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INFLATION EXPECTATIONS IN LATVIA: CONSUMER SURVEY BASED RESULTS

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WORKING PAPER



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ABBREVIATIONS

C–P approach – Carlson–Parkin or Probability Approach to quantify inflation expectations
 EU – European Union
 GDP – gross domestic product
 HICP – harmonised index of consumer prices
Latvijas Fakti – Market and Social Research Centre *Latvijas Fakti*
 US – United States of America
 VAR – vector autoregression

ABSTRACT

The objective of this study is the quantification of inflation expectations in Latvia using the results of consumer surveys and the assessment of the impact inflation expectations have on actual inflation. In order to attain the objectives set, the authors of the study quantified inflation expectations applying the widely accepted probability approach and produced a small-scale VAR model capturing actual inflation and the quantified inflation expectations. Both the surveyed balance sheet data and quantified values of inflation expectations confirm that inflation expectations strengthened substantially prior to Latvia's accession to the EU. The findings of the VAR model with inflation expectations indicate that inflation expectations have a statistically significant impact on inflation in Latvia. The response of inflation expectations to inflation and domestic demand shocks is positive, although a deviation implies that the response to a domestic demand shock is not statistically significant.

Key words: *inflation expectations, survey data, VAR model*

JEL classification codes: *C32, C83, D84, E31*

INTRODUCTION

Inflation expectations play an important role in the 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 the real interest rates, and the supply side, pushing up nominal wages and hence also production costs of businesses. This taken into account, strong inflation expectations should be perceived as an alarming signal predicting an eventual upward inflationary trend and a potential drop in economic agents' confidence in the activities of the central bank.

When dealing with inflation expectations, researchers face a problem: inflation expectations are not directly observable. There are two approaches to assessing the magnitude of inflation expectations in the economy. First, by drawing a number of assumptions relative to the expectation generation mechanism based on the economic theory (e.g. forward-looking rational expectations), an economic model incorporating an inflation expectations variable may be built. In this case, an indirect estimate of inflation expectations will strongly depend on the assumptions relative to the formation of expectations. Direct measuring of inflation expectations is an alternative approach to assessing inflation expectations. The related measurements may build on financial market indicators or the outcomes of business and consumer surveys.

The objective of this study is quantification of inflation expectations in Latvia using the results of consumer surveys and assessment of the inflation expectations impact on actual inflation. In order to attain the objectives set, the authors of the study quantified inflation expectations applying widely accepted probability approach and produced a small-scale VAR model capturing actual inflation and the quantified inflation expectations; the contribution of inflation expectations to actual inflation has likewise been estimated. However, the inflation formation mechanism has not been the issue to address; hence no inferences related to rationality and forward-looking behaviour of Latvia's economic agents are made.

Section 1 reviews the statistical data of Latvia's consumer surveys. Section 2 gives a brief overview of methods used for quantifying inflation expectations, describes the C–P approach and provides the assessment of perceived (actual) and expected inflation in Latvia. Section 3 analyses the interaction between inflation and inflation expectations using a VAR model. The findings of the study are summed up in the concluding part.

1 CONSUMER SURVEY DATA

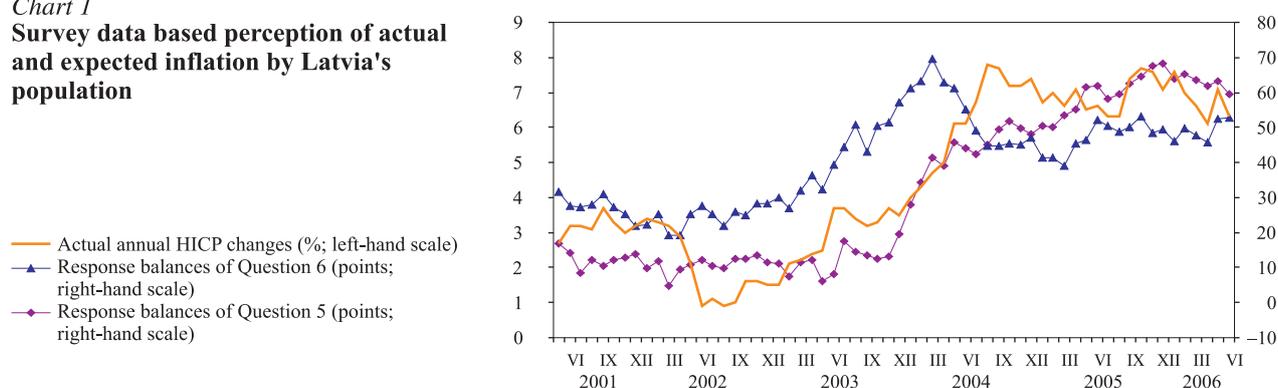
Consumer surveys in Latvia are conducted within the framework of a more comprehensive survey in compliance with the EC methodology to measure the Economic Sentiment Index (ESI). In the EU countries, such surveys have been run since the early 1960s, with the respective methodology gradually evolving. In Latvia, the researchers from *Latvijas Fakti* have been conducting public opinion polls on the social and economic situation and changes in the households' material well-being on a regular basis since May 2001. These are monthly surveys covering a sample of 1 000 respondents – residents of Latvia in the age group between 15 and 74. The sample size depends on the latest statistical data on residents of Latvia (in proportion to such parameters as gender, age, nationality and geographical dispersion). Each survey is conducted in every administrative territory of Latvia, 26 all together, at 146 sample points. During the survey, respondents are asked to provide answers to 15 questions assessing changes in the economic situation and material well-being of households in Latvia in the past 12 months, and to predict trend changes for the next 12 months.(7)

As the study primarily focuses on the analysis of inflation expectations, respondents' answers to 2 questions – Question 5 and Question 6 – are to be sought. Respondents are asked to evaluate the current consumer price level vis-à-vis that of 12 months ago and to voice their opinion concerning anticipated price movements in the next 12 months. A precise formulation of questions and answers is presented in Appendix 1. As a rule, the response statistics from the answers are published as balances or the difference between positive and negative response options (see formula in Appendix 1).

Business and Consumer Survey Results comprising data in the breakdown by month is a quarterly publication of the Latvian Statistical Institute. Easily applicable time series are available from the website of the European Commission, with option balances for each survey question calculated and released.

Chart 1 shows option balances of Latvia's residents for Questions 5 and 6 and the actual annual HICP movements.

Chart 1
Survey data based perception of actual and expected inflation by Latvia's population



Source: Business and consumer surveys, EC Directorate-General for Economic and Financial Affairs.
Data available at:
http://europa.eu.int/comm/economy_finance/indicators/businessandconsumersurveys_en.htm.

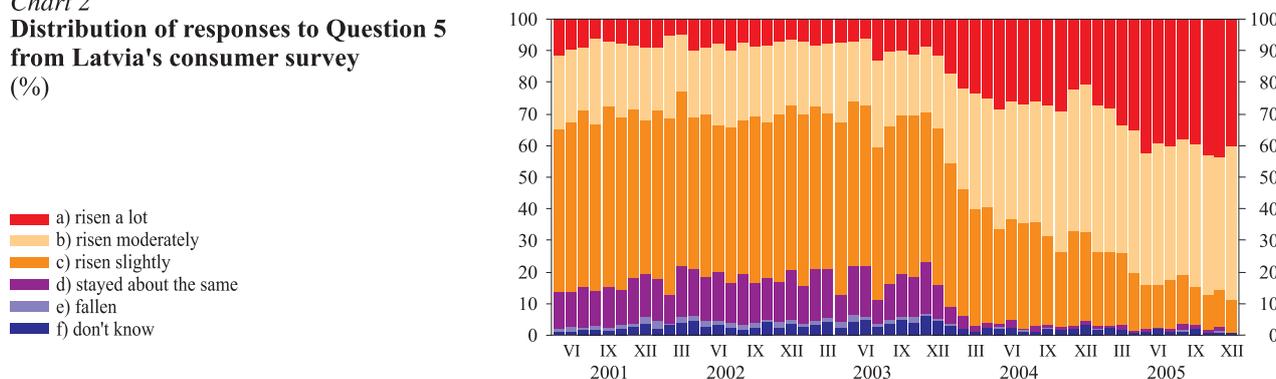
Chart 1 demonstrates that the option balances for Question 5 correlate with the actual inflation. The option balance for Question 5 was stable within the range of 10–20 points in 2001–2003 despite changes in the actual inflation. Apparently, the explanation for it is the long-run steady and comparatively low inflation rate in the period between 1999 and 2002, which did not encumber the economic decision-making process. Though slightly lagging behind the growth in actual inflation, consumers' perception of inflation was increasing significantly and at a fast pace at the beginning of 2004. Following the EU accession, the option balance values for Question 5 continued on a gradual upward trend and amounted to almost 70 points at the end of 2005, thus reflecting deterioration in the assessment of the actual situation. In contrast, with inflation gradually declining in 2006, the option balance values fell to 60 points in June 2006.

The response balance values for Question 6 also remained quite stable between 2001 and 2003. According to the balance indicator, inflation expectations increased significantly prior to Latvia's accession to the EU (end of 2003 and beginning of 2004), even rising to 70 points in one of the months. Immediately after the EU accession, the difference between the positive and negative response options gradually narrowed, albeit stabilising at around 50 points in mid-2006, a level exceeding the one prior to the EU accession.

Despite balance statistics being an explicit and compact indicator of consumers' opinion, much useful information on the distribution of respondents depending on their answers is discarded when presenting the results in one number. As a detailed distribution of answers to Questions 5 and 6 is required for the analysis, unpublished data from *Latvijas Fakti* have been used to calculate the balances.

The distribution of answers to Question 5 has also been rather steady for the period from May 2001 to November 2003 when around a half of all respondents maintained that prices "rose slightly" during the last 12 month, while almost 15% declared that they "stayed about the same". Only 20% believed that prices "rose moderately", whereas 10% stated that they "rose a lot". Consequently, by the end of 2003, the majority of residents believed that inflation was at a sufficiently low level. Chart 2 shows the distribution of answers for Question 5 reflecting the assessment of the actual situation.

Chart 2
Distribution of responses to Question 5
from Latvia's consumer survey
(%)



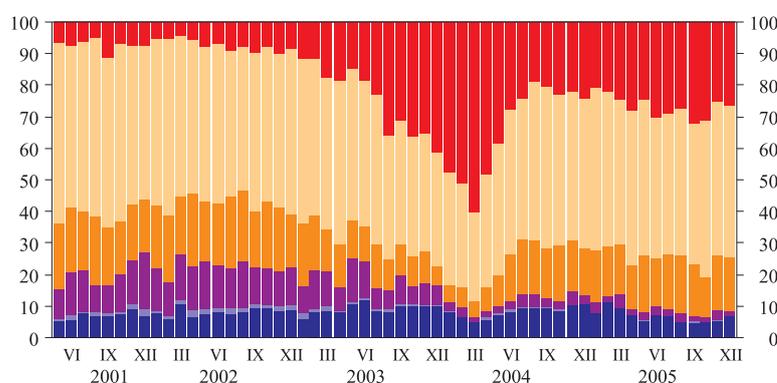
Source: *Latvijas Fakti* survey data.

The situation had changed radically since the first months of 2004, with the number of respondents believing that prices "rose moderately" or "rose a lot" increasing notably. At the same time, the number of respondents who had shared the view about prices "rising slightly" decreased, and almost nobody opted for such answers as "stayed about the same" or "fallen". The survey results indicate that the population perceived a surge in actual inflation in 2004. The latest data show that people's assessment of the actual situation was negative, for which almost 90% of all respondents stating that prices "had risen moderately" or "had risen a lot" is vivid evidence.

Chart 3 reflects the distribution of answers to Question 6 characterising respondents' perception of the future situation. According to the survey results, inflation expectations had been relatively stable until the end of 2002, with more than a half of all respondents declaring that 12 months ahead prices would "increase at the same rate" and almost 20% predicting that they would "increase at a slower rate". The strengthening of inflation expectations began in 2003, with negative expectations reaching a high shortly before the EU accession when the proportion of respondents maintaining that prices would "increase more rapidly" exceeded 60%. The adverse expectations relative to price movements eased immediately after the EU accession due to still moderate actual inflation. Moreover, actual inflation was to a large extent determined by a number of institutional adjustments.

Chart 3
Distribution of responses to Question 6
from Latvia's consumer survey
(%)

- 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



Source: *Latvijas Fakti* survey data.

After the EU accession, the situation stabilised somewhat, and the most popular answer given by almost 50% of respondents at the end of 2005 was that prices would "increase at the same rate". It is known, however, that the actual growth in prices ("the same rate") proceeded at a significantly faster pace. Moreover, the proportion of respondents maintaining that prices would "increase more rapidly" also grew compared with the beginning of the sample period.

2 ASSESSMENT OF INFLATION EXPECTATIONS

2.1 C–P approach to inflation expectations

Consumer survey data to which the authors of the paper referred in the previous section provide a lot of useful information about how the respondents assess the actual situation and what their inflation expectations are. The primary data, however, 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 the actual inflation. That is why it would be more useful to express the expected inflation as an expected annual percentage growth of prices.

Such disadvantages can be eliminated by the inflation expectations estimates or quantification methods under which survey data are transformed into the annual percentage rate of change in prices. The probability or C–P approach is most often used in the quantification of inflation expectations. Initially J. A. Carlson and M. Parkin developed an original technique for quantifying the results of a three-category survey with the following three response options: "prices will rise", "prices will stay the same", and "prices will fall".(3) Later R. A. Batchelor and A. B. Orr extended this initial quantification methodology for a five-category survey with five response options (1), which are currently used in the EU surveys.

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 inflation expectations. There is an important assumption about the existence of a range of price increases that is close to zero and that the respondents are incapable to distinguish it from zero. In addition, the perceived inflation is surrounded by an area of price rises that respondents are incapable of distinguishing from the perceived rate of price rises. At first, J. A. Carlson and M. Parkin assumed that the expectations distribution range is common to all respondents and constant over time (3); R. A. Batchelor and A. B. Orr assumed later that the distribution range can vary over time; H. Seitz further softened the constraint assuming that the range can be asymmetric and stochastic.(14)

For the purpose of quantifying inflation expectations, the study uses the probability or C–P approach. Due to the Latvian consumer survey being a five-category one, a C–P approach adjusted by R. A. Batchelor and A. B. Orr has been selected. (1) Short time series of the Latvian consumer surveys did not allow for the application of another approach, which has been proposed by H. Seitz.

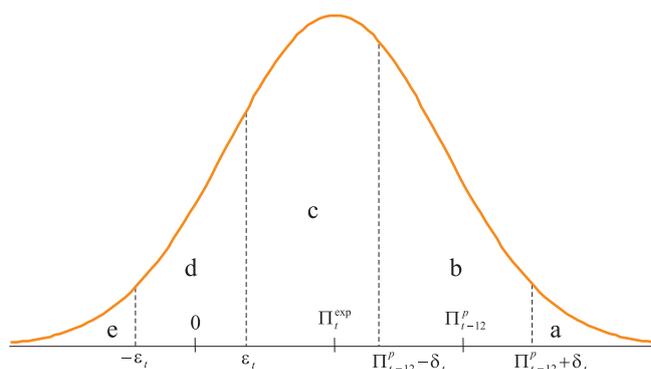
The C–P method uses the assumption that respondents have already formed their inflation expectations Π_{it}^{exp} regarding price movements in the coming 12 months when answering the survey questions. These expectations build on a subjective probability distribution function $f_i(\Pi_{it} | I_{i,t-12})$ for future inflation of each respondent i depending on the set of information $I_{i,t-12}$ available at time $t-12$. The aggregation process of subjective probability distribution is expressed

as $g(\Pi_t | \Omega_{t-12})$ where $\Omega_{t-12} = \bigcup_{i=1}^N I_{i,t-12}$ represents the information set of all respondents. The objective of quantification is to derive the mean Π_t^{exp} of the aggregate distribution.

Chart 4

Aggregate density function of inflation expectations

- a) increase more rapidly
- b) increase at the same rate
- c) increase at a slower rate
- d) stay about the same
- e) fall



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 inflation expectations, i.e. as probabilities (see Chart 4). Those respondents who opted for the answer "don't know" were proportionally allocated to the remaining response categories. In addition, the C–P method cannot be employed in cases where the share of respondents is equal to zero (as in some months the response share in the falling prices category was zero, the study assumes that in such cases the response share is 0.05%).

The C–P approach uses a number of assumptions.

- Around zero, there exists a range of price changes which respondents cannot distinguish from unchanging prices, and around the perceived inflation rate there is a range of price rises at the rate that cannot be distinguished from the perceived rate of inflation. Hence the respondent considers that prices will not change and chooses answer d) where the expected inflation is within the range $-\varepsilon_t$ to ε_t , with ε_t denoting the size of the range. The respondent believes that the annual inflation rate will not change either and chooses answer b) where the expected inflation is within the range $\Pi_{t-12}^p - \delta_t$ to $\Pi_{t-12}^p + \delta_t$, with Π_{t-12}^p representing the perceived inflation and δ_t standing for the size of the range.
- It is assumed that these indifference areas around zero and perceived inflation are common to all respondents, yet able to change over time.
- The aggregate distribution function corresponds to normal distribution. Traditionally, this assumption is justified by the Central Limit Theorem.(3) Some authors also use other distribution functions. Thus R. A. Bachelor and A. B. Orr used the standard logistic distribution function (1), whereas T. Łyziak employed the uniform distribution function.(8) However, the studies of H. Nielsen and J. M. Berk prove that alternative distribution functions do not influence results significantly.(9; 2)

According to the C–P approach, the next step is standardisation of the key points under the distribution function:

$$Z_t^1 = \frac{\Pi_{t-12}^p + \delta_t - \Pi_t^{\text{exp}}}{\sigma_t} \quad [1],$$

$$Z_t^2 = \frac{\Pi_{t-12}^p - \delta_t - \Pi_t^{\text{exp}}}{\sigma_t} \quad [2],$$

$$Z_t^3 = \frac{\varepsilon_t - \Pi_t^{\text{exp}}}{\sigma_t} \quad [3],$$

$$Z_t^4 = \frac{-\varepsilon_t - \Pi_t^{\text{exp}}}{\sigma_t} \quad [4].$$

Under the assumption of the cumulative density function, we can derive estimates for Z_t^i from the shares of responses to Question 6. Thus, $\Phi(Z_t^1)$ is the share of respondents who opt for answers b) to e), $\Phi(Z_t^2)$ represents the share of answers c) to e), $\Phi(Z_t^3)$ is the share of those who chose answers from d) to e), and $\Phi(Z_t^4)$ is the share of respondents whose answer is e). $\Phi(\cdot)$ denotes the cumulative normal distribution function.

The transformation of equations [1]–[4] leads to an inflation expectations equation (see (2)):

$$\Pi_t^{\text{exp}} = -\frac{Z_t^3 + Z_t^4}{Z_t^1 + Z_t^2 - Z_t^3 - Z_t^4} \cdot \Pi_{t-12}^p \quad [5].$$

Equations for a standard error σ_t of the aggregate distribution of inflation expectations and indifference ranges ε_t and δ_t can be obtained in a similar way:

$$\sigma_t = \frac{2}{Z_t^1 + Z_t^2 - Z_t^3 - Z_t^4} \cdot \Pi_{t-12}^p \quad [6],$$

$$\varepsilon_t = \frac{Z_t^3 - Z_t^4}{Z_t^1 + Z_t^2 - Z_t^3 - Z_t^4} \cdot \Pi_{t-12}^p \quad [7],$$

$$\delta_t = \frac{Z_t^1 - Z_t^2}{Z_t^1 + Z_t^2 - Z_t^3 - Z_t^4} \cdot \Pi_{t-12}^p \quad [8].$$

As Question 6 incorporates a comparison, the perceived inflation Π_{t-12}^p is of great importance for the estimation of inflation expectations and other indicators. Perceived inflation can be estimated in several ways.

It may be assumed that the respondents perceive the actual inflation correctly, hence its rate shall coincide with the officially published inflation ($\Pi_{t-12}^p = \Pi_{t-12}$).

Alternatively, the perceived inflation can be assessed using the C–P approach in a similar way, building on the percentage share of answers to Question 5 (see equation [9]).

$$\Pi_{t-12}^p = -\frac{A_t^3 + A_t^4}{A_t^1 + A_t^2 - A_t^3 - A_t^4} \cdot \Pi_{t-12}^m \quad [9]$$

where A_t^i is analogous to Z_t^i in equations [1]–[4]. However, there is a problem that Question 5 has only one anchor point, i.e. answer d) (zero inflation in this case). Theoretical literature suggests using answer b) as the second anchor point Π_{t-12}^m , which corresponds to moderate inflation. In such a case, an additional assumption is to be made as to what respondents consider to be a moderate rate of inflation. Theoretical literature describes the following assumptions on moderate rate of inflation.

- The average annual inflation over the sample period.(13)
- The average from the beginning of the sample period to the point of conducting the survey.(9)
- Finally, a linear interpolation between the average of the first half of the period and the average of the second half of the period.(4)

2.2 Quantifying inflation expectations in Latvia

Chart 5 shows inflation expectations in Latvia, quantified by the C–P approach under the assumption that the respondents correctly perceive the actual inflation and $\Pi_{t-12}^p = \Pi_{t-12}$. Here, as usually accepted, inflation expectations refer to the period when consumers were surveyed instead of the period to which the expectations actually refer. The quantified inflation expectations are very close to the actual inflation rate, which is determined by the assumption that perceived inflation is the same as actual inflation and the fact that answer b) to Question 6 (*increase at the same rate*) has the largest share during the sample period.

The only period with inflation expectations differing substantially from actual inflation was observed shortly before Latvia joined the EU. Then quantified inflation expectations exceeded the actual inflation rate by more than 2 percentage points.

Chart 5

Inflation expectations in Latvia
(C–P approach; perceived inflation equals actual inflation; annual growth; %)

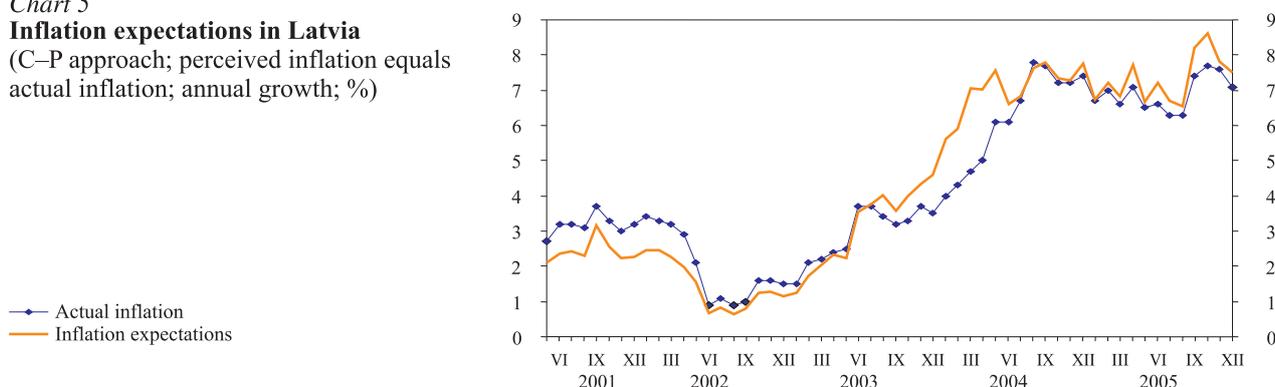


Chart A3 in Appendix 2 presents standard deviation of inflation expectations. It shows that the estimated standard deviation of inflation expectations increased notably from around 1.5% at the beginning of the sample period to around 3% at its end. This is due to the inclusion of perceived inflation variable in equation [6]. It may be interpreted as an increase in uncertainty along with the rising level of actual inflation.

Using equations [7] and [8], size ε_t and size δ_t of the indifference ranges are estimated. They, in turn, are used to determine numerical areas of each response category of Question 6 (see Chart A4 of Appendix 2). Similar to the previous diagram, the size of ranges increased substantially at the end of the sample period, related again to an increase in actual inflation. Chart A4 shows that the average inflation expectations stayed in b) area almost all the time despite being in the lower part of the area at the beginning of the period and in the upper part of it at the end. The only period of time with the average inflation expectations in a) area (implying that the majority of respondents expected prices to increase at a fast rate) was a few months before Latvia joined the EU. This serves as an explanation for so radical a difference between the estimated inflation expectations and the actual inflation rate during that period.

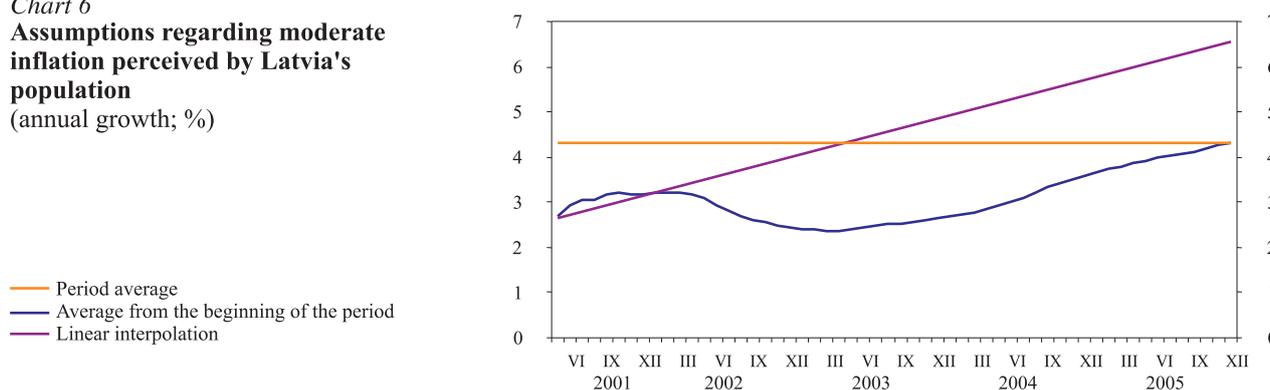
It may be argued that the assumption regarding absolutely correct perception of actual inflation by respondents can be questioned, and that the perceived inflation shall also be quantified using the method described above. However, it should be first decided what inflation rate is considered moderate by Latvian respondents.

It should be noted that the Latvian translation of answer b) on Question 5 in the survey conducted by research centre *Latvijas Fakti* does not accurately correspond to the respective question in English from the European Commission's user guide. The authors of this paper believe that in Latvian *diezgan lielā mērā augstākas* (which would be translated as *sufficiently higher*) implies a steeper growth rate than *risen moderately* in English, as it captures a strong price rise rather than provides a neutral explanation (see Appendix 1).

In line with the first assumption (see p. 9), the authors of this paper estimated inflation, which the Latvian respondents categorised as prices that have *risen moderately* (from this point forward, the formulation of the European Commission's user guide will be used), as an average of the sample period; in compliance with the second assumption, inflation was estimated as the average from the beginning of the

sample, whereas the third assumption gave rise to linear interpolation (the average of the period until 2004 for the opening month of the sample period, the average of the period from the beginning of 2004 for the final month). Chart 6 shows the three assumptions in respect of Latvian inhabitants' perception of prices that have *risen moderately* in comparison with the respective period of the previous year.

Chart 6
Assumptions regarding moderate inflation perceived by Latvia's population
(annual growth; %)



Further, the three assumptions are compared and their plausibility tested.

- Under the assumption of the average inflation of the sample period, it was estimated that the consumers' understanding of prices that have *risen moderately* corresponds to the annual price rise of 4.3% (see Chart 6). This assumption seems to hold for the period from May 2001 to the end of 2003 when the average actual inflation was 2.6% (a half of all respondents classified it as *slightly risen* prices; see Chart 2), yet it does not hold for the period starting with 2004 when actual inflation exceeded 6%.
- The assumption of the average inflation from the beginning of the sample period denoted even lower *moderate* inflation (2.7% annual price rise at the beginning of the sample period and 4.3% at the end of it; see Chart 6). Consequently, this assumption does not hold for the period starting with 2004 either.
- The authors of the paper believe that the linear interpolation method is the most suitable for Latvia. According to it, the customers' understanding *risen moderately* corresponds to the annual price rise of 2.6% at the beginning of the sample period and 6.5% at the end of it (see Chart 6). This assumption produces a reliable approximation of customers' perception for periods with both low and high inflation.

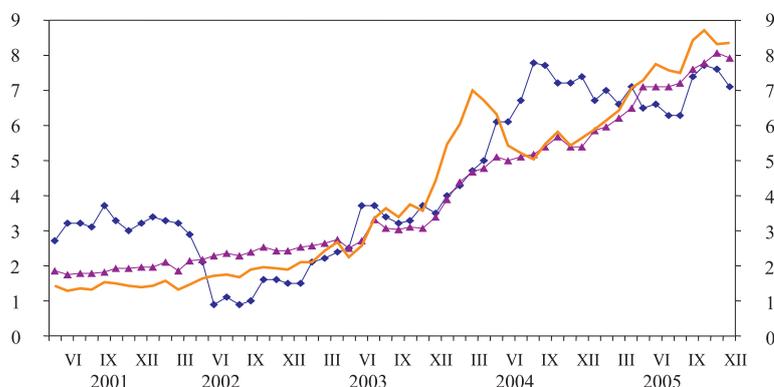
Henceforth, the method of linear interpolation is used in calculations (Charts A1 and A2 of Appendix 2 show inflation expectations and perceived inflation estimated with the methods of period average and average from the beginning of the period). Chart 7 shows inflation expectations and the perceived inflation rate that were quantified using the C–P approach and the method of linear interpolation.

Chart 7

Inflation expectations and perceived inflation

(C–P approach; moderate inflation estimated using linear interpolation; annual growth; %)

—◆— Actual inflation
 —▲— Perceived inflation
 — Inflation expectations



The perceived inflation rate obtained by the C–P approach differs from the actual inflation. Thus in 2001 and 2002, the perceived rate was stable (around 2%) despite a notable variance in actual annual inflation within the range of 3.7% and 0.9%. It can be interpreted as people not perceiving inflation fluctuations so strongly when inflation rate is rather low. That is why in 2001 and 2002, the predominant response to Question 5 was option c) – *risen slightly*, keeping perceived inflation at a low and stable level.

The perceived inflation started to increase in the second half of 2003. It was driven by the increase of *moderate* inflation in line with the assumption as well as by a gradual increase in the share of answers a) and b) to Question 5. Perceived inflation surged even more rapidly at the beginning of 2004 and kept on rising until the end of the sample period. Moreover, in the second half of 2004 and at the beginning of 2005, the level of perceived inflation lagged markedly behind that of actual inflation, pointing to some inertia in customers' perception.

As in the previous estimation, inflation expectations were very close to the perceived inflation rate except for the period before Latvia's accession to the EU when an upward leap in quantified inflation expectations was observed. In contrast to inflation expectations dynamics in Chart 5, inflation expectations even eased immediately after the EU accession to become more pronounced afterwards due to the increasing level of perceived inflation.

Standard deviation of inflation expectations and numerical areas of response options of Question 6 are showed in Charts A5 and A6 of Appendix 2. As in the approach which assumes that perceived inflation is the same as actual inflation, the estimated standard deviation and areas increase with time due to accelerating rate of perceived inflation.

3 VAR MODEL WITH INFLATION EXPECTATIONS

3.1 VAR model description

As both inflation and inflation expectations are endogenous, the application of a single equation would lead to incorrect conclusions. In order to find out how and to what extent inflation expectations are linked with inflation in Latvia, a VAR model has been employed. A similar approach to determining the role of inflation expectations for the euro area was shared by M. Paloviit and M. Virén (11) who estimated a VAR model for three variables: actual inflation, inflation expectations, and the output gap.

The VAR model for Latvia has the following variables.

- π_t^{HICP} denotes annual changes in Latvia's HICP in period t , capturing actual inflation in Latvia.
- π_t^{exp} is the assessment of anticipated inflation or inflation expectations in period t (opinion about price movements over the next period of 12 months). Quantification of inflation expectations and perceived inflation using the C–P approach and linear interpolation method in assessing *moderately risen* prices was described in the previous section (see Chart 7).
- y_t is the output gap for Latvia. As in the paper by D. Stikuts (16), the output gap has been measured using the Hodrick–Prescott filter (as monthly data have been used, $\lambda = 14\,400$). In this model, the output gap captures the domestic demand of the Latvian economy. As Latvia's GDP data is only available on a quarterly basis, interpolation was carried out, and the quarterly data were broken into monthly data, with unchanged quarterly sum total maintained. Interpolation has been made on the basis of industrial output monthly data and retail trade turnover at constant prices, considering their shares in GDP. The remaining share of GDP is interpolated using the square polynomial method.

However, when developing a VAR model for Latvia with other variables included along with the inflation rate, the strong pressure on inflation from a number of supply-side factors should be taken into account. These factors are to be included in the model otherwise the effects of inflation expectations and domestic demand on prices would be overestimated. Hence the following exogenous variables are included in the VAR model.

- oil_t is *Brent* crude oil prices (in US dollars). As fuel prices in Latvia largely depend on the global oil prices, the latter should also be included in the model as an exogenous indicator.
- e_t is the nominal effective exchange rate of the lats against the currencies of Latvia's 13 major trade partners (US, Denmark, France, Italy, the United Kingdom, the Netherlands, Finland, Germany, Sweden, Estonia, Russia, Lithuania and Poland). This factor figures prominent for measuring inflation due

to the small size and large openness of the Latvian economy as well as the share of tradable goods in the HICP basket of goods.

- π_t^* is inflation in foreign countries capturing annual consumer price changes in Latvia's 13 major trade partner countries. This is the underpinning factor affecting prices of tradable goods in Latvia.

For the purpose of capturing some large supply shocks related to administered prices, tax rate adjustments and movements in unprocessed food prices, the following dummy variables have been included in the model.

- adm_t^{2004-1} is a dummy variable that equals 1 between January and December 2004. It reflects the increase in electricity tariffs at the beginning of 2004.
- adm_t^{2005-4} captures medical service price rises in spring 2005 and equals 1 in the period of next 12 months (from April to December 2005, which is the period covered by the model).
- $adm_t^{2004-10}$ describes the increase in heat tariffs in autumn 2005 due to gas price rises. In this case, the variable is equal to 1 for the period from October to December 2005.
- $food_t^{2001}$ equals 1 from May 2001 to April 2002. It is related to bad weather conditions and poor harvest as well as rabies epidemic in 2001.
- $food_t^{2003}$ equals 1 from June to September 2003 and can be associated with unfavourable weather and poor fruit and vegetable crop in summer 2003, i.e. it captures seasonally untypical price movements.
- tax_t^{2004-5} equals 1 from May 2004 to April 2005. It captures the supply shock caused by tax rate changes that came into effect in May 2004 (excise tax on fuel, VAT base extension and rate adjustment).

The VAR model is estimated for the period from May 2001 (the beginning of the consumer survey) to December 2005 on a monthly basis. Despite the non-stationarity of variables, the levels of variables are used in the VAR model, thus assuming indirectly that there is a long-term linkage and co-integration among them. According to several information criteria (Schwarz and Hannan–Quinn information criteria) the VAR model includes 1 lag. The model residuals are not subject to autocorrelation and heteroscedasticity problems. Appendix 3 presents the estimated coefficients, lag length choice and residual tests of the VAR model.

Although analysis and economic interpretation of coefficients estimated by VAR model are not common, the authors of the present study provide a brief analysis of the coefficients before exogenous variables to find out their impact on endogenous variables.

According to the VAR model results, inflation abroad and oil prices have a positive effect on annual changes in HICP in Latvia. The impact of the nominal effective

exchange rate is also statistically significant (it is negative because the increase in the nominal effective exchange rate implies the appreciation of lats). The coefficients before the dummy variables indicate that both changes in administered prices, and poor weather conditions and harvest strongly affected inflation. The upward pressure of taxation changes related to the EU accession on the annual inflation rate was also statistically significant.

The exogenous variables of the model also have an impact on inflation expectations. Expectations are significantly influenced by the exchange rate and one of the dummies representing administered price changes. The model produces an unexpected finding about inflation expectations: they are negatively and statistically significantly related to inflation abroad. The output gap, in turn, is rather independent of the variables included in the model: it is significantly affected only by inflation abroad and some dummy variables.

In order to test the interaction among 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: the output gap, annual inflation and inflation expectations. However, considering insignificant correlation of model residuals, the impulse response functions were little affected by changes in the sequence of variables. Impulse response functions of the VAR model are given in Chart 8.

VAR model impulse response functions demonstrate that the reaction of inflation rate in Latvia to changes in inflation expectations, i.e. to an inflation expectations shock, is positive and statistically significant. According to the model results, the reaction of inflation to an inflation expectations shock is the strongest after 3–5 months, with the effects of the shock gradually easing afterwards. A prompt inflation response to an inflation expectations shock may in part be associated with the inflation forecasting horizon which is rather short. According to H. Nielsen's study, when giving answers to survey questions respondents usually predict inflation for the next 3–6 months.⁽⁹⁾

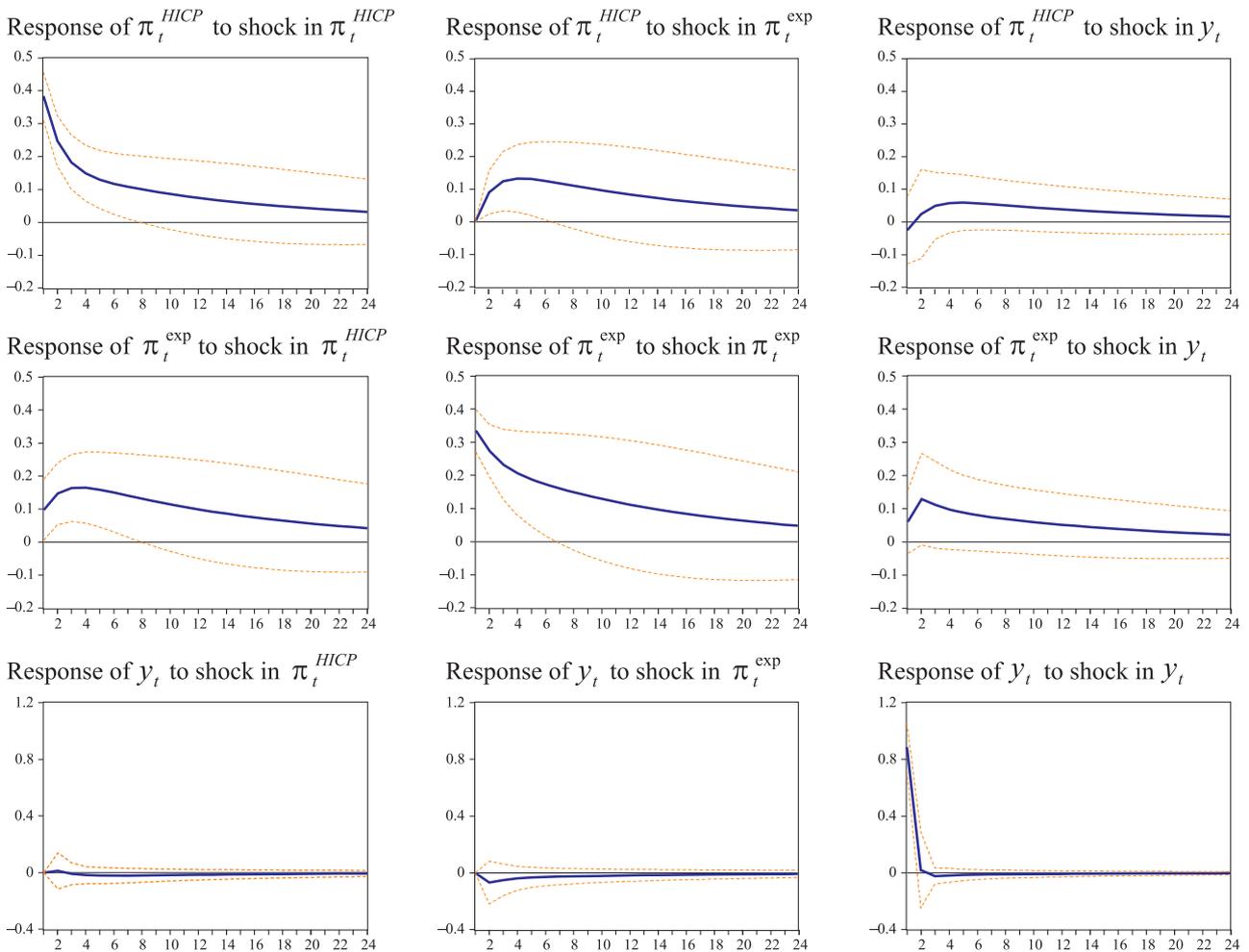
In the same positive (albeit statistically insignificant) way, inflation in Latvia reacts to a domestic demand shock, with the maximum impact achieved in 4–6 months. Inflation is also positively and significantly affected by an inflation shock, thus indicating that inflation inertia can be interpreted as an indirect effect from other factors. The estimated VAR model coefficients demonstrate that the accumulated indirect impact is approximately equal to the direct impact (the coefficient before lagged inflation is 0.58 in the inflation equation).

At the same time, the response of inflation expectations to inflation shocks and domestic demand shocks is positive as well. However, the inflation expectations response to a domestic demand shock has weak statistical significance. In addition, Chart 8 demonstrates the prolonged response of inflation expectations to an inflation expectations shock, which is an indication of inflation expectations inertia. Finally, the output gap in this model is close to being exogenous, as its response to inflation and inflation expectations shocks is weak and statistically insignificant.

Chart 8

VAR model impulse response functions

(C-P approach used in inflation expectations quantification; moderate inflation estimated using linear interpolation; in percentage points)



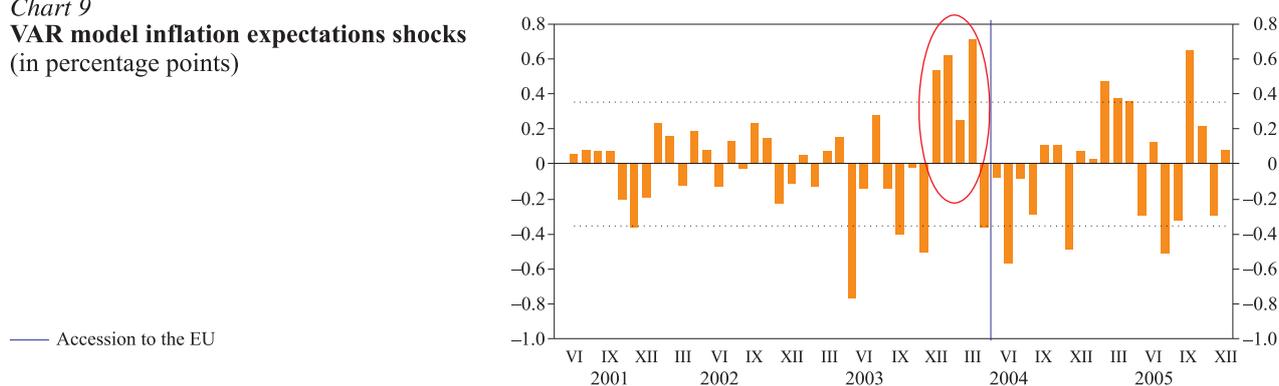
In order to test robustness of the results obtained by the inflation expectations quantification method, the authors of the study estimated similar VAR models using alternative approaches to expectation assessment described in Section 2.2 (see Chart 5 as well as Chart A1 and A2 of Appendix 2). The functions of alternative VAR model impulse responses are given in Charts A8, A9 and A10 of Appendix 4. In all three cases, actual inflation positively responds to inflation expectations shocks: in one case the response is statistically significant (see Chart A9) but in other two cases it is of marginal significance. In a similar way, inflation expectations respond positively and significantly to inflation shocks. Under the assumption that the rate of perceived inflation is the same as of the actual inflation, the model displays a pronounced correlation between inflation and inflation expectations shocks. Overall, the impulse response functions are quite identical; hence findings about the interrelation between the rates of actual inflation and inflation expectations do not depend on the method used in the quantification of inflation expectations.

3.2 Contribution of inflation expectations shocks

It is possible to measure the contribution of inflation expectations shocks to the annual inflation in Latvia by using the results of a VAR model with inflation expectations. First, the difference between the contribution of inflation expectations and that of inflation expectations shocks should be defined. If inflation expectations were exogenous, the two concepts would coincide. However, inflation expectations in this model are not exogenous, for they are affected by the inflation rate, domestic demand and several supply-side variables (oil prices, exchange rates, etc). As inflation expectations often depend on other variables, a large share of their contribution may be treated as an implicit contribution by other variables. The contribution of an inflation expectations shock to the inflation rate is equal to the total contribution of inflation expectations less the contribution indirectly depending on other variables of the model.

Inflation expectations shock is the share of inflation expectations that cannot be explained using other variables included in the model – inflation, domestic demand and supply-side variables. Chart 9 presents the estimated series of inflation expectations shock.

Chart 9
VAR model inflation expectations shocks
(in percentage points)



According to the VAR model results, the largest part of inflation expectations variance is explained by other variables of the model; as a result, the shock is comparatively moderate. Inflation expectations surging prior to Latvia's accession to the EU are basically a result of rises in administered prices at the beginning of 2004 (primarily due to higher electricity tariffs) and strengthening of the euro exchange rate, while psychological factors have only a marginal impact on changes in inflation expectations and the actual inflation rate.

Shortly before Latvia's accession to the EU, a number of substantial positive inflation expectations shocks were recorded. This may be due to a negative information campaign in mass media, sceptical attitude of the people towards the EU, and the anticipated tax rate increases. The inflation expectations shock of September 2005 might be taken as the people's response to the global oil and fuel price changes due to hurricane Katrina, which supported the strengthening of inflation expectations.

Chart 10 shows the contribution of the estimated inflation expectations shock to the annual inflation rate in Latvia. The contribution has been calculated only for the

period starting in May 2003 due to a two-year period required by VAR model impulse response functions to approach zero.

Chart 10

Contribution of inflation expectations shocks to annual inflation in Latvia
(in percentage points)

— Accession to the EU

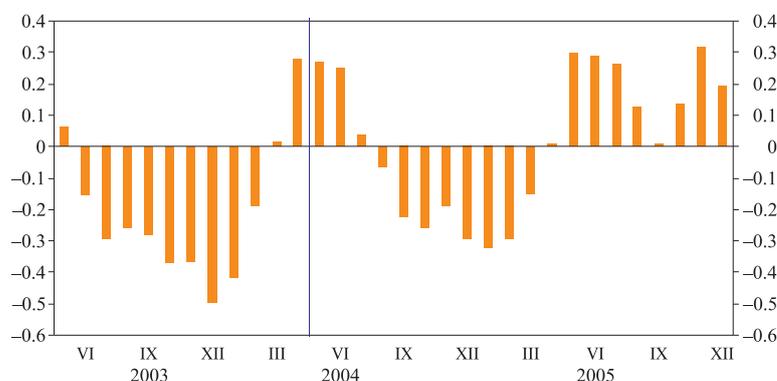


Chart 10 shows that the contribution of inflation expectations shock is relatively moderate, as the largest part of inflation expectations is explained by other variables, both demand-side and supply-side, of the VAR model. The contribution of inflation expectations shock for the given period does not exceed 0.3–0.4 percentage point. A positive contribution of inflation expectations shock was observed during the EU accession process, which might be a result of a sceptical information campaign. Afterwards, the contribution became weaker, turning negative (pessimistic expectations regarding higher inflation during the EU accession process possibly did not materialise, and this fact might have had a positive effect on further inflation expectations). In mid-2005, however, the contribution of inflation expectations shock to aggregate inflation again rose, turning positive. It might have happened on the back of concerns regarding sustainability of high inflation over a longer horizon as well as rising oil and fuel prices in the second half of the year.

Inflation expectations are a statistically significant factor that is likely to affect inflation rate. However, the findings of the VAR model 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 the actual inflation, on the other. The inflation expectations inertia is also to be reckoned with. It means that with the effects of demand and supply shocks on the actual inflation subsiding, the inflation expectations inertia will not let the actual inflation fall instantly, thus determining a certain degree of inertia of the actual inflation as well.

4 CONCLUSIONS

Consumer surveys are a valuable source of information providing data on inflation rates actually perceived and expected by the population. The employment of the probability approach allows for the modification of the survey data in a way to express the perceived inflation and inflation expectations as annual percentage price increases. Both the surveyed balance sheet data and the quantified values of inflation expectations confirm that inflation expectations strengthened substantially prior to Latvia's accession to the EU, with the expected inflation rate surging notably above the actually observed price rises. After the EU accession, the expected inflation rate again approached the level of the actual inflation.

The findings of the VAR model with inflation expectations indicate that inflation expectations have a statistically significant impact on inflation in Latvia. The most pronounced reaction of inflation to the inflation expectations shock is observed within 3 to 5 months, gradually subsiding afterwards. The response of inflation expectations to the inflation and domestic demand shocks, in turn, is positive, though the deviation implies that the response to the domestic demand shock is not statistically significant.

The process of modelling disclosed that inflation expectations are slow to respond to the inflation expectations shocks, which is a testimony of inflation expectations inertia of a certain degree. It implies that with the effects of demand and supply shocks on actual inflation subsiding, inflation expectations inertia will not allow the actual inflation rate to fall immediately, in such a way partly determining the inertia of actual inflation as well.

According to the results of the VAR model, the strengthening of inflation expectations shortly before Latvia's accession to the EU to a large extent can be associated with the rises in administered prices at the beginning of 2004 and appreciation of the euro, whereas psychological factors are responsible for only a small part of changes in inflation expectations and the actual inflation rate.

Residuals in inflation expectations equation indicate that several substantial positive inflation expectations shocks were in place prior to Latvia's accession to the EU; they may be associated with a negative information campaign in mass media, sceptical stances of the population and the anticipated adjustments of indirect tax rates. The contribution of inflation expectations shocks to the annual inflation rate in Latvia has been estimated using a VAR model. The contribution was quite moderate and did not exceed 0.3–0.4 percentage point during the sample period, as the largest contribution came from other – supply and demand side – variables included in the VAR model. The contribution from the inflation expectations shocks was positive at the time of EU accession (likely due to the negative information campaign and sceptical attitudes) and in the second half of 2005 (likely associated with the concerns about sustainability of high inflation pressures over a longer horizon and fuel price rises toward the end of the year).

Inflation expectations are an indicator to be taken into account when projecting inflation over a short horizon. However, the outcomes of the study show that they are strongly affected by certain demand and supply factors. The set of information

available forms the so called impact of psychological factors as a part of the anticipated and actual inflation. Hence unbiased and easily perceivable information to the population about factors that affect prices may constrain inflation expectations and reduce the rate of actual inflation in the country.

APPENDICES

Appendix 1

Questions 5 and 6 of consumer survey

Latvian	English
<p>5. jautājums. Kā Jūs novērtētu patēriņa preču cenu līmeni salīdzinājumā ar to, kāds tas bija pirms 12 mēnešiem? Vai, pēc Jūsu domām, cenas ir kļuvušas:</p> <p>a) ievērojami augstākas; b) diezgan lielā mērā augstākas; c) nedaudz augstākas; d) palikušas bez pārmaiņām; e) zemākas; f) grūti pateikt/NA.</p>	<p>Question 5. How do you think that consumer prices have developed over the last 12 months? They have ...</p> <p>a) risen a lot; b) risen moderately; c) risen slightly; d) stayed about the same; e) fallen; f) don't know.</p>
<p>6. jautājums. Salīdzinājumā ar pašreizējo situāciju kādas pārmaiņas, pēc Jūsu domām, varētu notikt nākamajos 12 mēnešos?</p> <p>a) cenas strauji celsies; b) cenas pieaugs līdzšinējā tempā; c) cenas pieaugs lēnākā tempā; d) cenas paliks līdzšinējā līmenī; e) cenas samazināsies; f) grūti pateikt/NA.</p>	<p>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 ...</p> <p>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.</p>

Response statistics are usually published only as balances of positive and negative response options. Response balances for Questions 5 and 6 are calculated using the following formula (see (6)):

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

where Σ is the response balance;

a , b , d , e are percentages of responses a), b), d) and e).

Appendix 2

Estimation of inflation expectations in Latvia using C-P approach

Chart A1
Inflation expectations and perceived inflation
 (C-P approach; moderate inflation estimated as period average; annual growth; %)

—◆— Actual inflation
 —▲— Perceived inflation
 — Inflation expectations

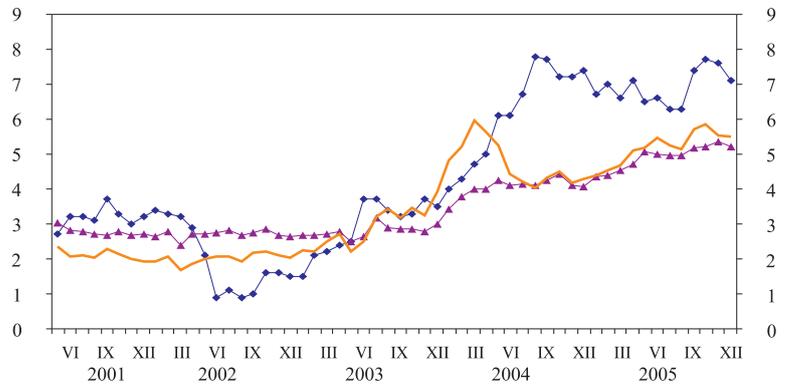


Chart A2
Inflation expectations and perceived inflation
 (C-P approach; moderate inflation estimated as the average from the beginning of the period; annual growth; %)

—◆— Actual inflation
 —▲— Perceived inflation
 — Inflation expectations

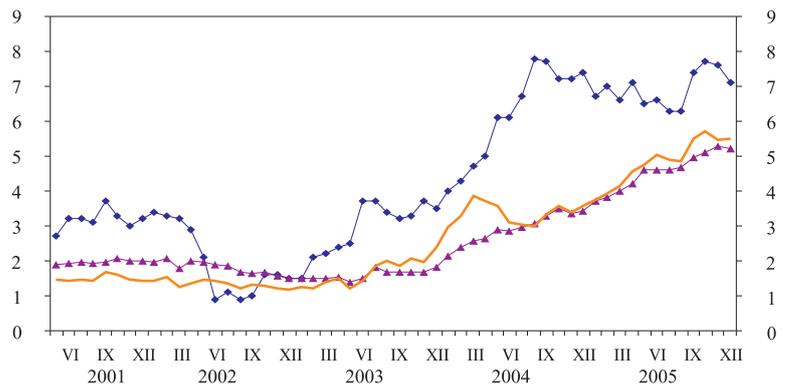


Chart A3
Inflation expectations and standard deviation of expectations
 (C-P approach; perceived inflation equals actual inflation; annual growth; %)

— Inflation expectations

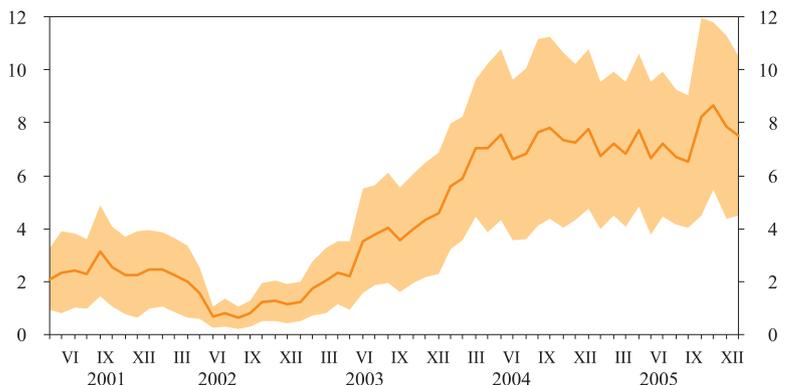


Chart A4
Inflation expectations and Question 6 response areas
 (C-P approach; perceived inflation equals actual inflation; annual growth; %)

— Inflation expectations

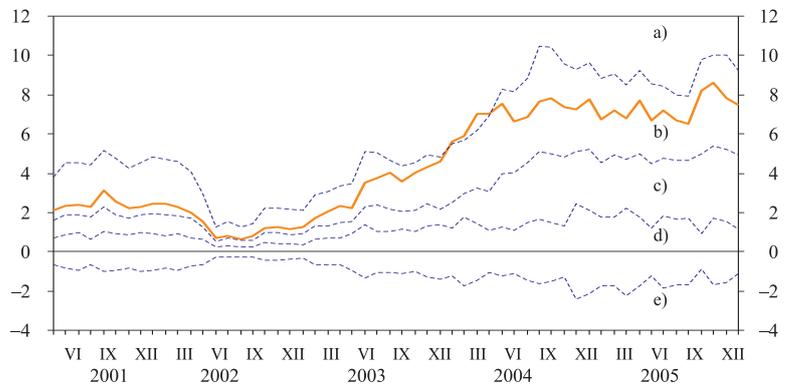


Chart A5
Inflation expectations and standard deviation of expectations
 (C-P approach; moderate inflation estimated using linear interpolation; annual growth; %)

— Inflation expectations

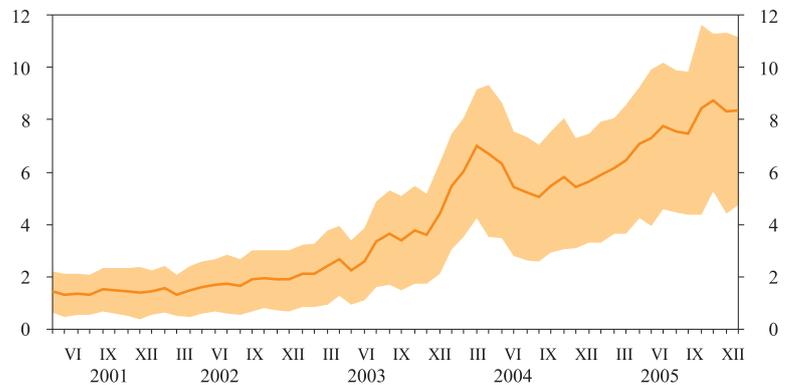
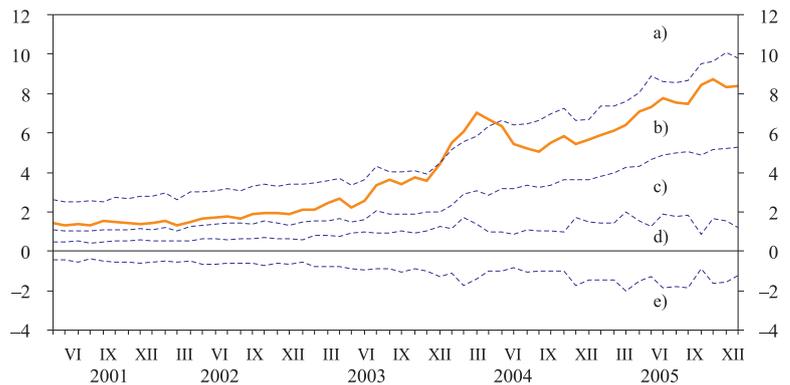


Chart A6
Inflation expectations and Question 6 response areas
 (C-P approach; moderate inflation estimated using linear interpolation; annual growth; %)

— Inflation expectations



Appendix 3

VAR model results

Table A1

Estimated VAR model

Period: from June 2001 to December 2005

	π_t^{HICP}	π_t^{exp}	y_t
π_{t-1}^{HICP}	0.575835 (0.08566) [6.72207]	0.175300 (0.07898) [2.21950]	0.081694 (0.19747) [0.41370]
π_{t-1}^{exp}	0.270382 (0.09652) [2.80136]	0.815192 (0.08899) [9.16051]	-0.202052 (0.22249) [-0.90812]
y_{t-1}	0.025702 (0.06676) [0.38502]	0.095078 (0.06155) [1.54478]	0.037275 (0.15388) [0.24223]
c	-0.820225 (0.73281) [-1.11928]	0.735175 (0.67566) [1.08809]	-0.954872 (1.68929) [-0.56525]
oil_t	0.003069 (0.00341) [0.90053]	-0.000409 (0.00314) [-0.13010]	0.001386 (0.00786) [0.17634]
e_t	-0.099514 (0.03877) [-2.56664]	-0.068354 (0.03575) [-1.91210]	0.054697 (0.08938) [0.61198]
π_t^*	0.175096 (0.22099) [0.79234]	-0.316589 (0.20375) [-1.55382]	0.611155 (0.50942) [1.19971]
adm_t^{2004-1}	0.687698 (0.23762) [2.89415]	0.069540 (0.21908) [0.31742]	0.936417 (0.54775) [1.70955]
adm_t^{2005-4}	0.351095 (0.40607) [0.86462]	0.447821 (0.37439) [1.19612]	0.610512 (0.93607) [0.65221]
$adm_t^{2005-10}$	0.310177 (0.31828) [0.97454]	-0.175507 (0.29345) [-0.59807]	-0.727397 (0.73370) [-0.99141]
$food_t^{2001}$	1.115921 (0.42647) [2.61666]	0.308077 (0.39320) [0.78351]	-1.887977 (0.98309) [-1.92044]
$food_t^{2003}$	0.587023 (0.23524) [2.49541]	-0.092500 (0.21689) [-0.42648]	-0.362417 (0.54228) [-0.66832]
tax_t^{2004-5}	0.835203 (0.35758) [2.33572]	-0.068983 (0.32969) [-0.20924]	-1.928718 (0.82429) [-2.33985]
R^2	0.976209	0.983798	0.391359

Note. () is the standard error, [] is the t -statistic.

Table A2
Lag length criteria

Lag length	Schwarz information criterion	Hannan–Quinn information criterion
0	8.232627	7.522279
1	6.371069*	5.447616*
2	6.738059	5.601502
3	6.849641	5.499979
4	7.214100	5.651334
5	7.492225	5.716355
6	7.634339	5.645364

* Indicates the lag order selected by criterion.

Table A3
Residual autocorrelation LM test

Lag length	LM-statistic	Probability
1	12.75437	0.1740
2	13.45584	0.1430
3	10.36950	0.3214
4	13.63802	0.1358
5	12.83708	0.1701
6	5.890237	0.7509

Table A4
Residual heteroscedasticity tests

Joint test

χ^2	Degrees of freedom	Probability
121.8751	108	0.1707

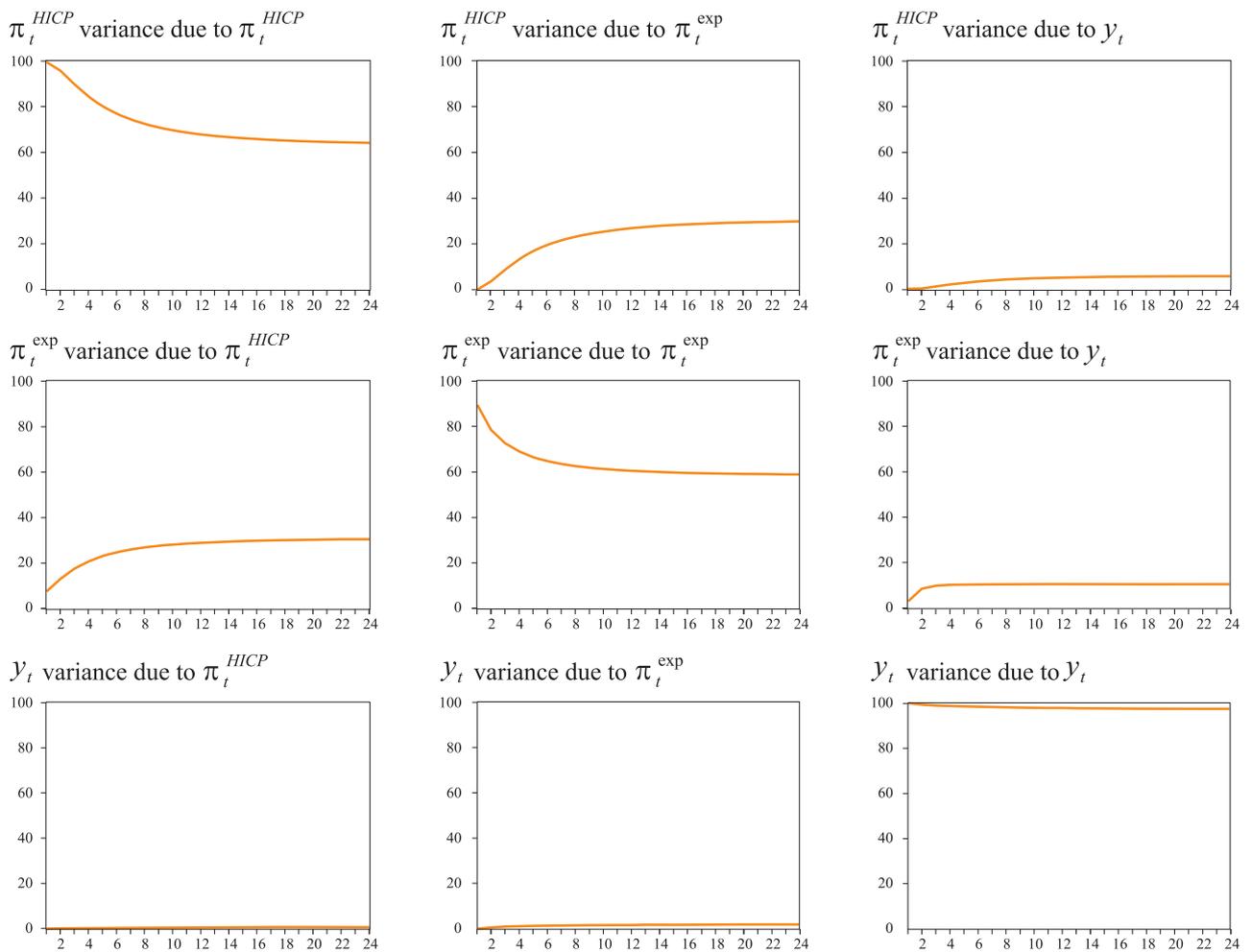
Individual components

	F-statistic	Probability	χ^2	Probability
res1*res1	0.518557	0.9307	11.32419	0.8801
res2*res2	1.549390	0.1292	24.00876	0.1547
res3*res3	1.278157	0.2584	21.44456	0.2576
res2*res1	1.474167	0.1575	23.33773	0.1779
res3*res1	0.952564	0.5287	17.74424	0.4726
res3*res2	1.601830	0.1124	24.45997	0.1405

Table A5
Residual correlation matrix

	u_t^{HICP}	u_t^{exp}	u_t^y
u_t^{HICP}	1.000	0.264	-0.066
u_t^{exp}	0.264	1.000	0.170
u_t^y	-0.066	0.170	1.000

Chart A7
VAR model variance decomposition
(%)



Appendix 4

Impulse response functions of VAR models with alternative inflation expectations quantifications

Chart A8

VAR model impulse response functions

(C-P approach used in inflation expectations quantification; perceived inflation equals actual inflation; in percentage points)

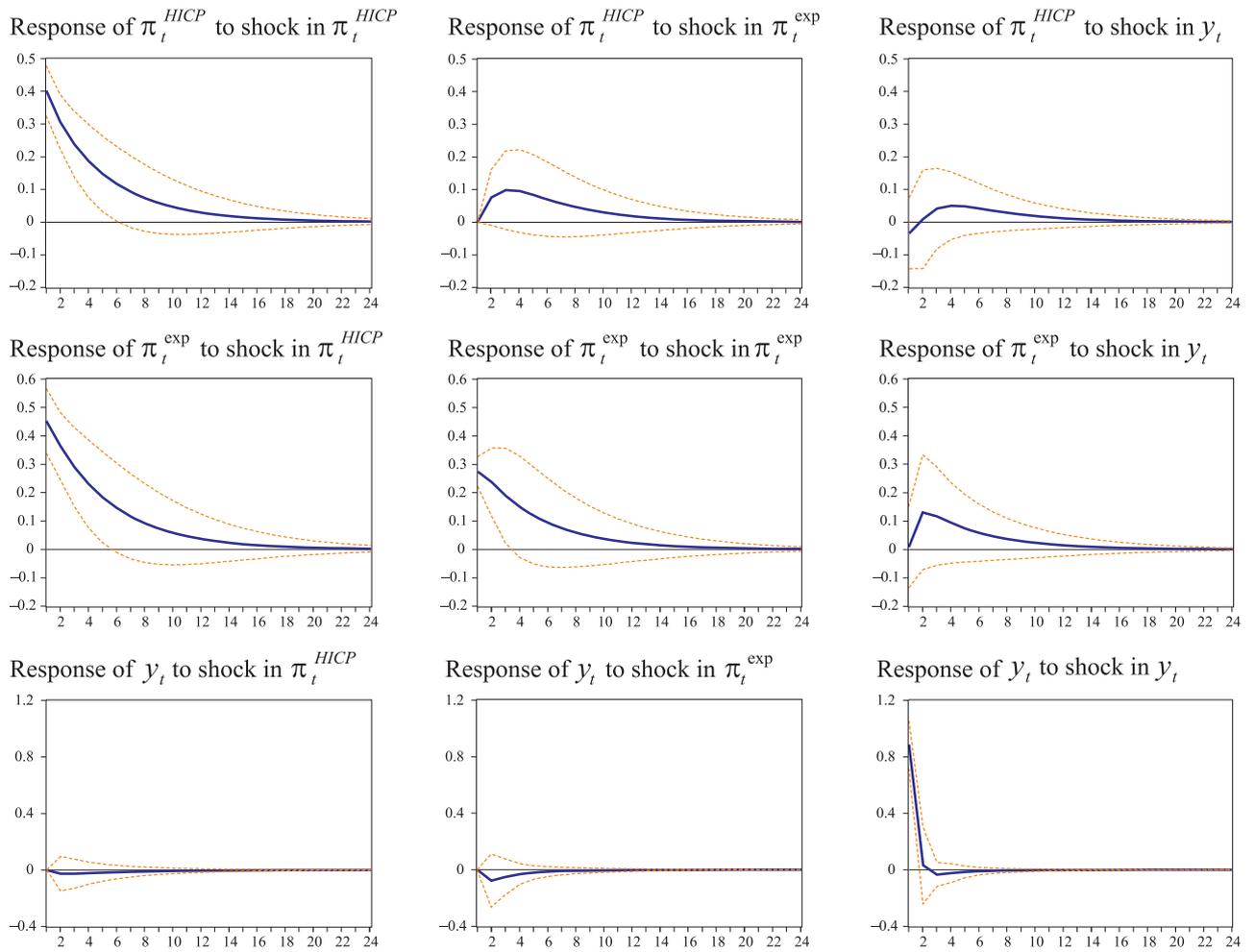


Chart A9

VAR model impulse response functions

(C-P approach used in inflation expectations quantification; moderate inflation estimated as period average; in percentage points)

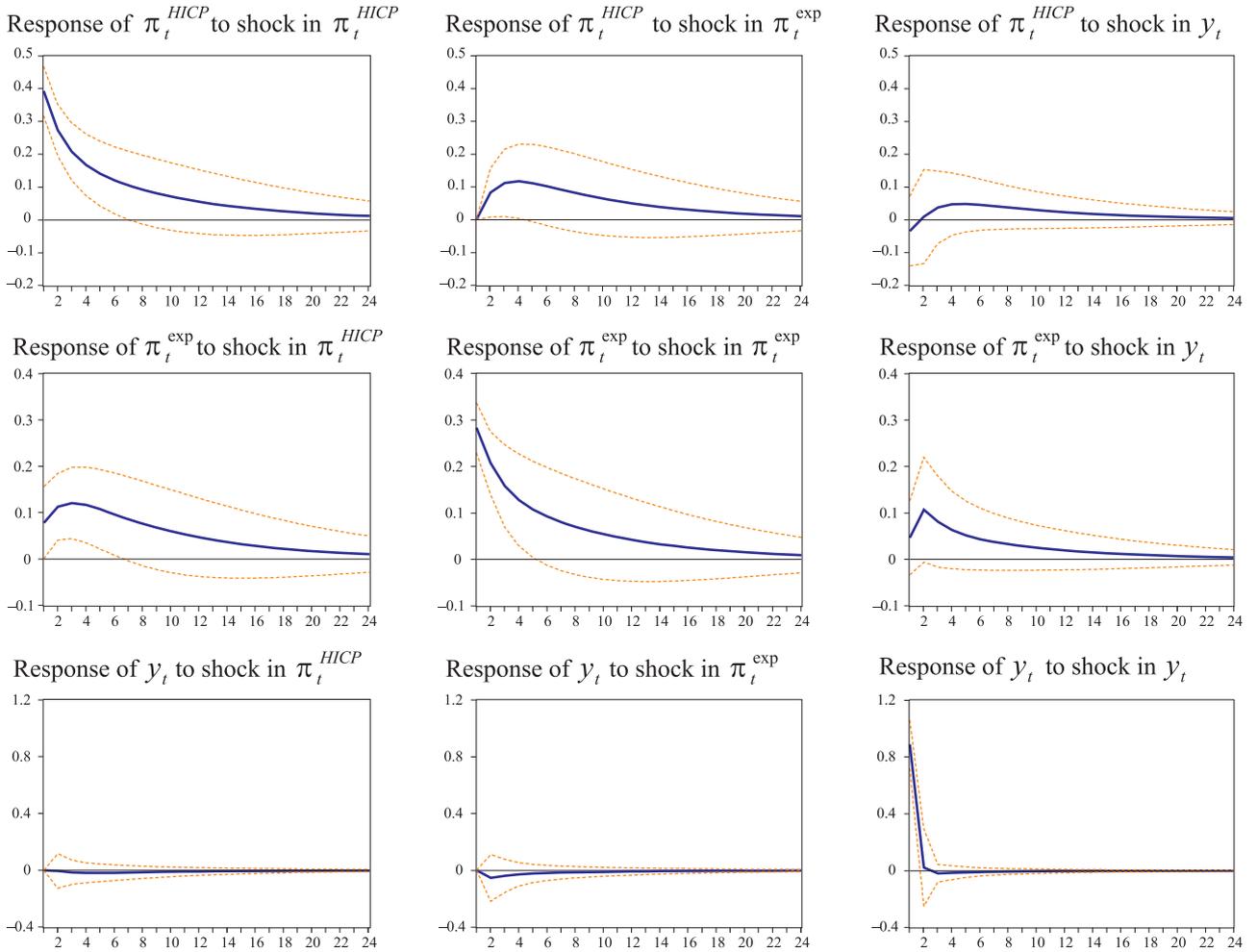
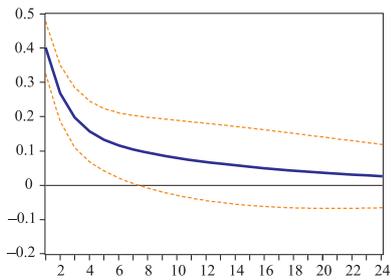


Chart A10

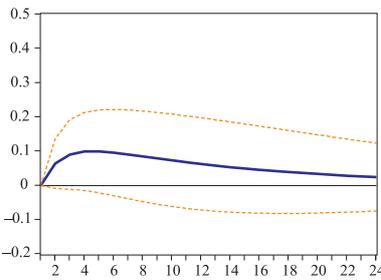
VAR model impulse response functions

(C-P approach used in inflation expectations quantification; moderate inflation estimated as the average from the beginning of the period; in percentage points)

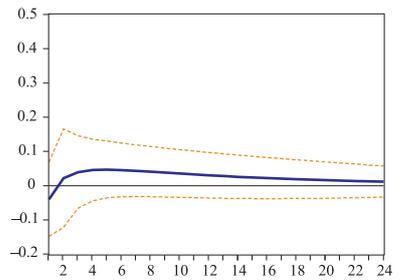
Response of π_t^{HICP} to shock in π_t^{HICP}



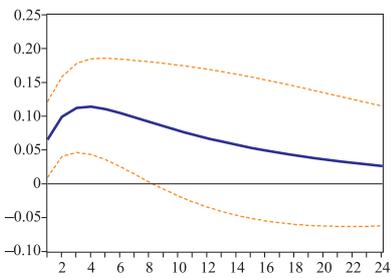
Response of π_t^{HICP} to shock in π_t^{exp}



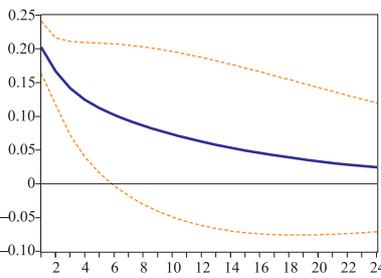
Response of π_t^{HICP} to shock in y_t



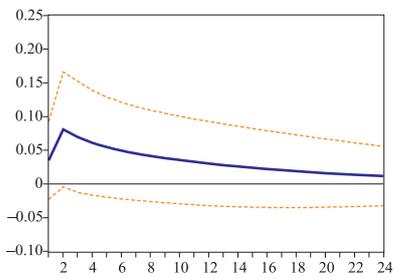
Response of π_t^{exp} to shock in π_t^{HICP}



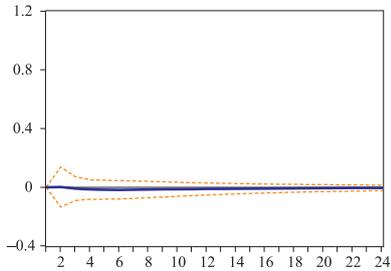
Response of π_t^{exp} to shock in π_t^{exp}



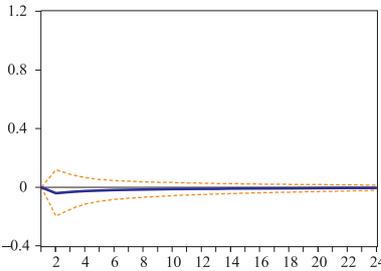
Response of π_t^{exp} to shock in y_t



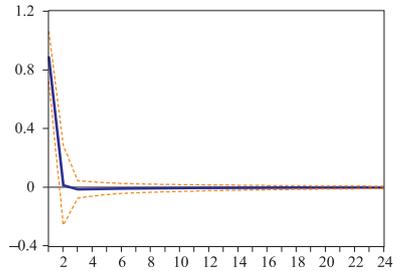
Response of y_t to shock in π_t^{HICP}



Response of y_t to shock in π_t^{exp}



Response of y_t to shock in y_t



BIBLIOGRAPHY

- 1 BATCHELOR, Roy A., ORR, Adrian B. Inflation Expectations Revisited. *Economica*, vol. 55, issue 219, August 1988, pp. 317–331.
- 2 BERK, Jan Marc. Measuring Inflation Expectations: a Survey Data Approach. *Applied Economics*, vol. 31, issue 11, 1999, pp. 1467–1480.
- 3 CARLSON, John A., PARKIN, Michael. Inflation Expectations. *Economica*, vol. 42, issue 166, May 1975, pp. 123–138.
- 4 CURTO MILLET, Fabien. Finding the Optimal Method of Quantifying Inflation Expectations on the Basis of Qualitative Survey Data. *Narodowy Bank Polski* conference materials, February 2006.
- 5 FORSELLS, Magnus, KENNY, Geoff. The Rationality of Consumers' Inflation Expectations: Survey-Based Evidence for the Euro Area. ECB Working Paper, No. 163, August 2002.
- 6 The Joint Harmonised EU Programme of Business and Consumer Surveys User Guide. European Commission, 2004.
- 7 Konjunktūras un patērētāju apsekojumu rezultāti 2005. gada IV ceturksnī: statistikas biļetens. Rīga : Latvijas Statistikas institūts, 2005. gada novembris, 60 lpp.
- 8 ŁYZIAK, Tomasz. *Consumer Inflation Expectations in Poland*. ECB Working Paper, No. 287, November 2003.
- 9 NIELSEN, Hannah. *Inflation Expectations in the EU – Results from Survey Data*. Discussion Paper, No. 13, March 2003. Discussion Papers of Interdisciplinary Research Project 373, Humboldt-Universität zu Berlin.
- 10 PALOVIITA, Maritta. *Inflation Dynamics in the Euro Area and the Role of Expectations*. Bank of Finland Working Paper, No. 20, September 2002.
- 11 PALOVIITA, Maritta, VIRÉN, Matti. *The Role of Expectations in the Inflation Process in the Euro Area*. Bank of Finland Discussion Paper, No. 6, February 2005.
- 12 PESARAN, Hashem M. Formation of Inflation Expectations in British Manufacturing Industries. *The Economic Journal*, vol. 95, No. 380, December 1985, pp. 948–975.
- 13 RECKWERTH, J. *Inflation and Output in Germany: The Role of Inflation Expectations*. Deutsche Bundesbank Discussion Paper, No. 5, 1997.
- 14 SEITZ, Helmut. The Estimation of Inflation Forecasts from Business Survey Data. *Applied Economics*, vol. 20, issue 4, April 1988, pp. 427–438.
- 15 SMITH, Jeremy, MCALEER, Michael. Alternative Procedures for Converting Qualitative Response Data to Quantitative Expectations: An Application to Australian Manufacturing. *Journal of Applied Econometrics*, vol. 10, issue 2, 1995, pp. 165–185.
- 16 STIKUTS, Dainis. Measuring Output Gap in Latvia. Rīga : Bank of Latvia, 2003. Working Paper 2/2003.