	9.8	21.6	17.8	6.3	1.8		
Mark-up									
goods	49	73	55	40	48	63	67	56	58
trade	41		50		16	71		37	53
services	49		50		43	45	48	46	43
Competitors' price									
goods	40	17	24	38	33	19	13	27	38
trade	33		26		35	21		30	47
services	39		31		18	24	8	24	57
Other:									
goods	11	10	22	22	19	18	19	17	4
trade	26		23		49	8		33	0
services	12		20		40	31	44	31	0

Notes: See notes to Table 2.1 for country definitions.

a. Re-scaled figures excluding non-responses.

b. In the case of Portugal the issue was not addressed directly; the information reported in the table has been estimated on the basis of answers to other questions.

c. Weighted averages (GDP weights).

The analysis of responses by sectors (see Table 2.11) reveals that the goods sector tops the list in terms of the share of firms setting prices according to the mark-up rule (58 percent), followed by the trade sector (53 percent) and services (43 percent). Given that very few firms chose 'Other' as their preferred response, basically all the remaining firms — 38 percent in the goods sector, 47 percent in trade and 57 percent in services — characterise themselves as largely price takers. As a result, an interesting pattern emerges if one contrasts the two sectors for which the above results differ the most: the ratio of firms setting prices as mark-ups to those following competitors' price is 60:40 in the goods sector but approximately 40:60 in the services sector. The 60:40 characterisation of the goods market is qualitatively similar to the full-sample result: mark-up pricing is not only widespread but also arguably the dominant price setting practice in the market. The 40:60 outcome for the services sector, on the other hand, indicates that the relative importance of the two price setting practices is quite different in a very considerable part of the economy. Finally, the comparison of our sectoral results with those reported by the IPN for the euro area confirms the pattern we observed when investigating the aggregate figures: the incidence of mark-up pricing is very

similar even at the sectoral level, but the share of price-taking firms is considerably higher in Estonia. One of the shortcomings of survey methodology is that it places limits on how precise a questionnaire can be in using certain theoretical concepts, even though they may have very specific meaning to economists. In other words, it is often the case that survey questions are compromises between theory, scientific rigor and the language that is understandable to ordinary market participants. This limitation notwithstanding, we still expect that the responses we collect will enable us to discriminate between alternative theories and perhaps even validate or reject some of them. For that to be the case, various consistency checks can be applied to infer whether survey evidence is informative and reliable enough, so that it can be used to discriminate between different theories. For example, the credibility of survey results would certainly be questionable if they happened to imply that firms with a lot of market power act as price takers or that price discrimination is common among firms operating in a market that is close to being perfectly competitive.

In this context, we may want to check whether some of our findings concerning price setting rules and the mode of competition are mutually consistent. For example, we already discussed the results of asking firms to evaluate the degree of competition in their main market (Table 2.3) and assess the importance of competitors' prices for their own price setting (Table 2.10). Since both questions can be seen as inquiring about how close (far) the functioning of a given market is to (from) the paradigm of perfectly competitive market, we follow Fabiani et al. (2005) and cross-check the answers by looking into whether the incidence of mark-up pricing is lower when the market is perceived to be very competitive. Figure 2.1 demonstrates that we indeed observe a negative association between the degree of perceived competition and the share of firms practicing mark-up pricing, but the relationship is not very strong. In particular, the incidence of mark-up pricing in the markets with low and high perceived competition is about 65 and 50 percent, respectively. Hence, although the difference in averages points to the right direction, the effect is quite marginal. Note, however, that our results are again very similar to those reported by the IPN.

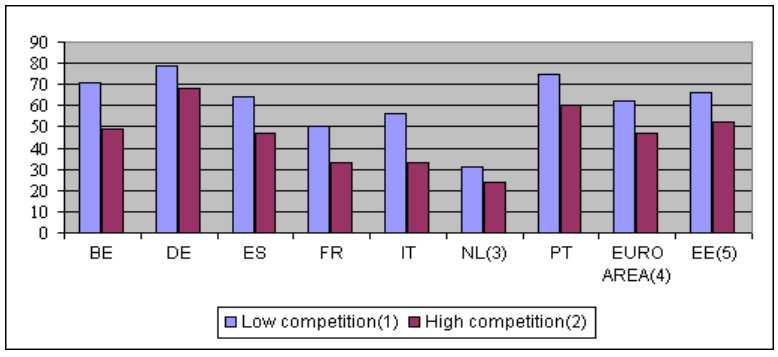

Figure 2.1 Mark-up rule and perceived competition, percent

Notes: For country codes see notes to Table 2.1.

1. Mean share for a 'very low' and 'low' degree of perceived competition.
2. Mean share for a 'very high' and 'high' degree of perceived competition.
3. For the Netherlands, the percentage of firms adopting a fixed mark-up is considered.
4. Weighted average (GDP weights).

In the case of Estonia the firms which considered the perceived competition 'medium' were classified as firms belonging to the low competition group

On the basis of these findings we conclude that our survey provides support for Stylised facts 4 and 5 put forward by Fabiani et al. (2005). In line with the former, we find that mark-up pricing is a predominant price setting practice in Estonia as well. We also confirm that this pricing method is used more frequently in the markets where the level of perceived competition is low. On the other hand, the incidence of prices being shaped mainly by competitors' prices is higher in our sample (45 percent) than in any other euro area country for which such data are provided by the IPN. Hence, we do find support for Stylised fact 5 in principle but note that the high proportion of price taking firms in Estonia exceeds the corresponding average for the euro area (30 percent) referred to in Fabiani et al. (2005). This higher incidence of price taking behaviour suggests that everything else being equal, there is a smaller case for nominal rigidity in Estonia.[48]

Following Fabiani et al. (2005), we have also tried to infer about the prevailing modes of competition in the economy by investigating how common it is for firms to possess enough market power to differentiate prices. In particular, we asked firms whether they practice price discrimination — quantity discounts and even case-by-case price setting — or sell their goods at the same price to all customers. Figure 2.2 shows that about 30 percent of firms set the same price to all customers, slightly more than that practice quantity discounts, and almost 40 of all firms set prices on a case-by-case basis. Perhaps the easiest way to compare these findings with the results reported by the IPN is to focus on the shares of those firms that do not practice price discrimination. The 30 percent share of such firms in Estonia appears to be relatively high in the context of the IPN surveys; since only Spain and Luxembourg report similar shares of non-discriminating firms, our figure is noticeably higher than the 20 percent share corresponding to the euro area average. Obviously, the reverse side of that is a lower incidence of price discrimination in Estonia relative to that in the eurozone. As for the relative significance of quantity discounts versus price setting on the case-by-case basis, both practices are more-or-less equally common among the majority of eurozone countries and Estonia. It is remarkable that so many firms say they set prices on a case-by-case basis.

[48] For example, Small and Yates (1999) find that stronger competition increases the responsiveness of prices to demand shocks. They do not confirm the same in the case of cost changes, however.

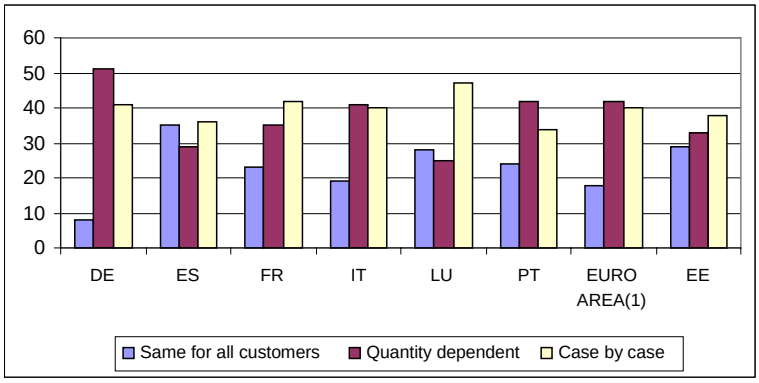

Figure 2.2 Price discrimination

Notes: For country codes see notes to Table 2.1.
Weighted average (GDP weights).

All in all, the evidence on price discrimination provided by our survey is very much in line with the Stylised fact 6 offered by Fabiani et al. (2005) on the basis of IPN surveys. Price discrimination is a common practice in Estonia as well, although here the share of firms practicing price discrimination (70 percent) is slightly lower than that in the eurozone on average (almost 80 percent). Note that this difference can be interpreted as implying that in Estonia, firms are somewhat more constrained by competitive market forces than in most euro area countries.

Finally, we switch our attention from the analysis of price setting practices and their relationship with the degree of competition in the market to the investigation of price changes. Since the nature of price changes has direct implications for the formation of inflation at the aggregate level, we investigate this topic more extensively and address it from several perspectives. First, we look at the frequency of price changes and compare it with the frequency of price reviews, the issue that was discussed earlier in greater detail. In then remaining sections we will investigate the factors that make prices sticky and the relative importance of different factors that induce price adjustments.

The frequency distribution of price changes per year is described in Table 2.12. The table reports the incidence of firms changing prices four or more times a year, two or three times a year, once a year and, finally, less than once a year. The table also shows the median number of price changes and provides all this information in the context of the corresponding statistics from the IPN, which are also reported.

The first thing to notice about the frequency distributions in all euro area countries but Germany and Luxembourg is that they have their modes at one price change per year. One price change a year is also the median frequency in all countries but Luxembourg. As shown in the last column of Table 2.12, the results for Estonia are no exception: the frequency distribution of price changes has both its mode and median at one price change per annum. In fact, even the share of firms that change prices once a year, which according to our survey amounts to 43

percent, is very similar to the respective share for the euro area, which is 39 percent.

Table 2.12. Frequency of price changes per year, percent[a]

	BE	DE	ES	FR	IT	LU	NL	AT	PT	EA[b]	EE
≥ 4	8	21	14	9	11	27	11	11	12	14	18
2 - 3	18	21	15	24	19	27	19	15	14	20	25
1	55	14	57	46	50	31	60	51	51	39	43
< 1	18	44	14	21	20	15	10	24	24	27	14
Median	1	1	1	1	1	2	1	1	1		1

Notes: See notes to Table 2.1 for country definitions.
a. Re-scaled figures excluding non-responses –
b. Weighted average (GDP weights).

However, a closer look at the table reveals that relative to the frequency distributions in euro area countries, the distribution of price changes in Estonia is skewed toward more frequent price changes. For example, only Germany and Luxembourg have more density mass in the case of the highest frequency group of at least four price changes than Estonia. As a result, its 18 percent share of firms belonging to this category exceeds the corresponding average share in the euro area, which is only 14 percent. Two or three price changes per year are reported by 25 percent of all firms, and that exceeds the respective average share in the eurozone by 5 percentage points. Finally, the easiest way to see that the frequency of price changes is higher in Estonia than in the euro area is to compare the densities in the lower tails of the distributions. The share of firms changing prices less often than once a year is 27 percent in the euro area but only 14 percent in Estonia.

We can now compare the frequencies of price reviews and price changes and see whether it is indeed the case that the latter are not as frequent as the former, indicating that nominal rigidity is more likely to be associated with the second stage of the price setting process than the first one. Instead of comparing the corresponding distributions, we follow Fabiani et al. (2005) and carry out the comparison by focusing on the incidence of up to three price reviews/changes per year, as presented in Table 2.13. This particular frequency divides the sample into those firms that on average review/change prices at least quarterly and those that do it less frequently.

According to Table 2.13, 61 percent of firms in our survey review prices at most three times a year, but the share of firms that change prices at this frequency is clearly higher and amounts to 82 percent. This evidence is very much in line with the IPN findings for the euro area, where the corresponding shares are 60 and 86 percent in the case of price reviews and changes, respectively.

Table 2.13. Comparison of price reviews and price changes per year, percent[a]

	BE	DE	ES	FR	IT	LU	NL	AT	PT	EA[b]	EE
Reviews ≤ 3	88	53	86	47	57	54	44	46	72	57	61
Changes ≤ 3	91	79	88	91	89	73	89	90	88	86	82

Notes: See notes to Table 2.1 for country definitions.

a. Re-scaled figures excluding non-responses.

b. Weighted averages (GDP weights).

To summarise, we find that the frequency of price changes is somewhat higher in Estonia than in euro area countries. That is especially evident if we consider the incidence of firms that change prices less often than once a year. The share of such firms in the euro area is 26 percent but only 14 percent in Estonia. In addition, we find clear support for Stylised fact 9 in Fabiani et al. (2005) that price changes are less frequent than price reviews (see Appendix A). Given that the incidence of price reviews is not binding for the frequency of price changes on average, the latter are relatively infrequent either because some price reviews show that price changes are unnecessary or because there are additional reasons that make firms unwilling to change prices. In the following section, we investigate which of a number of such explanations for price stickiness that economists have proposed seem to be the most relevant for the firms in our sample.

Price stickiness

There are many theories that aim to explain nominal price rigidity. However, as noted by Blinder (1991) and Blinder et al. (1998), assessing the empirical validity and relevance of different theories in this research area has proved to be particularly difficult. Partly because some theories are observationally equivalent, partly because the explanations are often based on the behaviour of certain variables that we cannot observe and measure. As an alternative, Blinder (1991) proposed using business surveys as a means of investigating price stickiness and even of inquiring about the empirical relevance of respective economic theories. Following that work and the surveys undertaken by the IPN, we also included a set of questions in the questionnaire asking firms to evaluate the relevance of a number of proposed explanations for what makes them refrain from or postpone price changes. In particular, we inquired about nine out of ten different reasons for nominal rigidity investigated by the IPN. The fact that different studies have implemented these inquiries using very similar questions and evaluation scales makes comparing our results and previous findings relatively easy. The second set of results we discuss in this section includes a summary of firms' responses to our inquiry about how much time it takes for firms to react to shocks by changing prices. As pointed out by Blinder et al. (1998), this question represents the most

direct way of learning about the existence and degree of price stickiness in the economy. In this context, it is particularly interesting to compare our results with those in Fabiani et al. (2005).

Table 2.14. Ranking of theories explaining price stickiness

	EA[a]	US	SW	UK	EE	EE ($p\uparrow$)[b]	EE ($p\downarrow$)[c]
Implicit contracts	1	4	1	5	2	1	2
Explicit contracts	2	5	3	1	3	2	5
Cost-based pricing	3	2	2	2	1	3	1
Co-ordination failure	4	1	4	3	4	4	4
Temporary shocks	5						
Judging price by quality	6	12		10	5		3
Change non-price factors	7	3		8	6	6	6
Menu costs	8	6	11	11	8	8	8
Costly information	9		13		9	7	9
Pricing thresholds	10	8	7	4	7	5	7

Notes: SW = Sweden. See notes to Table 2.1 for other country codes.

a. The ranking of the theories is based on the unweighted average of countries' scores.

b. The case of price increases.

c. The case of price decreases

The first column of Table 2.14 provides a list of explanations of price stickiness we asked firms to evaluate. The first two, referred to as implicit and explicit contracts, focus on the firm-client relationship and hypothesise that prices are not changed either because firms think that their customers prefer stable prices and thus expect that firms will guarantee price stability implicitly or because there are legally binding contracts or other explicit agreements that specify prices for some period of time, respectively. The explanation under the 'cost-based pricing' entry stipulates that firms delay price changes because they wait until their costs change and only then adjust prices accordingly. The hypothesis that firms do not alter prices because they are not sure that their competitors will follow suit is named co-ordination failure in Table 2.14. The idea that prices signal quality, and therefore firms refrain from lowering prices because they think that customers will perceive that as an indication of the product quality being degraded is listed as 'Judging quality by price'. Note that this explanation is applicable only for explaining downward price rigidity. The next explanation suggests that firms keep prices constant because they change the effective price of their product by adjusting other, less transparent characteristics of the product such as delivery terms and conditions. We also inquired if the firms think that certain specific costs associated with changing prices represent the reason for adjusting prices relatively infrequently. Although our previous findings already established that price reviews

are more frequent than price changes, we nevertheless asked firms to consider the hypothesis that prices are changed infrequently because of information costs associated with recalculating the optimal price. Finally, we inquired about the importance of attractive pricing (pricing thresholds) for nominal price stickiness.

To ensure the comparability of our results with those of previous surveys, we asked the firms to evaluate the relevance of the above explanations according to a 4-point scale that was often used in other studies: 1 – not important, 2 – of minor importance, 3 – important, 4 – very important. Table 2.14 provides the ranking of the explanations on the basis of the average scores that they received according to this 1–4 scale. Importantly, to capture possible asymmetries, we asked the firms to evaluate the hypotheses in the case of price increases and decreases separately. This enables us to report separate rankings for price increases and decreases, shown in columns EE($p\uparrow$) and EE($p\downarrow$), respectively, as well as the overall ranking based on pooled evaluations in Table 2.14.

It is quite evident from Table 2.14 that businesses tend to favor more-or-less the same explanations for price stickiness in spite of the fact that surveys are carried out in different countries and using somewhat different questionnaires. For example, the same four theories top the list according to the evidence obtained by the IPN and our survey. In particular, this set includes explanations based on the existence of implicit and explicit contracts, cost-based pricing and coordination failure. The only difference between the top-four rankings is the relative position of the hypothesis about cost-based pricing; it is ranked third in Fabiani et al. (2005) but appears to be the most important reason for price stickiness in Estonia. Note, however, that even this difference disappears if we ask firms to focus on upward price rigidity; in that case, cost-based pricing drops to the third place and the top-four ordering becomes identical.

No less interesting implications result if we differentiate the ranking of theories with respect to the direction of price changes, that is, whether the firms are refrained from increasing or decreasing prices. As mentioned above, the top four positions in the ranking corresponding to the upward price stickiness are given to the explanations based on implicit and explicit contracts, cost-based pricing and co-ordination failure. In contrast, the top four theories in the case of downward price stickiness are cost-based pricing, implicit contracts, judging quality by price and co-ordination failure. As a result, the comparison of the two rankings has several interesting implications. First, firms say that they do not want to lower prices unless and until after their costs have declined. Although the same argument is relevant in the case of price increases as well, it is not the most important consideration hindering price adjustment anymore. The understanding that prices should not be raised because customers dislike that is more important for upward price rigidity. Second, the presence of explicit contracts is not that important a cause of downward price stickiness, but the implicit understanding that customers prefer stable prices is. Third, judging quality by price ranks third in the list for downward price stickiness. This finding is quite remarkable, as it seems to be rather specific to our survey. Finally, Table 2.14 hints that pricing thresholds are quite more important for upward price stickiness in our survey than it is generally found to be in the euro area (Fabiani et al., 2005).

At this point, it is useful to consider our main findings concerning the reasons for sticky prices in the light of similar results by the IPN, which Fabiani et al. (2005) generalised in the form of Stylised fact 9. In particular, Fabiani et al. (2005) concluded that implicit and explicit contracts are the most relevant causes of price stickiness in the euro area, followed by cost-based pricing and co-ordination failure. They also noted that the first two explanations support the view that price stickiness largely results from customers' preference for stable nominal prices and that the four top-ranking explanations taken together imply that the main reasons preventing more frequent price adjustment are related to the price change stage rather than the price review stage of the price setting process. We can confirm, in turn, that the ranking of explanations for price stickiness in Estonia is broadly similar to that in the euro area, so the main implications carry through. We have evidence, however, that cost-based pricing and pricing thresholds are relatively more important reasons for sticky prices in Estonia than in the eurozone. In addition, our results indicate that there are differences between the most relevant reasons for upward and downward price stickiness. In particular, implicit contracts matter especially in the case of the former, while cost-based pricing and judging quality by price are more essential for the latter; the explanation based on the presence of explicit contracts is equally important in both cases.

It is possible that the differences between our and IPN findings with regard to the most relevant explanations for price stickiness result from differences in the sample coverage. For example, it can be argued that pricing thresholds appear to be more important in Estonia because our sample includes the trade sector and that is not always the case in the IPN country surveys. On the other hand, the possibility that there are systematic differences in the reasons for price stickiness among sectors is an interesting hypothesis in itself. We therefore look into the relative standing of the different explanations for price stickiness by sector. The average scores that the explanations received in the goods sector, trade sector and services are presented in Tables 2.15, 2.16 and 2.17, respectively.

According to Table 2.15, the four most relevant explanations for price stickiness in the goods sectors of Estonia and the eurozone as well as their respective rankings are essentially identical to those discussed in the case of aggregate results. As before, the top of the list is occupied by the explanations referring to implicit and explicit contracts, cost-based pricing and co-ordination failure. In fact, even the previous finding that cost-based pricing matters relatively more in the case of Estonia seems to emerge again. As for the remaining five explanations that do not receive much support, all of them get slightly higher evaluations in our survey than the average scores in the euro area as a whole. However, the 2.0 score that pricing thresholds got in our survey is considerably higher than the 1.5 average score received by this hypothesis in the case of the euro area, suggesting that differently from manufacturing firms in the eurozone, firms in the goods sector of Estonia do not consider this explanation for sticky prices to be completely irrelevant.

Some important differences in the ranking of explanations for nominal rigidity emerge if we turn to consider the trade sector (see Table 2.16). In the case of Estonia, cost-based pricing is still the most relevant reason for price stickiness (implicit contracts in the euro area), but it is very closely followed by the

explanation referring to pricing thresholds. Somewhat surprisingly, the latter result does not show up in the case of trade firms in the IPN surveys. The average score that the explanation based on pricing thresholds received in the euro area is 2.0, which is higher than the corresponding score in the case of its goods sector (1.5) but considerably lower than both the leading theory in the case of the trade sector in the eurozone (implicit contracts with the average score of 2.5) and the 2.5 average that pricing thresholds scored among the trade firms in our survey. The third and fourth most popular explanations for price stickiness in the trade sectors of Estonia are implicit contracts and co-ordination failure, which lead the list in the case of trade firms of the euro area as well. Finally, note that explicit contracts are rather unimportant for price rigidity according to trade firms in both our and IPN surveys (rank 6 in Estonia and 4–5 in the euro area).

Finally, in the case of the services sector, the four most relevant explanations for price stickiness in the euro area as well as Estonia are implicit and explicit contracts, cost-based pricing and co-ordination failure (see Table 2.17). Since that is exactly the same set of reasons for nominal rigidity that dominated the list when we considered the rankings at the aggregate level and the goods sector alone, it seems appropriate to conclude that these explanations indeed represent the four major impediments of more frequent price adjustment in both economies. That is particularly so in the case of the explanation referring to the presence of implicit contracts between firms and their customers. According to Table 2.17, this reason for price stickiness is acknowledged as the most relevant by services firms in our and almost all IPN surveys. Note, however, that there are two explanations, namely, judging quality by price and changing non-price factors, that received considerable support among the service firms in our sample but not in the majority of IPN surveys. The indication that judging quality by price is more relevant for pricing decisions in Estonia is most easily noticeable in the case of services firms, but the same tendency can be noticed in the other two sectors as well (see Tables 2.15 and 2.16). All in all, judging quality by price is a more important consideration in the pricing decisions of firms in Estonia than in the euro area.

Table 2.15. The scores of explaining of price stickiness – goods sector

	BE	DE	ES	FR	IT	LU	NL	AT	PT	EA[a]	EE
Implicit contracts	2.7		2.5	2.2		2.6	2.8	3.1	3.2	2.7	2.7
Explicit contracts	2.6	2.4	2.2	2.7	2.7	2.8	2.6	2.9	2.6	2.6	2.7
Cost-based pricing	2.4	2.2		2.5		2.7		2.7	2.7	2.5	2.7
Coordination failure	2.4		2.4	3.0	2.6	2.1	2.2	2.4	2.9	2.5	2.5
Temporary shocks	1.9	1.9	1.8	2.1	2.0	1.9	2.5	1.6	2.5	2.0	
Judging price by quality	1.9		1.7			1.8	2.4	1.8	2.3	2.0	2.2
Change non-price factors	2.0		1.4			1.9	2.1	1.6		1.8	2.1
Menu costs	1.5	1.4	1.3	1.4	1.5	1.7	1.6	1.5	1.9	1.5	1.8
Costly information	1.7		1.3			1.7		1.7	1.7	1.6	1.8
Pricing thresholds	1.5		1.3	1.6	1.3	1.6	1.7	1.3	1.8	1.5	2.0

Notes: See notes to Table 2.1 for country definitions.
a. Unweighted average of countries' scores

Table 2.16. The scores of explaining of price stickiness – trade sector

	BE	DE	ES	FR	IT	LU	NL	AT	PT	EA[a]	EE
Implicit contracts	2.4		2.6			2.4	2.6			2.5	2.4
Explicit contracts	1.8		1.9		1.9	2.3	2.3			2.1	2.2
Cost-based pricing	2.5					2.3				2.4	2.6
Co-ordination failure	2.2		2.6		2.7	2.4	2.3			2.4	2.4
Temporary shocks	1.8		1.8		2.1	1.7	2.4			2.0	
Judging price by quality	2.1		1.8			2.1	2.4			2.1	2.3
Change non-price factors	1.7		1.3			1.8	2.0			1.7	2.1
Menu costs	1.7		1.6		1.8	1.7	1.9			1.7	2.0
Costly information	1.6		1.4			1.7				1.6	2.0
Pricing thresholds	2.1		1.7		2.0	2.0	2.1			2.0	2.5

Notes: See notes to Table 2.1 for country definitions.
a. Unweighted average of countries' scores

Table 2.17. The scores of explaining of price stickiness – services sector

	BE	DE	ES	FR	IT	LU	NL	AT	PT	EA[a]	EE
Implicit contracts	2.7		2.6			2.8	2.8	3.0	3.0	2.8	2.9
Explicit contracts	2.7		2.6		3.0	2.8	2.5	3.0	2.8	2.8	2.7
Cost-based pricing	2.5					2.8		2.5	2.7	2.6	2.7
Co-ordination failure	2.0		2.4		2.3	2.0	2.1	2.1	2.7	2.2	2.6
Temporary shocks	1.7		1.8		1.9	1.7	2.3	1.5	2.2	1.9	
Judging price by quality	2.0		2.0			2.3	2.5	1.9	2.2	2.1	2.5
Change non-price factors	1.6		1.3			1.7	1.9	1.8		1.7	2.5
Menu costs	1.4		1.4		1.6	1.9	1.6	1.5	1.9	1.6	1.9
Costly information	1.6		1.3			1.8		1.6	1.7	1.6	1.9
Pricing thresholds	1.6		1.6		1.3	1.7	1.7	1.2	1.9	1.6	2.1

Notes: See notes to Table 2.1 for country definitions.

a. Unweighted average of countries' scores

The final issue we consider in this section is the speed of price adjustment, measured by the amount of time it takes for firms to change their prices in response to a shock. We asked the firms to consider four different shocks — higher demand, lower demand, higher costs, and lower costs — that are significant enough to make them willing to change the price, and inquired how much time, on average, it would normally take them to actually change their prices. We offered the following six options as possible answers: up to one month, from 1 to 3 months, from 3 to 6 months, from 6 months to one year, more than one year and, finally, the option saying that prices are not changed at all. We summarise these results for all firms of our survey in the bottom of Table 2.18. As before, we also show the respective findings of IPN surveys as reported by Fabiani et al. (2005).

A comparison of the bottom panel of Table 2.18 with the rest of the table shows very clearly that firms would change prices considerably quicker in Estonia than in the reference euro area countries. Even if we compare the implied speed of price adjustment in Estonia and Luxembourg, the country where the price adjustment is arguably the fastest among the sample of eurozone countries, the case for less price stickiness in Estonia carries through strongly. In particular, more than 60 percent of firms in our sample say they would adjust prices to changes in demand within one month. In contrast, the share of such firms in Luxembourg is only 35–40 percent. The difference between the incidence of firms that would alter prices in response to changes in costs within one month is not as great but still present: 51–52 percent in Estonia versus 40–47 in Luxembourg. It is worth stressing, however, that in Luxembourg, firms respond to shocks considerably more promptly than in the other euro area countries described in Table 2.18. All in all, it seems fair to say that according to this survey evidence, the share of firms that would change prices within one month after the occurrence of a shock is about twice as large in Estonia as in the euro area. We interpret this finding as a direct indication of a relatively higher nominal flexibility in Estonia.

The same conclusion can be reached even more easily if we consider an alternative way to compare the nature of price adjustment to shocks across different countries, namely, by contrasting the incidence of firms that say they would not adjust their prices at all. Surprisingly or not, the proportions of firms that choose this option as an answer are usually non-trivial, and they are reported in Table 2.19. The table shows very clearly that the share of firms that would not adjust prices in response to a demand or cost shock is systematically and considerably (about three times) lower in Estonia than in the reference euro area countries. Again, we take this as direct evidence of a relatively higher flexibility of prices in Estonia.

Table 2.18. Speed of price adjustment after shocks, percent[a]

	Higher costs	Lower costs	Higher demand	Lower demand
ES				
≤ 1 month	18	21	15	13
1-3 months	17	21	18	18
≥ 3 months	65	58	67	69
FR				
≤ 1 month	35	37	34	31
1-3 months	34	35	27	29
≥ 3 months	31	28	39	40
LU				
≤ 1 month	34	42	47	40
1-3 months	24	31	25	28
≥ 3 months	42	27	28	32
AT				
≤ 1 month	4	3	2	2
1-3 months	51	71	65	61
≥ 3 months	45	26	33	37
PT				
≤ 1 month	22	28	24	23
1-3 months	31	32	27	33
≥ 3 months	47	40	49	44
EE				
≤ 1 month	63	66	51	52
1-3 months	20	19	24	26
≥ 3 months	17	14	24	22

Notes: See notes to Table 2.1 for country definitions.

a. Re-scaled figures excluding non-responses

Table 2.19. Firms not adjusting their prices in response to a shock, percent[a]

	Higher demand	Lower demand	Higher costs	Lower costs
ES	33	26	13	25
FR	23	22	18	27
LU	38	33	12	32
AT	63	52	8	38
PT	34	26	9	19
EE	12	9	4	14

Notes: See notes to Table 2.1 for country definitions.

a. Re-scaled figures excluding non-responses

Having compared the survey evidence concerning the speed of price adjustment in Estonia and some euro area countries, we may next ask whether the source and direction of a shock matters for how promptly firms respond by adjusting their prices. In this regard, no particular pattern emerges from the IPN data presented in Table 2.18. Our results, on the other hand, seem to suggest that firms change prices more promptly in response to demand rather than cost shocks. For example, the incidence of firms that would change prices within a month after a demand shock is 60 percent compared to the 50 percent incidence in the case of a cost shock. This, of course, implies that the share of firms postponing price adjustment is higher in the case of cost than demand changes. For example, the share of firms that would respond to a cost shock with a 1–3 month delay is 24–26 percent, but only 19–20 percent of firms would postpone their price adjustments for that much after a demand shock. The difference in the incidence is even bigger in the case of price adjustments that are delayed for more than three months. All in all, our results suggest that firms are somewhat more sluggish when changing prices in response to cost shocks than demand shocks. However, given that we cannot observe the same pattern in the survey results of other countries, we leave this conjecture as a hypothesis for our follow-up research project in which we will analyse the Estonian survey data in greater detail.

Determinants of price changes

One of the most interesting general patterns that emerged from the IPN survey evidence was the finding that there is an asymmetry in terms of those factors that are more important for resulting in price increases and those that are more relevant for causing price decreases. Fabiani et al. (2005) have summarised this result in the form of Stylised fact 11, which says, in particular, that cost shocks appear to be more relevant in making prices be adjusted upwards than downwards but that changes in market conditions, such as shocks to demand and competitors' price, are more important for price decreases than increases. In this section, we look into the

importance of different factors for price increases and decreases as well as potential asymmetry using our survey data.

In the questionnaire, we asked firms to consider five factors and evaluate their relevance for resulting in price increases and decreases, one at a time. The set of factors included (changes in): labour costs, costs of raw materials, financial costs, demand and competitors' price. The evaluations were made using the same 1–4 scale. Tables 2.20 and 2.21 report the average scores that these factors receive in the case of price adjustments upwards and downwards, respectively.

Table 2.20. The importance of different factors driving price increases, mean scores

	BE	DE	ES	FR	IT	LU	NL	AT	PT	EA[a]	EE
Labour costs	2.9	2.7	2.7	2.5	2.9	3.5	2.7	3.4	3.3	3.0	2.8
Costs of raw material	2.9	3.4	3.1	3.0	3.3		2.5	3.1	3 .6	3.1	3.6
Financial costs	2.2	1.9	1.8		2.3	3.0	2.1	1.9	2.5	2.2	1.7
Demand	2.2	2.2	2.4	2.0	2.4	2.3	2.3	1.9	2.5	2.2	2.5
Competitors' price	2.5	2.1	2.5	2.3	2.6	2.4	2.5	2.0	2.7	2.4	2.7

Notes: See notes to Table 2.1 for country definitions.
a. Unweighted average of countries scores.

According to Table 2.20, the factor that is particularly relevant for driving prices up in Estonia is increases in the cost of raw materials. Its average score of 3.6 is very high indeed. Increases in labour costs represent the second most important reason for raising prices, closely followed by changes in competitors' price. Increases in demand are relatively less important, while changes in financial costs turn out to be basically immaterial. In principle, these results are not very different from the respective findings by the IPN but it is fair to say that the relevant divide between the cost factors and the remaining ones is not as clear-cut in Estonia as, say, in the case of the euro area as a whole. What we observe is an overwhelming agreement about the significance of rises in the cost of raw materials and the irrelevance of increases in financial costs for pushing prices up. The importance of changes in labour costs and competitors' price receive more-or-less equal support.

On the other hand, the dominant factors behind price decreases in Estonia are reductions in competitors' price, demand and costs of raw materials (see Table 2.21). Decreases in labour costs are not as important, while reductions in financial

costs are essentially irrelevant again.[49] Compared to the scores assigned to the five price determinants in Table 2.20, the ranking of price factors in Table 2.21 shows that in the case of price decreases, the emphasis is shifted toward competitors' price and demand. The relevance of changes in the cost of raw materials is not as overwhelming now but still remains high.

Table 2.21. The importance of different factors driving price decreases, mean scores

	BE	DE	ES	FR	IT	LU	NL	AT	PT	EA[a]	EE
Labour costs	2.1	1.9	2.0	1.9	2.4	2.6	2.1	1.3	3.0	2.1	2.0
Costs of raw material	2.3	2.8	2.6	2.6	2.9		2.0	2.2	3.3	2.6	2.9
Financial costs	1.8	1.6	1.5		2.1	2.5	1.8	1.6	2.3	1.9	1.7
Demand	2.5	2.4	2.4	2.3	2.8	2.7	2.5	2.0	3.0	2.5	2.9
Competitors' price	2.9	2.6	2.7	2 .8	2.8	2.8	2.7	2.6	2.9	2.8	3.0

Notes: See notes to Table 2.1 for country definitions.
a. Unweighted average of country scores.

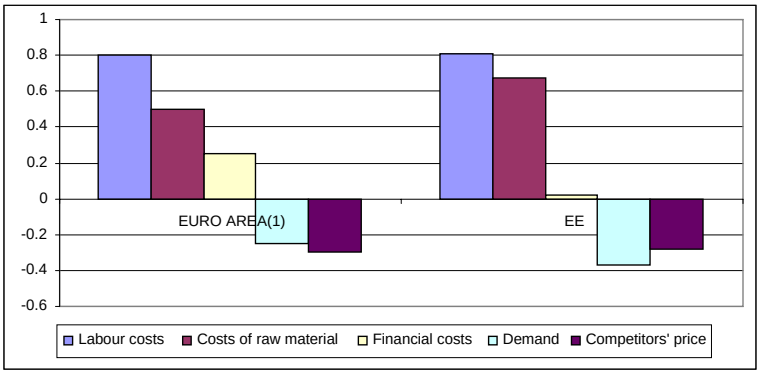

Figure 2.3 Asymmetries in price-driving factors

Notes: Differences between scores regarding price rises and price decreases.
1. Unweighted average of country scores

[49] It could be the case that the score assigned to labour costs is biased downwards due to the fact that there have hardly been any decreases in labour costs in the recent past, but we have no reference point to assess that. If anything, our average score for this factor is quantitatively very similar to the average for the eurozone reported by Fabiani et al. (2005).

Finally, to demonstrate and confirm the kind of asymmetry in price driving factors emphasised by Fabiani et al. (2005), we plot the difference between the average score that each of the five price determinants received in the question about price increases (Table 2.20) and the average score that they obtained in the inquiry about price decreases (Table 2.21). Figure 2.3 shows very clearly that the diagram corresponding to our findings is remarkably similar to the one drawn for the euro area. Figure 2.3 succinctly demonstrates that in the euro area as well as Estonia, cost factors are relatively more relevant for inducing price increases, while demand and competitors' price are more important for resulting in price reductions. Hence, our survey shows that Stylised fact 11 put forward in Fabiani et al. (2005) also applies to Estonia.

Conclusions

Our main objectives in this chapter are twofold: to provide a broad overview of the price setting survey of Estonian firms and to evaluate our main findings in the context of results obtained by similar research projects in the euro area. In the case of both undertakings, we drew substantially from Fabiani et al. (2005), taking their proposed stylised facts about the pricing behaviour of firms in the euro area as the main guidelines for our work.

Generally, the price setting patterns that emerge from our survey are quite similar to those observed in euro area countries. The points on which our findings accord with the conclusions of Fabiani et al. (2005) are as follows. First, our results suggest that the assumption of monopolistically competitive markets is a better description of reality than perfect competition paradigm in Estonia as well. For example, our analysis shows that the majority of firms set prices following mark-up rules, and that price discrimination is a very widespread phenomenon. It is worth noting, however, that the incidence of price taking behaviour is also non-negligible in Estonia and, in fact, is considerably higher than in the eurozone, suggesting that the pricing behaviour in certain segments of the economy may be reminiscent of perfect competition.

Second, we find that the majority of firms follow pricing rules that allow for elements of state-dependence. In fact, the share of such firms is somewhat higher in Estonia because the incidence of purely time-dependent pricing is lower in our sample than in the IPN country surveys. Everything else being equal, state-dependence implies more flexibility in price setting than time dependence.

Third, our survey data confirm that the main reasons for price stickiness are explicit: implicit contracts, coordination failure and cost-based pricing. In this context, the finding that is more specific to Estonia is the relative importance of explanations based on judging quality by price and pricing thresholds.

Finally, we find support for the stylised fact that firms adjust prices asymmetrically in response to shocks: cost shocks are more important for resulting in price increases than price decreases; reductions in demand are more likely to induce price changes than increases in demand.

On the other hand, a number of findings, including some already listed above, indicate that price setting is more flexible in Estonia than in the euro area. First, the share of firms using mainly time-dependent pricing rules is slightly lower in Estonia than in most of the euro area countries. Second, prices of around 45 percent of Estonian firms are mainly shaped by competitors' prices. Compared to other euro area countries for which these data are available, the Estonian ratio is the highest. Third, price changes are somewhat more frequent in Estonia than in the euro area. Finally, the speed of price adjustment after shocks is considerably higher and the share of firms not changing prices in the case of shocks is lower in Estonia than in the euro area. Basically the only result that points in the direction of higher price stickiness in Estonia is the finding that the share of firms setting prices in a forward-looking manner (as indicated by the information set they use) is lower in Estonia than in euro area countries.

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APPENDIX A

Stylised Facts

Fabiani et al. (2005) put forward the following list of stylised facts characterising the pricing behaviour of firms in the euro area:

Stylised fact 1. Both time and state-dependent pricing strategies are used by euro area firms. Around one-third of the companies follow time-dependent pricing rules while the remaining two-thirds use pricing rules with some element of state-dependence.

Stylised fact 2. Around half of the firms review their prices taking into account a wide range of information, including both past and expected economic developments; one-third of them adopt a backward-looking behaviour.

Stylised fact 3. In most countries the modal number of price reviews lies in the range of one to three times a year. Services firms review prices less frequently than firms in the other sectors. Firms facing high competition pressures review their prices more frequently.

Stylised fact 4. Mark-up (constant or variate) pricing is the dominant price setting practice adopted by firms in euro area. The lower the level of competition, the more frequently used this method is.

Stylised fact 5. Prices of around 30% of euro area firms are shaped by competitors' prices.

Stylised fact 6. Price discrimination is common practice for euro area firms.

Stylised fact 7. Competitors' prices on the foreign market and transportation costs are the most relevant factors for pricing to market behaviour.

Stylised fact 8. The median firm changes its price once a year. Prices are stickier in the services sector and more flexible in the trade sector. In most countries, firms facing strong competition pressures adjust their prices more frequently.

Stylised fact 9. Price changes are less frequent than price reviews.

Stylised fact 10. Implicit and explicit contracts are the most relevant explanations for sticky prices, which suggests that price rigidities are associated with customers' preference for stable nominal prices. Other relevant explanations rest on cost-based pricing and co-ordination failure. These results suggest that the main impediments for more frequent price adjustment are associated with the price change stage rather than with the price review stage of the price setting process.

Stylised fact 11. Cost shocks are more relevant in driving prices upwards than downwards, while shocks to market conditions (changes in demand and the competitors' price) matter more for price decreases than for price increases.

Stylised fact 12. Firms in highly competitive markets are more likely to respond to changes in underlying factors, especially in the case of demand shocks.

APPENDIX B

Questionnaire

GENERAL INFORMATION

Q: 1
How many employees on average were on the payroll in your company in the year 2004?
…… employees (open answer, number is entered)

Q: 2
How large was the turnover of your company in 2004?
……..… kroons (open answer, number is entered)

Q: 3
What was the cost structure of your company in 2004 (as a proportion of the total expenses)?

(3) purchased goods, services, materials, energy …….%
(4) labor costs …….%
(5) amortization …….%
(6) other costs (incl. other taxes) …….%
Total …….%

When answering the following questions please consider the product or product group that generates the largest share of your total turnover in the Estonian market and that is considered as a whole in terms of price setting. Further on this product is referred to as the "main product sold in the Estonian market".

Q: 4
What is the main product of your company in the Estonian market?
……

Q: 5
What was the share of the main product of your company distributed in the Estonian market in the total sales revenue in 2004?
…….% of the total sales revenue

Q: 6
What was the share of the main product of your company in the sales revenue of the Estonian market?
…….% of the sales revenue in the Estonian market

Q: 7
Does your firm have the possibility to set the price itself or is it set by

somebody else? (Please choose one option per row.)

		Completely	*Partly*	*Not at all*
(10)	*We set the price ourselves*	*1*	*2*	*3*
(11)	*Prices are set by the parent company/head office*	*1*	*2*	*3*
(12)	*Prices are set/regulated administratively by the government or the local authorities*	*1*	*2*	*3*
(13)	*Our main customers determine the price*	*1*	*2*	*3*
(14)	*Other (please specify)* ……	*1*	*2*	*3*

MARKET STRUCTURE

Please note that all the following questions only refer to the <u>main product of your company in the Estonian market.</u>

Q: 8
How would you characterize the degree of competition for your main product in the Estonian market? (Please choose one option.)

	Very tight	1
	Tight	2
(16)	Medium	3
	Weak	4
	Very weak or no competition	5
	Do not know/cannot say	6

Q: 9

What is the distribution of the sales turnover of your main product in the Estonian market by the following customer groups? (Please indicate the answer in percentages.)

(17)	Directly to consumers	……%
(18)	Companies and institutions	……%
	Total	……%

Q: 10

What is the share of regular customer groups in the sales revenue of your main product in the Estonian market?

(19) the share of the regular customer groups in the Estonian market in the sales revenue in the Estonian market is ……..%

Q: 11

Is the selling price (the price actually charged) of your main product in the Estonian market the same for all your customers simultaneously? (Please choose one option.)

	Yes, the selling price is the same for all customers	1
	The selling price varies according to the quantity sold	2
(20)	The selling price is decided case by case	3
	The selling price varies according to other indicators	4
	(Please specify) ……	

Q: 12.

Do you make arrangements with your customers in the Estonian market in which you guarantee to offer your main product at a specific price for a certain period of time?

	No	1	(please continue with question 13)
(22)	Yes	2	

Q: 12A

Transactions under such arrangements account for …….. share of your sales revenue in Estonia. (Please choose one option.)

	0–25%	1
(23)	26–50%	2
	51–75%	3
	76–100%	4

Q: 12B

If you have such arrangements in place, for how long do you usually guarantee the fixed selling price? (Please indicate the number of months.)

(24) Usually we guarantee the fixed selling price for …….. months.

Q: 13

Keeping everything else constant (including the price of your competitors), if you decided to increase the price of your main product in the Estonian market by 10%, to what extent would the quantity sold by your company change? (Please choose one option.)

(25)
- Quantity would decrease by approximately …..% 1
- Quantity would remain unchanged 2
- Quantity would increase by approximately …..% 3
- Do not know/cannot say 4

GENERAL PRICING

Q: 14

To what extent are the following pricing methods relevant in your company when determining the selling price of your main product in the Estonian market?

(Please choose one option per row.)

		Unimportant	*Minor Importance*	*Important*	*Very important*	*Do not know*
(28)	*We proceed from the cost price and add a profit ratio*	*1*	*2*	*3*	*4*	*5*
(29)	*The market is very competitive; therefore we set our price in accordance with the market price level*	*1*	*2*	*3*	*4*	*5*
(30)	*The price is regulated administratively by the government or the local authorities*	*1*	*2*	*3*	*4*	*5*
(31)	*The price is dictated*	*1*	*2*	*3*	*4*	*5*

	mainly by our customers					
(32)	*Other principle (please specify) …… ……*		*2*	*3*	*4*	

PRICE REVIEWING

Note: Consider a price revision (price recalculation) as a discussion, analyze or assessment of all information and factors relevant for price determination. However, price revision does not necessarily mean that the price is actually changed.

Q: 15
Do you review (recalculate) the price of your main product in the Estonian market…? (Please choose one option.)

(34)
… regularly, at specific time intervals 1
(please continue with question 15A)
… in response to specific events (e.g. the market situation has changed) 2
(please continue with question 16)
… at specific time intervals as well as in response to specific events 3
(please continue with question 15A)

Q: 15A
How often do you *review* the selling price of your main product in the Estonian market? (Please choose one option.)

	Once a week or more often	1
	Monthly	2
	Quarterly	3
(35)	Twice a year	4
	Once a year	5
	Less than once a year	6
	There are no regular time intervals	7

Q: 16
Considering your main product in the Estonian market, do the price reviews result in actual price changes in your company? (Please choose one option that best characterizes price changes in the case of your main product in the Estonian market.)

Yes, always 1

(36)	In general, yes, but not always	2
	In general, not	3

PRICE CHANGING

Q: 17

How often do you *change* the selling price of your main product in the Estonian market? (Please choose one option.)

	Once a week or more often	1
	Monthly	2
	Quarterly	3
(37)	Twice a year	4
	Once a year	5
	Less than once a year	6
	There are no regular time intervals	7

Q: 18

In which month/months are prices usually changed in this case? Several options could be selected!

(38)	January	1	July	1
(39)	February	1	August	1
(40)	March	1	September	1
(41)	April	1	October	1
(42)	May	1	November	1
(43)	June	1	December	1

Q: 19

What circumstances do you take into account most when changing the price of your main product in the Estonian market? (Please choose one option.)

Various information on <u>all</u> factors affecting the product price (e.g. changes in costs, in demand, in the price of main competitors, etc.) 1

(50) Usually <u>one certain</u> factor (e.g. increase in employees' wages, changes in the cost price of the product or increase in consumer prices) 2

Q: 20

What kind of information do you take into account most when changing the price of your main product? (Please choose one option.)

The *past and current behaviour* of the factors affecting the product price (demand, costs, the price of main competitors, etc.) 1

(51) The *recent behaviour* as well as *future* outlook of the factors affecting the product price, i.e. *expected* changes. 2

Q: 21

Do you adjust the timing of your own price changes for your main product in the Estonian market to those of your suppliers and competitors? (Please choose one option for suppliers as well as one for competitors.)

		Always	Sometimes	No
(52)	At the same time as the suppliers	1	2	3
(53)	At the same time as the competitors	1	2	3

Q: 22

Did your company raise or lower the selling price of your main product in the Estonian market during the last 12 months? (Please choose one option and indicate the share.)

(54)	Raised it	…. %	1
	Left it unchanged		2
	Lowered it	….. %	3

Q: 23

If you consider all the price changes (increases and reductions) for your main product in the Estonian market during the last 24 months, how were the price changes distributed? (Please choose one option per row.)

	We only raised the price	1
	Mostly we raised the price	2
(57)	Price increased and decreased equally	3
	Mostly we lowered the price	4
	We only lowered the price	5

Q: 24

Indicate the *most frequent* (typical) range of price changes for your main product in the Estonian market. (Please choose one option for price increase as well as one for price decrease.)

	Price increases		***Price decreases***	
	Price increased up to 2%	*1*	*Price decreased up to 2%*	*1*
	Price increased 2.1–5%	*2*	*Price decreased 2.1–5%*	
	Price increased 5.1–10%	*3*	*Price decreased 5.1–10%*	*3*
(58)	*Price increased 10.1–15%*	*4*	*Price decreased 10.1–15%*	*4*
	Price increased 15.1–20%	*5*	*Price decreased 15.1–20%*	*5*
	Price increased 20.1–25%	*6*	*Price decreased 20.1–25%*	*6*
	Price increased more than 25%	*7*	*Price decreased more than 25%*	*7*
	We did not raise the price	*8*	*We did not lower the price*	*8*

DETERMINANTS OF PRICE CHANGES

Q: 25

Please indicate the importance of factors that would make you raise/lower the price of your main product in the Estonian market? (Please choose one option per row.)

	Factors causing a price <u>increase</u>	*Un-import-ant*	*Minor Import-ance*	*Import-ant*	*Very Import-ant*
(60)	*An increase in labour costs in the company (wages, social tax)*	*1*	*2*	*3*	*4*
(61)	*An increase in interest costs*	*1*	*2*	*3*	*4*
(62)	*An increase in the price of purchased goods/services or raw materials*	*1*	*2*	*3*	*4*
(63)	*An increase in demand*	*1*	*2*	*3*	*4*
(64)	*An increase in competitors' price*	*1*	*2*	*3*	*4*

(65)	*An increase in consumer prices*	*1*	*2*	*3*	*4*
(66)	*A decrease in competition*	*1*	*2*	*3*	*4*
(67)	*An improvement of our product quality (incl. design)*	*1*	*2*	*3*	*4*
(68)	*A decrease in productivity*	*1*	*2*	*3*	*4*
(69)	*A decrease in stock reserves*	*1*	*2*	*3*	*4*
(70)	*Other factors (please specify) ……*		*2*	*3*	*4*
(72)	*……*		*2*	*3*	*4*
(74)	*……*		*2*	*3*	*4*

	Factors causing a price <u>decrease</u>	*Un-important-ant*	*Minor Import-ance*	*Import-ant*	*Very Import-ant*
(76)	*An decrease in labor costs in the company (wages, social tax)*	*1*	*2*	*3*	*4*
(77)	*An decrease in interest costs*	*1*	*2*	*3*	*4*
(78)	*An decrease in the price of purchased goods/services or raw materials*	*1*	*2*	*3*	*4*
(79)	*An decrease in demand*	*1*	*2*	*3*	*4*
(80)	*An decrease in competitors' price*	*1*	*2*	*3*	*4*
(81)	*An increase in competition*	*1*	*2*	*3*	*4*
(82)	*An increase in productivity*	*1*	*2*	*3*	*4*
(83)	*An intention to gain a market share*	*1*	*2*	*3*	*4*
(84)	*An increase in stock reserves*	*1*	*2*	*3*	*4*
(85)	*Other factors (please specify) ……*		*2*	*3*	*4*
(87)	*……*		*2*	*3*	*4*
(89)	*……*		*2*	*3*	*4*

Q: 26

Assume a change in demand or production costs occurs that is significant enough to make you consider adjusting the price of your main product in the Estonian market. How long would it usually take till you actually change the price? (Please choose one option for every circumstance (per every row).)

		Up to 1 week	*1 week to 1 month*	*1–3 months*	*3–6 months*	*6–12 months*	*More than 1 year*	*Prices are not changed*	*Do not know*
(91)	*Increase in demand*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
(92)	*Decrease in demand*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
(93)	*Increase*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*

	in pro-duction costs								
(94)	*Decrease in pro-duction costs*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*

The following questions concern the price changes during the period of Estonia's accession to the European Union in the year 2004.

Q: 27

Regarding your field of activity as a whole, please indicate whether Estonia's accession to the European Union affected the selling prices of the products in your field of activity. (Please choose one option.)

	In general selling prices increased	1
(95)	In general selling prices remained the same	2
	In general selling prices decreased	3
	Do not know/cannot say	4

Q: 28

Did you change the price of your main product in the Estonian market because of Estonia's entry to the European Union? (Please choose one option.)

	We increased the price of our main product	1
(96)	We did not change the price of our main product	2
	We lowered the price of our main product	3

Q: 29

Did joining the European Union have any effect on prices of goods and services *purchased* by your company? (Please choose one option.)

	Prices increased in general	1
(97)	Prices did not change in general	2
	Prices decreased in general	3

FACTORS HAMPERING PRICE ADJUSTMENT

Q: 30

There can be various reasons for why a price is not (or is very slightly) changed during a certain period. Please indicate their importance in your company. (Please choose one option per row.)

	Reasons for postponing (renouncing) price increases	*Un-import-ant*	*Minor import-ance*	*Import-ant*	*Very import-ant*	*I do not know*
(98)	*The existence of a formal (written) contract: prices can only be changed when the contract is reviewed*	*1*	*2*	*3*	*4*	*5*
(99)	*The existence of an informal contract (regular contact with a customer without any written contract): customers prefer a stable price, a change could damage customer relations*	*1*	*2*	*3*	*4*	*5*
(100)	*Price changes entail direct costs (printing new catalogues, updating the web site, etc.)*	*1*	*2*	*3*	*4*	*5*
(101)	*Costly in terms of collecting relevant information*	*1*	*2*	*3*	*4*	*5*
(102)	*Risk that competitors might not adjust their prices (your company might be the first)*	*1*	*2*	*3*	*4*	*5*
(103)	*Our costs per unit of output do not change much over the business cycle, thus making our prices relatively stable*	*1*	*2*	*3*	*4*	*5*

(Continued)

	Reasons for postponing (renouncing) price increases	*Un-import-ant*	*Minor import-ance*	*Import-ant*	*Very import-ant*	*I do not know*
(104)	*Our price is set at an attractive*	*1*	*2*	*3*	*4*	*5*

	threshold (e.g. 9.95 instead of 10.15), thus we wait when it is optimal to change our price to another attractive level					
(105)	*The company's decision-making process is time-consuming*	*1*	*2*	*3*	*4*	*5*
(106)	*Instead of price increases we change other product parameters, e.g. extend delivery time*	*1*	*2*	*3*	*4*	*5*
(107)	*Other factors (please specify) …… ……*		*2*	*3*	*4*	

	Reasons for postponing (renouncing) price decreases	*Un-important*	*Minor importance*	*Important*	*Very important*	*I do not know*
(109)	*The existence of a formal (written) contract: prices can only be changed when the contract is reviewed*	*1*	*2*	*3*	*4*	*5*
(110)	*The existence of an informal contract (regular contact with a customer without any written contract): customers prefer a stable price, a change could damage customer relations*	*1*	*2*	*3*	*4*	*5*
(111)	*Price changes entail direct costs (printing new catalogues, updating the web site, etc.)*	*1*	*2*	*3*	*4*	*5*
(112)	*Costly in terms of collecting relevant information*	*1*	*2*	*3*	*4*	*5*
(113)	*Risk that competitors might not adjust their prices (your company might be the first)*	*1*	*2*	*3*	*4*	*5*
(114)	*Our costs per unit of output do not change much over the business cycle, thus making our prices relatively stable*	*1*	*2*	*3*	*4*	*5*

(115)	*Our price is set at an attractive threshold (e.g. 9.95 instead of 10.15), thus we wait when it is optimal to change our price to another attractive level*	*1*	*2*	*3*	*4*	*5*
(116)	*The company's decision-making process is time-consuming*	*1*	*2*	*3*	*4*	*5*
(117)	*We are afraid that customer will interpret a price reduction*	*1*	*2*	*3*	*4*	*5*

	as a reduction in quality					
(118)	*Instead of price decreases we change other product parameters, e.g. extend delivery time*	*1*	*2*	*3*	*4*	*5*
(119)	*Other factors (please specify) …… ……*		*2*	*3*	*4*	

Appendix 3

Monetary Policy and EMU Enlargement: Issues regarding the ERM II and the Adoption of the Euro in Estonia

Raoul Lättemäe[*]
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Abstract

The aim of the paper is to give an overview of the issues related to Estonia's entry to ERM II. For that purpose the article describes the official position of the Estonian authorities regarding the entry to ERM II and the adoption of euro, explains the rationale for the early entry to ERM II and presents the reasons for maintaining the currency board arrangement until the full membership in EMU. Also the challenges of the adoption of the euro are discussed. The article concludes that early entry to ERM II is appropriate as the perceived costs - short-term costs of fiscal consolidation and the cost of giving up independent monetary policy and flexible exchange rates as stabilisation tools – are practically non-existent in Estonia. The paper argues that the high level of exchange rate stability and nominal convergence, relatively high flexibility of the economy and integration with the euro area support the rationale for maintaining the currency board arrangement and adopting the euro early.

JEL: E42, E65, F31

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Official position on the membership in ERM II and the euro adoption

Estonian authorities have declared that Estonia seeks to join the European Economic and Monetary Union as soon as possible with the goal of being technically prepared to adopt the euro in mid-2006. The Estonian government and the central bank intend to seek participation in the ERM II exchange rate mechanism soon after joining the EU, in accordance with all relevant multilateral procedures and within the established framework. The intention of the authorities is to participate in the ERM II with the standard fluctuation band and by maintaining unilaterally the currency board arrangement (CBA). The latter implies that the Estonian authorities will unilaterally guarantee a zero percent fluctuation margin of the Estonian kroon. As the authorities intend to be prepared to adopt the euro in mid-2006, the length of the stay in ERM II would be as short as possible.

What is the rationale for the early entry to ERM II?

The main motive for early entry of Estonia to ERM II is to reap the benefits of the monetary union as soon as possible. The latter include: (1) the maintenance of strong policy discipline, (2) an increase of the economic and financial integration of the Estonian economy with the euro area, (3) a reduction of the transaction costs and (4) a decrease in the interest rates via an elimination of the exchange rate risk premium. All of these in turn should intensify trade, foster economic growth and real convergence.

Usually, premature participation in ERM II is deemed to entail the potential costs in other areas, such as short-term costs of fiscal consolidation and the cost of giving up independent monetary policy and flexible exchange rates as stabilisation tools. Those costs are practically non-existent in case of Estonia, as the ERM II and later full participation in the euro area do not call for major adjustments in Estonia's macroeconomic policies.

Fiscal discipline has been strongly entrenched in the political culture of Estonia. During the last twelve years Estonia has maintained one of the most prudent fiscal policies among the acceding countries (see Figure 1 and Figure 2). Throughout this period the budget deficit has exceeded the Maastricht three per cent limit only once, in 1999 (due to economic adjustments after the Asian and Russian crises that coincided with the election cycle). The general government budget has recorded a surplus since 2001 (+2.6% in 2003) and is expected to be in balance in the coming years. As a result the government debt is the lowest among new member countries (5.8% of GDP in 2002)[50]. Debt level will remain low in the medium term, as the authorities intend to pursue a balanced budget policy also in the future. Therefore, joining the monetary union does not entail any significant change for the fiscal policy.

[50] As the general government's financial assets amount to 9 % of GDP the net financial position of the general governments is positive.

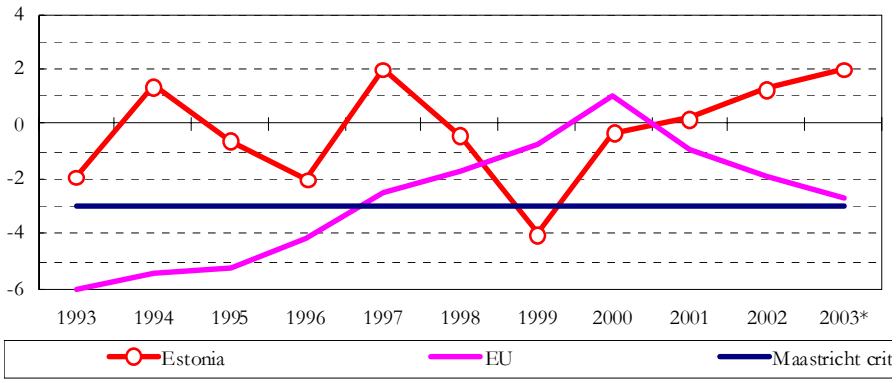

Figure 1 *General government balance (% of GDP).*

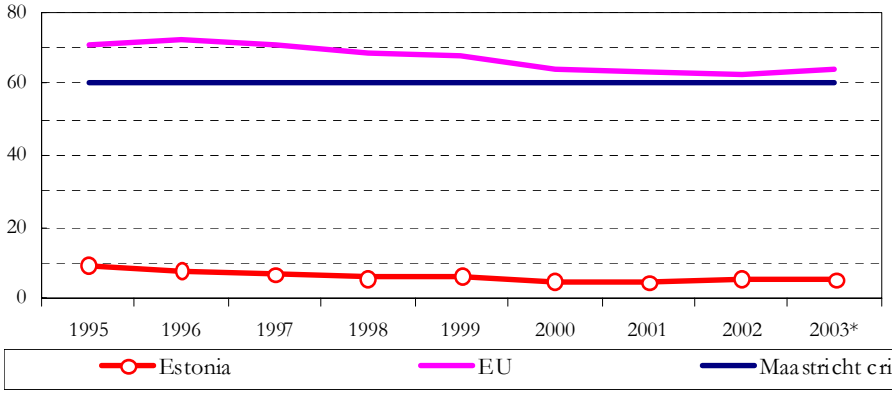

Figure 2 *General government debt (% of GDP).*

As compared to the present situation the costs related to possible loss of independent monetary policy are non-existent, as Estonia has operated a successful currency board vis-à-vis the euro (DEM) for almost twelve years, and therefore has not been able to pursue independent discretionary monetary policy. The currency board with its limited discretion is usually perceived to be the closest monetary regime to a full monetary union. Thus, Estonia has been practically in quasi-monetary union with the euro area core countries for almost a dozen years now. Participation in the ERM II and entrance into the euro area are therefore steps that do not entail giving up monetary independence, but eliminate remaining transaction costs and risk premiums, whereas adjustment and transmission mechanisms that are currently in place will remain largely unaltered after the entrance.

What is the rationale for the maintenance of the CBA?

The rationale for the maintenance of the CBA (implying the absence of the independent discretionary monetary policy) until the adoption of the euro is based on the high degree of nominal convergence and exchange rate stability, the flexibility of the markets and the strong integration of the Estonian economy to the euro area countries.

Exchange rate stability and nominal convergence

The nominal exchange rate of the Estonian kroon has been kept unchanged for the last 12 years. During that period the incidence of speculative attacks has been rare (1997, 1998). The stability of the exchange rate has been strongly entrenched, evidenced by the fact that the public has not seriously questioned the current monetary regime (and the level of the nominal exchange rate). Also the market participants expect the nominal exchange rate to remain at the current level for the next two years.

The currency board arrangement has created a nominal anchor for stable inflation and interest rates in Estonia (see Figure 3). Inflation in Estonia has decreased to single-digit levels since 1998 and is currently below EMU average (annual CPI was 1.3% in 2003). However, the core inflation (overall CPI with energy, food, alcohol and tobacco excluded) has however stayed about 1pp higher than the core inflation in EMU since mid-2002. Similarly to inflation there has been a steady decline in interest rates – the long-run interest rates of bank loans amount to 5-6 %. The remaining spreads over euro area interest rates are about 50bp for money market rates and about 50-100bp for real sector lending rates at the end of 2003[51].

[51] In 2003 Estonia fulfilled the Maastricht inflation, budget deficit and public debt criteria. As Estonian government has not issued debt in Estonian kroons, the fulfilment of the interest rate criterion cannot be assessed. However, as mentioned, the remaining spreads with the euro area interest rates are 50-100 bp for the real sector lending rates.

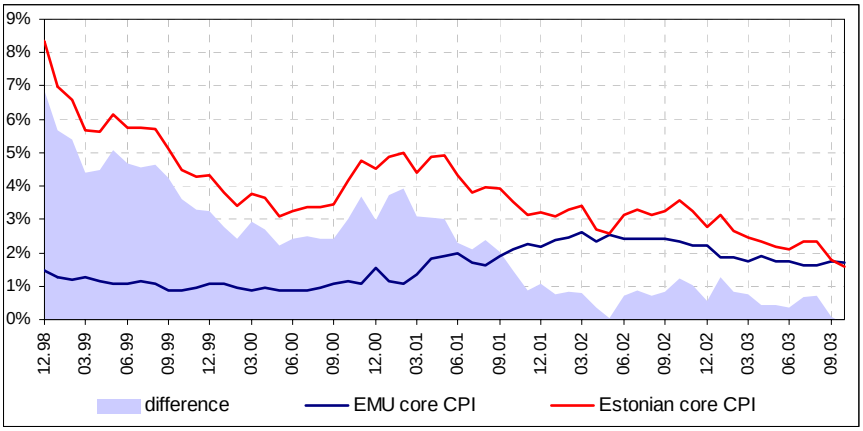

Figure 3 Core CPI (i.e. overall CPI excluding energy, food, alcohol and tobacco) in Estonia and EMU.

Trade and financial integration of Estonian economy to euro area countries

Estonia is a highly open economy, with total exports and imports (including services) accounting for about 180% of GDP. Estonia has close trade relations with the EU, the former accounts for approximately 80 % of Estonia's foreign trade. The Estonian economy is most closely connected to the economies of Finland and Sweden. These connections are visible in both trade and investments, as Finland and Sweden account for 41% of exports and 67% of foreign direct investments to Estonia.

Similarly to trade links, strong financial links should also reduce the exposure to asymmetric shocks, as they should smooth the impact of asymmetric shocks by cross-border flows of capital and by convergence of financial structures (Mongelli, 2002). The EU, especially the Nordic countries, plays an important role as a source of FDI inflows, as well as in the Estonian financial sector. Swedish and Finnish investors own 67% of FDI stock and 86% of Estonian banking sector, whereas the rest of the EU accounts for an additional 18% of FDI.

Comparable economic structures decrease the danger of asymmetric economic shocks and increase the similarity of shocks within a monetary union (Tavlas, 1994). The structure of the Estonian economy (both in terms of value added and employment) disaggregated into three main sectors, has practically converged to the economic structure of the present EU. On a more disaggregated level some differences remain.

Frenkel and Nickel (2002) have estimated the correlation of supply and demand shocks between the current E(M)U members and CEEC countries. Among the CEEC countries, Hungary, Slovenia, Czech Republic and Estonia showed higher

correlation of supply shocks with the EMU than the other acceding countries. Fidrmuc and Korhonen (2001) used a similar approach and found that the correlation of supply shocks of some acceding countries (including Estonia) with the EMU is already similar to the supply shocks correlation of some current EMU members.

However, the economic symmetries in Estonia should be higher vis-à-vis the Nordic countries than vis-à-vis the larger EMU members, as trade and investment links are stronger with this region. Indeed, some studies show that the Estonian business cycle is closely synchronized with Finland's business cycle (Danilov 2003, Kaasik et al 2003). Therefore, possible economic asymmetries in Estonia vis-à-vis the euro area as a whole depend also on possible asymmetries between the Nordic countries (especially Finland) and the other EMU economies. Thus, the business cycle synchronization between Estonia and EMU "core" members might remain smaller than in central European countries, as the synchronisation of the business cycle of the Nordic countries with the euro area is not very high.

The flexibility of the real sector

The need for nominal exchange rate adjustments is lower if wages and prices are flexible (especially downwards). It should be stressed that in spite of relatively weak economic ties with Germany in the early and mid-1990s, when the currency board was introduced, Estonia's growth and export performance has been favourable. As this has occurred under rigidly fixed exchange rate regime, the latter indirectly points to the flexibility of the real sector to cope with asymmetric shocks without the need for a more flexible exchange rate policy.

This is reconfirmed by the fact that incidences of exchange rate pressures have been rare throughout these years, save for only some contagion episodes during the Asian and Russian crises in 1997-98. While the Estonian economy experienced considerable output volatility in 1998-1999, the subsequent quick recovery from a strong external shock is a sign that the currency board provides fast and credible signals for the economy to react to changes in the global environment. As a result, the periods of restructuring have been fairly short.

Most studies have concluded that in international comparison Estonian labour markets appear to be relatively flexible and the labour market has been able to absorb asymmetric shocks by adjusting the labour costs and employment levels to new market conditions (see Figure 4).[52]

[52] Trends in the Estonian labour market since early 1990s have been similar to those in the other acceding countries. Hidden unemployment, a typical feature of centrally planned economies, became transparent and was accompanied by declining employment during the transitional recession. The "new equilibrium" seems to be characterised by still high unemployment (about 10% in 2003) and low participation level (about 64% in 2003 among 15-74 years old). It means that unemployment is still to a large extent a structural rather than cyclical problem in Estonia, i.e. related to skills mismatches, low capital to labour ratio and high levels of regional unemployment.

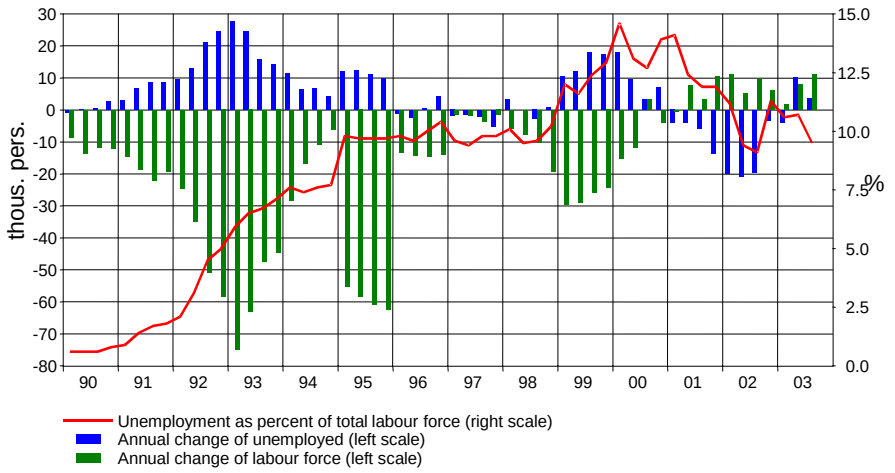

Figure 4 Labour market developments.

The structure of the Estonian employment has changed considerably during the 1990s. The labour force has been mobile across sectors and job tenure has been rather short. Labour flows between sectors in Estonia have been large compared to OECD countries as well as the other acceding countries (Faggio, Konings (1999), Haltivanger, Vodopivec, Gross (1999) and Eamets (2001)). Firing restrictions are comparable to those of an average EU country in terms of their strictness (according to OECD index).[53] Yet, geographical mobility of the labour force has been lower (reflected by high and persistent regional unemployment).

The institutional framework underpins the labour market flexibility. The wages are mostly bargained on the individual firm level. At the country level, for example, the contracts do not include direct increase in wages, but concentrate on minimum wages, unemployment benefits and other basic questions of income policy. Ex-ante indexation has no role in the Estonian wage setting system. Under these conditions wages in Estonia have demonstrated downward real (in the tradable sector even nominal) flexibility during the adverse shock of Russian crisis in 1998-99.

The means-tested character of the social safety net has also supported the flexibility of the labour market by curbing the negative impact of unemployment benefits (until 2003 the replacement ratio was less than 10% of the average gross salary). A mandatory unemployment insurance scheme was introduced in 2002, which has made the unemployment benefits more comparable to the average of EU in terms of amount and duration of the benefits (50% of the previous pay during

[53] The OECD index may overestimate the fact that in Estonia these restrictions are set by laws instead of being included into the collective contracts on the industry and enterprise level.

the first 100 days and 40% of the previous pay during the next 80 days). However the share of unemployed persons who are eligible to receive the higher unemployment benefits has been around 20 %.

Policy challenges of the adoption of the euro – current account deficit

In spite of the high degree of exchange rate stability, nominal convergence, integration with euro-area countries and the flexibility of the economy, there are challenges related to the adoption of the euro. They are mainly related to current account sustainability.

The recent sharp deterioration in the current account deficit (from 6 % of GDP in 2001 to 12.6 % of GDP in 2003) has posed questions about its excessiveness and sustainability. The possible excessiveness of the current account deficit is commonly analysed as a reflection of real sector competitiveness or relative price developments. The main aim is to benchmark current account deficit against some economic "fundamentals" or actual REER against fundamental REER.

Several studies have tried to assess the sustainability of the current account deficit in Estonia (See Haas et al 2003; Burgess et al 2003). The general conclusion from these studies is that some amount of current account deficit may be justified in the medium – term, as far as the competitiveness developments continue to be favourable. The estimates for "equilibrium" current account deficit in Estonia range around 5-8% of GDP. For example, the IMF has estimated that non-excessive current account deficit, which is sustainable and solvent in the medium – term, is around 7.5% of GDP, whereas longer-run "equilibrium" current account deficit is estimated to be around 5% of GDP in the Baltic countries (Haas et al 2003). Those results are also in line with the Bank of Estonia assessments.

The widening of the current account deficit in 2002-2003 could be attributed to several factors. The standard explanations for the increase in the current account deficit have been the incidence of "one-off" investments, intensified inflow of foreign capital due to confirmed EU accession as well as weaker global economic activity combined with sustained domestic demand. However, in the context of the entry to ERM II and the adoption of the euro, the issue of the possible misalignment of the real exchange rate also requires careful examination.

In general, the dynamics of different REER indices has been relatively stable since mid-1990s, with one rather strong incident of appreciation (about 12-16%) during the Russian crisis in 1998 due to the nominal appreciation of the EEK/RUR exchange rate (see Figure 5). The sharp appreciation of the REER in 1998 was followed by gradual depreciation of REER during 1999-2000.

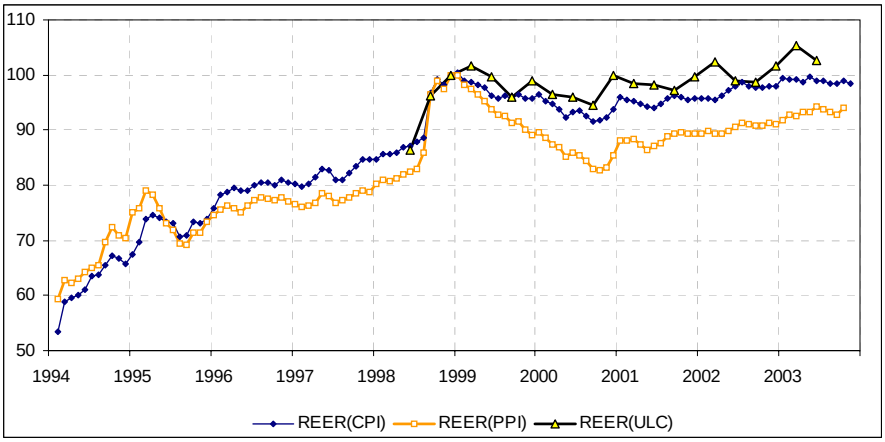

Figure 5 The Dynamics of different REER in Estonia (December 1998=100)

It should be noted that the changes in the real exchange rate of the Estonian kroon from mid-1990s have crucially depended on the price/cost index – the ULC-based, PPI-based REER and terms of trade have exhibited neither strong depreciation nor appreciation; the CPI-, GDP deflator and internal REER have shown various degrees of trend appreciation. The differences in the longer-run dynamics of various REER indices stem from the fact that the domestic inflation in non-tradable goods and services has been much higher than in the tradable sector. Therefore the indices that include a significant share of non-tradable goods and services exhibit a stronger appreciation that the indices with a lower share of non-tradable goods and services.

The relative stability of REER developments in the recent years reflects the fact that a considerable share of Estonia's exports is directed towards the EU. Moderate appreciating trends in the CPI-based REER in recent years can, therefore, be connected to the Balassa-Samuelson effect rather than to loss of competitiveness. Trend real appreciation due to the Balassa-Samuelson effect has been estimated at 1.5 - 2% annually. Other factors that had contributed to strong real appreciations in the early years of transition have, to varying degrees, dissipated (Burgess et al 2003).

Due to difficulties in interpreting the REER indices, equilibrium REER concept is sometimes used to assess possible exchange rate misalignments. The equilibrium REER concept presumes that there exists an equilibrium real exchange rate, which refers to REER that would prevail if the economy would be simultaneously in internal and external balance. This concept indicates that exchange rates can get seriously misaligned with economic fundamentals, thereby creating substantial macroeconomic imbalances. Moreover, misalignments can be a consequence of inappropriate macroeconomic policies and thus indicate the necessity of a shift in monetary or fiscal policy. Therefore, several studies have attempted to estimate the equilibrium level of the real exchange rate of the Estonian kroon.

Table 1. REER misalignment in Estonia – results of different studies

Author(s)	Period	Misalign. at the end of period	Method
Hinnosaar et al. (2003)	1995-2003	None	BEER
IMF (2003)	1994-2002	-5%	BEER
Coudert/Couharde (2002)	1993-2001	none	FEER
Šmidkovà et al. (2002)	1996-2001	10%	FRER
Randveer/Rell (2002)	1994-2000	none	BEER
Filipozzi (2000)	1994-1999	5%	BEER
Begg et al. (1999)	1990-1997	none	B-S, Panel

Although the Estonian REER have to some extent appreciated over the last decade, relevant literature has not found much evidence of misalignment of the Estonian kroon (see Table 1 for the summary of the results of different studies). The equilibrium REER estimates obtained from the different approaches indicate that the initial position in 1992 ranges from a 15% undervaluation to a small overvaluation of the kroon, depending on the model used. The initial undervaluation, found in several models, turned into a temporary 5-10% overvaluation in 1998 (due to adjustments related to both the Russian crisis as well as contagion effects). The deviation in 1998 was short-lived. At the end of the estimation period the actual real exchange rate was found to be close to the equilibrium in most studies.

Most assessments based on a broad range of indicators suggest no clear evidence of exchange rate misalignment that would call into question the underlying competitiveness of the Estonian economy. According to most calculations, the actual real exchange rate has not deviated significantly from its estimated "equilibrium" value throughout the period and is currently close to the equilibrium exchange rate.

In addition, the estimates of trade elasticity vis-à-vis exchange rate in those studies indicate that the impact of the REER or NEER on trade flows is limited. This result seems to be robust across different methods and specifications of the models employed, implying a secondary role for the exchange rate in achieving a sustainable position of external balance. The latter is also reflected by the fact that the dynamics of REER and current account are rather different, which suggests that trade flows have been determined primarily by income or supply factors rather than by movements in relative prices.

The weak relationship between current account deficit and real exchange rate is also evident by the dynamics of the components of current account deficit. In 2003 the deficit of the income balance (6 % of GDP) explained nearly half of the current account deficit. The size of the deficit of the income balance depends on the stock

of foreign investments in Estonia and the profitability of the foreign-owned firms[54], the latter is loosely related to the level of the real exchange rate. The deficit of the trade and service balance (7.9 % of GDP in 2003) was to a large extent explained by "one-off" investments. In 2003 these investments amounted to 3.2 % of GDP. Once again the relationship between these investments and the level of the real exchange rate is practically non-existent.

Summary

Estonian authorities seek to apply for ERM II membership soon after EU accession. The intention of the authorities is to participate in the ERM II with the standard fluctuation band and by maintaining unilaterally the currency board arrangement (CBA). The latter implies that the Estonian authorities will unilaterally guarantee a zero percent fluctuation margin of the Estonian kroon. As the authorities intend to be prepared to adopt the euro in mid-2006, the length of the stay in ERM II is as short as possible.

The early entry to ERM II is appropriate as the perceived costs - short-term costs of fiscal consolidation and the cost of giving up independent monetary policy and flexible exchange rates as stabilisation tools – are practically non-existent in Estonia. The rationale for the maintenance of the currency board arrangement and the early adoption of the euro is based on the high level of exchange rate stability and nominal convergence, relatively high flexibility of the economy and integration with the euro-area. The high current account deficit in Estonia is not related to the loss of competitiveness but reflects the incidence of "one-off" investments and intensified inflow of foreign capital due to confirmed EU accession.

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Appendix 4

ELULOOKIRJELDUS

1. Isikuandmed

Ees- ja perekonnanimi:	Martti Randveer
Sünniaeg ja -koht:	5. märts 1976, Tallinn
Kodakondsus:	Eesti

2. Kontaktandmed

Aadress:	Eesti Pank, Estonia pst. 13, 15095 Tallinn
Telefon:	(+372) 6 680 887
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3. Hariduskäik

Õppeasutus	Lõpetamise aeg	Haridus
Tallinna Tehnikaülikool Majandusteaduskond		Doktoriõpe majandusteooria alal
Tallinna Tehnikaülikool Majandusteaduskond	2001	Majandusteaduste magistri kraad rahvamajanduse erialal
Tallinna Tehnikaülikool Majandusteaduskond	2001	Sotsiaalteaduste bakalaureusekraad

4. Keelteoskus

Keel	Tase
Eesti	Emakeel
Inglise	Kõrgtasemel
Vene	Algtasemel
Saksa	Algtasemel
Soome	Algtasemel

5. Täiendusõpe

Õppimise aeg	Täiendusõppe läbiviija nimetus
7.12.2006-8.12.2006	Eesti Pank, kursus "*Taxation in theory and practice: selected topics and open economy*"
27.10.2003-28.10.2003	Eesti Pank/Uppsala Ülikool, kursus "*Unemployment and labour market policies*"
19.05.2003-21.05.2003	Eesti Pank, kursus "*Intensive course in econometrics*"

6. Teenistuskäik

Töötamise aeg	Tööandja nimetus	Ametikoht
Alates 2002	Eesti Pank	Osakonnajuhataja
1996 - 2002	Eesti Pank	Ökonomist

7. Teadustegevus

(1) Publikatsioonid (valikuliselt)

Dabušinskas, Aurelijus ja Martti Randveer (2009), 'Comparison of Pricing Behaviour of Firms in the Euro Area and Estonia', *Microfoundations of Economic Success: Lessons from Estonia*, Edward Elgar, lk. 19-76.

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Sustainability of the Currency Board Arrangement in Estonia', *Alternative Monetary Regimes in Entry to EMU*, Eesti Pank, Tallinn, lk. 327-362.

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(2) Esitlused konverentsidel (valikuliselt)

Randveer, Martti, *Price Stickiness in Estonia*, Eesti Majandusteaduse Seltsi 3. aastakonverents, 21.-22. jaanuar 2008, Pärnu, Eesti.

Randveer, Martti, *Price Stickiness in Estonia: Survey Evidence*, 3. rahvusvaheline konverents "Baltic Business and Socio-Economic Development", 18.-19. juuni 2007, Tallinn, Eesti.

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8. Kaitstud lõputööd

Magistritöö "Tulutaseme ja majandusstruktuuri konvergents", 2001. a.

Bakalaureusetöö "Tulutaseme konvergents", 2001. a.

9. Teadustöö põhisuunad

1) raha- ja vahetuskursipoliitika
2) inflatsioon ja ettevõtete hinnakujundus
3) migratsioon

Appendix 5

CURRICULUM VITAE

1. Personal data

Name:	Martti Randveer
Date and place of birth:	5 March 1976, Tallinn
Citizenship:	Estonian

2. Contact information

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E-mail:	randveer@epbe.ee

3. Education

Educational institution	Graduation of year	Education
Tallinn University of Technology School of Economics and Business Administration		Doctoral studies in economics
Tallinn University of Technology School of Economics and Business Administration	2001	Master of Arts in Economics
Tallinn University of Technology School of Economics and Business Administration	2001	Bachelor of Arts in Social Sciences

4. Language

Language	Level
Estonian	Native
English	Fluent
Russian	Basic
German	Basic
Finnish	Basic

5. Special courses

Period	Educational or other organisation
7.12.2006-8.12.2006	Bank of Estonia, course "*Taxation in theory and practice: selected topics and open economy*"
27.10.2003-28.10.2003	Bank of Estonia/University of Uppsala, course "*Unemployment and labour market policies*"
19.05.2003-21.05.2003	Bank of Estonia, course "*Intensive course in econometrics*"

6. Professional employment

Period	Organisation	Position
2002 to date	Bank of Estonia	Head of department
1996 – 2002	Bank of Estonia	Economist

7. Scientific Work:

(1) Publications (selected)

Dabušinskas, Aurelijus and Martti Randveer (2009), 'Comparison of Pricing Behaviour of Firms in the Euro Area and Estonia', *Microfoundations of Economic Success: Lessons from Estonia*, Edward Elgar, pp. 19-76.

Dabušinskas, Aurelijus and Martti Randveer (2008), 'Price Stickiness in Estonia: Survey Evidence', *The collection of articles of the 3rd international conference "Baltic Business and Socio-Economic Development"*, Berliner Wissenschafts-Verlag, pp. 41-56.

Dabušinskas, Aurelijus and Martti Randveer (2006), 'Comparison of Pricing Behaviour of Firms in the Euro Area and Estonia', *Working Papers of Eesti Pank,* No. 8/2006.

Lättemäe, Raoul, Martti Randveer and Urmas Sepp (2004), 'Monetary Policy in Estonia: The Transmission Mechanism', *The Euro Area and the New EU Member States*, Palgrave-McMillan Press, United Kingdom, pp. 130-163.

Lättemäe, Raoul and Martti Randveer (2004), 'Monetary Policy and EMU Enlargement: Issues Regarding ERM II and Adoption of the Euro in Estonia', *Atlantic Economic Journal*, Volume 32, Number 4, pp 293-301.

Kaasik, Ülo, Rasmus Kattai, Martti Randveer and Urmas Sepp (2004), 'The Monetary Transmission Mechanism in Estonia', *The Monetary Transmission Mechanism in the Baltic States*, Bank of Estonia, Tallinn, pp. 131-159.

Kattai, Rasmus and Martti Randveer (2003), 'Automatic Fiscal Stabilisers in Estonia', *Baltic Journal of Economics,* 4(1), pp. 93-115.

Randveer, Martti and Urmas Sepp (2002), 'Alternative Exchange Rate Regimes in Estonia', *Alternative Monetary Regimes in Entry to EMU*, Bank of Estonia, Tallinn, pp. 363-419.

Lättemäe, Raoul, Martti Randveer and Urmas Sepp (2002), 'The History and Sustainability of the Currency Board Arrangement in Estonia', *Alternative Monetary Regimes in Entry to EMU*, Bank of Estonia, Tallinn, pp. 327-362.

Randveer, Martti and Mari Rell (2002), 'The Relationship between Competitiveness and Real Exchange Rate', *Relationship between Real Exchange Rate and Competitiveness in the Baltic Countries,* Bank of Estonia, Tallinn, pp. 5-40.

Randveer, Martti and Urmas Sepp (2002), 'Aspects of the Sustainability of Estonian Currency Board Arrangement', *Working Papers of Eesti Pank*, No. 5/2002.

(2) Conference presentations (selected)

Randveer, Martti, *Price Stickiness in Estonia*, 3rd Annual Conference of the Estonian Economic Association, 21-22 January 2008, Pärnu, Estonia.

Randveer, Martti, *Price Stickiness in Estonia: Survey Evidence*, 3rd international conference "Baltic Business and Socio-Economic Development", 18-19 June 2007, Tallinn, Estonia.

Randveer, Martti, *Price Stickiness in Estonia: Survey Evidence*, Macro Summer School, 1-2 June 2007, Tallinn, Estonia.

Randveer, Martti, *The Comparison of the Pricing Behaviour of Firms in the Euro Area and Estonia*, International Atlantic Economic Conference, 5-8 October 2006, Philadelphia, United States.

Randveer, Martti, *Pricing Behaviour of Firms in the Euro Area and Estonia*, COPE Annual Conference, 15-22 July 2006, Beijing, China.

Randveer, Martti, *Price Block of Eesti Pank's Macromodel: Implication for*

Estonian Inflation, 1st Annual Conference of the Estonian Economic Association, 20-22 January 2006, Pärnu, Estonia.

Randveer, Martti, *Price Block of Eesti Pank's Macromodel: Implication for Estonian Inflation*, International Atlantic Economic Conference, 6-9 October 2005, New York, United States.

Randveer, Martti, *ERM II and the Adoption of the Euro in Estonia,* ISSEI Conference, 2-7 August 2004, Pamplona, Spain.

Randveer, Martti, *Monetary Policy and EMU Enlargement: Issues Regarding ERM II and Adoption of the Euro in Estonia*, International Atlantic Economic Conference, 10-14 March 2004, Lisbon, Portugal.

Randveer, Martti, *A Currency Board Arrangement versus Alternative Exchange Rate Regimes in Estonia*, Scientific Conference on Economic Policy, June 2002, Tartu-Värska, Estonia.

Randveer, Martti, *Aspects of the Sustainability of Estonian Currency Board Arrangement*, International Atlantic Economic Conference, 13-17 March 2002, Paris, France.

8. Defended theses

Master's Thesis "Income and structural convergence", 2001.

Bachelor's Thesis "Income convergence", 2001.

9. Current research topics:

1) monetary and exchange rate policies
2) inflation and pricing behaviour of firms
3) migration

KOKKUVÕTE

Käesoleva doktoritöö „Rahapoliitika ülekandekanalid, majanduse paindlikkus ja Eesti rahasüsteemi tulevikuväljavaated“ peamiseks eesmärgiks on hinnata Eesti majanduse kohanemisvõimet majanduskeskkonna järskude muutustega fikseeritud vahetuskursi tingimustes. Doktoritöö aluseks olevas kolmes uurimuses analüüsitakse, kuidas Eesti majandus on senini majanduskeskkonna muutustega hakkama saanud, samuti seda, kui edukas on Eesti majandus fikseeritud kursi tingimustes tulevikus. Majanduse toimetulek erinevate asetleidnud šokkidega ja edukas reageerimine neile on Eesti majandusarengu üks olulisemaid küsimusi.

Doktoritöö temaatika aktuaalsust suurendab asjaolu, et Eesti rahasüsteemis ei ole rahapoliitika efektiivne vahend majandusaktiivsuse kõikumiste vähendamiseks. Valuutakomiteel põhinevas süsteemis on ainsaks märkimisväärseks rahapoliitiliseks meetmeks pankade kohustusliku reservimäära muutmine. Samas on aga selle meetme tulemuslikkus tagasihoidlik, kuna Eesti pangandussektori integratsioon teiste Euroopa Liidu, eeskätt Põhjamaade, finantsturgudega on väga tugev. Lisaks iseseisva suvakohase rahapoliitika vähesele efektiivsusele majandustsükli silumisel on ka võimalike fiskaalpoliitiliste meetmete mõju keskmisest madalam. Eeskätt tuleneb see Eesti avatusest ja sellega kaasnevast kõrgest impordikalduvusest. Sellest tulenevalt peab Eesti majandus kohanema läbi muutuste kauba-, tööjõu- ja finantsturgudel. Nende kohanemiskanalite efektiivsus sõltub sellest, milline on kauba- ja tööjõuturgude paindlikkus ja finantssektori rahvusvaheline integratsioon. Samuti sõltub majanduse edukas kohanemine ka rahasüsteemi heast toimimisest ja usaldusväärsusest. Lisaks eeltoodule on doktoritöö temaatika tähtis ka tulevikus, kuna Eesti kavatseb tulevikus liituda euroalaga ning selle ajani säilitada valuutakomiteel põhinev rahasüsteem.

Hindamaks Eesti majanduse kohanemisvõimet fikseeritud kursi tingimustes, analüüsitakse doktoritöös:

(i) Eesti majanduse paindlikkust, pöörates põhitähelepanu hindade paindlikkusele;
(ii) Eesti majanduse kohanemiskanaleid, pöörates põhitähelepanu sellele, kuidas muutused intressitasemes, laenupakkumises ja vahetuskursi tasemes mõjutavad Eesti majandust;
(iii) Eesti majanduse sobilikkust liitumiseks europiirkonnaga.

Doktoritöö koosneb kolmest uurimusest:

(1) Lättemäe, Raoul, Martti Randveer ja Urmas Sepp (2004), ‘Monetary Policy in Estonia: The Transmission Mechanism’, *The Euro Area and the New EU Member States*, Palgrave MacMillan; lk. 130-163.

(2) Dabušinskas, Aurelijus ja Martti Randveer (2009), 'Comparison of Pricing Behaviour of Firms in the Euro Area and Estonia', *Microfoundations of Economic Success: Lessons from Estonia*, Edward Elgar; lk. 19-76.

(3) Lättemäe, Raoul ja Martti Randveer (2004), 'Monetary Policy and EMU Enlargement: Issues Regarding ERM II and Adoption of the Euro in Estonia, *Atlantic Economic Journal*, Volume 32, No. 4, lk. 293-301.

Doktoritöös jõutakse järeldusele, et Eesti majanduse senine edukas kohanemine majanduskeskkonna muutustega tuleneb suhteliselt kõrgest hindade ja palkade paindlikkusest, tugevast finants- ja väliskaubanduslikust integratsioonist teiste Euroopa Liidu riikidega, kõrgest fiskaalpoliitilisest distsipliinist ning raha- ja finantssüsteemi tugevusest. Kuna lähiaastatel ei ole ette näha nende Eesti majandust iseloomustavate näitajate muutust, on põhjendatud Eesti soov võtta kasutusele euro.

Majanduse paindlikkuse analüüsimisel pöörati doktoritöös põhitähelepanu Eesti hinnakujunduse paindlikkuse hindamisele. Uuringus selgus, et Eestis on hindade paindlikkus kõrgem kui euroala riikides tervikuna. Esiteks on Eestis nende ettevõtete osakaal, kes muudavad hindu kindla ajalise intervalli järel väiksem kui euroala riikides, mistõttu reageerivad ettevõtted kiiremini olulistele muutustele majanduskeskkonnas. Teiseks on ettevõtete osakaal, kes on turul hinnavõtjad, Eestis kõrgem kui europiirkonna riikides. Kolmandaks muudavad Eesti ettevõtjad oma hindu sagedamini kui euroala riikide ettevõtjad. Eriti ilmne on see ettevõtete puhul, kes muudavad hindu harvem kui üks kord aastas – Eestis on selliste ettevõtete osakaal kaks korda väiksem kui europiirkonnas. Neljandaks reageerivad Eesti ettevõtjad nõudlus- ja pakkumissõkkidele oluliselt kiiremini kui europiirkonna ettevõtted. Ainus tulemus, mis ei ole kooskõlas üldise järeldusega Eesti hindade kõrgemast paindlikkusest on seotud sellega, et Eestis on nende ettevõtete osakaal suurem, kes kujundavad oma ootusi mineviku informatsiooni põhjal.

Majanduse kohanemismehhanismide analüüsimisel uuriti esmajoones seda, kuidas muutused intressi- ja vahetuskursi tasemes ning laenupakkumises mõjutavad Eesti majandust. Selle mõju hindamiseks analüüsiti Eesti raha- ja finantssüsteemi ning selle seotust välismaiste finantsturgudega, Eesti finants- ja reaalsektori omavahelisi seoseid ning erinevate rahapoliitiliste ülekandekanalite olulisust. Doktoritöös leiti, et tulenevalt Eesti rahasüsteemi kõrgest usaldusväärsusest ja finantssektori tugevast integratsioonist teiste Euroopa Liidu riikide finantssektoriga avalduvad muutused euroala intressitasemes kiiresti ka Eestis. Doktoritöös, kus neid seoseid uuriti makroökonoomilise mudeli abil selgus, et senini on kolmest analüüsitavast näitajast (vahetuskurss, intressitase ja laenupakkumine) suurimat mõju Eesti majandusele avaldanud vahetuskursi taseme muutused. Samas võib aga eeldada, et viimastel aastatel aset leidnud finantsintegratsiooni tugevnemine ja finantssüvenemise kasv on oluliselt suurendanud intressitaseme muutuste mõju.

ABSTRACT

The main aim of the thesis "Monetary policy transmission channels, flexibility of the economy and future prospects of the Estonian monetary system" is to analyse the ability of the Estonian economy to adjust with shocks under a fixed exchange rate. The thesis comprises of three articles, where we analyse how the Estonian economy has managed to cope with the changes in the economic environment so far and how successful the Estonian economy would be in the future given its fixed exchange rate regime. The ability of the economy to cope with various shocks is one of the key questions in the development of the Estonian economy.

The importance of the issues analysed in the thesis is underlined by the fact that the monetary policy is not an effective tool for cyclical smoothing in the Estonian monetary system. In a currency board based system, changes in the rate of the compulsory reserve requirement for banks is the only noteworthy monetary policy measure. At the same time, the reserve requirement is ineffective given the high integration of the Estonian financial sector with the financial markets of the European Union, especially the Nordic countries. While the effectiveness of discretionary monetary policy in cyclical smoothing is limited, the effect of potential fiscal policy measures is also smaller than the average. The latter limitation is mostly due to the high level of openness of the Estonian economy and the concurrent high import propensity. As a result, the Estonian economy has to adjust via changes in product, labour and financial markets. The effectiveness of these channels depends on the flexibility of product and labour markets as well as the international integration of the financial sector. More generally, the success of the economy under a fixed exchange rate is determined by the confidence in the monetary system and its effective functioning. The field of study of this thesis will remain important in the future, as Estonia will maintain the present monetary arrangement until the planned adoption of the euro.

To evaluate the ability of the Estonian economy to adjust under the fixed exchange rate, we will analyse:

(i) the flexibility of the economy, focussing on price flexibility;
(ii) the impact and relevance of the main adjustment channels in the Estonian economy, focussing on how the changes in interest rates, loan stock and the level of the exchange rates affect the Estonian economy;
(iii) the suitability of the Estonian economy for joining the euro area.

The doctoral thesis comprises of three articles

(1) Lättemäe, Raoul, Martti Randveer and Urmas Sepp (2004), 'Monetary Policy in Estonia: The Transmission Mechanism', *The Euro Area and the New EU Member States*, Palgrave MacMillan; pp. 130-163.

(2) Dabušinskas, Aurelijus and Martti Randveer (2009), 'Comparison of Pricing Behaviour of Firms in the Euro Area and Estonia', *Microfoundations of Economic Success: Lessons from Estonia*, Edward Elgar; pp. 19-76.

(3) Lättemäe, Raoul and Martti Randveer (2004), 'Monetary Policy and EMU Enlargement: Issues Regarding ERM II and Adoption of the Euro in Estonia, *Atlantic Economic Journal*, Volume 32, No. 4, pp. 293-301.

We conclude that the successful functioning of the Estonian economy under a fixed exchange rate regime has been the result of relatively high price and wage flexibility, strong trade and financial integration with the other EU member countries, fiscal policy discipline and resilient monetary regime and financial sector. As there are no indications that these features of the economy will change, we argue that it is suitable for Estonia to maintain the fixed exchange rate regime – i.e. maintain the currency board arrangement until the adoption of the euro.

In assessing the flexibility of the economy, we focussed on evaluating price flexibility in Estonia. We found that price setting in Estonia is more flexible than in the euro area member countries. Firstly, the share of firms using mainly time-dependent pricing rules is lower in Estonia than in most of the euro area countries, suggesting that in the event of a shock, prices would be more flexible in Estonia. Secondly, compared to the euro area countries for which data is available, the share of firms that set their prices according to their competitors (i.e. take prices essentially as given) is the highest in Estonia. These results are in line with the finding that the perceived competition in Estonia is considerably higher than in the euro area. Thirdly, the frequency of price changes in Estonia is higher than in the euro area. It is especially evident in the share of firms that change their prices less than once a year: in Estonia, the share of such firms is twice lower than in the euro area. Fourthly, the speed of price adjustment after shocks is higher and the share of firms not changing prices in case of shocks is lower in Estonia than in the euro area. The only result that points in the direction of higher price stickiness in Estonia is the finding that the share of firms setting prices in a forward-looking manner (as indicated by the information set they use) is lower in Estonia than in the euro area countries.

In analysing the adjustment channels, we focussed on the effect of the changes in the level of interest rates, exchange rates and loan stock on the Estonian economy. To assess this impact, we analysed the Estonian monetary and financial system as well as its integration with international financial markets; the linkages between the financial and real sectors of the Estonian economy; the importance of various monetary transmission channels. We concluded that as a result of the high credibility of the Estonian monetary system and the high level of integration of the financial sector with the EU, the changes in the euro area interest rates have a quick

effect in Estonia. Using a macro model, we found that from the three variables (the exchange rate, interest rate and loan stock), changes in the exchange rate have been the most influential ones. However, we argue that the financial integration and financial deepening process in the recent years has strengthened the impact of euro area interest rate changes in Estonia.

DISSERTATIONS DEFENDED AT TALLINN UNIVERSITY OF TECHNOLOGY ON *ECONOMICS*

1. **August Aarma**. Segmented analysis of bank customers and banking information: Estonian case. 2001.
2. **Enn Listra**. The development and structure of banking sector: retail banking in Estonia. 2001.
3. **Tatyana Põlajeva**. The comparative analysis of market's attractiveness. 2001.
4. **Tuuli Tammeraid**. Modeling flow of funds for Estonia. 2002.
5. **Ivo Karilaid**. The choice in general method for investment and performance evaluation. 2002.
6. **Hele Hammer**. Strategic investment decisions: evidence from survey and field research in Estonia. 2003.
7. **Viljar Jaamu**. The methods and instruments for solving the banking crisis and development of the banking sector in Estonia. 2003.
8. **Katri Kerem**. From adoption to relationships: Internet banking in Estonia. 2003.
9. **Ly Kirikal**. Productivity, the malmquist index and the empirical study of banks in Estonia. 2005.
10. **Jaanus Raim**. The PPP deviations between Estonia and non-transitional countries. 2006.
11. **Jochen Sebastian Heubischl**. European network governance – corporate network systematic in Germany, the United Kingdom and France: an empirical investigation. 2006.
12. **Enno Lend**. Transpordiühenduse ja logistikasüsteemi interaktsioon (Saaremaa ja Hiiumaa näitel). 2007.
13. **Ivar Soone**. Interrelations between retail service satisfaction and customer loyalty: A holistic perspective. 2007.
14. **Aaro Hazak**. Capital structure and dividend decisions under distributed profit taxation. 2008.
15. **Laivi Laidroo**. Public announcements' relevance, quality and determinants on Tallinn, Riga, and Vilnius stock exchanges. 2008.