Eesti Pank
Bank of Estonia

KROON & ECONOMY

1/**2** 2009

SUBSCRIPTION

The quarterly Kroon & Economy can be subscribed by
fax: +372 6680 954
e-mail: publications@epbe.ee
mail: Eesti Pank
Publications Group
Estonia pst 13
15095 Tallinn
Estonia

The quarterly is free of charge to subscribers.

Information about publications of Eesti Pank by phone +372 6680 998.
The views expressed in the articles are those of the authors and do not necessarily represent the official views of Eesti Pank.

Publications of the Estonian central bank are available at:
http://www.bankofestonia.info

ISSN 1406-829X

KROON & ECONOMY
Eesti Pank quarterly

Executive editor: Kadri Põdra
Cover design & design: Vincent OÜ
Layout: Urmas Raidma

Printed in AS Aktaprint

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FOREWORD

The crisis that hit the global financial system last autumn brought about a recession in Europe and also elsewhere in the world, including Estonia. Among other things, the recession caused a decline in consumer prices, which started in the final months of 2008 and has lasted to this date.

The adjustment of the Estonian economy is under way but first the confidence of investors should be recovered in order to restore growth. Therefore Estonia has set itself the objective to adopt the euro as soon as possible. To this end, Estonia has to meet the so-called Maastricht criteria, including the criterion of price stability, which is based on the inflation rate.

Thus, the present issue of the "Kroon & Economy" gives an overview of the inflation developments in the three Baltic States. The overview is based on a joint research on inflation determinants, conducted by the central banks of Estonia and Latvia.

INFLATION IN THE BALTIC COUNTRIES

Konstantins Benkovskis, Dmitry Kulikov, Daina Paula, Laura Ruud*

INTRODUCTION

The Baltic countries are an example of a fast transformation from centrally planned economic systems to functioning market economies. The countries established balanced growth-oriented economic frameworks in the 1990s and experienced a strong economic expansion in the following decade. Broad-based economic reforms and institution building restored the credibility of the monetary system, bringing inflation down to levels consistent with a price stability objective. However, inflation remained higher than in more advanced economies.

The economies of the Baltic countries underwent multiple structural changes within a short time period, complicating any determination of the effects of inflation factors. Continuous economic adjustment to the rules of the market economy together with the accession to the European Union strongly affected the traditional cyclical development of the economies. Additionally, the small size, the relatively high level of openness and liberal economic policies of the Baltic countries expose the economies heavily to external developments that might determine inflation dynamics. The Baltic countries have exited their transition period successfully but are continuing to catch-up with the more advanced EU economies, which might create some additional inflation.

This report aims to define the determinants of inflation in the Baltic countries and assess their effect on core inflation from the 1990s until today. The report provides an overview of the main economic developments potentially affecting inflation. The potential determinants of inflation are divided into three broad categories: convergence factors, demand factors and supply factors. The determinants of core inflation are quantitatively estimated with a regression analysis, based on Phillips-curve models. A separate detailed analysis is conducted to assess the role of inflation expectations in inflation developments.

The report is structured as follows. Chapter 2 surveys the historical developments of inflation developments in the Baltic countries. Chapter 3 identifies the potential factors driving inflation in Estonia, Latvia and Lithuania. Chapters 4 and 5 provide an econometric analysis of inflation in the three countries within the framework of Phillips-curve models and the role of inflation expectations, respectively. Chapter 6 concludes the paper.

* The authors are very grateful to Ruta Rodzko and Ernestas Virbickas from the Bank of Lithuania for their contribution and assistance in the preparation of this report.

BRIEF OVERVIEW OF INFLATION DEVELOPMENTS IN THE BALTIC COUNTRIES

The Baltic countries have experienced relatively similar institutional and economic development resulting in comparable inflation patterns. The three countries started their independent state and institution building in the beginning of the 1990s, after regaining independence, establishing market economies and price stability-oriented monetary systems. The goal of accession to the European Union (EU) became a major supporting and accelerating factor to the economic and institutional transition.

All three Baltic countries chose a fixed exchange rate as the basis for a stable monetary system in their small open economies. The introduction of a credible monetary system was urgent and crucial for bringing down inflation rates from levels close to hyperinflation. Fixed exchange rate systems with elements of currency board arrangements increased the credibility of the domestic currency and enabled the Baltic countries to import price stability from their anchor currency countries. After the introduction of the new monetary systems, consumer price inflation decreased from levels of over 1000% in 1992 to single-digit levels in 1997–1998.

The financial crises in Asia and Russia in the second half of the 1990s led to a short-term economic recession that was reflected by low inflation rates (see Figure 1). Subsequently, inflation rates returned to moderate levels, partially caused by the external environment.

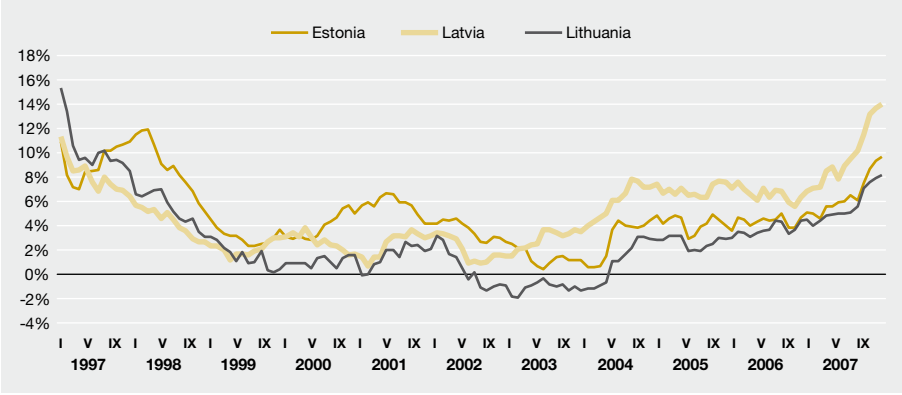

Figure 1. Annual HICP growth in the Baltic countries

Source: Eurostat

Slow economic activity in the major western European trading partner countries and the depreciation of the nominal effective exchange rate (NEER), due to the depreciation of the USD, hindered a rise in prices. Exchange rate developments affected price developments

in Latvia somewhat differently, causing higher inflation rates in 2003–2005, as prior to 2005 the lat was pegged to the SDR.

Global food and energy price growth remained limited as well, with the exception of developments at the end of 2000 and in 2001 that accelerated inflation, especially in Estonia. However, Latvia experienced a strong increase in electricity prices due to increases in electricity tariffs by the regulatory authority in 2003–2005 that added significantly to total inflation. At the same time increasing competition and productivity in the non-tradables sectors, particularly in telecommunications, prevented a further increase in price levels in all three Baltic States.

After becoming members of the European Union in May 2004, the Baltic countries experienced a sharp increase in consumer prices that was caused by a number of mutually overlapping factors: the harmonisation of the tax systems, an increase in global oil prices, and to some extent, increasing inflation expectations. Additionally, a one-off effect of an increase in customs tariffs against countries outside the European Union added to overall inflation. EU membership increased business and consumer confidence, which fuelled domestic demand and increased inflation expectations.

In the second half of 2005, after the impact of the harmonisation of customs duties had faded, an increase in global energy prices had an adverse effect on inflation in the Baltic countries. Increasing oil prices pushed up the prices of other types of energy (e.g., gas prices), causing an increase in prices across all sectors (especially in transport services and housing). Additionally, the effects of the rapid economic expansion started to affect inflation in 2006. Imbalances in growth across sectors and labour shortages combined with a robust growth in income and easy access to credit accelerated an increase in the prices of services. In 2007, increasing prices in global commodities markets further accelerated inflation in the Baltic countries. A high share of food and energy (incl. oil and gas) in the consumer basket amplified the impact on total inflation compared to the impact on the euro area economies. The ongoing harmonisation of excise duties (for alcohol and tobacco products) with EU requirements added to the overall price increase both in 2007 and 2008.

In summary, the catch-up nature of the Baltic economies and resulting higher average rates of GDP growth lead to a medium-term average inflation rate higher than that in the more advanced economies. Cyclical factors, determined by patterns of economic activity, may push the inflation rate above or below the long-term average. To a large extent, total inflation is often determined by external developments or changes in the administrative framework. In the following sections, the main convergence, and the supply and demand factors driving inflation, are analysed in more detail.

FACTORS AFFECTING INFLATION IN THE BALTIC COUNTRIES

Convergence

The development of the economies of the Baltic countries has been strongly affected by the convergence process with the European Union (EU). Gradually harmonising and adjusting policies with the requirements of the EU triggered a number of structural changes in these economies. Participation in the single European market of goods and services, as well as in the community-wide labour market, accelerated overall restructuring and adjustment. The ongoing catch-up process to the income levels of the more advanced economies keeps medium-term inflation in the Baltic countries above that in high-income EU economies.

Income and price convergence

Income and price levels in the Baltic countries are still well below the levels of the more advanced EU economies, leading to faster rates of growth. Faster productivity growth allows for a higher growth in income (real convergence) but is accompanied by a faster increase in prices (nominal convergence). Higher income triggers higher wages across economic sectors, increasing production costs and, consequently, consumer prices, especially for services. An increase in consumer prices or nominal convergence remains compatible with sustainable economic growth or real convergence until inflation rates lag behind productivity growth rates. However, labour productivity in the Baltic countries is still below the respective level in the euro area (see Figure 2), and therefore remains a source of income convergence.

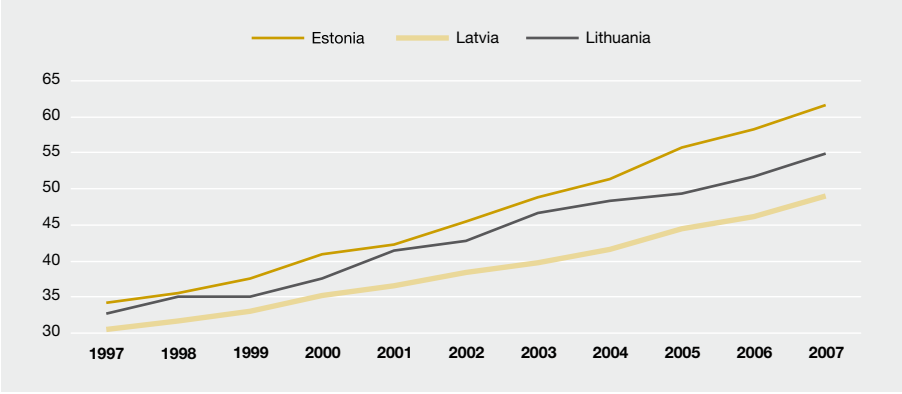

Figure 2. Labour productivity in terms of GDP per person employed, EA13[1] = 100

Source: Eurostat

[1] EA13 – the average of the euro area, consisting of 13 members (incl. Slovenia, who joined the euro area in 2007).

The speed of income convergence has been comparable to the speed of convergence in productivity. Both income and labour productivity levels nearly doubled relative to the average levels of the euro area within the past decade. Price convergence has largely coincided with income convergence. By 2007, the Baltic countries reached income and price levels of 50–60% of the euro area average compared to 35–45% in the late 1990s, respectively (see Figure 3).

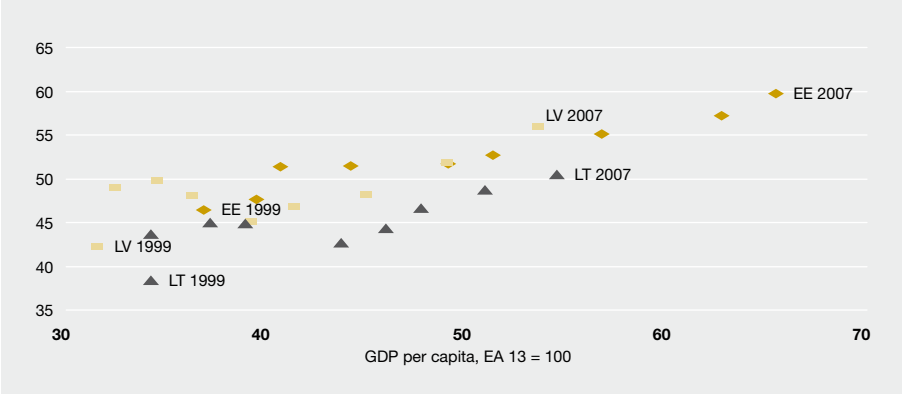

Figure 3. Comparative income and price levels in the Baltic countries, EA13 = 100

Source: Eurostat

Nominal convergence has been rather heterogeneous across product categories. Convergence is higher in prices of tradable rather than non-tradable goods, resulting from the small size and relatively high openness of the economies (the ratio of imported goods and services to GDP ranged from 70–80% in 2007). The prices of some tradable product categories (e.g., clothing and footwear, milk products) have almost fully converged to their respective average prices in the euro area (see Figure 4). The convergence of prices of other tradable products has been slower due to limited tradability (e.g., meat, vegetables) or lower excise duties (e.g., tobacco and fuel).

The price convergence of non-tradable goods and services is to a large extent determined by income convergence and often lags the convergence of the prices of tradable goods. In some service categories price levels have remained 30–50% below the average of the euro area (education, health). On the other hand, some product categories of non-tradables have relatively high price levels: 70–80% of the euro area average (e.g., communications, restaurants and hotels), partly because some of these sectors can be regarded as rather open.

Relative price levels across product categories are similar in all three Baltic countries, reflecting similarities in income level, economic structure and geographical location. The highest

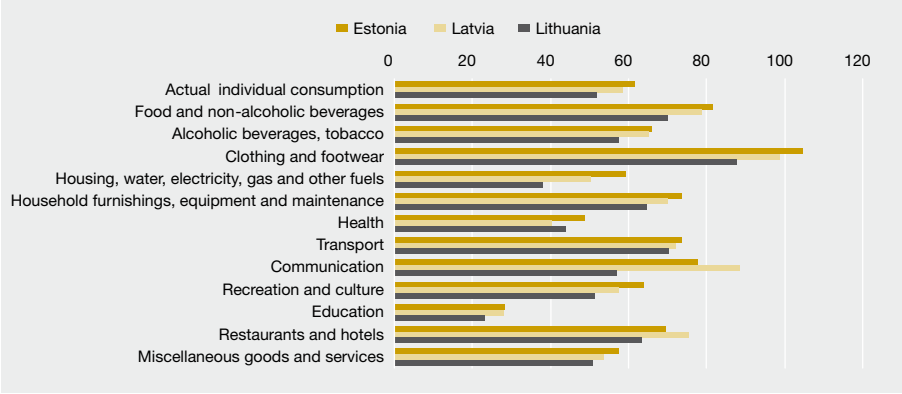

Figure 4. Comparative price levels by products in December 2007, EA13 = 100

Source: Eurostat, authors' calculations

prices are, with some exceptions, in Estonia, and the lowest in Lithuania, while differences remain within 10 percentage points in terms of the average price level in the euro area. The relative levels of the Baltic countries are still below the euro area average, indicating a scope for convergence and therefore possibly higher inflation than in the euro area.

Structure of consumption

A general increase in purchasing power in the Baltic countries has triggered a shift in the structure of households' consumption towards that of the euro area. Households can spend proportionally more on non-essential goods while becoming richer. Consequently, changes in the structure of consumption affect the contribution of the price movements of product categories on total inflation as the weights of product categories change. For example, the share of food expenditures in total consumption has declined significantly (see Figure 5) reducing the impact of changes in food prices on total inflation. At the same time the relative share of households' expenditures on services has increased, increasing the impact of wage increases on total inflation. The share of food consumption still remains higher than in the euro area, causing a stronger impact of changes in food prices compared to those same effects in the euro area.

The structure of consumption becomes especially relevant in cross-country comparisons, partly explaining the differences in inflation rates resulting from a common price shock. An increase in global oil prices affects inflation in the Baltic countries more than in the euro area, despite a lower share of total transport services in the consumption of households. In the Baltic countries the structure of consumption of transport-related services and products is dominated by expenditures on fuels, while in the euro area the structure of expenditures

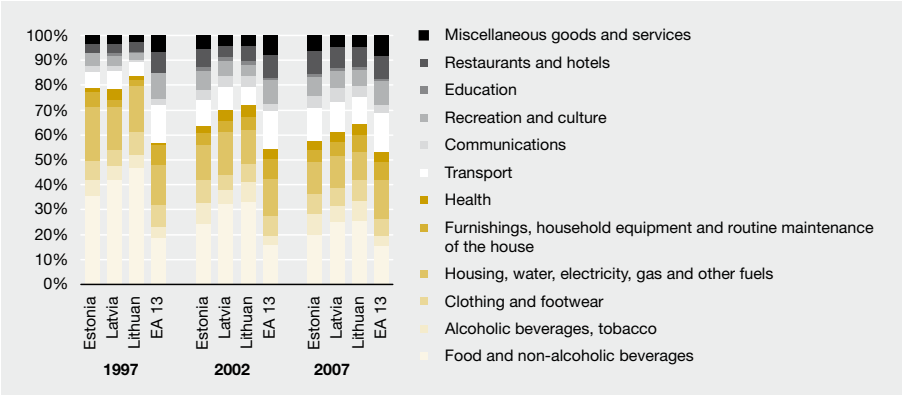

Figure 5. Structure of consumer baskets, 1997–2007

Source: Eurostat

on transport-related services and products is more heterogeneous. Moreover, the impact of changes in global oil prices is amplified by the accompanying increase in natural gas prices, especially in Latvia and Lithuania, which rely more heavily on gas heating compared to Estonia.[2]

Demand factors

The Baltic countries have faced a series of structural changes and economic shocks since they regained independence in the 1990s, which makes it difficult to determine business cycles in these economies. However, in recent years, the relationship between upswings of economic activity and higher inflation rates has become more evident.

Output gap

Domestic demand pressures lead to accelerating prices when an economy operates above its potential. In the Baltic countries excessive domestic demand induced price pressures that might have appeared at the end of 2005,[3] after relatively high growth rates (6–10% annually in real terms) for five consecutive years (see Figure 6). Economic activity might have started to exceed its medium-term potential immediately after the one-off impact of the increase of customs duties because of the EU accession started to fade, leading to additional price pressures.

[2] See more discussion on regulated prices in Section "Supply factors".
[3] See the output gap analysis in Chapter "Empirical Phillips curve models for Estonia, Latvia and Lithuania".

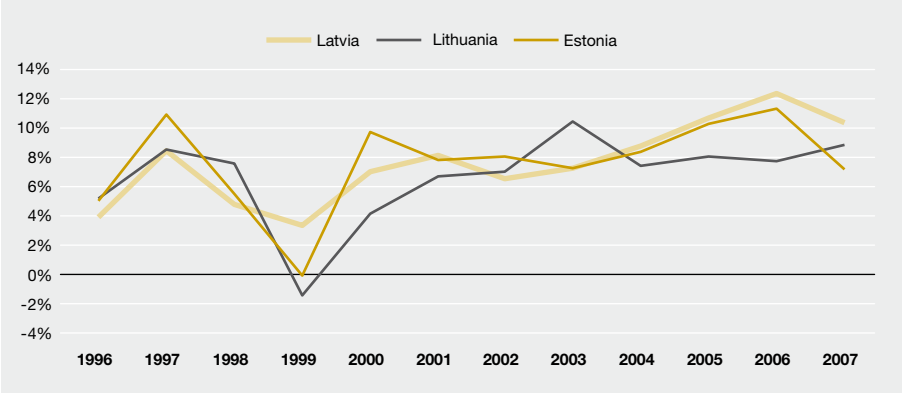

Figure 6. Real GDP annual growth in the Baltic countries

Source: National Statistics

Economic activity intensified, fuelled by strong foreign capital inflows through the foreign-owned banking sector. Increasing demand for real estate, especially for residential housing favoured by low real interest rates, created capacity constraints in the real estate sector that spilled over to other sectors.

A strong demand for labour in the real estate and construction sectors together with the liberalised mobility of labour across the member states of the EU created labour shortages. Demand-driven wage acceleration raised the purchasing power of households allowing for, together with a simplified access to consumer credit, temporarily higher mark-ups of prices in some sectors, as well as increasing the number of potential mortgage customers. At the same time, increasing production costs put pressures on the broad-based acceleration of inflation.

Foreign capital inflow

The foreign-owned banking sector provided the borrowers of the Baltic countries with funds at an accelerating pace, fuelling economic activity. In the credible fixed-peg-based monetary systems along with the intention of adopting the euro in the near future, increased borrowing in euros did not put any upward pressure on interest rates. The cost of borrowing rather decreased due to intensified competition in retail banking and a decrease in country risk. Globally, low interest rates and favourable credit conditions attracted borrowers, while increasing incomes widened borrowers' financial bases. The strong demand for mortgages led to total private-sector borrowing annual-growth rates of 60–70% in 2006 (see Figure 7). The private sector's (excl. the financial sector) credit stock increased to 85% of GDP in Estonia and Latvia in 2007 (up from 20% in 2001). In Lithuania, the private sector's credit stock remained somewhat lower (below 60% of GDP, up from 10% in 2001).

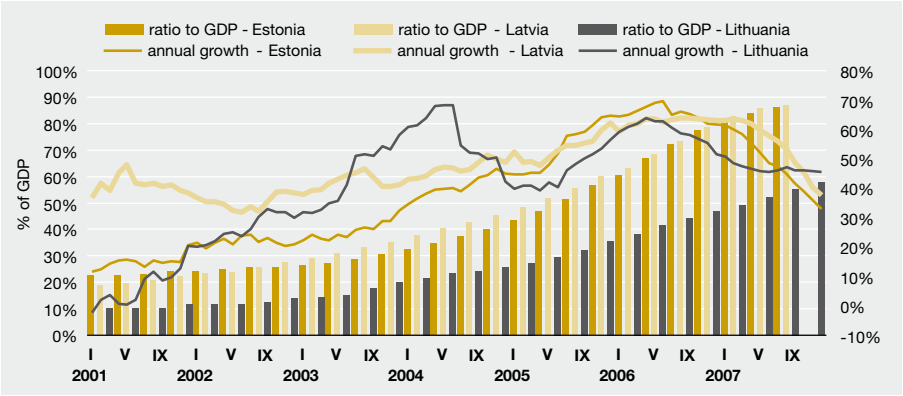

Figure 7. Lending to domestic households and non-financial corporations' development in the Baltic countries

Sources: Bank of Estonia, Bank of Latvia, Bank of Lithuania, Eurostat

A simplified access to mortgage loans and a higher number of eligible borrowers allowed residential housing suppliers to increase mark-ups. The resulting higher prices in housing required more extensive mortgages. Tight competition and a broadening range of credit products also led to a strong increase in consumer credit that heightened consumer demand. Increasing consumption allowed (temporarily) for additional price mark-ups.

Labour market

An environment of strong economic growth requires an intensive use of production factors, leading to shortages in the labour supply. The increasing demand for labour made use of the active population, reducing unemployment rates to 4–6% in 2007 (down from double-digit rates in 2001). Unbalanced strong economic growth caused a tightening of the labour market and mismatches between the supply and demand of labour across sectors, partially due to significant labour force outflows after the opening of the labour markets in some higher-income-level EU member states. Consequently, employment rates increased to 62–65%, up by 7–13 percentage points, with increasing wages and a high number of vacancies attracting the formerly inactive population as well. The ratio of economically active population increased in 2006–2007, coinciding with the period when economic activity exceeded its medium-term potential. Trading power in wage bargaining shifted towards employees, putting more pressure on wages. In recent years wage growth has exceeded productivity growth, creating demand pressures.

Mark-ups

The mark-up level is another factor that affects prices, dependent on both economic convergence and cyclical developments of the economy. Mark-ups affecting consumer prices are reflected in the ratio of profits (before taxes and interest-rate payments) to net sales of retail trade, are available for Estonia and Latvia since 2002 (data on Lithuania were not available). The level of mark-ups in Latvia and Estonia are proxy indicators and are not fully comparable due to possible differences in methodology, coverage and structure of the two economies.

During the last three years mark-ups had a tendency to increase, leading to upward pressures on prices (see Figure 8). The dynamics of mark-ups is to a large extent explained by changes in economic activity (see Annex 1).

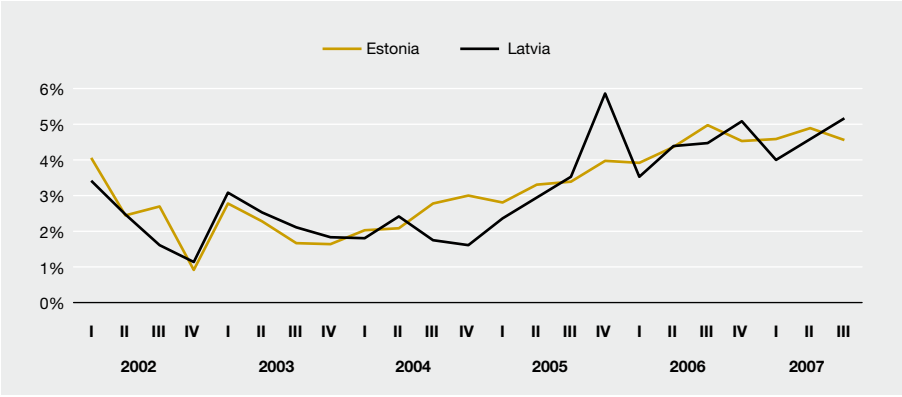

Figure 8. Ratio of profits to net sales in the retail trade sector, seasonally adjusted

Sources: Statistical Bureau of Latvia, Statistical Bureau of Estonia, authors' calculations

Reacting to the growth in demand, the level of mark-ups increased from ~2% in 2003 to more than 4% in 2006. However, the ratio of profits to net sales stabilized during the last 4-5 quarters of the reference period; therefore, it can be concluded that retail mark-up dynamics had no influence on Estonian and Latvian consumer prices in the second half of 2007. The ratios of profits to net sales in some other sectors (agriculture, manufacturing, hotels and restaurants), which are important to consumer prices, experienced more contained growth (see Annex 1).

The level of mark-ups can also be regarded as a structural or competition factor. In the cases of Latvia and Estonia, the mark-ups might also have been partly driven by an insufficient level of competition or possible formalisation (a shift from an informal to a formal economy) of profits during the observation period (see Annex 1).

Inflation expectations

The effects of domestic demand on inflation are also reflected in inflation expectations. Increased inflation expectations can significantly affect the inter-temporal distribution of consumption, reducing future consumption and increasing current consumption as well as domestic demand. This effect is more pronounced in cases of easy access to credit, which has been available in the Baltic countries over the previous years.

The impact of inflation expectations on inflation in the Baltic countries became more evident prior to EU accession, when actual inflation accelerated due to a series of mutually overlapping and coinciding factors. Quantified expected inflation and econometric analysis of the role of expectations is described in Chapter 5 of the report.

Supply factors

The small size and high degree of openness of the Baltic countries make their economies very susceptible to external shocks, which is transmitted to domestic prices via changes in import prices. Moreover, domestic supply factors like increasing nominal unit labour costs, indirect tax harmonisation with EU legislation, and hikes in regulated prices have also played an important role in Baltic inflation.

Nominal unit labour costs

Wage growth affects inflation both as a demand- and supply-side factor as it increases production costs for the corporate sector (given that other costs do not change). While the growth of unit labour costs is a part of nominal convergence, an excessively fast increase

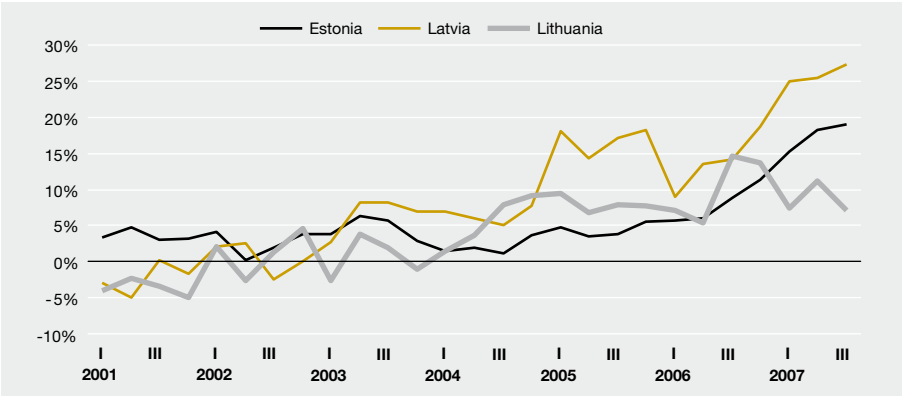

Figure 9. Annual growth of nominal unit labour costs in the Baltic countries

Source: Eurostat, authors' calculations

in labour costs might undermine a country's cost competitiveness. In the Baltic countries, nominal wage rate growth started to increasingly outperform real labour productivity growth in 2003, resulting in an acceleration of the increase in nominal unit labour costs (see Figure 9). The rapid increase in labour costs pushed up total production costs and increased consumer prices.

The dynamics of nominal unit labour costs also partly explains cross-country differences in the inflation rates of the Baltic countries. The faster growth in labour costs in Latvia pushed inflation up there more than in the other Baltic countries, while slower growth in labour costs contained inflation the most in Lithuania.

External price developments

Consumer prices in such small economies as the Baltic countries have are heavily influenced by changes in import prices. Import price developments have been rather similar in the three countries (see Figure 10). In the case of Latvia, the dynamics of import prices was affected additionally by the exchange rate peg to the SDR until 2005, as continuous euro appreciation led to a substantial increase in import prices in the domestic currency.

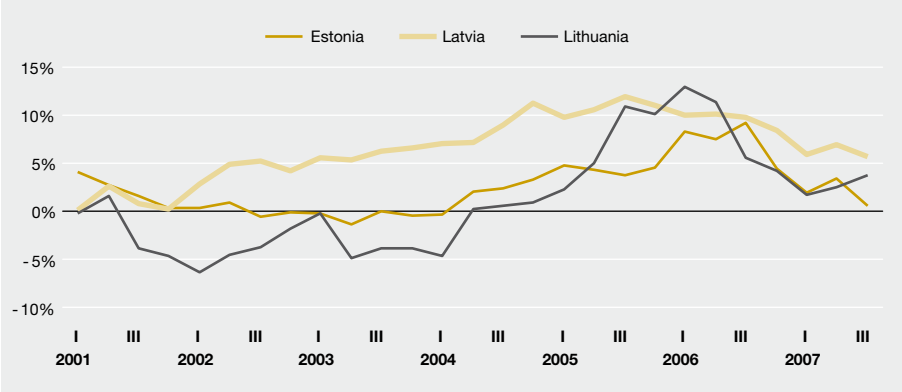

Figure 10. Import of goods and services deflator's annual changes in the Baltic countries

Source: Eurostat

Import prices were strongly affected by the oil price shock in 2005–2006 (see Figure 11) that was temporarily somewhat more pronounced in the case of Lithuania (see Figure 10), partially due to the significance of the oil refinery "Mažeiku naftas" in the production sector. In 2007, the increase in import prices remained limited in spite of a continuous growth in oil prices and a shock to commodity prices.

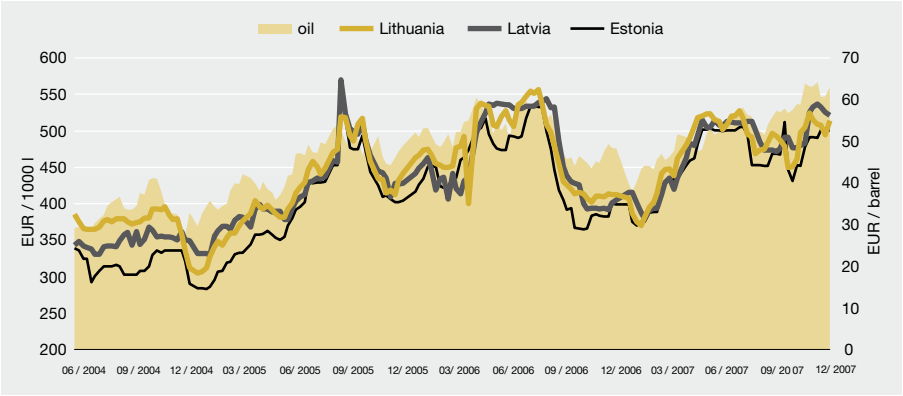

Figure 11. Fuel (Euro-super 95) prices in the Baltic countries, excluding taxes, and Brent Crude oil prices

Sources: European Commission (Weekly Oil Bulletin), Bloomberg

Increases in global oil prices strongly affected consumer prices. Their contribution to total inflation was more extensive than in the euro area economies due to the higher share of oil prices in the consumer basket and relatively lower excise duties.

Price regulations and indirect taxes

Price regulations and indirect taxes are another factor affecting inflation developments. In the following text, regulated prices refer to the prices directly or via methodology influenced or approved by state or municipal regulatory institutions – basically, gas and electricity, heating, public transport, several health and educational services, and postal services. The number of respective product groups varies across countries (see Annex 3); however, the detailed breakdown of HICP weights is not available for all countries, and therefore the following graphs are made using an equal breakdown of inflation in the main categories. Changes in regulated prices and indirect taxes add significantly to total consumer price inflation (see Figure 12). The main contributing factors are increases in energy prices and in excise taxes on alcohol and tobacco.

The impact of regulated prices on inflation depends on the extent of the use of a particular resource in the economy and the share of the respective expenditure in individual consumption. In Latvia and Lithuania, the impact of regulated energy prices has been higher than in Estonia due to their higher dependence on the developments of natural gas prices. Latvia uses natural gas more widely for heating, while Estonia relies to a large extent on domestic oil shale reserves (see Figure 13).

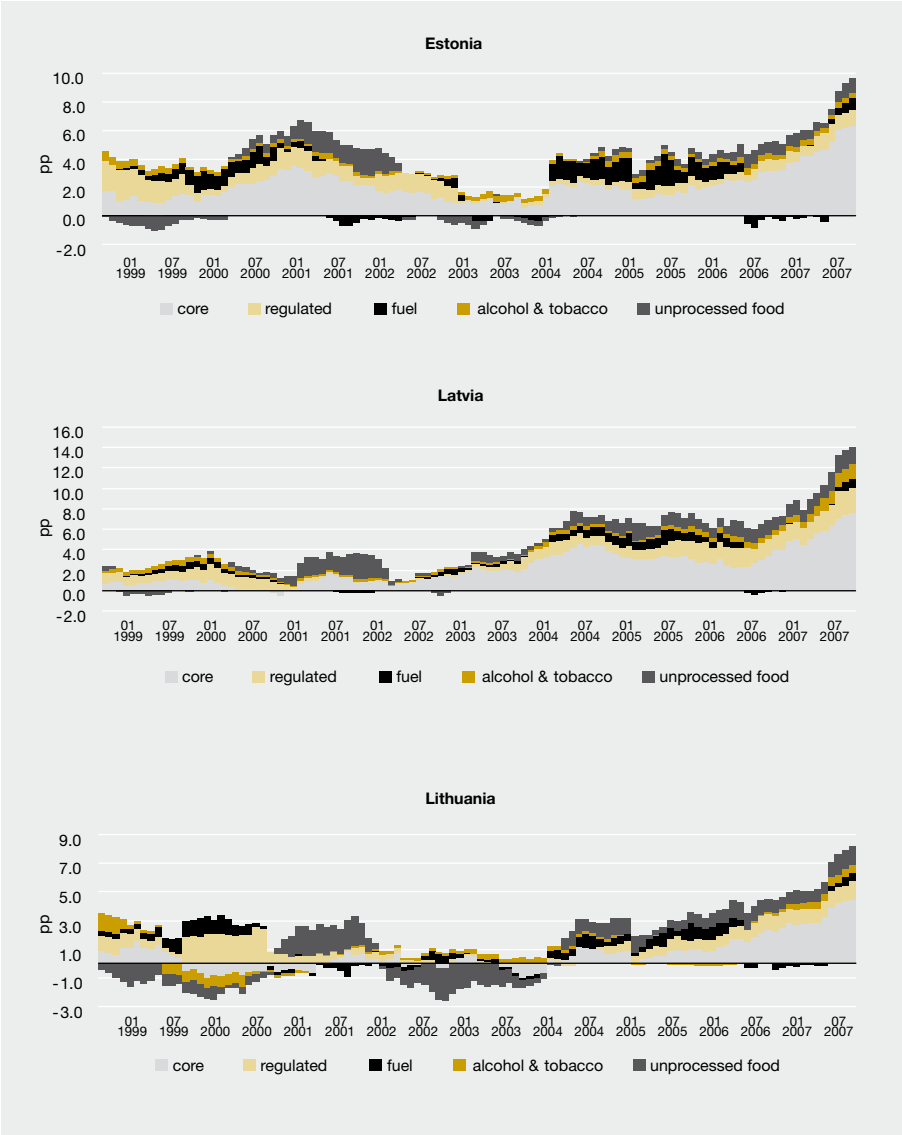

Figure 12. Contributions to HICP inflation in the Baltic countries

Sources: Eurostat, Bank of Estonia, Bank of Latvia, Bank of Lithuania, authors' calculations

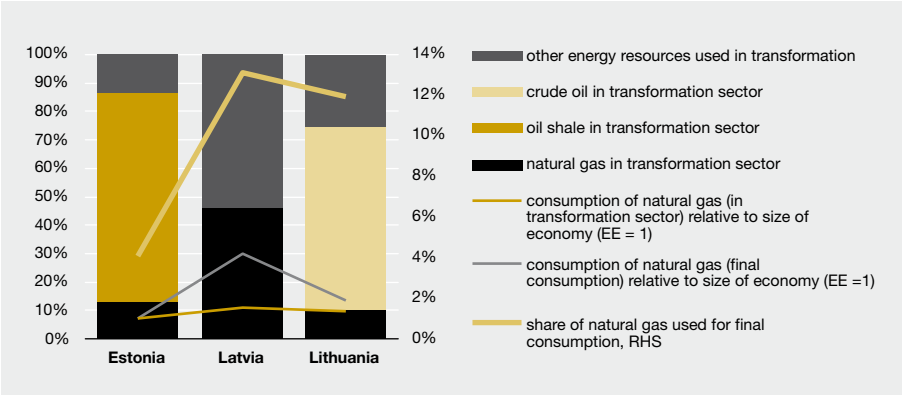

Figure 13. The structure of energy resources used for transformation into other energy types

Source: National statistical offices

Natural gas prices are either directly indexed to or dependent on oil prices due to the co-extraction of the two energy resources and possible mutual substitution in the production of heating energy. While the direct impact of changes in oil prices on domestic price levels is broadly limited to fuel prices and further to transportation costs, the indirect effect is much more significant and depends on energy use in the total economy – both for transformation into other energy resources and the final consumption of the corporate and household sectors.

The impact of institutional changes and administrative price decisions intensified after the EU accession in 2004 both due to tax harmonisation with the EU as well as increasing global energy prices (see Figure 14).

In recent years, increasing global energy prices triggered significant tariff increases, including public transportation fees. In the Baltic countries, electricity and gas prices are still significantly lower than in other EU Member States even after adjusting them for differences in taxation (see Annex 4). The lower prices were partly explained by the lower import prices for natural gas and therefore the price of electricity. Recently, the prices have been converging closer to the EU average.

The harmonisation of excise taxes with the minimum requirements of the EU continued gradually over the years. The prices of tobacco products are still below the euro area average mainly due to lower excise taxes. Minimum or close to minimum excise tax rates are imposed on fuels and alcohol, while the minimum excise tax rate on tobacco has to be imposed by January 1, 2009.

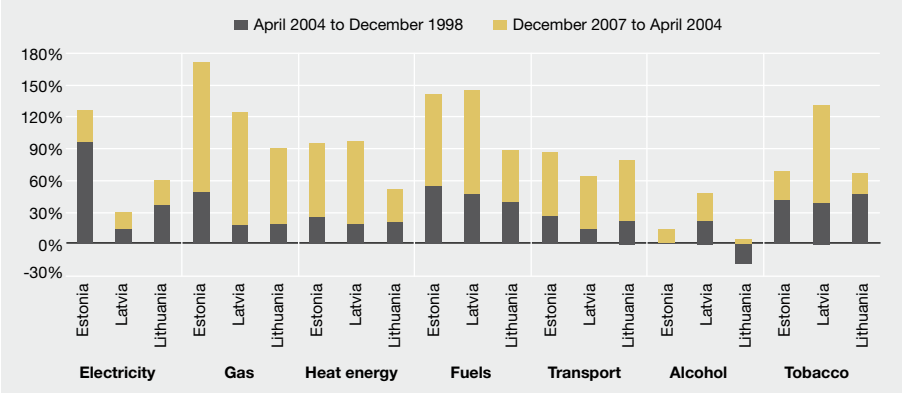

Figure 14. Increase in energy prices and the prices of other goods subject to the excise tax

Source: Eurostat, authors' calculations

EMPIRICAL PHILLIPS CURVE MODELS FOR ESTONIA, LATVIA AND LITHUANIA

This section reports inflation modelling results with the aim of understanding the similarities and differences in the inflation dynamics of Estonia, Latvia and Lithuania over the last decade. The idea is to employ econometric techniques to assess the factors affecting inflation in the three Baltic countries in a framework of a traditional backward-looking Phillips curve model. A side-by-side comparison of the empirical results for the three countries helps to bring out the main features driving their respective inflation processes.

Section "Factors affecting inflation in the Baltic countries" of this report highlighted the main factors standing behind a decade-long history of inflation in Estonia, Latvia and Lithuania. They have been divided into three main categories. The first category includes the determinants of inflation linked to the process of real and nominal convergence of the three Baltic economies to average EU levels. In particular, the high double-digit inflation rates of the early- and mid-nineties, as well as a part of the persistently higher-than-average inflation rates in recent years, can be attributed to the first category of determinants of inflation. The second group of factors relates to the demand-side pressures on inflation. Among those, the moderating impact of the Asian and Russian financial crises of the late nineties and accelerating inflation rates due to the large economic expansion of 2004-2007 stand out as two main examples. Finally, the third group of inflation drivers is linked to the supply-side shocks. As in other economies, these are mainly related to the prices of energy and main commodity groups, but their impact is even more pronounced in Estonia, Latvia and Lithuania because of the very open nature of the Baltic economies and their substantial reliance on imported energy.

This section combines the last two categories of potential determinants of inflation into a unifying econometric framework in order to give a statistical assessment of their relative importance with respect to the dynamics of core inflation in Estonia, Latvia and Lithuania.[4]

The empirical methodology in this section is based around a traditional backward-looking Phillips curve model with a separate part linked to inflation inertia, and demand- and supply-side factors. The alternative, more up-to-date forward-looking New Keynesian Phillips curve has been dismissed due to unstable coefficient estimates sensitive to the choice of instrumental variables. The role of inflation expectations as a possible factor behind the inflation dynamics in the three Baltic countries is examined in detail in Section "Inflation expectations in the Baltic countries: consumer survey-based results".

There are several recent studies that have examined the issue of inflation dynamics in the Baltic region. Masso and Staehr (2005) study inflation dynamics in Estonia, Latvia and Lithuania during the period 1995 to 2003. They estimate using forward-looking Phillips curve models both individually for each country as well as in the panel data setting, where they restrict a number of parameters by equalizing them across the three Baltic countries. Masso and Staehr (2005) parameterize their model such that the monthly rate of consumer price inflation is explained by the quarterly forward- and backward-looking inflation rates. They find that in some model specifications the forward-looking inflation component and the industrial production-based output gap have a positive and statistically significant effect on consumer price inflation in Estonia, Latvia and Lithuania. The real oil price and real effective exchange rate indicators were also found to be significant inflation determinants in the three Baltic countries.

In another recent paper, Dabušinskas and Kulikov (2007) estimate the New Keynesian Phillips curve for Estonia, Latvia and Lithuania using ten years of quarterly observations on GDP deflator-based inflation rates. The New Keynesian models estimated by the authors are based on strict theoretical grounds, and the main interest lies in obtaining inference on deep structural parameters such as the coefficient of price stickiness and the degree of backward indexation of prices. Therefore, less attention was paid to how well the estimated inflation models fit. Dabušinskas and Kulikov (2007) obtained statistically significant effects of the forward-looking component and, in some specifications, the capacity utilization measure on the GDP deflator-based inflation rates for all three Baltic countries.

Meļihovs and Zasova (2007) estimate both the traditional and New Keynesian Phillips curves for Latvia using quarterly data over the period 1996 to 2006. They report statistically significant effects of the forward-looking inflation component, output gap measure and foreign price shocks on the core inflation rate in Latvia.

[4] A quantitative assessment of the contribution of long-term convergence factors to inflation levels of the three Baltic States requires an altogether different empirical methodology and will not be attempted in this section.

Data and empirical methodology

The empirical Phillips curve models for Estonia, Latvia and Lithuania presented in this section use core inflation as the dependent variable in the models. In order to have comparable data for all three countries, the core inflation series is based on Eurostat's HICP sub-index which excludes highly volatile energy, food, alcohol and tobacco components.[5] The core inflation series are computed as month-on-month or quarter-on-quarter annualized changes in the respective HICP sub-index for the sample period spanning from 1996 to the start of 2008. Seasonal variations in the core inflation series are filtered out using the seasonal dummies approach, where changing seasonal patterns are accounted for by having different sets of seasonal dummy variables in the first and the second halves of the sample. The resulting core inflation series for the three Baltic countries are displayed in Figure 15 and Figure 16.

Despite seasonal adjustment and the absence of the volatile food component, the monthly series still exhibit substantial variability over the sample period. The monthly core inflation series appear to be especially volatile in the first part of the sample, reaching as high as a 30% annualized inflation rate for Latvia in August 1997, over the period when high inflation rates prevailed in all three countries. The quarterly inflation series depicted in Figure 16 are noticeably less volatile, with a maximum annualized inflation rate of around 18% for Latvia in the third quarter of 1997 and a minimum inflation rate of -6% for Lithuania in the third quarter of 2003. It can be observed that the long-term behaviour of the inflation series for all three

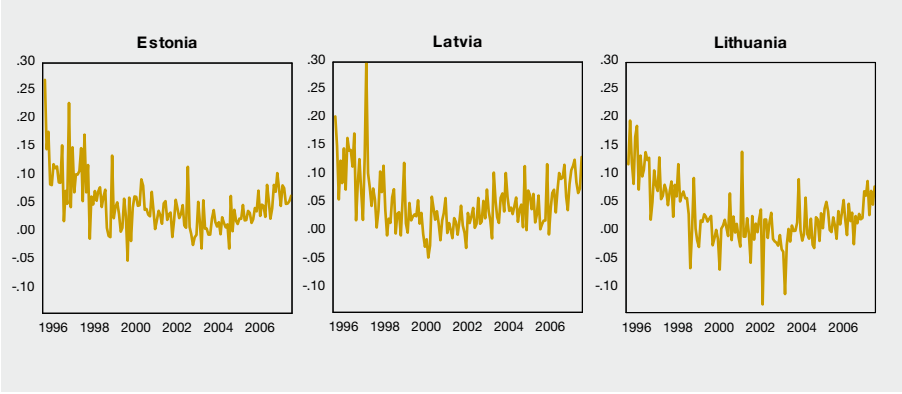

Figure 15. Annualized month-on-month seasonally adjusted core inflation series for Estonia, Latvia and Lithuania from 1996M1 to 2008M1

[5] The national central banks of Estonia, Latvia and Lithuania use slightly different definitions of core inflation in their internal forecasting and policy analysis exercises. The common definition adopted in this section corresponds to the one used by Eesti Pank.

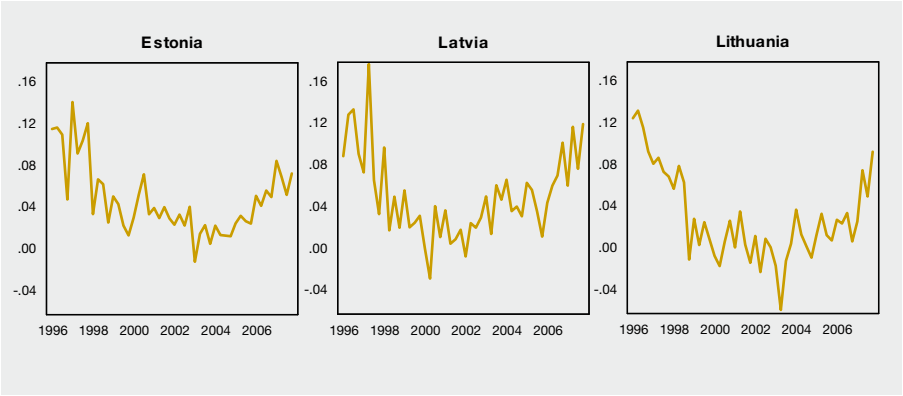

Figure 16. Annualized quarter-on-quarter seasonally adjusted core inflation series for Estonia, Latvia and Lithuania from 1996Q1 to 2008Q1

Baltic countries in Figure 15 and Figure 16 is very similar, with very high inflation rates for the mid-1990s down to single digits in 1998-1999, followed by a tendency towards rising to double digits again in 2006-2007.

The empirical Phillips curve models in this section are specified as traditional backward-looking models, where core inflation is explained by a number of inflation lags, the cyclical demand factor and a set of supply shocks. Lags of inflation in the backward-looking models help to pick up the persistence of the inflation process, which can be linked to inflation expectations as well as intrinsic inflation inertia. The cyclical demand factor, represented by the output gap variable, relates inflation to the real side of the economy, where the inflation process is expected to behave pro-cyclically. The supply shocks help to explain part of the volatility of inflation which can be attributed to specific price change events such as energy price shocks, changes in import prices, innovations in regulated prices and so on. It is of particular interest to understand the propagation mechanism of the supply shocks in core inflation dynamics. While the cyclical demand factor in the Phillips curve model is expected to explain the long-term component of inflation, the supply shocks are normally short-lived and may take a longer time to be fully incorporated into the core prices.

The output gap series for Estonia, Latvia and Lithuania are used as the cyclical demand factors in the empirical Phillips curve models.[6] The output gap series are estimated using

[6] Virtually identical sets of empirical Phillips curve models for Estonia, Latvia and Lithuania can be obtained by switching from the output gap to the unemployment gap, where the latter is computed by a simple linear de-trending of the corresponding unemployment rate series. The unemployment gap variables enter all models with statistically significant negative coefficients. These results are not reported in the section, but can be obtained from the authors upon request.

quarterly real gross value-added series for the three Baltic countries sourced from Eurostat's homepage. The series are seasonally adjusted and their log-deviations from the country-specific linear trends are computed. The resulting output gap series, denoted by Gap_t in the empirical models, are shown in Figure 17. Note that the series are interpolated from the quarterly to the monthly frequency as needed in the monthly empirical Phillips curve models using a simple linear interpolation method. While statistically this induces a degree of smoothness to the output gap series, the economic interpretation of the gap is such that it is not expected to fluctuate dramatically from month to month.

The resulting output gap series were also compared to the annual output gaps estimated for Estonia, Latvia and Lithuania by the European Commission using the production function approach.[7] A pair-wise comparison for each of the three countries reveals that the two alternative output gap series display very similar dynamics. The most prominent feature of the three series in Figure 17 is the effect of the Russian financial crisis on the three Baltic economies in 1998-1999, after which a prolonged period of underperformance followed until the European Union accession in 2004 when all three countries experienced very high levels of economic growth, resulting in an unprecedented deviation of the real GDP series from its long-term linear trend.

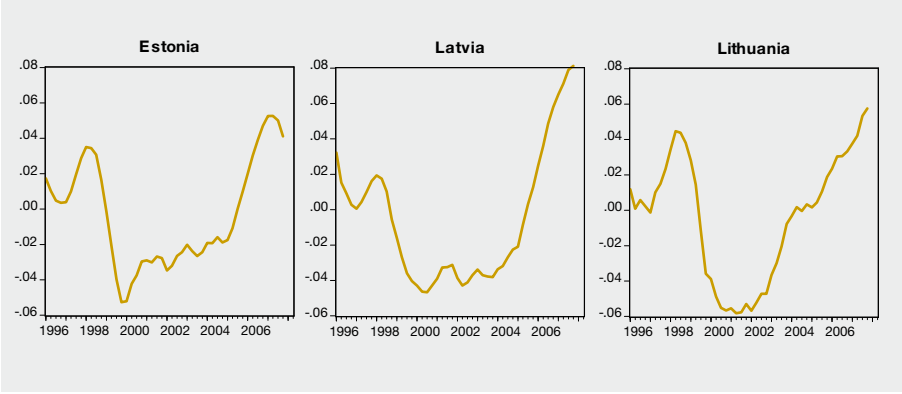

Figure 17. Estimated output gap series for Estonia, Latvia and Lithuania from 1996Q1 to 2008Q1

The supply-side shocks in the empirical Phillips curve models for Estonia, Latvia and Lithuania are given by the following variables, where the first three are defined as month-on-month changes in the monthly empirical models, and as quarter-on-quarter changes in the quarterly models:

[7] Refer to circa.europa.eu/Public/irc/ecfin/outgaps/home for DG ECFIN estimated output gaps and related methodology.

- ΔOil_t is the annualized change of the price of oil in percentages over the previous period, where the price of oil is measured in local currencies, sourced from the ECB database;
- $\Delta Food_t$ is the annualized change of the food and non-alcoholic beverages component (CP01) of HICP in percentages over the previous period, sourced from Eurostat's homepage;
- $\Delta Elgas_t$ is the annualized change of the electricity, gas and other fuels component (CP045) of HICP in percentages over the previous period, sourced from Eurostat's homepage;
- $\Delta Import_t$ is the annualized change of the import price deflator in percentages over the previous quarter, sourced from Eurostat's homepage;
- $\Delta Neer_t$ is the annualized change of the nominal effective exchange rate against a group of 41 countries in percentages over the previous month, sourced from Eurostat's homepage.

The effects of these supply-side shocks on inflation dynamics is expected to be positive, apart from the $\Delta Neer_t$ variable that is used as a proxy for import prices in the monthly models with a positive $\Delta Neer_t$ indicating relatively cheaper imports. For the highly open economies of the Baltic region the effect of changing fuel prices on inflation can be substantial, as was indicated in Section "Factors affecting inflation in the Baltic countries". The comparison of oil price dynamics with changes in car fuel prices in Figure 11 reveals a high degree of correlation between the two. However, while the impact of fuel prices is visible in the broad HICP inflation index, the corresponding effect on core inflation, a big part of which is related to prices in the service sector and hence wage dynamics, might not be immediate and is likely to be gradual and dependent on the cyclical position of the economy. Similar considerations apply to the impact of import and food prices on core inflation: the volatile food sub-component of HICP is absent from core inflation and the effect of changing food and import prices is likely to find its way into core inflation over a period of time.

As was pointed out in Subsection "Supply factors", regulated prices may constitute an important part of the supply-side factors that affect inflation in the Baltic region. Unfortunately, there are no comparable statistical series on administrative prices in the three Baltic countries. In order to pick up some of these effects in a way that is comparable across Estonia, Latvia and Lithuania, another explanatory variable is set as a proxy for the regulated prices. The price changes of electricity, gas and other fuels represented by $\Delta Elgas_t$ contain a sizable component of administratively adjusted prices in each Baltic country. This explanatory variable is included in the supply-shocks section of the empirical Phillips curve models.

The final econometric specification of the empirical Phillips curve models for Estonia, Latvia and Lithuania is given by:[8]

$$\pi_t = c + \sum_{j=1}^{q} \phi_j \pi_{t-j} + \delta_1 Gap_{t-1} + \delta_2 \Delta Oil_{t-1} + \delta_3 \Delta Food_{t-1} + \delta_4 \Delta Elgas_{t-1} + \delta_5 \Delta Import_{t-1} + \varepsilon_t$$

In this equation the core inflation variable is denoted by π_t, while the notation of all other variables is as before. Note that in monthly models $\Delta Neer_t$ is used in place of $\Delta Import_t$ due to the absence of comparable monthly import price indices in the three Baltic countries. Unit root tests have been carried out prior to the estimation to make sure that all left- and right-hand side variables in this model are stationary, and that obtained statistical inference from the coefficients is valid when the models are estimated by the ordinary least squares and the maximum likelihood methods.[9]

The empirical Phillips curve models for Estonia, Latvia and Lithuania are estimated using monthly and quarterly data. For each data frequency, two sets of results are available: one where the models are estimated individually country-by-country without any cross-country restrictions, and the other where the coefficients δ_1 to δ_5 are restricted to being the same across the three countries. In all cases, the number of lags of the past inflation q in the empirical models has been determined for each country individually using the general-to-specific approach. Care has been taken to ensure that the lag structure of the models is sufficient for the residuals ε_t to be white noise, so that statistical inference from the model coefficients is valid. Country-by-country models are estimated using the ordinary least squares method, while the statistical inference from the restricted models is obtained by the maximum likelihood methods in the context of the seemingly unrelated regressions estimator (see Hamilton, 1994).

[8] Note that the models include one lag of the supply-side shocks. ***A priori*** there is no reason to expect the shocks to impact the core inflation process over one period, calling for a distributed lags structure. However, the specification in this report is partly motivated by the existing literature, where just one round of shocks is usually appended to empirical inflation models, and partly by the statistical model selection criteria. Specifically, neither Akaike nor Schwartz's information criteria support adding extra lags into both quarterly and monthly models for Estonia and Latvia. For Lithuania, the information criteria suggest the second lag of supply-side shocks in the monthly model, but none of the newly included lagged explanatory variables are statistically significant.

[9] The results of the unit root tests are not presented in this report. They are available from the authors upon request.

Empirical results

The estimation results of quarterly and monthly empirical Phillips curve models are shown in Tables 1 and 2. The overall conclusion that follows from the empirical models is that the dynamics of core inflation in the Baltic countries is best of all explained by the cyclical demand factor: the output gap. The output gap accounts for a large part of the long-term inflation fluctuations in Estonia, Latvia and Lithuania, and the remaining own persistence of the core inflation process in all three countries tends to be relatively small. Apart from some of the effects of regulated energy prices in Lithuania, there is little evidence that the supply-side shocks help explain the fluctuations of the core inflation rates in the Baltic region. Below we further elaborate on these conclusions.

Table 1. Quarterly empirical Phillips curve models

	ESTONIA		LATVIA		LITHUANIA	
	COUNTRY-BY-COUNTRY MODELS					
c	0.0147	(0.0078)	0.0396	(0.0096)	0.0060	(0.0053)
Π_{t-1}	—		0.2151	(0.1379)	0.6821	(0.1065)
Π_{t-2}	0.2605	(0.2059)	—		—	
Π_{t-3}	0.2567	(0.1224)	—		—	
Gap_{t-1}	0.2217	(0.0957)	0.4485	(0.1605)	0.1660	(0.1171)
ΔOil_{t-1}	0.0016	(0.0061)	0.0053	(0.0078)	0.0146	(0.0089)
$\Delta Food_{t-1}$	-0.0119	(0.0310)	0.0241	(0.0875)	0.0868	(0.0796)
$\Delta Elgas_{t-1}$	0.0370	(0.0295)	0.0664	(0.1039)	0.0064	(0.0397)
$\Delta Import_{t-1}$	0.1183	(0.0842)	-0.0312	(0.0478)	-0.0520	(0.0455)
R^2	0.5073	0.5260	0.6247			
	RESTRICTED SYSTEM OF EQUATIONS					
c	0.0197	(0.0062)	0.0346	(0.0069)	0.0088	(0.0049)
Π_{t-1}	—	0.2861	(0.0996)		0.5890	(0.0824)
Π_{t-3}	0.2662	(0.1100)	—		—	
Gap_{t-1}			0.2955	(0.0763)		
ΔOil_{t-1}			0.0040	(0.0045)		
$\Delta Food_{t-1}$			0.0267	(0.0395)		
$\Delta Elgas_{t-1}$			0.0247	(0.0261)		
$\Delta Import_{t-1}$			0.0156	(0.0277)		
R^2	0.4589		0.4926		0.5947	

Notes: The upper part of the table shows the results of unrestricted country-by-country models estimated by the ordinary least squares method. The lower part shows the restricted system of equations results, where the coefficients of the output gap and supply shocks are restricted to being the same across Estonia, Latvia and Lithuania, estimated by the seemingly unrelated regressions estimator. Heteroscedasticity-consistent standard errors are shown in parentheses next to the coefficient estimates. The underlined coefficients are statistically significant at the 10% level. The effective sample size is 45 observations for Estonia (1997q1 to 2008q1), and 47 observations for Latvia and Lithuania (1996q3 to 2008q1).

Table 2. Monthly empirical Phillips curve models

	ESTONIA		LATVIA		LITHUANIA	
	COUNTRY-BY-COUNTRY MODELS					
c	0.0247	(0.0043)	0.0405	(0.0075)	0.0099	(0.0016)
Π_{t-1}	—		0.2304	(0.0716)	0.2511	(0.0880)
Π_{t-2}	0.2460	(0.0848)	—		—	
Π_{t-3}	—		0.2331	(0.0852)	0.3566	(0.0735)
Π_{t-4}	0.2276	(0.0756)	—		—	
Gap_{t-1}	0.2028	(0.0756)	0.2897	(0.0912)	0.2804	(0.0113)
ΔOil_{t-1}	0.0046	(0.0035)	0.0010	(0.0030)	0.0004	(0.0030)
$\Delta Food_{t-1}$	-0.0312	(0.0194)	-0.0190	(0.0311)	-0.0027	(0.0327)
$\Delta Elgas_{t-1}$	0.0123	(0.0130)	0.0061	(0.0255)	0.0228	(0.0116)
$\Delta Neer_{t-1}$	0.0058	(0.0055)	-0.0079	(0.0075)	-0.0064	(0.0123)
R^2	0.4328		0.4300		0.4824	
	RESTRICTED SYSTEM OF EQUATIONS					
c	0.0279	(0.0044)	0.0405	(0.0075)	0.0099	(0.0016)
Π_{t-1}	—		0.2304	(0.0716)	0.2511	(0.0880)
Π_{t-2}	0.2226	(0.0726)	—	—		
Π_{t-3}	—		0.2331	(0.0852)	0.3566	(0.0735)
Π_{t-4}	0.1893	(0.0651)	—		—	
Gap_{t-1}			0.2565	(0.0560)		
ΔOil_{t-1}			0.0019	(0.0018)		
$\Delta Food_{t-1}$			-0.0157	(0.0139)		
$\Delta Elgas_{t-1}$			0.0155	(0.0085)		
$\Delta Neer_{t-1}$			-0.0015	(0.0079)		
R^2	0.4209		0.4260		0.4760	

Notes: The upper part of the table shows the results of unrestricted country-by-country models estimated by the ordinary least squares method. The lower part shows the restricted system of equations results, where the coefficients of the output gap and supply shocks are restricted to being the same across Estonia, Latvia and Lithuania, estimated by the seemingly unrelated regressions estimator. Heteroscedasticity-consistent standard errors are shown in parentheses next to the coefficient estimates. The underlined coefficients are statistically significant at the 10% level. The effective sample size is 140 observations for Estonia (1997m06 to 2008m01), and 141 observations for Latvia and Lithuania (1996m05 to 2008m01).

The link between the output gap and core inflation in all three Baltic countries appears to be statistically significant and with the expected positive sign. In addition, recursive estimations suggest that the output gap coefficient is stable across the sample period for all estimated models. An examination of Figures 15 to 17 offers additional evidence of the strong long-term co-movements between the core inflation process and the cyclical demand factor in Estonia, Latvia and Lithuania. On average, the estimated coefficient in front of the output gap lies within the interval 0.2 to 0.3 across the three countries. This result is in line with the findings of Meļihovs and Zasova (2007) for their traditional Phillips curve specifications, and implies a 0.2 to 0.3 percentage point effect on the core inflation rate for a 1 percentage point change

in the output gap. The empirical results of Masso and Staehr (2005) further corroborate the size of the estimated coefficient in front of the output gap variable, when the differences between the empirical specifications of their models and the models in Tables 1 and 2 are taken into account.

There is a notable similarity across the estimated output gap coefficients for Estonia, Latvia and Lithuania both for quarterly and monthly sets of results. This fact might not be very surprising in lieu of the similar experiences that the three Baltic economies went through over the last decade. Nevertheless, the comparable output gap coefficients in Tables 1 and 2 once again underscore the degree of resemblance between the three countries in terms of economic structure, monetary and fiscal arrangements, and the level of development which manifests itself in similar linkages between the nominal and the real sides of their economies.

Another prominent feature of the empirical Phillips curve models in Tables 1 and 2 is the lack of statistically significant supply-side effects on the core inflation process in all three Baltic countries. There is marginal evidence of the impact of regulated prices on the inflation process in Lithuania, but this result is found to be inconsistent across different sub-periods in the recursive estimations, and is not statistically significant in quarterly models. Combined with the previously identified link between the output gap and inflation, this finding appears to suggest that the core inflation process in Estonia, Latvia and Lithuania is driven solely by the cyclical position of their economies and the intrinsic persistence in inflation.

The lack of statistically significant supply-side inflation push-ups in Tables 1 and 2 appears to somewhat contradict the findings of Meļihovs and Zasova (2007) for Latvia. They report a statistically significant and correctly signed effect of $\Delta Neer_t$ on the quarterly core inflation rates during the period 1997 to 2006, but this result does not hold across all their estimated models. Furthermore, they investigate the impact of just two supply shocks in their empirical Phillips curve models, some of which also include the forward-looking inflation component, and therefore a direct comparison of their results with those in Tables 1 and 2 is not feasible. Masso and Staehr (2005) report a statistically significant effect of oil price shocks, but their models use headline consumer price inflation which is expected to be more responsive to changes in energy prices.

The high volatility of the core inflation series has resulted in somewhat low estimated autoregressive coefficients in the empirical Phillips curve models for Estonia, Latvia and Lithuania. The highest estimated autoregressive roots vary from 0.3 to 0.6 across the three countries. In addition, the lag structure of the models in Tables 1 and 2 is different from country to country. This appears to be a consequence of the strong long-term co-movement of the core

inflation rates and the output gap measure: the remaining persistence of the core inflation process seems to be relatively modest. From the policy perspective, this result leads to the following conclusion: the most effective way of controlling the core component of the inflation processes in Estonia, Latvia and Lithuania appears to be related to the demand side, which includes fiscal policy measures. The response of core inflation to these policy interventions is expected to be relatively quick, since the intrinsic persistence of the core inflation process in all three Baltic countries is not very high.

INFLATION EXPECTATIONS IN THE BALTIC COUNTRIES: CONSUMER SURVEY-BASED RESULTS

Inflation expectations play an important role in contemporary macroeconomic theory and practice to the extent that they affect the behaviour of economic agents, their expenditure, savings and investment decisions. Measuring inflation expectations is of particular importance for central banks whose key objective is to ensure price stability. Higher inflation expectations affect prices from both the demand side, pushing down real interest rates, and the supply side, pushing up nominal wages and hence the production costs of businesses too. With this taken into account, strong inflation expectations should be perceived as an alarm signal predicting an eventual upward inflationary trend and a potential drop in the confidence of economic agents in the activities of the central bank.

When dealing with inflation expectations, researchers face a problem: inflation expectations are not directly observable. One approach to assessing the magnitude of inflation expectations in the economy is direct measurement, which can be based on the outcomes of consumer surveys. The objective of this Section is the quantification of inflation expectations in the Baltic countries using the results of consumer surveys and an assessment of the inflation expectations' impact on actual inflation. To attain the objectives set, inflation expectations were quantified applying the probability approach. Moreover, small-scale VAR models capturing actual inflation and the quantified inflation expectations in the Baltic countries were produced. The contribution of inflation expectations to actual inflation has likewise been estimated.

Consumer survey data on inflation expectations in the Baltic countries

Consumer surveys are qualitative economic surveys, intended for short-term economic analysis and made in the framework of the Joint Harmonised EU Programme of Business and Consumer Surveys. The data published by the European Commission (EC) are based on surveys carried out by public and private institutes in the Member States. Consumer surveys are carried out on a monthly basis, although some additional questions are asked

on a quarterly basis. The presentation and methods of these monthly and quarterly surveys do not differ across countries, while the questions are harmonised following EU guidelines. We use data from consumer surveys from May 2001 onward, as from this point forward data is available for all 3 Baltic countries. The sample size varies from 800 in Estonia to 1200 in Lithuania.

As the study focuses on the analysis of inflation expectations, respondents' answers to 2 questions – Question 5 and Question 6 – are analysed. Respondents are asked to evaluate the current consumer price level vis-à-vis that of 12 months ago and to express their opinion concerning anticipated price movements in the next 12 months (the precise formulation of questions and answers is presented in Annex 5). As a rule, the response statistics are published as balances or the difference between positive and negative response options (see the formula in Annex 5).

Figure 18 shows the option balances for Question 5 and 6 and the actual HICP movements. Despite balance statistics being an explicit and compact indicator of consumers' opinions, much useful information on the distribution of respondents depending on their answers is discarded when presenting the results in one number. That is why the percentages of replies to Questions 5 and 6 are presented in Annex 6.

Figure 18 demonstrates that the option balances for Question 5, which represents consumers' perception of price changes, is highly correlated with actual inflation. However, it is interesting to underline some cases when consumers' perceptions differed from the actual situation. First, consumers did not capture changes in actual inflation when the level of actual annual inflation was moderate. This was the case for Latvia in 2001-2003, when

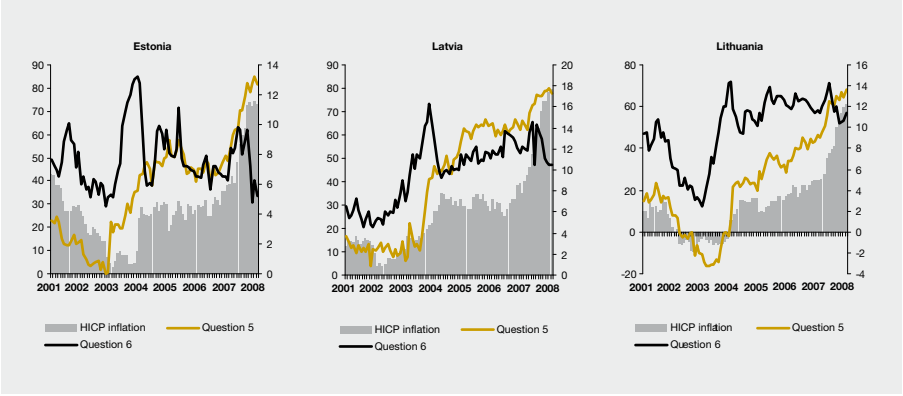

Figure 18. Perception of actual and expected inflation based on survey data (May 2001 – May 2008, points for balances of Questions 5 and 6 and % of annual HICP growth)

despite some fluctuations in HICP annual growth between 1% and 3%, the option balances for Question 5, as well as the distribution of responses, were rather stable. Perhaps, as the moderate rate of inflation did not encumber the economic decision-making process, the respondents did not perceive changes in HICP growth.

The second misperception of inflation can be noticed during the period of deflation in Lithuania (2002-2003). Although the balances of responses to Question 5 show a low level of perceived inflation, the distribution of responses shows that consumers perceived a slight growth in prices rather than deflation, as only 10% of consumers answered that prices had "fallen", while more than half of the respondents stated that prices were increasing.

As regards inflation expectations, the survey data reports that there was a significant increase in expectations prior to EU accession. Right before the accession, the share of respondents expecting that prices will "increase more rapidly" reached more than 60% (almost 80% in Estonia). Inflation expectations calmed down almost immediately after the accession and remained stable until 2007. During that period, the most popular answer was that prices would "increase at the same rate". However, it should be noted that the actual growth in prices ("the same rate") proceeded at a significantly faster pace. Finally, inflation expectations were on the rise in 2007 as more and more respondents expected that prices "will increase more rapidly".

Quantifying inflation expectations using the Carlson-Parkin approach

Consumer survey data provide a lot of useful information about how the respondents assess the actual situation and what their inflation expectations are. However, the primary data have some disadvantages. First, it should be noted that the formulation of Question 6 implies a comparison with the current situation. Hence, the magnitude of inflation expectations is expressed not only in the answers to Question 6 but also in the perception of the current situation. Second, survey data are difficult to interpret economically, as they are not directly comparable with actual inflation.

Such disadvantages can be eliminated by the inflation expectations estimates or quantification methods under which survey data are transformed into a percentage rate of annual change in prices. The probability or Carlson-Parkin approach is most often used in the quantification of inflation expectations. Under the probability approach, the response shares from each question of the survey can be interpreted as maximum likelihood estimates of the areas under the aggregate density function of aggregate inflation expectations. More details on the Carlson-Parkin approach can be found in J.A. Carlson and J.M. Parkin (1975), R.A. Batchelor and A.B. Orr (1998) or K. Benkovskis and D. Paula (2007). Figure 19 shows

perceived inflation and inflation expectations in the Baltic countries quantified by the Carlson-Parkin approach.

The highest peak of inflation expectations relative to perceived inflation before accession to the EU was observed in Estonia, where this difference was almost 5 pp high. In other periods expectations were closer to perceptions except for some months in 2005 and the end of 2007. Before 2004, perceptions did not capture actual inflation well – perceived inflation even grew in mid-2003 when actual inflation was still decreasing. However, there was a strong link between actual and perceived inflation starting from mid-2004.

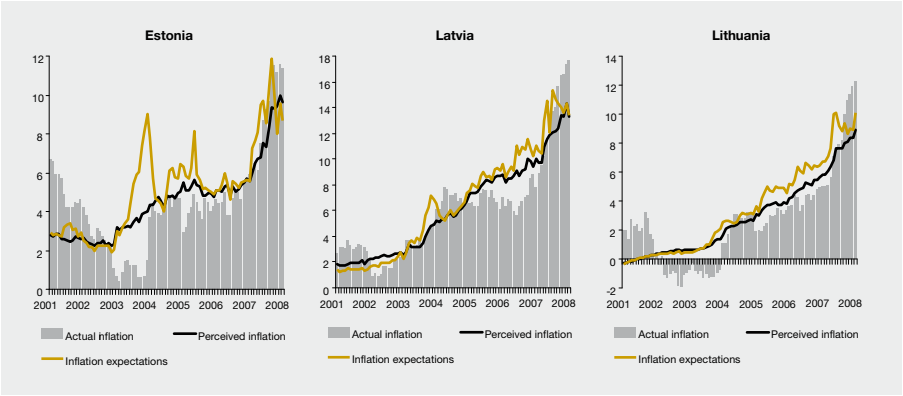

Figure 19. Quantified inflation expectations and perceived inflation in the Baltic countries (Carlson-Parkin approach, moderate inflation estimated using linear interpolation, May 2001 – May 2008, %)

In 2001-2002, the perceived rate of inflation was stable in Latvia despite some variance in actual annual inflation. The perceived inflation started to increase in the second half of 2003 and kept on rising until the end of the sample period. Inflation expectations were very close to the perceived inflation rate except for the period before accession to the EU and 2006-2007 when an upward leap in quantified inflation expectations was observed.

As in the other Baltic countries, quantified perceived inflation in Lithuania was stable before 2004 despite some changes in actual figures. It was even positive (also quite low, ~1%) during the deflation of 2002-2003. However, starting from mid-2004, perceived inflation captured changes in actual figures well. Regarding quantified inflation expectations in Lithuania, they were similar to perceived inflation until the end of 2003, while expectations slightly exceeded perceptions afterwards.

VAR Model with inflation expectations

In order to find out how and to what extent inflation expectations are linked with inflation in the Baltic countries, a VAR model has been employed. A similar approach to determining the role of inflation expectations was shared by M. Paloviita and M. Virén (2005) for the euro area and K. Benkovskis and D. Paula (2007) for Latvia, who estimated a VAR model with three variables: actual inflation, inflation expectations and the output gap.

In this paper we modified the abovementioned approach using a VAR model in levels, thus searching for long-term relationships and allowing for cointegration analysis. The VAR model has the following endogenous variables:

- $CORE_t$ denotes the level of HICP in period excluding unprocessed food and energy components, capturing the actual consumer price level in the country. We will call this variable core HICP and changes in this variable – core inflation (note that it may not coincide with national definitions of core inflation).
- EXP_t are inflation expectations in period relative to the perceived inflation in period. As we use a VAR model in levels, it is not possible to use quantified inflation expectations expressed as expected annual changes of consumer prices. Therefore, we use inflation expectations quantified by the Carlson-Parkin approach divided by perceived inflation. The advantage of this approach is the indifference of to the perceived inflation's assessment.
- GAP_t is the output gap, measured using the simple Hodrick–Prescot filter (as monthly data have been used, λ = 14400). In this model, the output gap captures the domestic demand of the economy. As only quarterly GDP data are available, interpolation was carried out, and the quarterly data were broken up into monthly data, with an unchanged quarterly sum total maintained. Interpolation has been made using the state space model on the basis of real industrial output and retail trade turnover at constant monthly prices data.

When developing a VAR model which includes the consumer price level, the strong pressure on inflation from a number of supply-side factors in the Baltic countries should be taken into account. These factors are to be included in the model; otherwise, the effects of demand and inflation expectations on prices would be incorrectly estimated. Thus, the following exogenous variables are included in the VAR model:

- OIL_t is the Brent crude oil price (in domestic currency). As fuel prices largely depend on global oil prices, the latter should also be included in the model as an exogenous indicator.
- P_EU_t is HICP in the EU27, capturing consumer price levels in the major trade partners of the Baltic countries. This is the underpinning factor affecting the prices of tradable goods.
- $FOOD_t$ denotes the log-differenced producer price index of the domestic food industry, representing the supply shocks for food products (harvest, epidemics, etc.).
- $ENERGY_t$ is the log-differenced producer price index of the domestic energy sector, representing the supply shocks for energy products apart from changes in oil prices (it should be noted that energy prices for consumers and producers are regulated by local authorities).

- $I\_EUR\_3M_t$ is the EURIBOR 3-month money market rate, which describes the monetary policy of the ECB.
- $NEER_t$ – the nominal effective exchange rate of the national currency against the currencies of 41 major trade partners. This factor is important due to the openness of the Baltic countries' economies as well as the share of tradable goods in the HICP basket of goods.

In addition to the abovementioned exogenous variables we use step dummy variables to describe shifts in price level determined by administrative decisions not captured by other variables; e.g., tax changes.

In order to test the interaction among the endogenous variables of the VAR model, impulse response functions were constructed. In doing so, the Choleski decomposition technique was used. The sequence of variables is as follows: GAP_t, log $CORE_t$, EXP_t. The output gap does not react immediately to the shock in actual core inflation and inflation expectations, while expectations react immediately to all shocks in the model.

Results of the VAR models

The VAR models are estimated for the period from May 2001 (the beginning of the consumer survey) to November 2007 on a monthly basis. Despite the non-stationarity, the VAR models include the levels of variables, thus assuming indirectly that there is a long-term linkage and co-integration. The choice of the lag length of the model was made according to information criteria (Schwarz information criteria).

The VAR-model impulse response functions demonstrate that the response of the HICP level is positive to shock in inflation expectations in two Baltic countries (see Figure 20). The

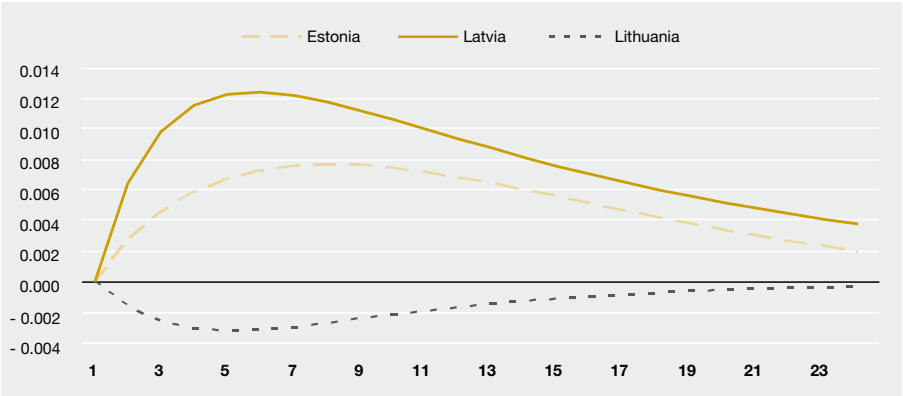

Figure 20. Responses of HICP to shock in expectations (responses to unit shock in expectations' ratio to perceived inflation)

highest response of consumer prices to shock in expectations' ratio to perceived inflation is observed in the VAR model for Latvia. Responses are also positive and statistically significant in the VAR model for Estonia. However, shock in inflation expectations has no statistically significant impact on prices in Lithuania. The full set of impulse response functions for all 3 VAR models is given in Annex 7, Figures A12-A14.

The other factor behind inflation in our models is the output gap. However, the VAR models found a positive effect of domestic demand on prices only for Latvia and Lithuania (the effect is not statistically significant). For Estonia, the output gap has a negative impact on actual inflation, which could indicate some omitted supply-side factors in the exogenous part of the model.

The expectations' variables do not react with statistical significance to actual inflation in all the models, which is determined by the definition of variable. The expectations variable is defined as the ratio of expected to perceived inflation, meaning that if the expected reaction to the inflation rate to change in perceived inflation is one to one, the abovementioned impulse response in the model should be equal to zero. Therefore, inflation expectations in the Baltic countries change in line with actual inflation.

According to the VAR models' results, inflation expectations have some inertia, which shows that the inflation expectations in the Baltic countries are to a large extent backward-looking. The inertia of inflation expectations is something to be reckoned with, as it means that along with the effects of demand and supply shocks on the actual subsiding of inflation, the inertia of inflation expectations will not allow actual inflation to fall instantly, thus creating a certain degree of persistence to actual inflation as well.

Contributions of inflation expectations shocks

It is possible to measure the contribution of expectations shocks to the changes in consumer prices of the Baltic countries using the results of a VAR model. First, the difference between the contribution of inflation expectations and that of inflation expectations shocks should be defined. Inflation expectations in this model are not exogenous, for they are affected by price level, domestic demand, interest and exchange rate as well as several supply-side variables (oil, food, energy prices, etc.). As inflation expectations depend on other variables, a large share of their contribution may be treated as an implicit contribution by other variables.

An inflation expectations shock is the share of inflation expectations that cannot be explained using other variables included in the model – inflation, as well as domestic demand- and supply-side variables. Figure A15 in Annex 7 presents the estimated series of inflation expectations shocks for the Baltic countries. According to the VAR model results, the largest

part of inflation expectations variance is explained by the other variables of the model; as a result, the shocks are comparatively moderate.

Figure 21 shows the contribution of the estimated inflation expectations shock to the annual inflation rate in the Baltic countries. The contribution has been calculated only for the period starting from May 2003, due to the period of at least two years required by VAR model impulse response functions to decrease.

The contribution of inflation expectations shock is relatively moderate, with the highest contributions obtained for Estonia and Latvia. For most cases the contributions of inflation expectations shock to actual inflation does not exceed 0.3 pp. Although the dynamics of these contributions differs from country to country, some common features can be found. The contributions from expectations shocks were positive shortly after the accession to the EU (except for Lithuania due to the negative and insignificant response of inflation to expectations).

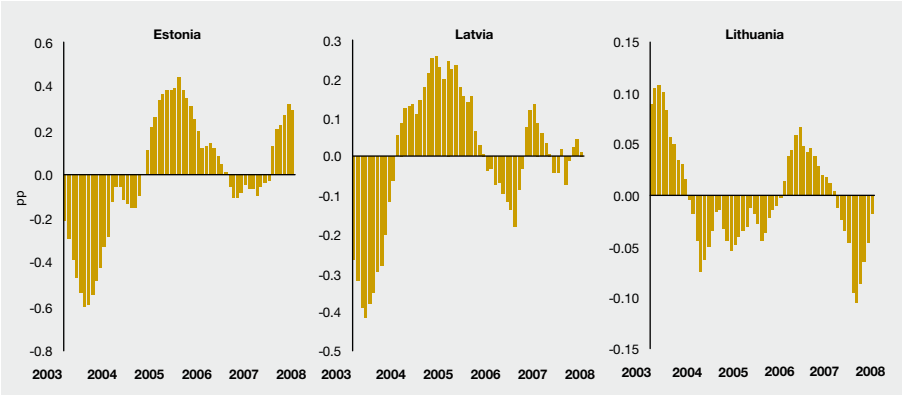

Figure 21. Contribution of inflation expectations to the HICP level (May 2003 – March 2008)

As was described above, inflation expectations increased significantly prior to the EU accession. This increase can only be partially explained by economic factors included in our VAR models: the actual price level, and supply and demand factors. Therefore, this increase was to a large extent driven by positive expectations shocks and can be explained by psychological rather than economic factors (a sceptical information campaign, fears that domestic prices will achieve European levels, etc.). As a result, the set of positive expectations shocks before accession to the EU (which could be well seen in the cases of Latvia and Estonia in Figure A15) materialized in a positive contribution to the actual inflation rate after the accession in late 2004 and 2005.

Regarding the end of the sample period, our calculations show that the contribution from the expectations shocks was even less than in 2005, perhaps because of a diminished ratio of inflation expectations relative to perceived inflation right after accession to the EU.

Inflation expectations are a statistically significant factor that is likely to affect the inflation rate. However, the findings of the VAR models lead to an inference that inflation expectations are endogenous and can be regarded as a transmission stage between the supply and demand shocks, on the one hand, and actual inflation, on the other. The effect of inflation expectations on actual inflation, which could be driven by psychological rather than economic factors, is rather limited in the Baltic countries.

CONCLUSIONS

The economies of the Baltic countries underwent deep changes during the past two decades that were also reflected in their inflation patterns. The three countries successfully transformed their economies from planned systems to functioning market economies in the 1990s, enabling them to achieve price stability. Inflation rates fell sharply from levels close to hyperinflation after the introduction of a credible monetary system based on a fixed exchange rate. The process of accession to the EU accelerated economic reforms and gave an additional stimulus to economic activity. The report identifies a number of potential determinants of inflation and estimates their quantitative impact on core inflation in the Baltic countries.

The range of determinants of inflation in the Baltic countries is broad, with the main drivers changing over time. In addition to cyclical factors, imported inflation, administrative price changes and the on-going catch-up process with the more advanced EU economies continues to affect inflation. The current price and income level of 55–65% of the EU average leaves considerable room for convergence, requiring a relatively faster increase both in incomes and prices. Additionally, the remaining differences in the composition of households' expenditure between the Baltic countries and the more advanced EU economies contribute to inflation differences despite similar global price shocks.

Regarding inflation drivers related to the evolution of economic cycles, an output gap is one of the main demand factors. A positive output gap (economic growth exceeding its medium-term sustainable average) seems to have occurred in 2005, adding to inflation pressures in the following years. Excessive economic activity was fuelled by intense foreign capital inflows through the banking sector, mainly targeted at real estate, especially residential housing investments. The main constraint on the economic expansion was the limited supply of labour, shifting the advantage in wage negotiations strongly towards employees in 2005–2007. The high demand for labour in the construction sector together with some labour force

outflow to other EU member states created an additional pressure on wage growth, creating demand pressures. The environment of strong demand allowed for a remarkable increase in the mark-ups of the prices of goods and services, contributing to the general price increase. Additionally, inflation expectations increased in the wake of EU membership but their impact on inflation remained limited.

On the supply side, a rapid increase in nominal unit labour costs due to wage growth exceeding productivity growth has added to an increase in consumer prices, respectively, especially since 2005. External price developments or imported inflation have also had a significant effect on consumer price inflation in the Baltic countries. The economies are small and open, and their households' structure of expenditures contributes to a relatively higher impact of global food and energy prices. Additionally, the harmonisation of excise duties with the EU minimum requirements (especially on alcohol and tobacco) added to inflation, together with regulated increases in energy prices (heating energy and electricity).

Quantitative estimates in a framework of the standard backward-looking Phillips curve model confirm that a cyclical demand factor, the output gap, explains a large part of the long-term inflation in the Baltic countries. A higher output gap in the previous period contributes to the increase in core inflation in all three economies and the effect is statistically significant. The remaining persistence (in addition to the co-movement with the output gap) of the core inflation process is relatively small. The result suggests that core inflation could be hindered by policies affecting the demand side of the economies of the Baltic countries, including fiscal measures. Response to the measures is expected to be relatively quick as inflation persistence is rather low. The applied methodological framework does not allow for measuring supply-side effects.

The quantitative estimates of the effect of inflation expectations on consumer price inflation show a statistically significant positive relation but a rather limited effect in the Baltic countries. The contribution to actual inflation was especially pronounced after accession to the EU in late 2004 and 2005. However, the findings of the VAR (vector-autoregressive) models confirm that inflation expectations are endogenous and can be regarded as a transmission stage from supply and demand shocks to actual inflation. Inflation expectations themselves are driven by psychological rather than by economic factors.

The analysis confirms that despite a broad range of factors affecting inflation, core inflation seems to be strongly affected by demand developments in the Baltic countries. That link makes core inflation responsive to economic policies that affect domestic demand, including fiscal policies. In order to reduce core inflation, policies oriented towards reducing excessive domestic demand could be efficient.

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ANNEXES

Annex 1. Supplement on mark-ups in Estonia and Latvia

The information on mark-ups can be obtained from the financial statistics of enterprises as it contains data on net sales and profits across the sectors of the economy. This source of information has serious drawbacks: time series are very short, starting from 2002 in Estonia and 2001 in Latvia; Moreover, the quality of data is questionable, especially for the profit side. Nevertheless, the financial statistics of enterprises is the only way to evaluate the approximate level and dynamics of mark-ups in the Baltic countries.

In order to address the question of whether the dynamics of mark-ups in Estonia and Latvia were driven only by cyclical factors or some structural changes in the level of competition, a simple econometric analysis can be implemented. The analysis is restricted by a very short time series. Regressing the ratio of retail profits to net sales (*R*) in Latvia and Estonia on the output gap (*GAP*, representing the demand factors and obtained using the HP filter) and linear trend (trend, representing possible changes in the level of competition) gives very similar results for both countries:

$$R_t^{LV} = \underset{(2.500)}{0.0156} + \underset{(1.372)}{0.295} \cdot GAP_t^{LV} + \underset{(2.636)}{0.00104} \cdot trend$$

$$R_t^{EE} = \underset{(3.093)}{0.0135} + \underset{(0.953)}{0.157} \cdot GAP_t^{EE} + \underset{(4.431)}{0.00123} \cdot trend$$

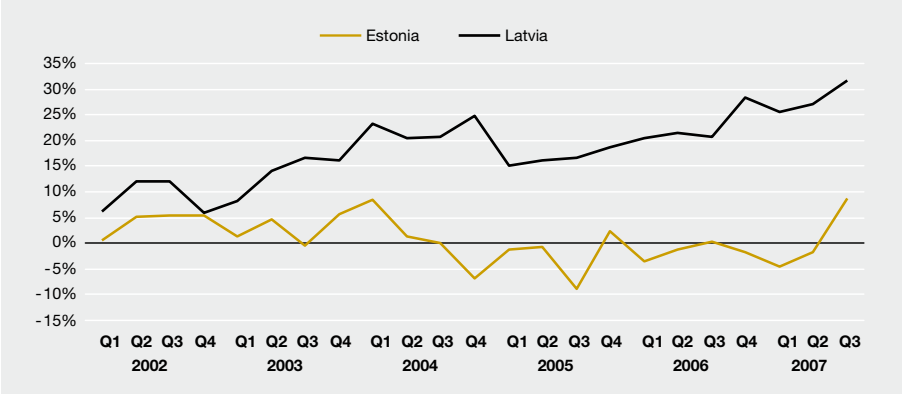

Figure A1. The ratio of profits to net sales in the agriculture sector, seasonally adjusted

Sources: Statistical Bureau of Latvia, Statistical Bureau of Estonia, authors' calculations

The level of mark-ups is positively related to the output gap (although the statistical significance is not very high) and is statistically significantly driven by a positive time trend. Although the result of the time trend can be interpreted as an insufficient level of competition in the Estonian and Latvian retail sectors, this econometrical evidence should be taken with a great deal of caution due to the quality of data and possible formalisation (a shift from informal to formal economy) of profits during the observation period.

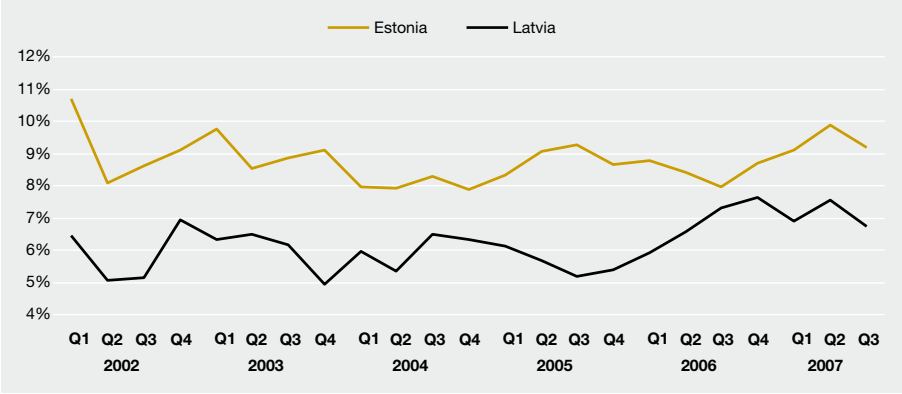

Figure A2. The ratio of profits to net sales in the manufacturing sector, seasonally adjusted

Sources: Statistical Bureau of Latvia, Statistical Bureau of Estonia, authors' calculations

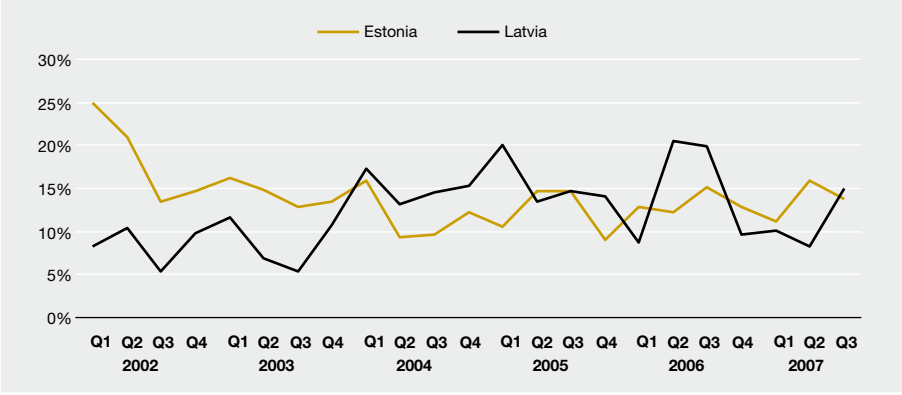

Figure A3. The ratio of profits to net sales in the hotels and restaurants sector, seasonally adjusted

Sources: Statistical Bureau of Latvia, Statistical Bureau of Estonia, authors' calculations

Annex 2. Perceived inflation and inflation expectations in the Baltic countries

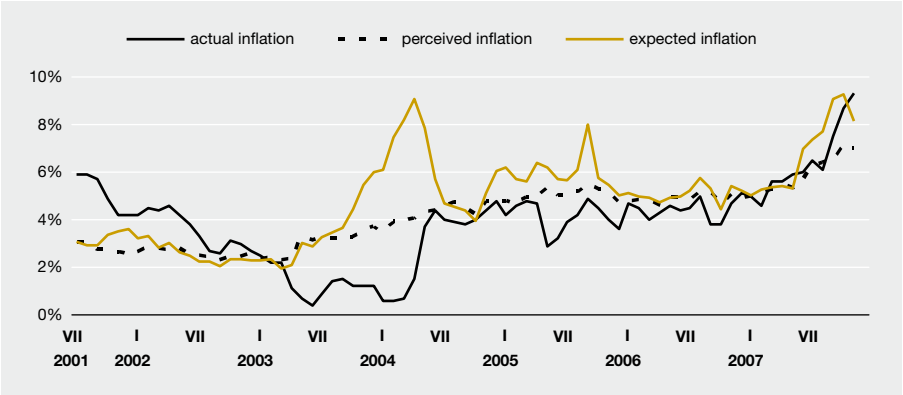

Figure A4. Perceived inflation (interpolation method) and inflation expectations (CP approach) in Estonia

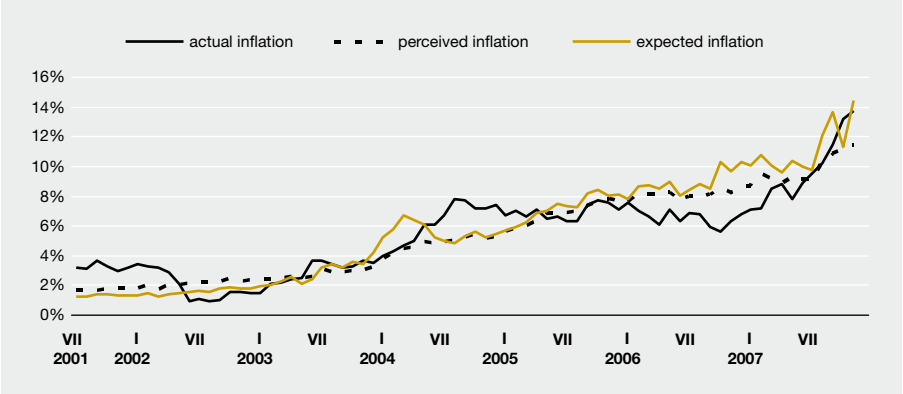

Figure A5. Perceived inflation (interpolation method) and inflation expectations (CP approach) in Latvia

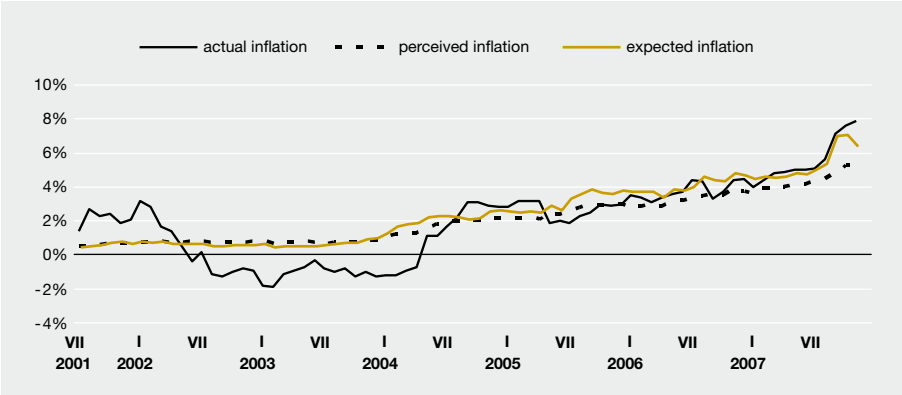

Figure A6. Perceived inflation (interpolation method) and inflation expectations (CP approach) in Lithuania

Annex 3. Products not included in the core inflation basket

Estonia	Latvia	Lithuania
cp02 Alcoholic beverages, tobacco and medicines	*cp02* Alcoholic beverages, tobacco and medicines	*cp02* Alcoholic beverages, tobacco and medicines
cp0722 Fuels and lubricants for personal transport equipment	*cp0722* Fuels and lubricants for personal transport equipment	*cp0722* Fuels and lubricants for personal transport equipment
foodunp Unprocessed food	foodunp Unprocessed food	foodunp Unprocessed food
cp0441 Water supply	*cp041* Actual rentals for housing*	*cp0441* Water supply
cp0442 Refuse collection	*cp0441* Water supply	*cp0442* Refuse collection
cp0443 Sewerage collection	*cp0442* Refuse collection	*cp0443* Sewerage collection
cp0451 Electricity	*cp0443* Sewerage collection	*cp0451* Electricity
cp0452 Gas	*cp0451* Electricity	*cp0452* Gas
cp0455 Heat energy	*cp0452* Gas	*cp0455* Heat energy
cp0444 Other services relating to the dwelling n.e.c.	*cp0455* Heat energy	*cp0731* Passenger transport by railway
cp0735 Combined passenger transport	*cp062* Out-patient services	*cp0732* Passenger transport by road
cp081 Postal services	*cp063* Hospital services	*cp0734* Passenger transport by sea and inland waterway
cp083 Telephone and telefax services	*cp0731* Passenger transport by railway	*cp0735* Combined passenger transport
cp127 Other services n.e.c.	*cp0732* Passenger transport by road	
	cp0734 Passenger transport by sea and inland waterway	
	cp081 Postal services	
	cp083 Telephone and telefax services*	
	cp124 Social protection	
	cp1254 Insurance connected with transport	

* The name of the group is taken from the breakdown of main consumption groups in the HICP basket; however, only the prices of some goods/services in the whole group are regulated, and this has been taken into account when estimating the impact of regulated prices on inflation.

Annex 4. Electricity and gas prices for households in 2007[10]

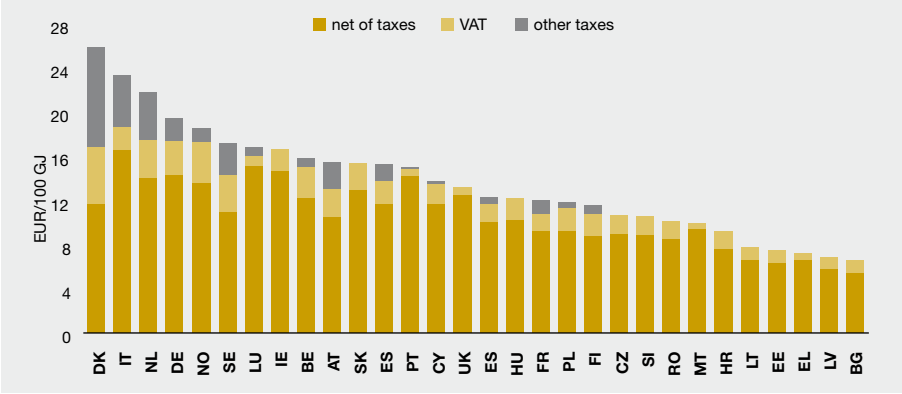

Figure A7. Electricity prices for households in 2007

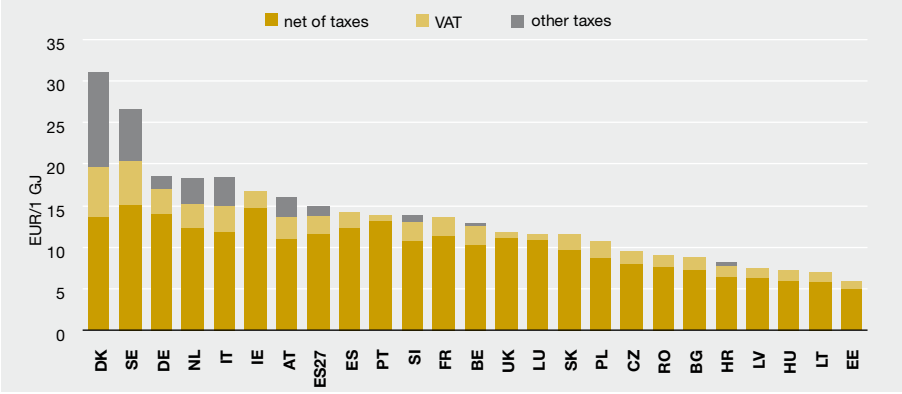

Figure A8. Gas prices for households in 2007, standard consumer

[10] Source: Eurostat

Annex 5. Questions 5 and 6 of consumer survey

Question 5: How do you think that consumer prices have developed over the last 12 months?

a) risen a lot
b) risen moderately
c) risen slightly
d) stayed about the same
e) fallen
f) don't know

Question 6: By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months? They will…

a) increase more rapidly
b) increase at the same rate
c) increase at a slower rate
d) stay about the same
e) fall
f) don't know

Response statistics are usually published as balances of positive and negative response options. Response balances for Question 5 and 6 are calculated using the following formula (see the Joint Harmonised EU Programme of Business and Consumer Surveys User Guide (2004)):

$$\Sigma = a + 0.5 \cdot b - 0.5 \cdot d - e$$

where Σ is the response balance
a, b, d, e are the percentages of responses a), b), d) and e)

Annex 6. Distribution of responses in the Baltic countries

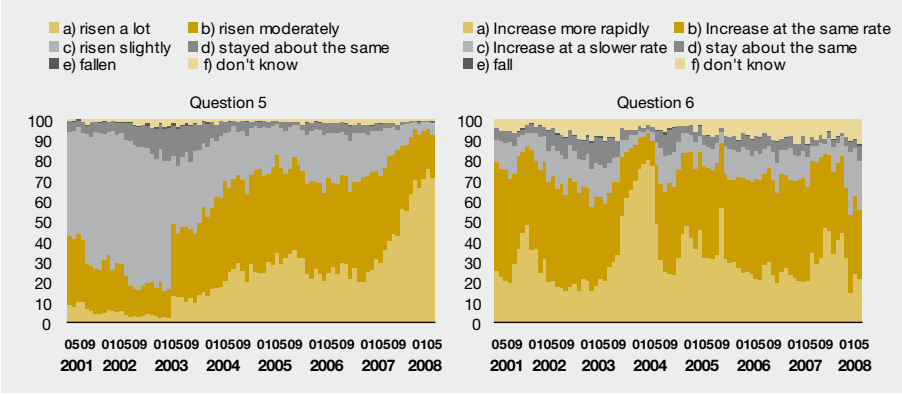

Figure A9. Distribution of responses from Estonia's consumer survey

(May 2001 – May 2008)

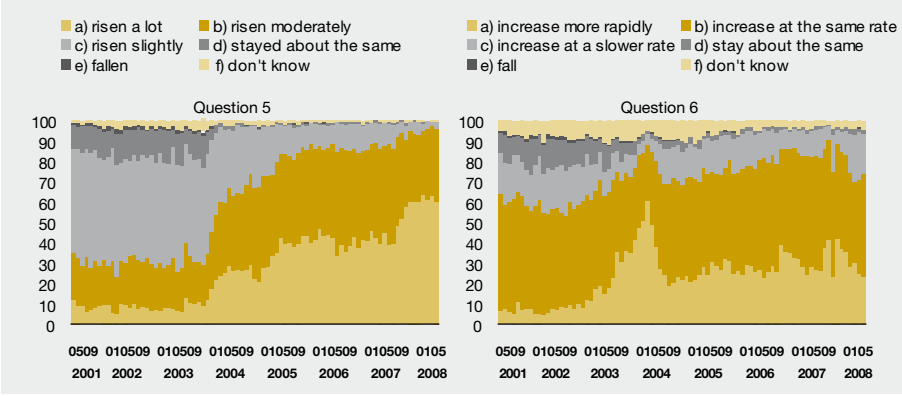

Figure A10. Distribution of responses from Latvia's consumer survey

(May 2001 – May 2008)

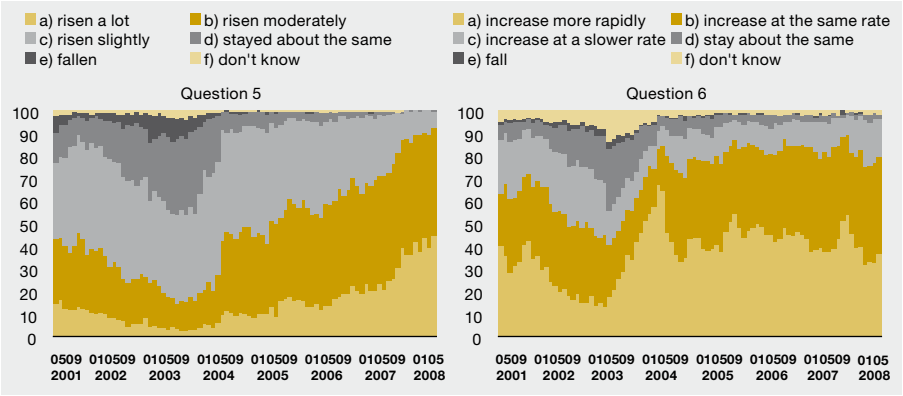

Figure A11. Distribution of responses from Lithuania's consumer survey
(May 2001 – May 2008)

Annex 7. VAR impulse response functions

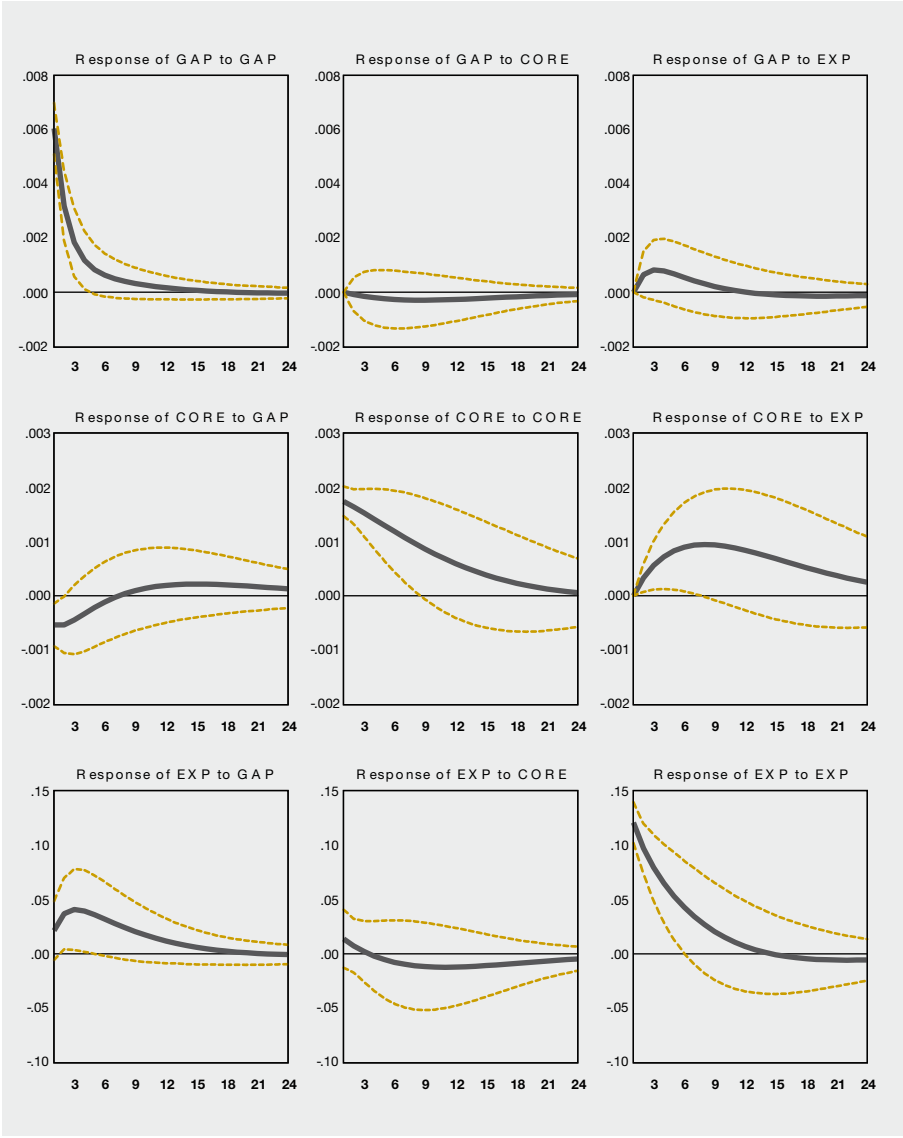

Figure A12. VAR model impulse response functions for Estonia

(Responses to 1 SE shocks)

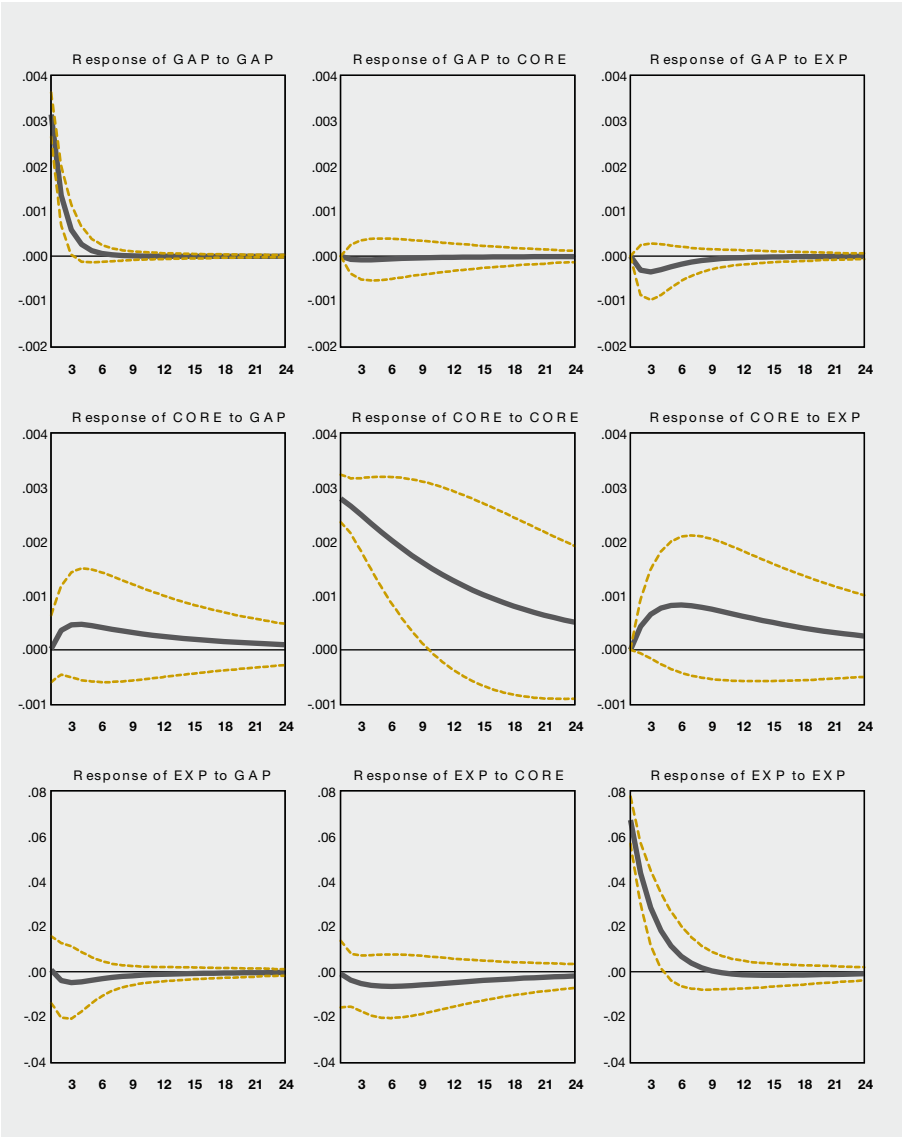

Figure A13. VAR model impulse response functions for Latvia
(Responses to 1 SE shocks)

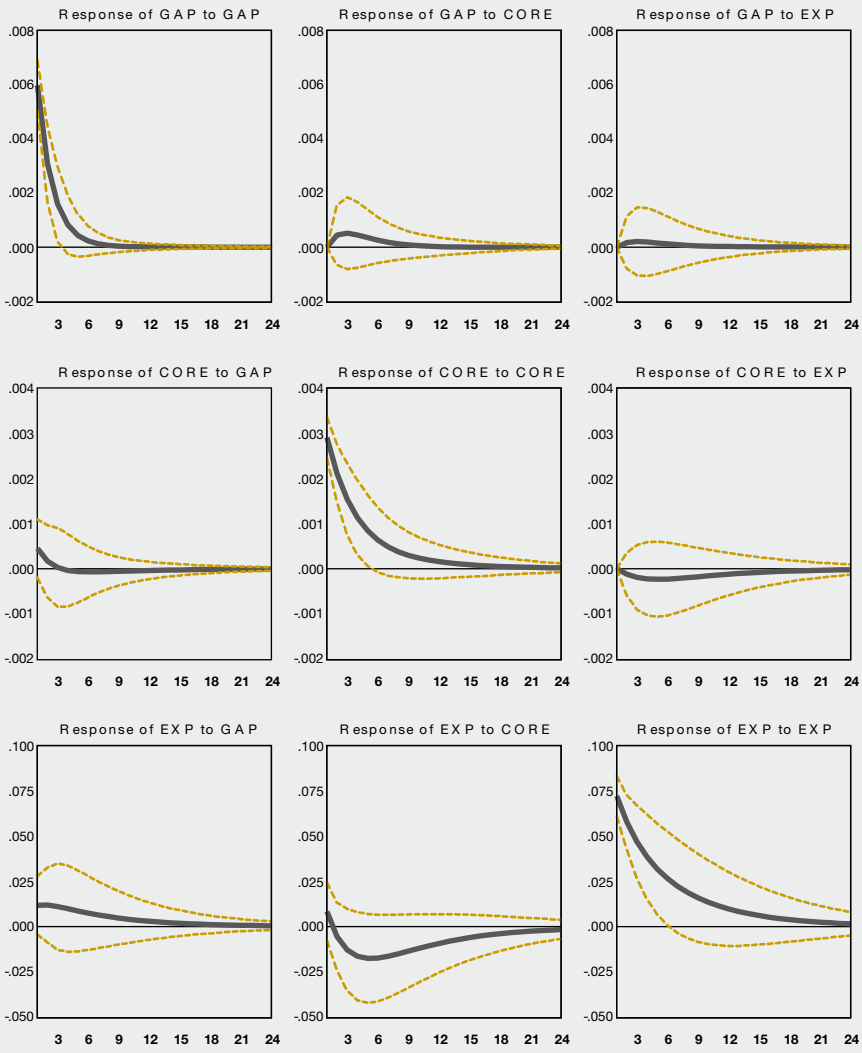

Figure A14. VAR model impulse response functions for Lithuania

(Responses to 1 SE shocks)

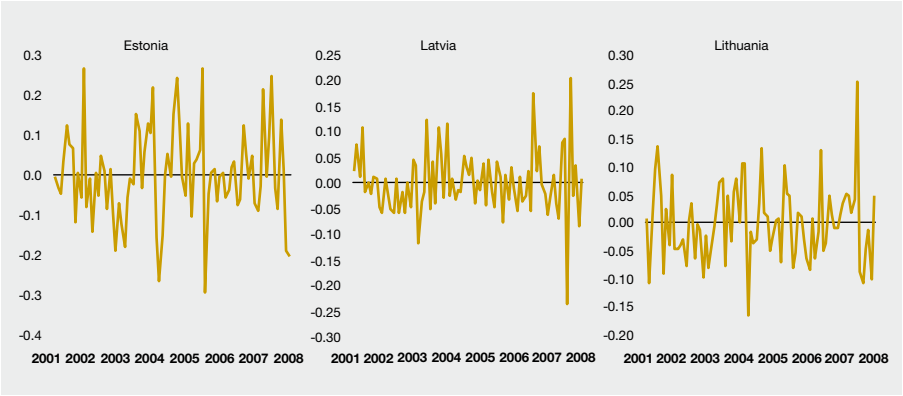

Figure A15. VAR model inflation expectations shocks

(May 2001 – March 2008)

MAIN QUARTELY INDICATORS OF THE ESTONIAN ECONOMY as at 24 August 2009

	Unit	Period	Indicator	Change compared to the previous period (%)	Change compared to the same period last year (%)	Source
Gross domestic product*						SA
Current prices	EEK m	Q1 2009	52,229.2			
Constant prices	EEK m	Q1 2009	32,773.8	-14.5	-15.1	
Industry						SA
Volume index of industrial production (at constant prices (2000 = 100)	%	Q2 2009		-1.1	-32.6	
Investments in fixed assets (at current prices)	EEK m	Q1 2009	8,465.8	-8.9	-10.2	SA
Construction						SA
Construction activities of construction enterprises (at current prices)	EEK m	Q1 2009	8,221	-40	-30.6	
Usable floor area of completed dwellings	thousand m^2	Q2 2009	84.3	38.9	-28.4	
Usable floor area of non-residential buildings	thousand m^2	Q2 2009	269.3	3.6	0.3	
Consumption						
Retail sales volume index (at constant prices, 2000 = 100)	%	Q2 2009		10	-14	SA
New registration of passenger cars	No	Q2 2009	5,838	27	-59.9	ARK
Prices						
Consumer price index	%	Q2 2009		-1.2	-0.3	SA
Producer price index	%	Q2 2009		-1.3	-0.6	SA
Export price index	%	Q2 2009		-2	-4.5	SA
Import price index	%	Q2 2009		0.9	-7	SA
Construction price index	%	Q2 2009		-3.9	-8.8	SA
Real effective exchange rate (REER) of the Estonian kroon	%	Q2 2009		-2	1.1	EP
Labour market and wages						
Employment rate (based on the Labour Force Survey)**	%	Q2 2009	57	58.9	63	SA
Unemployment rate (based on the Labour Force Survey)**	%	Q2 2009	13.5	11.4	4	SA
Registered unemployed (according to the Labour Market Board)	persons per month	Q2 2009	64,045.7	37	279.2	TK
% of population between 16 years old and pension age**	%	Q2 2009	9.8	7.1	2.6	TK
Average monthly gross wages and salaries (health insurance benefits excluded)	EEK	Q1 2009	12,147	-7.4	-1.5	SA
General government budget (net borrowing not included here)***						RM
Revenue	EEK m	Q4 2007	25,768	1.3	21.6	
Expenditure	EEK m	Q4 2007	26,887	30	17	
Balance (+/-)**	EEK m	Q4 2007	-1,119	4,759.2	-1,804.7	
Period's revenue to the planned annual revenue**	%	Q4 2007	29.1	28.8	29.5	
Transport						SA
Carriage of passengers	thousand	Q1 2009	47,762.3	-1	-3.5	
Carriage of goods	thousand tons	Q1 2009	22,526	2	-3.1	

	Unit	Period	Indicator	Change compared to the previous period (%)	Change compared to the same period last year (%)	Source
Tourism, accommodation						SA
Visitors from foreign countries received by Estonian travel agencies	thousand	Q1 2009	154	-19.5	2.2	
Visitors sent to foreign tours by Estonian travel agencies	thousand	Q1 2009	74.2	-37.4	-43.8	
Accommodated visitors	thousand	Q2 2009	562.4	56.6	-13.3	
o/w foreign visitors	thousand	Q2 2009	379.5	95.6	-9.3	
Foreign trade (special trade system)						SA EP
Exports	EEK m	Q2 2009	25,167.1	8	-27.6	
Imports	EEK m	Q2 2009	27,766	1.1	-37.6	
Balance**	EEK m	Q2 2009	-2,599	-4,156.1	-9,765.9	
Foreign trade balance/exports**	%	Q2 2009	-10.3	-17.8	-28.1	
Balance of payments**						EP
Current account balance	EEK m	Q1 2009	-1.5	-3,038.2	-9,670	
Current account balance to GDP	%	Q1 2009	0	-5	-16.4	
Foreign direct investment inflow	EEK m	Q1 2009	2,617.8	3,783.7	9,139.4	
Foreign direct investment outflow	EEK m	Q1 2009	-1,841.5	-1,901.8	-4,734.3	
International investment position						EP
Net international investment position	EEK m	Q1 2009	-189,359.1	0.4	0	
Direct investment in Estonia	EEK m	Q1 2009	177,389.7	0.1	-4.7	
Net external debt	EEK m	Q1 2009	287,905.1	-3.3	1.7	
o/w government	EEK m	Q1 2009	9,527.3	24.2	12.9	
EEK/USD average quarterly exchange rate	EEK	Q2 2009	11.5	-4.2	14.9	EP

* Preliminary estimation of the GDP growth has been calculated according to the new methodology. Whereas, Statistics Estonia previously calculated the GDP growth at the constant prices of fixed year 2000, since 2008 the growth is calculated by chain-linking method in which the year preceding the accounting period is applied as a base year.

** Instead of changes comparing to previous periods, absolute figures for the periods are shown by this indicator.

*** Net borrowing is not included here.

Source:
SA – Statistics Estonia
ARK – Motor Vehicle Registration Centre
EP – Eesti Pank /Bank of Estonia
TTA – Labour Market Board
RM – Ministry of Finance
EKI – Estonian Institute of Economic Research