

DISCUSSION PAPER

KONSTANTĪNS BEŅKOVSKIS
KRISTA KALNBĒRZIŅA
LUDMILA FADEJEVA

PRICE SETTING BEHAVIOUR IN LATVIA:
DESCRIPTIVE EVIDENCE FROM
CPI MICRODATA

1•2010

CONTENTS

Abbreviations	1
Abstract	2
Introduction	3
1. Theoretical and empirical background	5
1.1 Time-dependent and state-dependent pricing models	5
1.2 Empirical findings	6
2. Description of the database and basic definitions	7
2.1 Database	7
2.2 Definitions	8
3. Description of the price setting mechanism in Latvia	10
3.1 Methodology	10
3.1.1 The duration approach	10
3.1.2 The frequency approach	10
3.1.3 The average size of price changes	12
3.1.4 Aggregation	12
3.2 Main characteristics of consumer price setting mechanism in Latvia	13
3.2.1 Averages for 2003–2009	13
3.2.2 International comparisons	20
3.2.3 Changes in price setting mechanism over time	22
4. Time-dependent and state-dependent pricing in Latvia	29
4.1 Decomposition and synchronisation of price changes	29
4.2 Empirical results	31
Conclusions	33
Appendix	35
Bibliography	55

ABBREVIATIONS

COICOP	– Classification of Individual Consumption by Purpose
CPI	– Consumer Price Index
CSB	– Central Statistical Bureau of Latvia
DSGE	– Dynamic Stochastic General Equilibrium
EU	– European Union
n.a.	– not available
US	– United States of America
VAT	– Value Added Tax

ABSTRACT

The question of price stickiness remains one of the most important in macroeconomics, as price flexibility partly determines how long it takes for inflation and real economic variables to return to their potential levels after a shock. To get a better understanding of price change frequency and size, the empirical work on price stickiness based on microdata from surveys on prices of individual products from individual outlets is needed. The main goal of this study is to provide descriptive evidence on the degree of nominal rigidity of consumer prices in Latvia at aggregate and disaggregate levels. To achieve this goal, we use the micro database on consumer prices provided by the CSB. The main finding of the paper is that during 2003–2009 Latvia's consumer prices were flexible. The average duration of a price spell was 3.5 months, and every month on average 28.7% of consumer prices were changed.

Keywords: price setting behaviour, Latvia's consumer prices, frequency of price change, duration, size of price change, sales, time-dependent pricing, state-dependent pricing

JEL codes: D40, E31

The views expressed in this publication are those of the authors, who are employees of the Monetary Policy Department of the Bank of Latvia. The authors assume responsibility for any errors and omissions.

The authors would like to thank the CSB for cooperation.

INTRODUCTION

The question of price stickiness remains one of the most important in macroeconomics, as price (and wage) flexibility partly determines how long it takes for inflation and real economic variables to return to their potential levels after a shock. High price flexibility means good functioning of the price-wage adjustment mechanism and ensures that consequences of various real and nominal shocks will not last for a long time. Therefore, understanding of price setting behaviour is crucial for economic analysis, forecasting and policy making. Moreover, empirical evidence on price setting is also important for building macro models with adequate microdata foundations.

This is not a first attempt to assess Latvia's price flexibility. One research we refer to is the paper by Meļihovs and Zasova (2007) where the traditional Phillips curve, new Keynesian Phillips curve and hybrid Phillips curve were estimated for Latvia. The authors found that companies in Latvia adjusted their output prices quite frequently (two times per year on average). Another research was done by Ajevskis and Vītola (2009) who estimated a small open economy DSGE model for Latvia and among other results estimated the coefficient before marginal costs in Phillips curve, which appeared to be around 1.6, indicating quite a high degree of price flexibility. Both these papers, however, use an indirect method of evaluation relying on macroeconomic data only, thus giving only a very narrow evaluation of the price formation mechanism in Latvia.

The analysis of microdata, e.g. surveys on prices of individual products from individual outlets, can provide a better understanding of price change frequency and size. The advantage of such an approach is twofold: first, it allows of studying the price setting mechanism directly; second, it gives information not only of aggregate price setting, but provides details at the sector and individual product levels. Perfect examples of empirical evidence about price stickiness have recently been provided for the US (Bils and Klenow (2004), Klenov and Kryvtsov (2008)), and euro area countries under the Eurosystem Inflation Persistence Network (IPN) project (e.g. Lünemann and Mathä (2005), Fougère et al. (2005), Aucremanne and Dhyne (2004), Kurri (2007), Veronese et al. (2005), Baudry et al. (2004), Jonker et al. (2004), and Hoffmann and Kurz-Kim (2006)).

The main goal of this study is to provide descriptive evidence about the degree of nominal rigidity of consumer prices in Latvia at aggregate and disaggregate levels. To achieve this goal, we use the micro database on consumer prices provided by the CSB. The sample contains partially anonymous 6-digit COICOP level records for prices of individual products (only 4-digit COICOP level is known) in particular outlet at monthly frequency from January 2003 to December 2009 (84 months). The total number of records is 590 016 for 185 products.

The descriptive empirical analysis of price stickiness is mainly based on two approaches – the duration approach, directly tracking the number of months for which prices remain unchanged, and the frequency approach computing the proportion of price quotes that change in a given period. In addition, inflation variance decomposition and price change synchronisation are used to determine whether the price setting behaviour in Latvia follows time-dependent or state-dependent pricing models.

The paper is structured as follows. In Section 1 we highlight the main theoretical models of price setting and then briefly review empirical works done on price stickiness based on microdata. Section 2 describes the database and introduces some main definitions. Section 3 discusses the methodology of estimation of price flexibility, focusing on the duration and frequency approaches. Then, we present empirical evidence on frequency and size of consumer price changes and duration of consumer price spells in Latvia at different aggregation levels. At first, the average characteristics of price formation mechanism are described for the whole sample period covering years 2003–2009. Then some international comparisons are made. Finally, we evaluate the changes that occur in Latvia's consumer price formation mechanism over time. The question whether price setting behaviour in Latvia follows time-dependent or state-dependent pricing models is answered in Section 4, and the last Section concludes.

1. THEORETICAL AND EMPIRICAL BACKGROUND

Prices do not adjust immediately in response to changing demand and supply conditions. The degree of price stickiness is a major issue determining the impact of various shocks on the economy. Moreover, price (and wage) flexibility partly determines how long it takes for inflation and real economic variables to return to their potential levels after a shock: the higher the flexibility, the better the price-wage adjustment mechanism. The understanding of price setting behaviour is crucial for economic analysis, forecasting and policy making. Empirical evidence about price setting is also important for building macro models with adequate micro foundations. In this section we highlight the main theoretical models of price setting and then briefly review the empirical works done on price stickiness based on microdata.

1.1 Time-dependent and state-dependent pricing models

Based on the assumptions about factors underlying price change frequency, the theoretical models can broadly be classified as time-dependent pricing models where price changes are determined exogenously at fixed or randomly selected times (Taylor (1980), Calvo (1983)), and state-dependent pricing models where the frequency of price changes depends on the state of the economy (Caplin and Spulber (1987), Dotsey et al. (1999), Dotsey and King (2005), Golosov and Lucas (2007)).

In the staggered contract model developed by Taylor (1980), prices are set for a fixed number of periods ($N > 1$) and in each period $1/N$ fraction of firms change their "contract prices". Calvo (1983) modified the Taylor model by suggesting that contracts end randomly according to a geometric distribution, thus developing a random duration version of the model where in every period some fixed percentage of firms change their prices. Both models feature exogenous staggering of price change in the economy over fixed or randomly selected periods, with a constant fraction of firms adjusting their prices in every period. The time-dependent pricing approach implies that the probability of a price change does not depend on the state of the economy, therefore, despite being widely used, this approach is criticised as not completely describing the sticky price mechanism.

An assumption behind the state-dependent pricing approach is that each firm faces menu cost of price adjustment and will change prices when the benefits from price changes are likely to exceed the respective expenses. The menu cost can be specified as fixed as in Caplin and Spulber (1987), and Golosov and Lucas (2007), or random as in Dotsey et al. (1999), Dotsey and King (2005). The latter models present a combination of features of the Calvo approach and state-dependent prices.

As shown in many papers on macroeconomic models, e.g. Klenow and Kryvtsov (2008), Golosov and Lucas (2007), Dotsey and King (2005), the implications of state-dependent and time-dependent models differ a lot. A key prediction of any menu cost model is that the fraction of firms adjusting prices will increase with the increase in inflation rate, thus taking into account the state of economy and speeding up the adjustment process. As a result, the main difference between the models is persistence of responses to monetary shocks, i.e. a faster and less persistent effect on macro variables in state-dependent models due to ability to

channel the response through faster price adjustments for firms with lower menu costs contrary to random and therefore slower price adjustment in time-dependent models. Also, as shown by Klenow and Kryvtsov (2008), state-dependent models might have problems with generating a database with an adequate number or size of price changes, i.e. "missing middle" of price changes for the Golosov and Lucas (2007) model specification or insufficient number of large absolute price changes for the Dotsey et al. (1999) model specification. Thus, it is important for the economic analysis to distinguish between price stickiness modelling approaches.

1.2 Empirical findings

The empirical work on price stickiness based on monthly or quarterly microdata from surveys on prices of individual products from individual outlets leads to better understanding of price change frequency and provides micro foundation for macro models used in the policy analysis. Comprehensive empirical evidence about price stickiness has recently been provided for US (Bils and Klenow (2004), Klenow and Kryvtsov (2008)) and euro area countries under the Eurosystem Inflation Persistence Network (IPN) project¹ (Lünnemann and Mathä (2005), Fougère et al. (2005), Aucremanne and Dhyne (2004), Kurri (2007), Veronese et al. (2005), Baudry et al. (2004), Jonker et al. (2004), and Hoffmann and Kurz-Kim (2006)). There are also research papers on price stickiness for Switzerland (Kaufmann (2008), (2010)) and Slovakia (Horváth and Coricelli (2006)).

The main findings in above mentioned researches, as reported in the overview work on IPN project results by Dhyne et al. (2005) and Álvarez et al. (2005) are as follows. First, prices change rarely and the average price adjustment in the euro area is considerably less frequent than in the US (15.1% of all products change prices in a given month in the euro area compared with 24.8% in the US). Second, the frequency of price changes is heterogeneous across products with similar ranking of the main consumer product categories in the euro area and the US (in ascending order of price change frequencies: services, non-energy industrial goods, processed food, unprocessed food, energy products). Third, there is no evidence about general downward price rigidity for all countries, i.e. price decreases are only slightly less frequent than price increases. Fourth, price reductions and price increases are of similar magnitude, although price reductions are on average larger (8.2% and 10.0% in the euro area and 12.7% and 14.1% in the US respectively). Fifth, the observed price change mechanisms in above mentioned countries do not fully satisfy the assumption about constant price change frequency underlying the time-dependent pricing process. Although the obtained results cannot be compared directly, there is some evidence that the time-dependent pricing is more pronounced in the US than in the euro area countries.

¹ Studies have been conducted for Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain.

2. DESCRIPTION OF THE DATABASE AND BASIC DEFINITIONS

2.1 Database

The database used in the current research is provided by the CSB and is generally used as a part of the database for Latvia's CPI estimation. The sample contains partially anonymous 6-digit COICOP records for prices of individual products (only 4-digit COICOP level is known) in a particular outlet at monthly frequency from January 2003 to December 2009 (84 months). The total number of records is 590 016 for 185 products. There are 7 024 individual product-outlet pairs with 13–71 outlet records per individual product per month (38 outlet records per product on average).

According to confidentiality restrictions, the statistical database used in this research does not contain data on products for which prices from a very limited number of producers or outlets are available, e.g. heat, water, telecommunication services. Therefore, it is necessary to stress that the sample, similarly to researches for other countries (see Table A1 in Appendix), does not cover all products (see Table 1).

Table 1

Sample coverage in 2009 for Latvia

	Shares in CPI	Shares in sample	Coverage
1 Food and non-alcoholic beverages	24.0	14.9	62.0
2 Alcoholic beverages, tobacco	7.1	6.0	84.5
3 Clothing and footwear	7.4	3.6	48.9
4 Housing, water, electricity, gas and other fuels	12.2	1.7	14.3
5 Furnishing, household equipment and routine household maintenance	5.5	2.8	51.3
6 Health	4.4	1.3	29.1
7 Transport	13.9	5.0	36.3
8 Communication	4.6	0.2	3.7
9 Recreation and culture	9.0	3.6	40.1
10 Education	1.3	0.1	4.6
11 Restaurants and hotels	5.5	2.6	46.9
12 Miscellaneous goods and services	5.0	2.4	47.4
Total	100.0	44.2	44.2

Sources: CSB and authors' calculations.

Notes: Shares in CPI show the shares of particular groups or categories in CPI basket in 2009 in %. The share in the sample denotes the share of products from a particular group or category presented in our database in the CPI basket in 2009 in %. Coverage indicates the share of products covered by our database within a group or category in 2009 in %.

The fullest coverage of product prices is in food and non-alcoholic as well as alcoholic beverages and tobacco (more than 60% and 80% respectively); the least representative are transport (4%, mostly represented by fuel, maintenance and repair of personal transport equipment prices) and education (5%, represented by tertiary education prices). On average, we have detailed information on 44.2% of the CPI basket. A detailed list of products (only 4-digit COICOP level) included in the database is given in Table A3 in Appendix. Although the coverage of our database is slightly less than a half, we are still able to produce a reasonably good proxy for the annual rate of official annual inflation from this data (see Figure A1 in Appendix).

The two exceptions are the first half of 2008 and the end of 2009 when the proxy overestimated the inflation rate.

In addition to price levels, the price database provides information on two types of specific data issues which also need to be taken into account while performing the analysis of the price formation mechanism: first, the cases when the data point is estimated rather than observed (imputations) and, second, the cases when a product is replaced by another similar product.

Imputations are used by the CSB in the case of short-term absence of product in an outlet (for a period less than 2–3 months) or for seasonal products (the price is not posted year-round). It is done by extrapolating the data series based on dynamics of other observable products in the respective price group. In the present database are registered 129 730 price changes with price imputations taken into account, and 114 302 are observed directly; as a result, approximately 12% of price changes can be attributed to price imputations (see Table A2 in Appendix). The highest percentage of imputations is present in clothing and footwear (57%) due to seasonal nature of the products and the smallest is recorded for food and non-alcoholic beverages (6%). Price imputations might result in a biased frequency of price changes (especially for seasonal products), therefore, although we concentrate on the results obtained from the database including price imputations, we also estimate price change frequencies using the data with only real observations thus ignoring imputations.²

As regards product replacement, it almost always contains a shift in the price level, which, however, is not informative. Therefore, we account for this effect while calculating the price change series by throwing out the price change at the moment of replacement and consequently producing inner-left and inner-right censored spells within the time series.

The concept of price censoring is based on the fact that we can observe duration of a price spell (an episode of unchanged price) only in cases when the spell starts and ends with a real price change, i.e. the spell is uncensored.³ Due to sample restrictions and product replacements, the data sometimes do not satisfy this requirement and some spells are left-censored, right-censored or double-censored. Left-censored spells do not contain observations of the spell's beginning either because the price change occurs before the sample period or because it is a newly replaced product. Right-censored spells do not contain observations of the spell's end, i.e. the price change happens after the sample period or the product is replaced. In case of a double-censored spell there are no observations of both the spell's beginning and end.

2.2 Definitions

Prior to moving to empirical analysis and results, we first provide a set of definitions to be used in our further analysis. The definitions are similar to the ones used by Baudry et al. (2004).

² As discussed below, the results are not significantly altered for most groups of products. The results obtained from the database ignoring price imputations are available upon request.

³ More on use of censored series in the calculation of frequencies and durations can be found in the section on Descriptive Statistics.

- **Price quote** (price raw observation in our database) is denoted as $P_{j,k,t}$ where j denotes an individual product ($j=1,\dots,J$; J is total number of different products), k stands for outlet selling product j ($k=1,\dots,K_j$; K_j is the number of outlets selling product j), and t is time index ($t=1,\dots,\Gamma$; Γ is total number of observations). Therefore, an individual observation in our database is the price of product j sold in outlet k at time t .
- **Price spell** is an episode of fixed price for specific product j in particular outlet k . An individual observed episode of fixed price for specific product-outlet pair (j,k) is denoted by index $i=1,\dots,N_{j,k}$ where $N_{j,k}$ is the number of observed product spells for product j in outlet k . The **total number of price spells** for all products in all outlets is equal to
$$N = \sum_{j=1}^J \sum_{k=1}^{K_j} N_{j,k} .$$
- **Price spell duration** $T_{j,k,i}$ is the time (in our research in months) between two price changes for product j in outlet k at episode i ($T_{j,k,i} \geq 1$).
- **Price change indicator** $I_{j,k,t}$ is a binary variable that takes value 1 if the price of product j in outlet k changes at time t , or is equal to 0 if the price is unchanged vis-à-vis the previous period. In a similar way, **indicators** $I_{j,k,t}^+$ and $I_{j,k,t}^-$ of **positive and negative price changes** can be constructed.
- **Price change** $S_{j,k,t} = \ln(P_{j,k,t}) - \ln(P_{j,k,t-1})$ is a variable that shows the logarithmic change of price of product j in outlet k at time t .
- Product **weights** ω_j are the weights of product j in the overall basket. As the coverage of our database is not full, we calculate product weights by dividing the product weights in the CPI basket by the coverage of our database. In addition, we use the sample period average weights.

3. THE DESCRIPTION OF PRICE SETTING MECHANISM IN LATVIA

3.1 Methodology

The descriptive empirical analysis of price stickiness is mainly based on two approaches – the duration approach directly tracking the number of months during which the price remains unchanged, and the frequency approach computing the proportion of price quotes that change in the given period.

3.1.1 The duration approach

According to the duration approach, average price duration \bar{T}_j , i.e. the number of months for which the price of product j on average remains unchanged, can be directly calculated from the total length of price spells (for all outlets) divided by the number of price spells for each product:

$$\bar{T}_j = \frac{\sum_{k=1}^{K_j} \sum_{i=1}^{N_{j,k}} T_{j,k,i}}{\sum_{k=1}^{K_j} N_{j,k}} \quad (1).$$

The average frequency of price changes for product j (F_j) can be indirectly estimated from the average price duration:

$$F_j = \frac{1}{\bar{T}_j} \quad (2).$$

An important quality of the duration approach is that we can calculate the total length of spells only for uncensored price spells (a price spell starts and ends with an observed price change), thus, in equation (1), $T_{j,k,i}$ and $N_{j,k}$ stand for duration and number of uncensored spells only. As a result, due to the right and left censoring, we will lose some part of available information. Moreover, by ignoring any censored spells, the duration approach tends to underestimate average duration of price spells and, thus, to overestimate the degree of price flexibility, as many potentially long price spells (especially double censored) are not taken into account during the estimation process.

3.1.2 The frequency approach

The frequency approach proposed by Bils and Klenow (2004) uses average frequency of product's j price changes F_j (the number of price changes divided by total number of observations) as an indirect measure of average duration:

$$F_j = \frac{\sum_{k=1}^{K_j} \sum_{t=2}^{\Gamma_j} I_{j,k,t}}{(\Gamma_j - 1) \cdot K_j} \quad (3).$$

In addition, the frequency approach allows for splitting average frequency into frequency of positive and negative price changes for product j (F_j^+ and F_j^- respectively):

$$F_j = F_j^+ + F_j^- = \frac{\sum_{k=1}^{K_j} \sum_{t=2}^{\Gamma_j} I_{j,k,t}^+}{(\Gamma_j - 1) \cdot K_j} + \frac{\sum_{k=1}^{K_j} \sum_{t=2}^{\Gamma_j} I_{j,k,t}^-}{(\Gamma_j - 1) \cdot K_j} \quad (4).$$

Moreover, average frequency of price changes for product j at time t could be defined as:

$$F_{j,t} = \frac{1}{K_j} \sum_{k=1}^{K_j} I_{j,k,t}, \text{ for } t = 2, \dots, \Gamma \quad (5).$$

By construction, the frequency approach ignores only the first observation in the sample; hence it is ambitious to assume that the actual time series starts already with a price change. Thus, compared with the duration approach, a larger dataset can be used.

Aucremanne and Dhyne (2004) showed that it is possible to express frequency term in notation of price spells by decomposing the expressions for the number of price changes and the number of observations into uncensored left, right and double censored price spells ($N_{j,nc}, N_{j,lc}, N_{j,rc}, N_{j,dc}$) and their average lengths ($\bar{T}_{j,nc}, \bar{T}_{j,lc}, \bar{T}_{j,rc}, \bar{T}_{j,dc}$).

$$F_j = \frac{N_{j,nc} + N_{j,lc}}{N_{j,nc} \bar{T}_{j,nc} + N_{j,lc} E(\bar{T}_{j,nc})} = \frac{N_{j,nc} + N_{j,lc}}{N_{j,nc} \bar{T}_{j,nc} + N_{j,lc} \bar{T}_{j,lc} + N_{j,lc} \bar{T}_{j,rc} + N_{j,lc} \frac{N_{j,dc}}{N_{j,rc}} \bar{T}_{j,dc}} \quad (6).$$

Since only uncensored and left censored data are used in frequency calculations, the first part of equation (6) presents the frequency of price changes as a number of price changes divided by the length of related price spells where $E(\bar{T}_{j,nc})$ is the expected duration of the left censored price spell which can be further decomposed into the number and length of the observed left, right and double censored spells. Aucremanne and Dhyne (2004) propose that by using all available spells in evaluation of the expected left censored duration, one can get unbiased estimation of the price change frequency. In the present paper, we will mostly use frequency measures as in equation (3), although equation (6) will also be employed for comparison.

The average duration can be indirectly estimated from the average frequency:⁴

⁴ In the context of the theory of renewal processes, Lancaster (1990) provided an asymptotical proof of inverse relationship between frequency and mean duration under the assumption of stationarity and, as noted by Baudry et al. (2004), homogeneity of price change behaviour in a cross-section dimension.

$$\bar{T}_j = \frac{1}{F_j} \quad (7).$$

The duration and frequency approaches should lead to the same results if the assumption about no price spell selection bias between the two holds and the price changes occur at discrete time. However, since the frequencies are an indirect approach of evaluating price duration, they allow for characterising only the average duration but not full distribution of price durations, which is a disadvantage of the method.

Equation (7) is derived under the implicit assumption of discrete time. If assumed that prices can be changed at any moment, with the probability of a price change being constant within a given month, one can calculate the "continuous time" average duration:

$$\bar{T}_j = -\frac{1}{\ln(1 - F_j)} \quad (8),$$

and the median time between two price changes is equal to:⁵

$$\bar{T}_j^{median} = \frac{\ln(0.5)}{\ln(1 - F_j)} \quad (9).$$

3.1.3 The average size of price changes

Another important indicator of price setting behaviour which is estimated in this paper is the average size of price change for product j (S_j). Its calculations are straightforward and somewhat similar to the estimations of average frequency of price changes:

$$S_j = \frac{\sum_{k=1}^{K_j} \sum_{t=2}^{\Gamma_j} S_{j,k,t}}{\sum_{k=1}^{K_j} \sum_{t=2}^{\Gamma_j} I_{j,k,t}} \quad (10).$$

Similar to the frequency, it is possible to estimate the average size of positive and negative price changes for product j (S_j^+ and S_j^- respectively) as well as the average size of price changes for product j at date t .

3.1.4 Aggregation

In order to compute aggregate measures of average price duration and frequency of changes, several papers (e.g. Baudry et al. (2004), Álvarez et al. (2005), Lünemann and Mathä (2005)) proceed in two steps: first, since the CPI weights are often not defined at the outlet level but at the product level only, they first calculate the average duration at the product level and, second, average it over all products using the product weights. Also, it is noted that due to the prices with frequencies close to

⁵ See, for example, Veronese et al. (2005).

zero (i.e. very high durations), the aggregated duration measure can be biased, therefore an alternative indicator – the weighted median of inverse frequencies – might be a better duration estimate. We first calculate measures of frequency (F_j , F_j^+ and F_j^-), using either the duration or frequency approach. Afterwards, we calculate the aggregated frequency (F) by directly weighting product frequencies by product weights:

$$F = \sum_{j=1}^J F_j \cdot \omega_j \quad (11).$$

We are aware that, if we weight duration instead of frequencies, the acquired duration values would be higher by a property of harmonic mean as shown in Baudry et al. (2004). Then we calculate the aggregate measures of price duration (\bar{T} , \bar{T}^{median}) by using equations (7), (8) or (9) and replacing the frequency of price changes for product j by the aggregated frequency from equation (11).

3.2 Main characteristics of consumer price setting mechanism in Latvia

In this subsection, we present the empirical evidence on frequency and size of consumer price changes and duration of consumer price spells in Latvia. The analysis of consumer prices is done at different levels: aggregate level, 12 COICOP groups, main economic categories (unprocessed food, processed food, energy, services, and non-energy goods)⁶ as well as individual products. At first, the average characteristics of price formation mechanism are described for the whole sample period covering years 2003–2009. Then some international comparisons are made. Finally, we evaluate the changes that occur in Latvia's consumer price formation mechanism over time at an aggregate level as well as in different price groups and categories.

3.2.1 Averages for 2003–2009

As described in the previous subsection, the main indicators that describe the price formation mechanism are frequency of price changes, duration of price spells (closely related to frequency) and size of price changes. All these indicators are presented in Table 2. Frequency and duration are calculated using the frequency approach.

⁶ Classification of products by economic categories could be found in Appendix, Table A3.

Table 2

Frequency and average size of price changes, duration of price spells by COICOP group and main economic category (2003–2009)

	Frequency approach		Average price change
	Frequency	Duration	
1 Food and non-alcoholic beverages	0.326	3.07	0.019
2 Alcoholic beverages, tobacco	0.198	5.06	0.060
3 Clothing and footwear	0.260	3.85	-0.065
4 Housing, water, electricity, gas and other fuels	0.133	7.50	0.058
5 Furnishing, household equipment and routine household maintenance	0.168	5.97	0.013
6 Health	0.066	15.09	0.172
7 Transport	0.701	1.43	0.019
8 Communication	0.441	2.27	-0.052
9 Recreation and culture	0.163	6.15	0.074
10 Education	0.079	12.67	0.065
11 Restaurants and hotels	0.098	10.24	0.091
12 Miscellaneous goods and services	0.157	6.37	0.046
Unprocessed food	0.377	2.65	0.014
Processed food	0.246	4.06	0.025
Energy	0.659	1.52	0.023
Services	0.079	12.73	0.126
Non-energy goods	0.208	4.81	0.013
Total	0.287	3.48	0.031

Sources: CSB and authors' calculations.

Notes: Frequency shows the average share of prices that are changed during one month, equation (3). Duration denotes the average duration of price spells in months, equation (7). Average price changes show the average logarithmic changes of prices, equation (10).

Our calculations demonstrate that each month during 2003–2009, 28.7% of consumer prices were changed on average. This means that the average duration of a price spell was approximately 3.5 month, indicating quite a high degree of price flexibility.

Obviously, these figures are not homogenous for different types of products, and we should take a look at a more disaggregated level. According to Table 2, the highest flexibility (highest frequency and shortest duration) is observed for transport (average price spell duration of 1.4 months), communication (2.3 months), food and non-alcoholic beverages (3.1 months), and clothing and footwear (3.9 months) prices. However, we should take into account that the results for transport and communication are biased due to sample problems (see Table 1). The high flexibility of transport prices was on account of fuels, while the purchase of vehicles and transport services with obviously lower price flexibility were underrepresented in our database. A similar problem is in communication, as we have no data on postal and telephone services. Therefore, it could be argued that the flexibility of prices in transport and communication sectors is overestimated.

On the other side, the lowest price flexibility (lowest frequency and longest duration) is obtained for health (15.1 months), education (12.7 months), and restaurants and hotels (10.2 months). Also, there are some sample problems with the education prices, although it could be argued that duration of approximately 12 months is quite natural and could be valid also for those education subgroups which

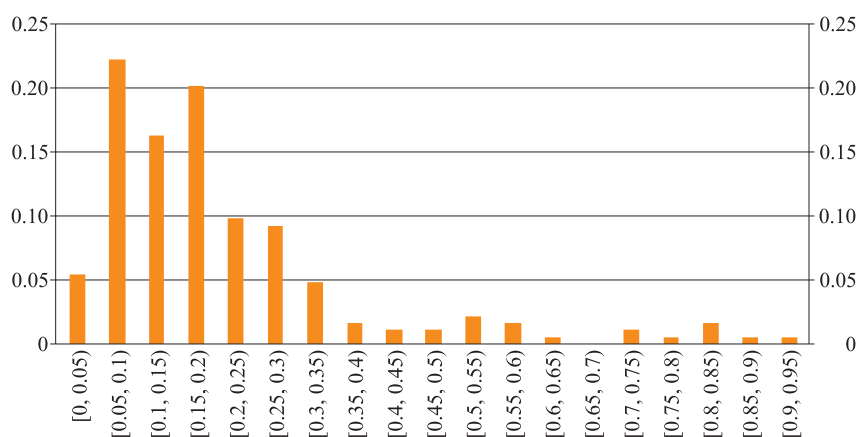
are not included in our database. As for health, we lack information only about hospital services prices, which are also expected to be rather inflexible.

If we look at price flexibility by economic category, we find that price flexibility of the highest degree is observed for energy products (1.5 months) and unprocessed food (2.7 months), while the highest price rigidity is typical for services (12.7 months). The average flexibilities of processed food and non-energy prices are rather similar (4.1 and 4.8 months respectively).

Frequencies and duration for individual goods are reported in Table A4 in Appendix, while the distribution of frequencies for individual product price changes is reported in Figure 1. Table A4 in Appendix shows that price flexibilities differed not only across groups of products but also within them. Moreover, the range of frequencies and duration was quite impressive: for instance, the longest average price spell duration in our database is observed for other services n.e.c. (60.4 months), while the shortest duration is observed for vegetable prices (1.1 months). The distribution in Figure 1 indicates that the frequency mode (for around 22% of observed products) was in the interval between 0.05 and 0.1. For another 20% of products, the frequency of price changes was in the interval between 0.15 and 0.2.

Figure 1

Distribution of price change frequencies for individual products (2003–2009)



Sources: CSB and authors' calculations.

Notes: Frequency shows the average share of prices that are changed during one month, equation (3). Vertical axis denotes the share of individual products within particular frequency interval.

All above mentioned results are obtained by using the frequency approach, which is in line with the typical practice in other empirical researches on this topic. However, it is necessary to compare these results with those obtained by alternative methodologies in order to check the robustness of our conclusions. This is done in Table A5 and Table A6 in Appendix where the frequency of price changes and duration of price spells are estimated not only using the traditional frequency approach, but also the frequency approach (see equation (6)) and duration approach (see equations (1) and (2)) modified by Aucremanne and Dhyne (2004). In addition, for duration we also compute the continuous time mean and median duration (using the frequency approach; see equations (8) and (9)).

Overall, the main differences are between the frequency and duration approach, and in all cases the duration approach leads to higher evaluation of price flexibility (higher frequency and lower duration). It was already mentioned in the previous subsection that the duration approach has a tendency to overestimate price flexibility, as it uses only uncensored spells. The differences, however, are not too big: the average price spell duration estimated by the duration approach was 2.8 months, and, in addition, conclusions about price flexibilities of individual price groups and categories are still valid.

Another important robustness test should be done to check whether price imputations seriously affect our conclusions. To do that, we calculated frequency and duration indicators using a dataset in which price imputation data are ignored and treated as missing. By doing so, we reduce the number of observations and increase the number of censored spells. We report the effect of price imputations in Table A7 in Appendix. The average frequency and duration of all consumer prices estimated by the two methods are very close, therefore acknowledging or ignoring price imputations does not have important consequences for our conclusions on the total price flexibility. This conclusion is valid also for the major part of groups and categories. The only exception where imputations play a significant role is clothing and footwear prices: price spell duration of 6.9 months without price imputations and duration of 3.9 months with price imputations. This is due to a highly pronounced seasonal pattern of clothing and footwear trade and therefore a very high share of price imputations for this price group. Therefore, it should be kept in mind that price flexibility of the clothing and footwear group can be overvalued due to price imputations.

Along with the frequency and duration indicators that characterise price flexibility, the size of price changes is also an important feature of the price formation mechanism. Information about all consumer prices on average as well as for the main groups and categories can be found in the last column of Table 2. The average consumer price change in 2003–2009 was 3.1%, although this indicator is rather heterogeneous as well. For instance, the largest changes are observed for health (17.2%), restaurant and hotel (9.1%), and recreation and culture (7.4%) prices. On the other hand, the average change of clothing and footwear as well as communication prices was even negative (–6.5% and –5.2% respectively). Overall, a tendency of larger price changes for groups with the smallest frequency of price changes has been observed. It is especially pronounced for services category in which the average price change was 12.8%.

The analysis above was carried out for all price changes, either positive or negative. However, a lot of useful conclusions about the price formation mechanism can be drawn from separately analysing upward and downward price changes. Table 3 shows frequency and average size of price increases and decreases by groups and economic categories.

Table 3

Frequency and size of upward and downward price changes by COICOP group and main economic category (2003–2009)

	Frequency			Size		
	All	Upward	Downward	All	Upward	Downward
1 Food and non-alcoholic beverages	0.326	0.198	0.128	0.019	0.107	0.125
2 Alcoholic beverages, tobacco	0.198	0.148	0.049	0.060	0.100	0.071
3 Clothing and footwear	0.260	0.159	0.101	-0.065	0.073	0.212
4 Housing, water, electricity, gas and other fuels	0.133	0.098	0.036	0.058	0.115	0.111
5 Furnishing, household equipment and routine household maintenance	0.168	0.105	0.062	0.013	0.079	0.111
6 Health	0.066	0.061	0.006	0.172	0.197	0.159
7 Transport	0.701	0.426	0.274	0.019	0.051	0.054
8 Communication	0.441	0.045	0.397	-0.052	0.052	0.064
9 Recreation and culture	0.163	0.076	0.087	0.074	0.137	0.141
10 Education	0.079	0.055	0.023	0.065	0.143	0.121
11 Restaurants and hotels	0.098	0.081	0.016	0.091	0.128	0.105
12 Miscellaneous goods and services	0.157	0.100	0.057	0.046	0.136	0.150
Unprocessed food	0.377	0.222	0.155	0.014	0.109	0.125
Processed food	0.246	0.160	0.086	0.025	0.104	0.123
Energy	0.659	0.403	0.256	0.023	0.061	0.058
Services	0.079	0.067	0.011	0.126	0.161	0.133
Non-energy goods	0.208	0.127	0.081	0.013	0.092	0.127
Total	0.287	0.178	0.110	0.031	0.103	0.119

Sources: CSB and authors' calculations.

Notes: Frequency shows the average share of prices that are changed during one month, equations (3) and (4). Average price change shows the average logarithmic change of prices, equation (10).

According to our calculations, during the investigated time period price increases occurred almost 1.6 times more often than price decreases: on average, 17.8% of prices were changed upwards each month, while only 11.0% of prices were revised downwards. This asymmetry when the positive price changes are more probable than the negative ones was typical for almost all groups and categories. The only exceptions are communication prices (we should keep in mind the above mentioned sample problems, although price decreases were quite typical also for telephone services prices), and recreation and culture prices.

The highest asymmetry between upward and downward price revisions is observed in restaurants and hotels (8.1% and 1.6% respectively), health (6.1% and 0.6%), and alcoholic beverages and tobacco (14.8% and 4.9%). The latter is, to a large extent, driven by changes in excise tax rates. As to economic categories, there is a tendency that the largest asymmetry was recorded for the least flexible services sector (6.7% and 1.1% respectively), while the smallest was observed in the most flexible categories: unprocessed food (22.2% and 15.5% respectively) and energy (40.3% and 25.6% respectively).

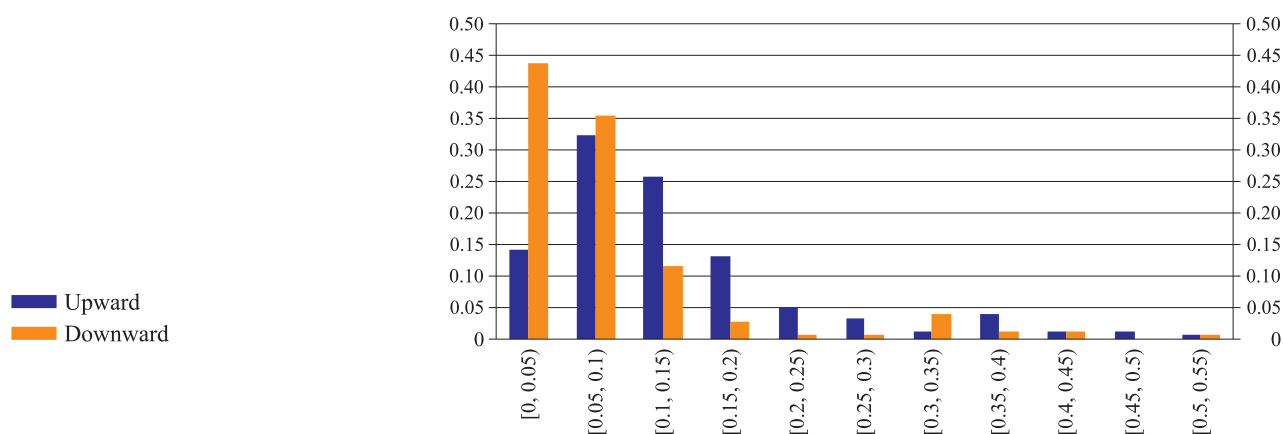
As to the average size of price increases and decreases, asymmetry was not so pronounced: the average consumer price increase during 2003–2009 was 10.3%, while the average decrease was only slightly higher larger, at 11.9%. Also, for most price groups and categories, the size of upward and downward price revisions was rather similar. A clear outlier in this respect was clothing and footwear, for which

the size of positive price changes (7.3%), was significantly smaller than the size of negative price changes (21.2%). Another interesting conclusion can be made from Table 3: there is a strong negative correlation between price flexibility and the average absolute size of price changes. In groups with most flexible prices (transport, communication), we observe the smallest price changes, either positive or negative, while in health, education as well restaurants and hotels the prices were changed rarely and by a larger amount.

The distribution of frequencies and size of upward and downward price changes for individual products is shown in Figures 2 and 3.

Figure 2

Distribution of frequencies of upward and downward price changes for individual products (2003–2009)



Sources: CSB and authors' calculations.

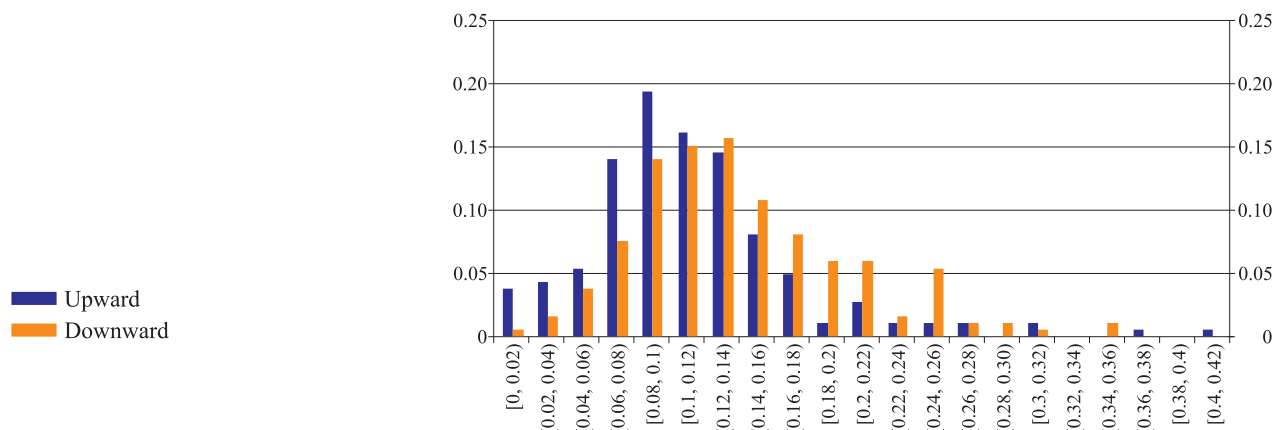
Notes: Frequency shows the average share of prices that are changed during one month, equation (4). Vertical axis denotes the share of individual products within particular frequency interval.

Figure 2 confirms our previous conclusions about the asymmetry of price change frequency. For upward price revisions the most widespread frequency lies in the interval between 0.05 and 0.1 (typical for more than 30% of products), while for another 25% of products upward frequency is in the interval between 0.1 and 0.15. As for negative price changes, the frequency mode (for more than 40% of products) is between 0 and 0.05, for another 35% of products downward frequency is in the interval between 0.05 and 0.1.

The distributions of size of upward and downward price revisions look more similar (see Figure 3), although the distribution of downward revisions is somewhat shifted to the right and is more widespread, indicating that the average downward revision was slightly larger than the upward. The mode of the upward size (almost 20% of products) lies between 8% and 10%, while the mode of the downward size (approximately 15% of products) lies between 12% and 14%.

Figure 3

Distribution of size of upward and downward price changes for individual products (2003–2009)



Sources: CSB and authors' calculations.

Notes: The size of price changes shows the average logarithmic change of prices, equation (10). Vertical axis denotes the share of individual products within particular size interval.

Another interesting question connected with the price formation mechanism and frequency of price decreases is the role of sales. We define sales as a temporary price decrease (for one month) with a subsequent price increase to the previous level. The share of such temporary price decreases is analysed in Table 4.

Our calculations indicate that in 13.5% of cases, the consumer price decreases were just temporary decreases or sales, with no long-term effect on the overall price level. Sales were mostly used in the categories of processed food (23.5% of all price decreases) and non-energy goods (15.3%), while this practice was not typical for the price formation in services (5.1%) and energy (5.5%) categories. The analysis of sales by product groups shows that sales were very often used in miscellaneous goods and services (35%, with an obvious predominance of goods), furnishing, household equipment and routine household maintenance (17.6%) as well as alcoholic beverages and tobacco (15.5%). On the other hand, the mechanism of sales was rarely used in categories of communication (3.5%), education (4.0%), restaurants and hotels (4.5%), and transport (5.1%).

Some intermediate conclusions can be made here. During 2003–2009, Latvia's consumer prices were flexible. The average duration of a price spell was 3.5 months, and every month 28.7% of consumer prices were changed on average. However, flexibility of prices could be slightly overestimated due to low sample coverage in some product groups. During the investigated time period, price increases occurred around 1.6 times more often than price decreases: each month on average, 17.8% of prices were changed upwards, while only 11.0% of prices were revised downwards. On the other hand, the asymmetry is not so pronounced for the size of price changes: an average consumer price increase was 10.3%, while an average decrease was 11.9%. We also found a strong negative correlation between price flexibility and average absolute size of price changes. The highest flexibility and the smallest absolute price change are observed for energy and unprocessed food prices, with the lowest flexibility and the largest absolute change for services prices. Finally, temporary price reductions or sales played an important role in the price formation

mechanism in processed food and non-energy categories but were rarely used for services.

Table 4

Number of price decreases and sales by COICOP group and main category (2003–2009)

	Price decreases	Sales	Share of sales
1 Food and non-alcoholic beverages	29 373	4 027	13.7
2 Alcoholic beverages, tobacco	1 777	276	15.5
3 Clothing and footwear	4 324	318	7.4
4 Housing, water, electricity, gas and other fuels	742	112	15.1
5 Furnishing, household equipment and routine household maintenance	2 306	407	17.6
6 Health	405	38	9.4
7 Transport	3 888	200	5.1
8 Communication	1 809	63	3.5
9 Recreation and culture	2 197	294	13.4
10 Education	25	1	4.0
11 Restaurants and hotels	449	20	4.5
12 Miscellaneous goods and services	2 766	984	35.6
Unprocessed food	20 693	1 989	9.6
Processed food	8 680	2 038	23.5
Energy	3 725	204	5.5
Services	800	41	5.1
Non-energy goods	16 163	2 468	15.3
Total	50 061	6740	13.5

Sources: CSB and authors' calculations.

Notes: Sales are defined as a temporary price decrease (for one month) with a subsequent price increase to the previous level. The share of sales is in %.

3.2.2 International comparisons

In order to see whether the results of price descriptive statistics for Latvia differ from similar results of other countries, we compare the obtained frequencies of price changes for Latvia with the results of 10 euro area countries and the US, using the analysis by Dhyne et al. (2005) based on common sample of 50 products defined by 6-digit COICOP level (see Table 5; the list of 50 products is presented in Table A8 in Appendix).

Table 5

Frequency of price changes by economic category in the euro area, the US and Latvia

	Unproces- sed food	Processed food	Energy	Non- energy products	Services	Total	
						Country weights	Euro area weights
Austria	0.375	0.155	0.723	0.084	0.071	0.154	0.171
Belgium	0.315	0.191	0.816	0.059	0.030	0.176	0.156
Germany	0.252	0.089	0.914	0.054	0.043	0.135	0.150
Spain	0.509	0.177	n.a.	0.061	0.046	0.133	0.115
Finland	0.527	0.128	0.893	0.181	0.116	0.203	–
France	0.247	0.203	0.769	0.180	0.074	0.209	0.204
Italy	0.193	0.094	0.616	0.058	0.046	0.100	0.120
Luxembourg	0.546	0.105	0.739	0.145	0.048	0.230	0.192
The Netherlands	0.308	0.173	0.726	0.142	0.079	0.162	0.190
Portugal	0.553	0.245	0.159	0.143	0.136	0.211	0.187
Euro area	0.283	0.137	0.780	0.092	0.056	0.151	0.158
US	0.477	0.271	0.741	0.224	0.150	0.248	–
Latvia	0.377	0.246	0.659	0.208	0.079	0.287	0.275

Sources: Dhyne et al. (2005) for the euro area countries, Bils and Klenov (2004) for the US, and authors' calculations for Latvia.

Notes: Sample periods covered for each individual euro area country and the US are shown in Table A1. Latvia's figures are based on the full dataset available for the period from January 2003 to December 2009. Figures for the euro area individual countries presented in this table are computed on the basis of the 50 products sample (see Table A8 in Appendix), with the only exception of Finland for which figures derived from the entire CPI are presented. Figures based on a larger coverage of the CPI for each individual country, when available, can be found in papers referred to in Table A1 in Appendix. The Spanish database contains no energy products, which biases the aggregate frequency downwards. The total from country weights is calculated using country-specific weights for each item. The total of the euro area weights is calculated using common euro area weights for each sub-index. No figures are provided for Finland because of the lack of comparability of the sample of products used in this country.

It should be noted that the results for different countries are acquired for different periods (see Table A1 in Appendix). Also, the product codes for Latvia are defined only at a 4-digit COICOP level and therefore the results are based on a full dataset of 185 products, thus the conclusions should be made with caution.

Similar as in Dhyne et al. (2005), we find that euro area, Latvia and the US share a common ranking of 5 main components of CPI with respect to frequency of price changes, i.e. (in ascending order of price change frequencies) services, non-energy industrial goods, processed food, unprocessed food, and energy products. With the exception of energy sector, price changes in Latvia were on average more frequent compared with the euro area but less frequent than in the US: for instance, price duration in the unprocessed food sector in the euro area was on average 3.5 months, 2.7 months in Latvia, and only 2.1 months in the US.

Nevertheless, total price change frequency in Latvia is higher than in the US. Each month on average, 28.7% of consumer prices were changed in Latvia and 24.8% in the US. This result should not be misstated, however, as it is driven by structural differences of consumer baskets, mainly due to a higher share of processed and unprocessed food and lower share of services in Latvia's CPI.

It is also possible to look closer at the results obtained for frequency and size of price increases and decreases in different euro area countries and Latvia in particular (see Table 6 and Tables A9–A12 in Appendix).

Table 6

Frequency and size of price changes in Latvia and the euro area

			Unprocessed food	Processed food	Energy	Non-energy products	Services	Total
Frequency	Increases	Euro area	0.148	0.071	0.420	0.042	0.042	0.083
		Latvia	0.222	0.160	0.403	0.127	0.067	0.178
	Decreases	Euro area	0.133	0.059	0.358	0.032	0.010	0.059
		Latvia	0.155	0.086	0.256	0.081	0.011	0.110
Size	Increases	Euro area	0.147	0.069	0.034	0.094	0.073	0.082
		Latvia	0.109	0.104	0.061	0.092	0.161	0.103
	Decreases	Euro area	0.163	0.081	0.024	0.114	0.097	0.100
		Latvia	0.125	0.123	0.058	0.127	0.133	0.119

Sources: Dhyne et al. (2005) for euro area countries and authors' calculations for Latvia.

Notes: Sample periods covered for each individual euro area country are shown in Table A1. Latvia's figures are based on a full dataset available for the period from January 2003 to December 2009. The figures for the euro area are computed on the basis of the 50 products sample (see Table A8 in Appendix).

In the unprocessed food category, Latvia's prices changed more often in both directions but the size of changes was smaller than in the euro area. The opposite is true for the Latvian energy sector where prices changed less frequently but to a larger extent in both price increase and price decrease cases. As a result, the total effect of price revisions in unprocessed food and energy product categories in the euro area and Latvia might be similar.

In Latvia's sectors of processed food and non-energy industrial goods, the price changes tended to be both more frequent and sizeable, with the effects of upward price revisions being more pronounced. Frequencies of price changes in the services sector in the euro area and Latvia were very similar for both positive and negative price changes; however, the size of revisions was larger in Latvia.

The above mentioned results lead to the conclusion that product prices in Latvia were on average more flexible than in the euro area; this conclusion is valid for all product category prices, except energy. Moreover, the prices in Latvia compared with the euro area were more volatile, with the only exception of unprocessed food, which, to a large extent, can be explained by higher economic swings in Latvia during sample period.

3.2.3 Changes in the price setting mechanism over time

Up to this point, we have analysed the average measures of price changes for the period between 2003 and 2009; it is very likely, however, that the price formation mechanism changed somewhat during this period. To check it, we first calculate the frequencies of upward and downward price changes for different sub-periods (see Table 7). The choice of sub-periods was determined by the following factors. The first sub-period covers the time between 2003 and 2007, which corresponds to the period of buoyant economic growth in Latvia. The second sub-period covers 2008–2009 and represents the time of a sharp downturn in the economic activity. Finally,

we analyse the year of 2009 separately for two reasons. First, this is the last year in our database enabling us to uncover the most recent characteristics of the price setting mechanism. Second, 2009 was also a very specific year due to consumer price deflation (in month-on-month terms; although in the second half of 2009, the CPI growth turned to the negative zone also year-on-year).

Table 7 shows that, indeed, there were significant changes in the frequency of price changes over time. The frequency of all price changes (either positive or negative) increased from 26.3% in 2003–2007 (which corresponds to the duration of 3.8 months) to 34.8% in 2008–2009 (2.9 months). Moreover, the flexibility of prices was even higher in 2009 (36.7% or 2.7 months). On the one hand, it could indicate the increasing flexibility of consumer prices over time. On the other hand, however, it could be the reaction to the very specific economic circumstances in 2008–2009 and should be treated as an outlier. In addition, we must not forget about VAT and excise tax increases at the beginning of 2009, which definitely caused price increases and affected frequency of price changes. The tendency of increasing price change frequency remains also at a more disaggregated level and was typical for all groups and categories of prices.

Table 7

Frequency of upward and downward price changes in different sub-periods by COICOP group and main economic category (the frequency approach)

	2003–2007		2008–2009		2009	
	Upward	Downward	Upward	Downward	Upward	Downward
1 Food and non-alcoholic beverages	0.191	0.108	0.215	0.181	0.202	0.224
2 Alcoholic beverages, tobacco	0.123	0.039	0.212	0.077	0.262	0.096
3 Clothing and footwear	0.166	0.077	0.146	0.143	0.105	0.200
4 Housing, water, electricity, gas and other fuels	0.101	0.018	0.085	0.079	0.063	0.133
5 Furnishing, household equipment and routine household maintenance	0.097	0.054	0.123	0.086	0.108	0.115
6 Health	0.054	0.003	0.077	0.012	0.050	0.018
7 Transport	0.428	0.237	0.421	0.369	0.457	0.323
8 Communication	0.046	0.371	0.043	0.464	0.055	0.475
9 Recreation and culture	0.064	0.088	0.108	0.085	0.109	0.088
10 Education	0.047	0.013	0.076	0.050	0.067	0.100
11 Restaurants and hotels	0.080	0.007	0.083	0.040	0.045	0.066
12 Miscellaneous goods and services	0.085	0.047	0.133	0.081	0.124	0.091
Unprocessed food	0.216	0.133	0.236	0.213	0.220	0.263
Processed food	0.152	0.070	0.182	0.128	0.178	0.168
Energy	0.405	0.219	0.393	0.353	0.424	0.325
Services	0.064	0.005	0.075	0.027	0.048	0.044
Non-energy goods	0.115	0.070	0.161	0.104	0.168	0.129
Total	0.170	0.093	0.197	0.151	0.194	0.173

Sources: CSB and authors' calculations.

Note: Frequency shows the average share of prices that are changed during one month, equation (4).

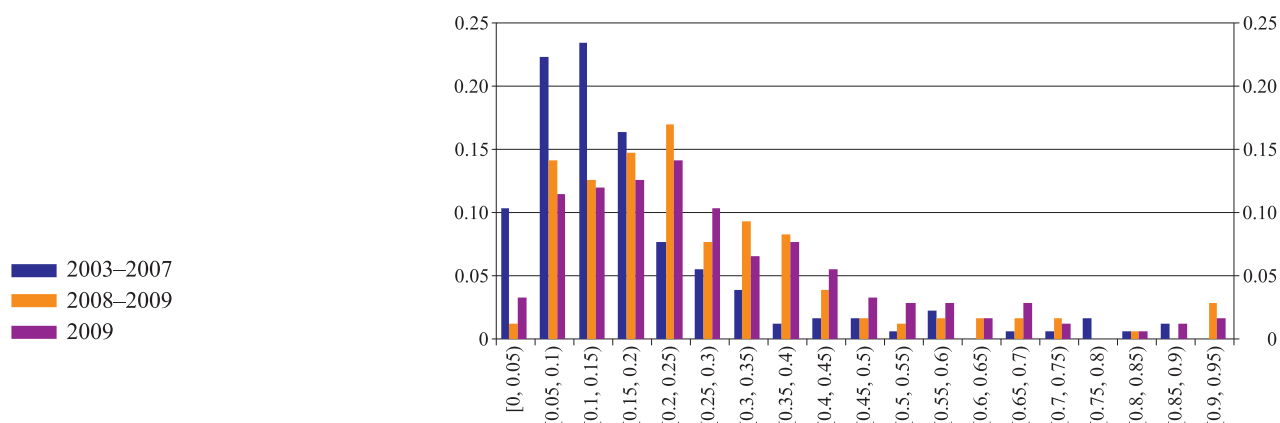
Frequency of price changes is not the only price setting indicator that was altered – the asymmetry also changed a lot. In the first sub-period, the frequency of positive price changes (17.0%) was almost twice as high as the frequency of negative price

changes (9.3%). In 2008–2009, however, the frequency of upward price revisions remained almost unchanged (19.7%), while the frequency of downward price revisions increased to 15.1%. The figure for downward frequency was even higher in 2009 (17.3%) when the deflation process came into force. The most pronounced changes (especially if 2009 is compared with 2003–2007) are observed for clothing and footwear, housing, water, electricity, gas and other fuels as well as restaurants and hotels.

The increase in frequencies of price changes at the individual product level is clearly shown in Figure 4 (for all price changes) and in Figure A3 in Appendix (separately for positive and negative price changes). For all price changes, the frequency mode shifted from interval 0.1–0.15 in 2003–2007 to interval 0.2–0.25 in 2008–2009. For positive and negative price changes separately, the modes remained unchanged over time, although the right tails of frequency distributions become "fatter" in 2008–2009 and 2009, especially pronouncedly for the downward price revisions.

Figure 4

Distribution of price change frequencies by individual product and different sub-period



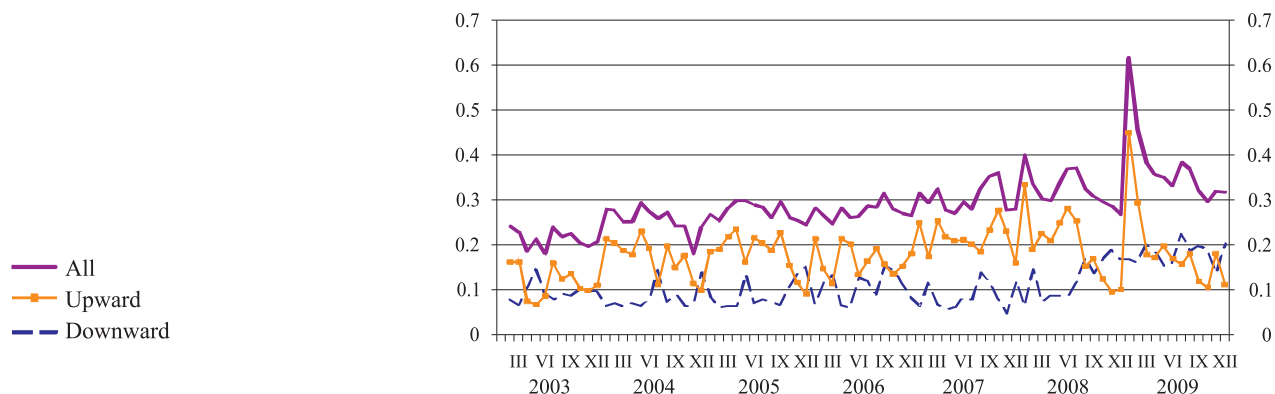
Sources: CSB and authors' calculations.

Notes: Frequency shows the average share of prices that are changed during one month, equation (4). Vertical axis denotes the share of individual products within particular frequency interval.

An advantage of the frequency approach is that it allows for analysing not only a whole sample period but also each particular month; as a result we are able to draw a continuous time-line for frequencies of price changes during 2003–2009 (see Figure 5).

Figure 5 shows that the frequency of all price changes exhibited a clear upward change during the analysed time period. In 2003, the frequency of price changes fluctuated around 22%, while in 2009 it exceeded 30%. The increase over time was rather steady, although there was one noticeable spike at the beginning of 2009, when more than 60% of all prices were changed during one month. It can most probably be explained by a VAT rate increase from 18% to 21% in January 2009. The frequency of price changes was also high in February most likely due to changes in some excise tax rates and the lagged effects of VAT increase.

Figure 5
Frequency of price changes over time for all prices (2003–2009)



Sources: CSB and authors' calculations.

Note: Frequency shows the average share of prices that are changed during one month, equation (5).

It is possible to make the same analysis of positive and negative price changes separately. The pattern is not as clear in this case; nevertheless, some interesting facts could be noted. First, until the end of 2008, the frequency of upward price changes exceeded the frequency of downward price changes, this being especially pronounced in 2007. Then, as of the last months of 2008, the frequency of negative price changes was similar to or slightly above the frequency of positive price changes, with January–February 2009 as an exception due to tax rate changes. Second, until the end of 2008, an increase in the frequency of price changes was driven by positive price changes, while the frequency of negative price changes was fluctuating around 10%. In the period of economic crisis, however, the frequency of negative price revisions increased to almost 20%.

The same analysis can be conducted also for different groups and categories of products (see Figure A4 in Appendix; except for communication and education, as data on only one product is available in these groups). These figures reveal the following most interesting facts. The pattern of frequencies for food and non-alcoholic beverages, furnishing, household equipment and routine household maintenance as well as miscellaneous goods and services was very similar to that of total products: frequencies of price changes were steadily increasing over time driven by the positive changes in the pre-crisis period and by the negative changes in the crisis period.

The frequency of price changes for alcoholic beverages and tobacco was very volatile, the peaks were usually observed in January and July obviously due to regular increases in excise tax rates on alcohol and tobacco. Most price changes were positive, with the frequency of downward price changes being very small prior to 2009. The frequency of price changes regarding clothing and footwear shows a clear seasonal pattern, with the highest level of frequency recorded in summer months (more than 40%), while its lowest level was observed at the end of each year. Although it was mostly driven by the positive price changes, the frequency of negative changes also had seasonal peaks in January and July.

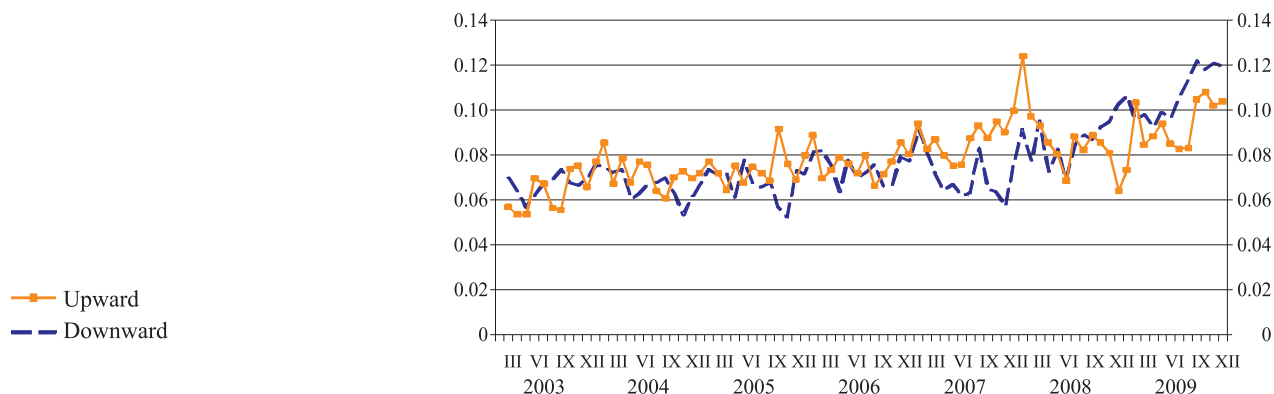
The frequency of price changes in housing, water, electricity, gas and other fuels was very volatile, and the total frequency was dominated by frequency of positive price changes until 2009 and by negative price changes in 2009. We observe a very volatile frequency for health and restaurants and hotels as well; moreover, the frequency of negative price changes prior to 2009 was close to zero. The highest price change frequency is observed for transport prices (mainly driven by fuels). Although the total frequency was rather stable, the frequencies of positive and negative price changes taken separately were very volatile, as fuel prices closely followed the world energy price dynamics. Finally, the frequency of price changes in recreation and culture was quite stable over time and the frequencies of positive and negative changes were fluctuating in similar intervals.

Overall, it can be seen that the pattern was rather similar for unprocessed and processed food and non-energy goods: the frequencies of price changes were increasing over time driven by the positive changes in the pre-crisis period and by the negative changes in the crisis period. Speaking about services, the increasing tendency is in place only until the end of 2008, and it was driven solely by the positive changes, while the negative price changes appear only in 2009. Energy prices (non-regulated) closely follow the world prices and the frequency of price changes was stably high.

As before, we are not limiting our analysis to frequencies of price changes and investigate also the size of price changes, which can also vary during the sample period. First, let us compare the distribution of positive and negative price changes for different sub-periods (see Figure A5 in Appendix; as before, we analyse 2003–2007, 2008–2009, and 2009). In both cases we see that distributions are shifting to the right. For upward revisions, the mode was moving from 6%–10% interval in 2003–2007 to 8%–10% interval in 2008–2009. For downward revisions, the movement was even more pronounced – from 8%–10% to 12%–14%. Hence we can conclude that the sizes of price changes were also increasing over time.

More detailed investigation could be made by analysing the average size of price changes in every month during 2003–2009 (see Figure 6), like it was done for the frequencies above. Figure 6 confirms that the average size of price changes was increasing over time. For the positive price changes it went up from 6%–7% in 2003 to almost 10% at the end of 2007. Then a temporary decrease was observed, although in 2009 a rebound to 10% level occurred. As for the downward price changes, the average size of decrease was fluctuating between 6% and 8% in 2003–2007, and a significant increase is observed in the crisis period: at the end of 2009, the typical downward price revision was 12%.

Figure 6
Size of price changes over time for all prices (2003–2009)



Sources: CSB and authors' calculations.

Note: The size of price changes shows the average logarithmic change of prices, equation (10).

As before, the same analysis could be made for different groups and categories of products (see Figure A6 in Appendix). Again, the time pattern in food and non-alcoholic beverages, furnishing, household equipment and routine household maintenance as well as miscellaneous goods and services was similar to the pattern of average consumption product. The size of a typical price increase was approximately equal to a typical decrease, with both going up and especially pronounced as of 2007. A similar story can be told about alcoholic beverages and tobacco, although there were several spikes in the size of upward price revisions – again due to the changes in excise tax rates. A very interesting conclusion can be made about the price changes in clothing and footwear. Figure A4 in Appendix shows, that price increases were much more typical than decreases, while Figure A6 in Appendix indicates that price decreases, although less frequent, were significantly larger than price increases. As before, the size of price changes shows a clear seasonal pattern, although no significant long-term tendencies can be observed.

Housing, water, electricity, gas and other fuels, recreation and culture as well as restaurants and hotels showed a slightly different pattern: in the pre-crisis period, the size of positive changes exceeded that of negative ones, while in the crisis period, the size of negative changes enlarged and exceeded the size of positive changes. This was even more pronounced for health products, for which the average size of price decreases before 2009 had been negligible. Finally, the average positive changes of transport product prices (mainly fuels) were significantly larger than the negative ones until 2009 due to the growing world energy prices.

As to economic categories of products, the size of price changes for unprocessed and processed food and non-energy products was balanced on the positive and negative sides and growing over time. For energy, the size of positive changes was dominating over that of negative ones due to world energy prices, while for services the size of upward revisions clearly dominated over the size of negative revisions until the beginning of 2009.

Table 8

Share of sales in price decreases in different sub-periods by COICOP group and main category

	2003–2007	2008–2009	2009
1 Food and non-alcoholic beverages	13.4	13.9	13.1
2 Alcoholic beverages, tobacco	15.2	15.1	12.2
3 Clothing and footwear	7.5	6.6	5.7
4 Housing, water, electricity, gas and other fuels	19.9	8.5	4.1
5 Furnishing, household equipment and routine household maintenance	17.1	17.0	16.8
6 Health	10.4	6.6	2.4
7 Transport	5.6	4.3	6.3
8 Communication	3.4	3.4	4.8
9 Recreation and culture	12.8	13.8	14.0
10 Education	0.0	6.7	6.7
11 Restaurants and hotels	5.3	4.0	4.6
12 Miscellaneous goods and services	37.9	31.1	26.7
Unprocessed food	9.0	10.3	9.8
Processed food	24.7	21.2	19.1
Energy	5.8	4.8	6.7
Services	7.3	4.1	4.6
Non-energy goods	15.5	14.1	12.3
Total	13.4	13.0	12.1

Sources: CSB and authors' calculations.

Notes: Sales are defined as a temporary price decrease (for one month) with a subsequent price increase to the previous level. The share of sales in price decreases is shown in %.

Finally, we also study whether the role of sales was changing during the sample period (see Table 8). We found, that the share of sales in price decreases had a tendency to contract, albeit not very strongly: the sales still determined 12.1% of all price decreases in 2009. The downward tendency was typical for almost all product groups and categories, except recreation and culture. This does not mean, however, that sales were used less intensively in 2009 compared with the initial years of the sample. The absolute number of sales increased, with the number of price decreases not related to sales (permanent price decreases) going up at a higher pace.

Overall, our analysis showed that both the frequencies and sizes of price changes were increasing over time. Regarding frequencies of price changes, they were driven not only by tax rate shifts at the end of the sample, but also by increases in the frequency of negative price changes during the crisis period. As for the size of price changes, the upward trend was typical for both positive and negative price changes. The same is true of the price formation mechanism of food and non-energy goods. The prices of services tell a different story: they appeared to change almost uniquely upwards in the pre-crisis period (indicated by both frequency and size), whereas in 2009 the downward changes were more frequent and larger than the positive changes. Energy prices were flexible during the whole sample period, in line with the world energy prices.

4. TIME-DEPENDENT AND STATE-DEPENDENT PRICING IN LATVIA

4.1 Decomposition and synchronisation of price changes

The study by Klenow and Kryvtsov (2008) provided a simplified way of examining which pricing process (state-dependent or time-dependent) suits the factual data better. The authors of the study proposed to decompose inflation into a fraction of products with price change fr_t and a weighted average of price change dp_t :

$$\pi_t = \sum_{j=1}^J \sum_{k=1}^{K_j} \omega_{j,k} I_{j,k,t} \cdot \frac{\sum_{j=1}^J \sum_{k=1}^{K_j} \omega_{j,k} (p_{j,k,t} - p_{j,k,t-1})}{\sum_{j=1}^J \sum_{k=1}^{K_j} \omega_{j,k} I_{j,k,t}} = fr_t \cdot dp_t \quad (12)$$

where $p_{j,k,t}$ represents the log price of product j in outlet k in month t , and $\omega_{j,k}$ denotes the share of product j in outlet k in the overall basket. That taken into account, we assume all outlets to have the same weights for one product, $\sum_{k=1}^{K_j} \omega_{j,k} = \omega_j$.

As the next step, the authors decomposed variance of inflation into variance of the fraction of items changing price (time-dependent term) and variance of the average magnitude of price changes and covariance between the two (state-dependent term):

$$\text{var}(\pi_t) = \underbrace{\text{var}(dp_t) \cdot \overline{fr}^2}_{\text{time-dependent}} + \underbrace{\text{var}(fr_t) \cdot \overline{dp}^2 + 2 \cdot \overline{fr} \cdot \overline{dp} \cdot \text{cov}(dp_t, fr_t)}_{\text{state-dependent}} + O_t \quad (13)$$

where O_t is higher order term and upper bar denotes average values. In some papers (Klenow and Kryvtsov (2008), Kurri (2007)), covariance and higher order term are assumed to be small and, therefore, are dropped from the equation. Hence the share of variance accounted by time-dependent term can be presented as

$$\alpha_{KK} = \frac{\text{var}(dp_t) \cdot \overline{fr}^2}{\text{var}(\pi_t)} \quad (14)$$

Dias et al. (2006) criticised the exclusion of covariance term and interpretation of acquired coefficient since the latter was not confined within the range $[0; 1]$, and presented two alternative estimators for measuring the importance of time-dependent setting scheme:

$$\alpha_{FK} = 1 - \sqrt{\frac{\text{var}(fr_t)}{\overline{fr}(1 - \overline{fr})}} \quad (15)$$

and

$$\alpha_U = 1 - \max(fr_t) + \min(fr_t) \quad (16)$$

where the values of α_{FK} and α_U are restricted to interval $[0; 1]$. Unlike α_{KK} , the α_{FK} and α_U indexes do not measure the contribution of time-dependent variance, but rather provide an upper bound for the proportion of prices that are set by adopting the time-dependent pricing rule, where α_{FK} index is derived under more restrictive assumptions than α_U . Dias et al. (2006) claim that the results of α_U index are more reliable than for other two indexes. In order to get preliminary evaluation of price setting behaviour in Latvia, we will compare the results of all three approaches.

Another empirical approach of how to test the available microdata on whether the underlined pricing process follows uniform staggering (constant frequency of price changes) as defined by Calvo (1983) is proposed by Dias et al. (2004) and is based on the index of synchronisation of price changes introduced by Fisher and Konieczny (2000). Perfect synchronisation is present when either all or no outlets change their prices simultaneously for product j . The absence of any synchronisation can be a sign of time-dependent pricing process (i.e. constant price change frequency), since in the case of state-dependent pricing process the state of the economy determines the moment for price changes and thus forces outlets to change prices simultaneously.

The index of synchronisation $SYNC_j$ is the ratio between the observed standard deviation of frequencies of price changes at product level SD_j and the theoretical standard deviation of price changes computed at product level under the assumption of perfect synchronisation $SDMAX_j$:

$$SYNC_j = \frac{\sqrt{\frac{1}{\Gamma-1} \sum_{t=2}^{\Gamma} (F_{j,t} - F_j)^2}}{\sqrt{F_j(1-F_j)}} = \frac{SD_j}{SDMAX_j} \quad (17).$$

Perfect synchronisation means that the proportion of outlets changing the price of product j will be either one or zero, and, therefore, standard deviation of this price change $SDMAX_j$ can be calculated from the average frequencies of product j . If the observed price changes follow the state-dependent pricing process (i.e. tend to be synchronised), the value of synchronisation index will tend to be close to 1.

Dias et al. (2004) showed that it is possible to test the null hypothesis of uniform staggering (absence of synchronisation, i.e. time-dependent pricing) using test statistics Q_j formed from the synchronisation index by Fisher and Konieczny (2000) which follows the chi-square distribution $-Q_j \sim \chi^2_{(\Gamma-2)}$:

$$Q_j = K_j \cdot (\Gamma - 1) \cdot SYNC_j^2 \quad (18).$$

Rejection of the null hypothesis shows that the pricing process tested does not satisfy the non-synchronisation assumption and thus cannot be described solely by time-dependent process; hence it can be assumed that both time-dependent and state-dependent pricing processes are underlying the price setting mechanism.

4.2 Empirical results

According to the above specified definitions, we calculated three indexes measuring the presence of time-dependent pricing process (α_{KK} , α_{FK} , and α_U), synchronisation index *SYNC* and probability of null hypothesis of uniform staggering (Table 9).

The analysis of the Klenow-Kryvtsov decomposition shows that the share of inflation variance that could be explained by time-dependent pricing process in Latvia was relatively smaller than in other known country examples, i.e. according to Klenow and Kryvtsov (2005), the α_{KK} index for the US could be from 0.91 to 0.97 (0.84 for Latvia), and, according to Dias et al. (2006), the results for Portugal were between 0.88 and 0.9 for α_{FK} index and between 0.78 and 0.79 for α_U index (0.86 and 0.56 for Latvia respectively).

Our results for α_U index show that the product groups in Latvia that more than others tend to follow the time-dependent pricing process are recreation and culture services, restaurants and hotels, and health, or from the point of view of product categories – the services. The energy sector's prices, on the other hand, seem to be the least time-dependent, i.e. they did not change at a constant pace and are likely to depend on the state of the economy more than other sectors.

Table 9

Synchronisation and Klenow-Kryvtsov decomposition of inflation variation by COICOP group and main category (2003–2009)

	Synchronisation		Klenow–Kryvtsov decomposition		
	SYNC	p-value	α_{KK}	α_{FK}	α_U
1 Food and non-alcoholic beverages	0.160	0.000	0.968	0.840	0.418
2 Alcoholic beverages, tobacco	0.314	0.000	0.178	0.686	0.249
3 Clothing and footwear	0.315	0.000	1.836	0.684	0.516
4 Housing, water, electricity, gas and other fuels	0.328	0.000	0.172	0.673	0.477
5 Furnishing, household equipment and routine household maintenance	0.141	0.000	0.689	0.859	0.702
6 Health	0.264	0.000	0.184	0.736	0.694
7 Transport	0.325	0.000	0.771	0.671	0.410
8 Communication	0.233	0.000	0.540	0.767	0.522
9 Recreation and culture	0.136	0.000	0.582	0.863	0.620
10 Education	0.601	0.000	0.090	0.416	0.333
11 Restaurants and hotels	0.204	0.000	0.299	0.797	0.728
12 Miscellaneous goods and services	0.176	0.000	0.743	0.824	0.536
Unprocessed food	0.158	0.000	1.022	0.842	0.456
Processed food	0.186	0.000	0.726	0.813	0.359
Energy	0.301	0.000	0.779	0.696	0.346
Services	0.185	0.000	0.335	0.816	0.713
Non-energy goods	0.171	0.000	0.617	0.828	0.597
Total	0.138	0.000	0.835	0.862	0.563

Sources: CSB and authors' calculations.

The results of the price synchronisation index show that the decisions to change prices were most synchronised in such product groups as education, clothing and footwear (probably due to seasonality), alcoholic beverages and tobacco (probably due to tax changes), and transport (most likely due to common fuel price shocks). On a more aggregated level, energy prices showed the highest degree of synchronisation and confirmed the results of inflation variance indexes, i.e. the importance of the state-dependent pricing process in this sector. The null hypothesis is rejected for all products, therefore the pricing mechanism in none of the product groups can be described as solely time-dependent, thus showing the presence of both time-dependent and state-dependending mechanisms in determining the pricing process in each group. This means that time-dependent pricing mechanisms *a la* Calvo (1983) are not able to describe adequately the price formation mechanism in Latvia.

CONCLUSIONS

The main goal of this study is to provide descriptive evidence on the degree of nominal rigidity of consumer prices in Latvia at the aggregate as well as disaggregate levels. To achieve the goal, we use the micro database on consumer prices provided by the CSB.

The main finding of the paper is that during 2003–2009 Latvia's consumer prices were flexible. The average duration of a price spell was 3.5 months, and each month 28.7% of consumer prices were changed on average. The flexibility of prices, however, could be slightly overestimated due to low sample coverage in some product groups. The other stylised facts about the price formation mechanism in Latvia are as follows.

- 1 Consumer prices in Latvia were on average more flexible than in the euro area, and this conclusion is valid for all product categories, except energy.
- 2 Price changes in Latvia were also more sizeable compared with the euro area, with the only exception of unprocessed food obviously to be explained, to a large extent, by higher economic swings in Latvia during sample period.
- 3 During the investigated time period, the price increases occurred around 1.6 times more often than the price decreases: each month 17.8% of prices were changed upwards on average, while only 11.0% of prices were revised downwards. However, we should take into account that the sample period does not cover a full business cycle and the period of growth is overrepresented. As a result, the balance between the frequencies of upward and downward price changes is also likely to be biased towards the upward price changes.
- 4 The asymmetry is not pronounced for the size of price changes: the average consumer price increase was 10.3%, while the average decrease was 11.9%.
- 5 We found a strong negative correlation between price flexibility and average absolute size of price changes. The highest flexibility and the smallest absolute changes are observed for energy and unprocessed food prices, while the lowest flexibility and the largest absolute changes are typical for services prices.
- 6 Temporary price reductions or sales played an important role in price formation mechanism in processed food and non-energy categories, while they were rarely used in services.
- 7 Frequencies of price changes were increasing over time.
- 8 The upward trend for the size of price changes was pronounced for both positive and negative price changes.
- 9 The frequency of price changes remained high during the crisis period when the rate of downward changes increased, driven not only by tax rate changes at the end of the sample but also by increases in the frequency of negative price changes during the crisis period. Consequently, we can conclude that prices in Latvia are flexible also for downward revisions.
- 10 The changes in price formation mechanism for food and non-energy goods are close to those observed for total prices. Different dynamics was observed in

service prices, which appeared to change almost solely upwards in the pre-crisis period (indicated both by frequency and size), while in 2009, the downward changes were more frequent and larger than the positive ones. Energy prices were flexible during the whole sample period in line with the world energy prices.

- 11 The share of sales in price decreases had a tendency, although not very strong, to contract. This does not mean, however, that compared with the years from the beginning of the sample sales were used less intensively in 2009. The absolute number of sales increased, although that of price decreases not related to sales (permanent price decreases) went up at a higher pace.
- 12 The synchronisation coefficients and inflation decomposition based on Klenow and Kryvtsov (2008) showed that the pricing mechanism in none of the product groups can be described as solely time-dependent, thus showing presence of both time-dependent and state-depending mechanisms in determining the pricing process in each group. This means that time-dependent pricing mechanisms *a la* Calvo (1983) are not able to describe adequately the price formation mechanism in Latvia.

Finally, this paper is just a first descriptive attempt of discovering the price setting behaviour in Latvia. The next step should be taken towards constructing an econometric model (panel logit) to describe the price setting mechanism in Latvia more formally.

APPENDIX

Table A1

Coverage of national databases

Country	Coverage / number of products	Sample period
Austria	90 (80 considered)	01.1996–12.2003
Belgium	68	01.1989–12.2001
Finland	100	01.1997–12.2003
France	65	06.1994–02.2003
Germany	20 / (52 products)	01.1998–01.2004
Italy	20 / (50 products)	01.1996–12.2003
Luxembourg	100	01.1999–12.2004
The Netherlands	8 / (49 products)	11.1998–04.2003
Portugal	100 (95 considered)	01.1992–01.2001
Spain	70	01.1993–12.2001
US	70	01.1995–12.1997

Sources: Dhyne et al. (2005) and Bils and Klenow (2004).

Note. Coverage indicates the share of products covered by the database used in research in %.

Table A2

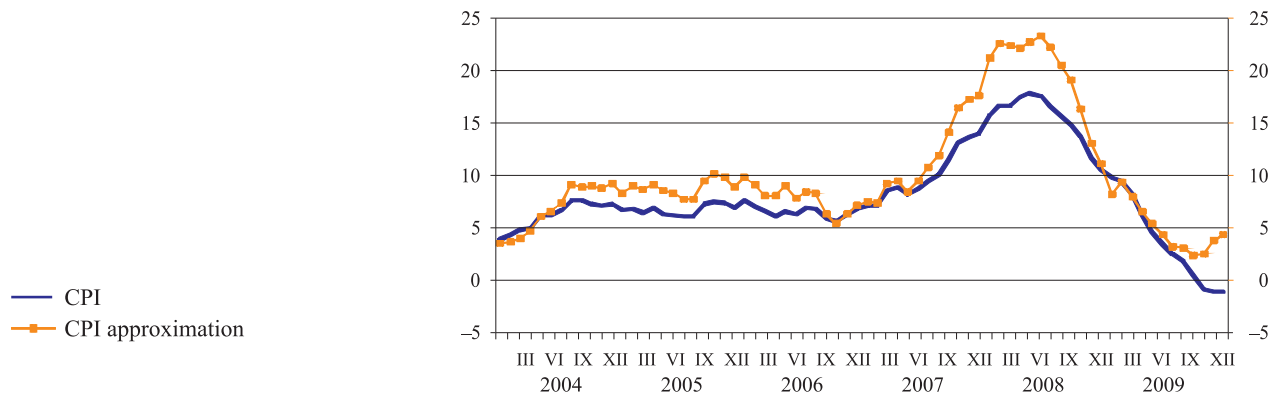
Number of outlets and observed price changes, including and excluding price imputations, by COICOP group and main category (2003–2009)

	Number of outlets	Number of price changes					
		With price imputations			Without price imputations		
		All	Upward	Downward	All	Upward	Downward
1 Food and non-alcoholic beverages	3 007	73 159	43 786	29 373	68 816	40 606	28 210
2 Alcoholic beverages, tobacco	366	6 393	4 616	1 777	5 974	4 251	1 723
3 Clothing and footwear	762	11 894	7 570	4 324	5 107	1 934	3 173
4 Housing, water, electricity, gas and other fuels	169	2 351	1 609	742	1 982	1 322	660
5 Furnishing, household equipment and routine household maintenance	655	6 493	4 187	2 306	5 239	3 224	2 015
6 Health	223	1 918	1 513	405	1 811	1 407	404
7 Transport	229	9 997	6 109	3 888	9 809	5 980	3 829
8 Communication	62	2 014	205	1 809	1 596	204	1 392
9 Recreation and culture	574	5 294	3 097	2 197	4 529	2 612	1 917
10 Education	13	84	59	25	66	48	18
11 Restaurants and hotels	333	2 411	1 962	449	2 214	1 804	410
12 Miscellaneous goods and services	631	7 722	4 956	2 766	7 159	4 482	2 677
Unprocessed food	1 599	48 350	27 657	20 693	45 516	25 693	19 823
Processed food	1 408	24 809	16 129	8 680	23 300	14 913	8 387
Energy	170	9 554	5 829	3 725	9 476	5 766	3 710
Services	874	5 071	4 271	800	4 687	3 963	724
Non-energy goods	2 973	41 946	25 783	16 163	31 323	17 539	13 784
Total	7 024	129 730	79 669	50 061	114 302	67 874	46 428

Sources: CSB and authors' calculations.

Note: Imputations are used by the CSB in the case of short-term absence of product in an outlet or for seasonal products.

Figure A1
Annual changes of CPI and CPI approximation (2004–2009)



Sources: CSB and authors' calculations.

Note: Annual changes of CPI and CPI approximation are calculated from the database provided by the CSB in %.

Table A3

Classification of products by economic category

Economic category	Product
Unprocessed food	0112 Meat
	0113 Fish and seafood
	0114 Milk, cheese and eggs
	0116 Fruits
	0117 Vegetables
Processed food	0111 Bread and cereals
	0115 Oils and fats
	0118 Sugar, jam, honey, chocolate and confectionery
	0119 Food products n.e.c.
	0121 Coffee, tea and cocoa
	0122 Mineral waters, soft drinks, fruit and vegetable juices
Energy	0451 Electricity
	0452 Gas
	0453 Liquid fuels
	0454 Solid fuels
	0455 Heat energy
	0722 Fuels and lubricants for personal transport equipment
Services	0314 Cleaning, repair and hire of clothing
	0322 Repair and hire of footwear
	0411 Actual rentals paid by tenants
	0412 Other actual rentals
	0421 Imputed rentals of owner-occupiers
	0422 Other imputed rentals
	0432 Services for the maintenance and repair of the dwelling
	0442 Refuse collections
	0443 Sewerage collections
	0513 Repair of furniture, furnishing and floor coverings
	0533 Repair of household appliances
	0562 Domestic services and household services
	0621 Medical services
	0622 Dental services
0623 Paramedical services	
0630 Hospital services	

Economic category	Product
	0723 Maintenance and repair of personal transport equipment
	0724 Other services in respect of personal transport equipment
	0731 Passenger transport by railway
	0732 Passenger transport by road
	0733 Passenger transport by air
	0734 Passenger transport by sea and inland waterway
	0735 Combined passenger transport
	0736 Other purchased transport services
	0810 Postal services
	0830 Telephone and telefax services
	0915 Repair of audio-visual, photographic and information processing equipment
	0923 Maintenance and repair of other major durables for recreation and culture
	0935 Veterinary and other services for pets
	0941 Recreation and sporting services
	0942 Cultural services
	0943 Games of chance
	0960 Package holidays
	1010 Pre-preliminary and primary education
	1020 Secondary education
	1030 post-secondary non-tertiary education
	1040 Tertiary education
	1050 Education non definable by level
	1111 Restaurants, cafes and the like
	1112 Canteens
	1120 Accommodation services
	1211 Hairdressing salons and personal grooming establishments
	1220 Prostitution
	1240 Social protection
	1251 Life insurance
	1252 Insurance connected with the dwelling
	1253 Insurance connected with health
	1254 Insurance connected with transport
	1255 Other insurance
	1261 Financial intermediation services indirectly measured
	1262 Other financial services n.e.c.
	1270 Other services n.e.c.
Non-energy products	0211 Spirits
	0212 Wine
	0213 Beer
	0220 Tobacco
	0230 Narcotics
	0311 Clothing materials
	0312 Garments
	0313 Other articles of clothing and clothing accessories
	0321 Shoes and other footwear
	0431 Materials for the maintenance and repair of the dwelling
	0441 Water supply
	0511 Furniture and furnishings
	0512 Carpets and other floor coverings
	0520 Household textiles
	0531 Major household appliances
	0532 Small electric household appliances
	0540 Glassware, tableware and household utensils
	0551 Major tools and equipment

Economic category	Product
	0552 Small tools and miscellaneous accessories
	0561 Non-durable household goods
	0611 Pharmaceutical products
	0612 Other medical products
	0613 Therapeutic appliances and equipment
	0711 Motor cars
	0712 Motor cycles
	0713 Bicycles
	0714 Animal drawn vehicles
	0721 Spare parts and accessories for personal transport equipment
	0820 Telephone and telefax equipment
	0911 Equipment for the reception, recording and reproduction of sound and pictures
	0912 Photographic and cinematographic equipment and optical instruments
	0913 Information processing equipment
	0914 Recording media
	0921 Major durables for outdoor recreation
	0922 Musical instruments and major durables for indoor recreation
	0931 Games, toys and hobbies
	0932 Equipment for sport, camping and open-air recreation
	0933 Gardens, plants and flowers
	0934 Pets and related products
	0951 Books
	0952 Newspapers and periodicals
	0953 Miscellaneous printed matter
	0954 Stationery and drawing materials
	1212 Electric appliances for personal care
	1213 Other appliances, articles and products for personal care
	1231 Jewellery, clocks and watches
	1232 Other personal effects

Sources: CSB and authors' classification.

Notes: Some 4-digit COICOP groups contain products from different economic categories (e.g. 0114 Milk, cheese and eggs contains both processed and unprocessed food). In such cases, as more detailed classification was not available, we assumed that all products from such a 4-digit group belong to one category.

Table A4

Frequency of price changes, duration of price spells and average price changes by individual product (2003–2009)

	Frequency approach		Average price change (logarithmic)	
	Frequency	Duration		
	1	2	3	4
0111 Bread and cereals	0.200	5.00	0.044	
	0.237	4.23	0.053	
	0.191	5.24	0.029	
	0.188	5.32	0.028	
	0.180	5.56	0.033	
	0.215	4.65	0.034	
	0.223	4.48	0.040	
	0.149	6.70	0.020	
	0.189	5.30	0.028	
	0.240	4.17	0.019	
0112 Meat	0.258	3.88	0.020	
	0.260	3.85	0.017	
	0.269	3.71	0.017	
	0.319	3.14	0.018	
	0.259	3.86	0.019	
	0.297	3.36	0.015	
	0.298	3.36	0.015	
	0.200	4.99	0.026	
	0.193	5.18	0.018	
	0.336	2.98	0.010	
0113 Fish and seafood	0.234	4.28	0.022	
	0.122	8.20	0.028	
0114 Milk, cheese and eggs	0.287	3.48	0.029	
	0.252	3.96	0.029	
	0.306	3.27	0.024	
	0.192	5.22	0.023	
	0.228	4.39	0.029	
	0.352	2.84	0.018	
	0.338	2.96	0.020	
	0.373	2.68	0.014	
0115 Oils and fats	0.288	3.47	0.028	
	0.330	3.03	0.020	
0116 Fruits	0.701	1.43	0.012	
	0.720	1.39	0.005	
	0.781	1.28	0.002	
0117 Vegetables	0.881	1.14	-0.017	
	0.568	1.76	-0.026	
	0.562	1.78	-0.005	
	0.180	5.56	0.016	
	0.228	4.39	0.019	
	0.181	5.52	0.031	
	0.610	1.64	-0.039	
	0.909	1.10	-0.020	
0118 Sugar, jam, honey, chocolate and confectionery	0.282	3.55	0.013	
	0.228	4.39	0.029	
	0.200	4.99	0.019	
	0.156	6.42	0.031	
	0.105	9.50	0.036	

	1	2	3	4
0119 Food products n.e.c.		0.136	7.36	0.029
		0.194	5.16	0.021
		0.146	6.84	0.024
		0.171	5.86	0.017
		0.149	6.71	0.012
0121 Coffee, tea and cocoa		0.201	4.98	0.025
		0.393	2.54	0.015
		0.297	3.36	0.018
0122 Mineral waters, soft drinks, fruit and vegetable juices		0.221	4.52	0.017
		0.331	3.02	0.014
0211 Spirits		0.218	4.58	0.027
		0.255	3.93	0.022
0212 Wine		0.291	3.44	0.008
0213 Beer		0.232	4.31	0.026
0220 Tobacco		0.189	5.29	0.093
		0.165	6.08	0.089
		0.152	6.60	0.068
0312 Garments		0.082	12.13	-0.034
		0.537	1.86	-0.028
		0.146	6.84	-0.150
		0.109	9.14	-0.029
		0.290	3.45	-0.038
		0.085	11.82	0.007
		0.076	13.08	0.023
		0.470	2.13	-0.023
		0.184	5.43	-0.197
		0.083	12.09	0.007
		0.075	13.33	-0.023
		0.120	8.33	-0.076
		0.117	8.51	-0.053
		0.055	18.30	0.023
		0.501	2.00	-0.038
		0.109	9.18	-0.086
		0.064	15.59	0.025
		0.481	2.08	-0.029
		0.096	10.37	0.009
0313 Other articles of clothing and clothing accessories		0.328	3.05	-0.023
		0.335	2.99	-0.027
0314 Cleaning, repair and hire of clothing		0.068	14.64	0.088
0321 Shoes and other footwear		0.574	1.74	-0.043
		0.167	5.97	-0.105
		0.151	6.61	-0.145
		0.450	2.22	-0.046
		0.142	7.03	-0.128
		0.161	6.21	-0.020
		0.539	1.86	-0.038
0322 Repair and hire of footwear		0.054	18.50	0.132
0431 Materials for the maintenance and repair of the dwelling		0.170	5.89	0.013
		0.273	3.67	0.012
		0.151	6.63	0.035
		0.171	5.86	0.027
0452 Gas		0.133	7.51	0.070

	1	2	3	4
0454 Solid fuels		0.107	9.33	0.066
0511 Furniture and furnishings		0.131	7.65	0.015
		0.181	5.52	0.019
		0.148	6.76	0.013
0520 Household textiles		0.076	13.23	0.039
		0.099	10.07	-0.010
0531 Major household appliances		0.319	3.14	-0.012
0532 Small electric household appliances		0.188	5.31	-0.007
		0.160	6.25	-0.007
0540 Glassware, tableware and household utensils		0.112	8.97	0.014
		0.074	13.47	-0.002
		0.126	7.96	0.009
		0.160	6.26	0.010
0552 Small tools and miscellaneous accessories		0.139	7.18	0.020
		0.147	6.80	0.023
		0.058	17.37	0.056
		0.042	23.53	0.025
		0.147	6.79	0.024
0561 Non-durable household goods		0.184	5.42	0.014
		0.128	7.79	0.026
		0.113	8.85	0.025
		0.032	31.26	0.031
0562 Domestic services and household services		0.065	15.42	0.092
0612 Other medical products		0.175	5.72	0.042
		0.182	5.51	0.031
0621 Medical services		0.060	16.54	0.211
0622 Dental services		0.065	15.45	0.159
		0.066	15.20	0.169
0623 Paramedical services		0.047	21.19	0.113
		0.064	15.69	0.179
0713 Bicycles		0.157	6.38	-0.014
0721 Spare parts and accessories for personal transport equipment		0.118	8.46	0.027
0722 Fuels and lubricants for personal transport equipment		0.847	1.18	0.008
		0.813	1.23	0.009
		0.826	1.21	0.010
0723 Maintenance and repair of personal transport equipment		0.064	15.75	0.074
0732 Passenger transport by road		0.076	13.22	0.102
0820 Telephone and telefax equipment		0.441	2.27	-0.052
0911 Equipment for the reception, recording and reproduction of sound and pictures		0.289	3.45	-0.027
0913 Information processing equipment		0.539	1.86	-0.027
0931 Games, toys and hobbies		0.088	11.33	0.020
0932 Equipment for sport, camping and open-air recreation		0.072	13.86	0.010
		0.132	7.55	-0.045
0933 Gardens, plants and flowers		0.167	5.98	0.006
		0.150	6.67	0.035
0934 Pets and related products		0.187	5.36	0.017
		0.156	6.41	0.030
0935 Veterinary and other services for pets		0.038	26.00	0.281
0941 Recreational and sporting services		0.104	9.62	0.080
0942 Cultural services		0.030	33.75	0.133
		0.038	26.44	0.247
		0.034	29.15	0.227
0951 Books		0.075	13.39	0.011

	1	2	3	4
0952 Newspapers and periodicals		0.044	22.74	0.156
0954 Stationery and drawing materials		0.068	14.61	0.037
		0.100	10.01	0.033
		0.042	23.88	0.077
1040 Tertiary education		0.079	12.67	0.065
1111 Restaurants, cafes and the like		0.093	10.77	0.083
		0.062	16.07	0.093
		0.068	14.80	0.107
		0.084	11.84	0.082
		0.139	7.19	0.045
		0.085	11.75	0.079
		0.082	12.13	0.089
1112 Canteens		0.074	13.43	0.177
1120 Accommodation services		0.123	8.13	0.008
1211 Hairdressing salons and personal grooming establishments		0.071	14.14	0.106
		0.080	12.52	0.097
		0.057	17.49	0.145
		0.058	17.11	0.138
1213 Other appliances, articles and products for personal care		0.246	4.06	0.016
		0.292	3.43	0.011
		0.179	5.57	0.012
		0.226	4.42	0.019
		0.212	4.72	0.018
		0.186	5.38	0.015
		0.169	5.93	0.015
		0.177	5.64	0.004
		0.188	5.31	0.012
1231 Jewellery, clocks and watches		0.055	18.22	0.044
1232 Other personal effects		0.071	14.05	0.016
		0.141	7.09	0.005
		0.080	12.44	0.089
1270 Other services n.e.c.		0.017	60.41	0.379

Sources: CSB and authors' calculations.

Notes: Frequency shows the average share of prices that are changed during one month, equation (3). Duration denotes the average duration of price spells in months, equation (6). Average price change shows the average logarithmic change of prices, equation (10).

Table A5

Frequency of price changes estimated by different approaches by COICOP group and main category (2003–2009)

	Frequency approach		Duration approach
	Traditional, Bils and Klenow (2004)	Aucremanne and Dhyne (2004)	
1 Food and non-alcoholic beverages	0.326	0.298	0.390
2 Alcoholic beverages, tobacco	0.198	0.190	0.232
3 Clothing and footwear	0.260	0.233	0.470
4 Housing, water, electricity, gas and other fuels	0.133	0.128	0.173
5 Furnishing, household equipment and routine household maintenance	0.168	0.153	0.279
6 Health	0.066	0.065	0.098
7 Transport	0.701	0.687	0.722
8 Communication	0.441	0.382	0.589
9 Recreation and culture	0.163	0.145	0.254
10 Education	0.079	0.076	0.120
11 Restaurants and hotels	0.098	0.094	0.146
12 Miscellaneous goods and services	0.157	0.149	0.264
Unprocessed food	0.377	0.338	0.440
Processed food	0.246	0.235	0.313
Energy	0.659	0.646	0.678
Services	0.079	0.076	0.116
Non-energy goods	0.208	0.191	0.319
Total	0.287	0.269	0.361

Sources: CSB and authors' calculations.

Notes: Frequency shows the average share of prices that are changed during one month. Traditional approach – equation (3); Aucremanne and Dhyne (2004) – equation (6); duration approach – equation (2)

Table A6

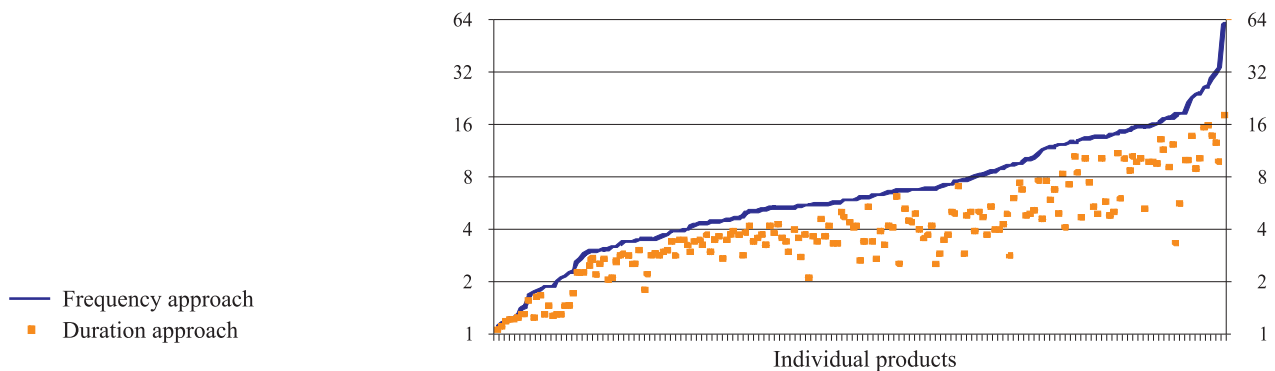
Duration of price spells estimated by different approaches by COICOP group and main category (2003–2009)

	Frequency approach				Duration approach
	Traditional, Bils and Klenow (2004)			Aucremanne and Dhyne (2004), discrete mean	
	Discrete mean	Cont. mean	Cont. median		
1 Food and non-alcoholic beverages	3.07	2.54	1.76	3.36	2.56
2 Alcoholic beverages, tobacco	5.06	4.54	3.15	5.26	4.31
3 Clothing and footwear	3.85	3.32	2.30	4.30	2.13
4 Housing, water, electricity, gas and other fuels	7.50	6.98	4.84	7.81	5.79
5 Furnishing, household equipment and routine household maintenance	5.97	5.45	3.78	6.53	3.58
6 Health	15.09	14.59	10.11	15.48	10.24
7 Transport	1.43	0.83	0.57	1.46	1.39
8 Communication	2.27	1.72	1.19	2.62	1.70
9 Recreation and culture	6.15	5.63	3.90	6.91	3.94
10 Education	12.67	12.16	8.43	13.15	8.34
11 Restaurants and hotels	10.24	9.73	6.75	10.63	6.87
12 Miscellaneous goods and services	6.37	5.85	4.06	6.70	3.78
Unprocessed food	2.65	2.11	1.46	2.96	2.27
Processed food	4.06	3.54	2.45	4.25	3.20
Energy	1.52	0.93	0.64	1.55	1.47
Services	12.73	12.22	8.47	13.14	8.59
Non-energy goods	4.81	4.29	2.98	5.23	3.14
Total	3.48	3.72	2.95	2.05	2.77

Sources: CSB and authors' calculations.

Notes: Duration denotes the average duration of price spells in months. Discrete mean – equation (7), continuous mean – equation (8), continuous median – equation (9), duration approach – equation (1).

Figure A2

Distribution of price spell duration by individual product (2003–2009)

Sources: CSB and authors' calculations.

Notes: Duration denotes the average duration of price spells in months. Frequency approach – equations (3) and (7), duration approach – equation (1).

Table A7

Frequency and duration of price spells by COICOP group and main category with and without price imputations (2003–2009)

	Taking into account price imputations		Ignoring price imputations	
	Frequency	Duration	Frequency	Duration
1 Food and non-alcoholic beverages	0.326	3.07	0.315	3.17
2 Alcoholic beverages, tobacco	0.198	5.06	0.189	5.30
3 Clothing and footwear	0.260	3.85	0.144	6.93
4 Housing, water, electricity, gas and other fuels	0.133	7.50	0.122	8.21
5 Furnishing, household equipment and routine household maintenance	0.168	5.97	0.142	7.06
6 Health	0.066	15.09	0.063	15.75
7 Transport	0.701	1.43	0.698	1.43
8 Communication	0.441	2.27	0.385	2.60
9 Recreation and culture	0.163	6.15	0.148	6.78
10 Education	0.079	12.67	0.066	15.24
11 Restaurants and hotels	0.098	10.24	0.096	10.41
12 Miscellaneous goods and services	0.157	6.37	0.148	6.78
Unprocessed food	0.377	2.65	0.366	2.73
Processed food	0.246	4.06	0.237	4.22
Energy	0.659	1.52	0.656	1.52
Services	0.079	12.73	0.076	13.22
Non-energy goods	0.208	4.81	0.170	5.88
Total	0.287	3.48	0.269	3.72

Sources: CSB and authors' calculations.

Notes: Frequency shows the average share of prices that are changed during one month, equation (3). Duration denotes the average duration of price spells in months, equation (6). Imputations are used by the CSB in the case of short-term absence of product in an outlet or for seasonal products.

Table A8

Common sample of 50 products used in frequency calculations for euro area countries

COICOP group	Economic category	Weight	Selected product
1 Food and non-alcoholic beverages	Unprocessed food	9.26	Steak, fresh fish, lettuce, banana
	Processed food	9.64	Milk, sugar, frozen spinach, mineral water, coffee
2 Alcoholic beverages, tobacco	Processed food	4.70	Whisky, beer in a shop
3 Clothing and footwear	Non-energy industrial goods	8.83	Socks, jeans, sport shoes, shirt
	Services	0.27	Dry cleaning (suit)
4 Housing, water, electricity, gas and other fuels	Energy	1.06	Gasoline (heating purposes)
	Non-energy industrial goods	5.30	Acrylic painting, cement
	Services	4.24	Hourly rate of an electrician, hourly rate of a plumber
5 Furnishing, household equipment and routine household maintenance	Non-energy industrial goods	8.54	Toaster, electric bulb, 1 type of furniture, towel
	Services	1.16	Domestic services
7 Transport	Energy	4.75	2 fuels
	Non-energy industrial goods	1.19	Car tyre
	Services	7.26	Hourly rate in garage, car wash, balancing of wheels, taxi
8 Communication	Services	3.30	Fax machine
9 Recreation and culture	Non-energy industrial goods	7.26	Television set, god food, tennis ball, construction game (Lego)
	Services	4.84	Movie, videotape rental, photo development
11 Restaurants and hotels	Services	10.30	Hotel room, glass of beer in a bar, 1 meal in restaurant, hot-dog, cola based lemonade in a bar
12 Miscellaneous goods and services	Non-energy industrial goods	3.32	Toothpaste, suitcase
	Services	4.87	Haircut (men), hairdressing (ladies)

Source: Dhyne et al. (2005).

Table A9

Frequency of price increases for the euro area countries and Latvia

Country	Unprocessed food	Processed food	Energy	Non-energy products	Services	Total
Austria	0.186	0.076	0.359	0.034	0.047	0.078
Belgium	0.168	0.103	0.430	0.034	0.029	0.098
Germany	0.131	0.040	0.487	0.033	0.033	0.077
Spain	0.266	0.099	n.a.	0.042	0.041	0.080
Finland	0.294	0.097	0.442	0.111	0.086	0.126
France	0.128	0.106	0.447	0.053	0.052	0.105
Italy	0.100	0.049	0.331	0.029	0.033	0.056
Luxembourg	0.296	0.061	0.462	0.088	0.043	0.137
The Netherlands	0.168	0.107	0.303	0.082	0.064	0.095
Portugal	0.291	0.135	0.159	0.082	0.093	0.127
Euro area	0.148	0.071	0.420	0.042	0.042	0.083
Latvia	0.222	0.160	0.403	0.127	0.067	0.178

Sources: Dhyne et al. (2005) for the euro area countries and authors' calculations for Latvia.

Notes: Sample periods covered for each individual euro area country are shown in Table A1. Latvia's figures are based on the full dataset available for the period from January 2003 to December 2009.

Table A10

Frequency of price decreases for the euro area countries and Latvia

Country	Unprocessed food	Processed food	Energy	Non-energy products	Services	Total
Austria	0.180	0.073	0.363	0.027	0.017	0.064
Belgium	0.150	0.087	0.387	0.025	0.003	0.079
Germany	0.121	0.049	0.427	0.021	0.010	0.058
Spain	0.242	0.078	n.a.	0.019	0.004	0.052
Finland	0.233	0.031	0.450	0.070	0.030	0.077
France	0.112	0.085	0.322	0.064	0.011	0.078
Italy	0.088	0.027	0.275	0.009	0.007	0.031
Luxembourg	0.249	0.044	0.277	0.057	0.005	0.093
The Netherlands	0.139	0.066	0.423	0.060	0.015	0.067
Portugal	0.262	0.111	0.001	0.062	0.043	0.084
Euro area	0.133	0.059	0.358	0.032	0.010	0.059
Latvia	0.155	0.086	0.256	0.081	0.011	0.110

Sources: Dhyne et al. (2005) for the euro area countries and authors' calculations for Latvia.

Notes: Sample periods covered for each individual euro area country are shown in Table A1. Latvia's figures are based on the full dataset available for the period from January 2003 to December 2009.

*Table A11***Size of price increases for the euro area countries and Latvia**

Country	Unprocessed food	Processed food	Energy	Non-energy products	Services	Total
Austria	0.191	0.130	0.034	0.136	0.071	0.106
Belgium	0.148	0.070	0.035	0.071	0.073	0.076
Germany	0.156	0.074	0.042	0.084	0.067	0.076
Spain	0.165	0.056	n.a.	0.062	0.080	0.082
Finland	0.174	0.039	0.042	0.136	0.083	0.094
France	0.153	0.062	0.026	0.113	0.057	0.083
Italy	0.074	0.068	0.019	0.070	0.091	0.075
Luxembourg	0.165	0.090	0.051	0.097	0.070	0.100
The Netherlands	0.247	0.072	0.050	0.189	0.098	0.128
Portugal	0.167	0.066	0.045	0.110	0.087	0.101
Euro area	0.147	0.069	0.034	0.094	0.073	0.082
Latvia	0.109	0.104	0.061	0.092	0.161	0.103

Sources: Dhyne et al. (2005) for the euro area countries and authors' calculations for Latvia.

Notes: Sample periods covered for each individual euro area country are shown in Table A1. Latvia's figures are based on the full dataset available for the period from January 2003 to December 2009.

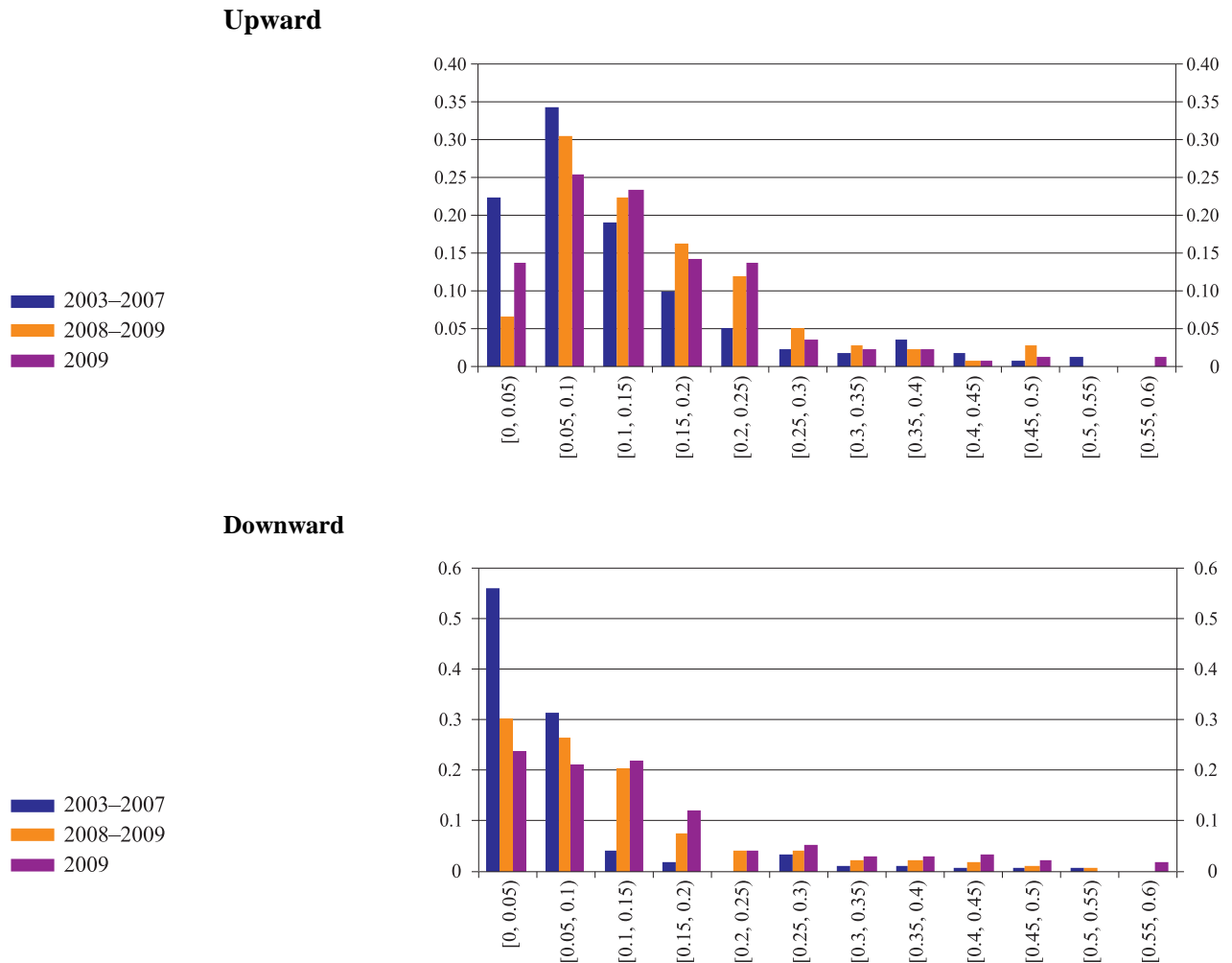
*Table A12***Size of price decreases for the euro area countries and Latvia**

Country	Unprocessed food	Processed food	Energy	Non-energy products	Services	Total
Austria	0.189	0.136	0.030	0.178	0.118	0.139
Belgium	0.158	0.076	0.029	0.083	0.064	0.078
Germany	0.172	0.100	0.027	0.098	0.086	0.091
Spain	0.172	0.062	n.a.	0.082	0.105	0.100
Finland	0.211	0.065	0.043	0.174	0.137	0.134
France	0.177	0.066	0.021	0.152	0.093	0.110
Italy	0.080	0.063	0.015	0.070	0.115	0.085
Luxembourg	0.195	0.107	0.057	0.110	0.051	0.107
The Netherlands	0.287	0.102	0.032	0.236	0.101	0.148
Portugal	0.167	0.069	0.025	0.136	0.092	0.110
Euro area	0.163	0.081	0.024	0.114	0.097	0.100
Latvia	0.125	0.123	0.058	0.127	0.133	0.119

Sources: Dhyne et al. (2005) for the euro area countries and authors' calculations for Latvia.

Notes: Sample periods covered for each individual euro area country are shown in Table A1. Latvia's figures are based on the full dataset available for the period from January 2003 to December 2009.

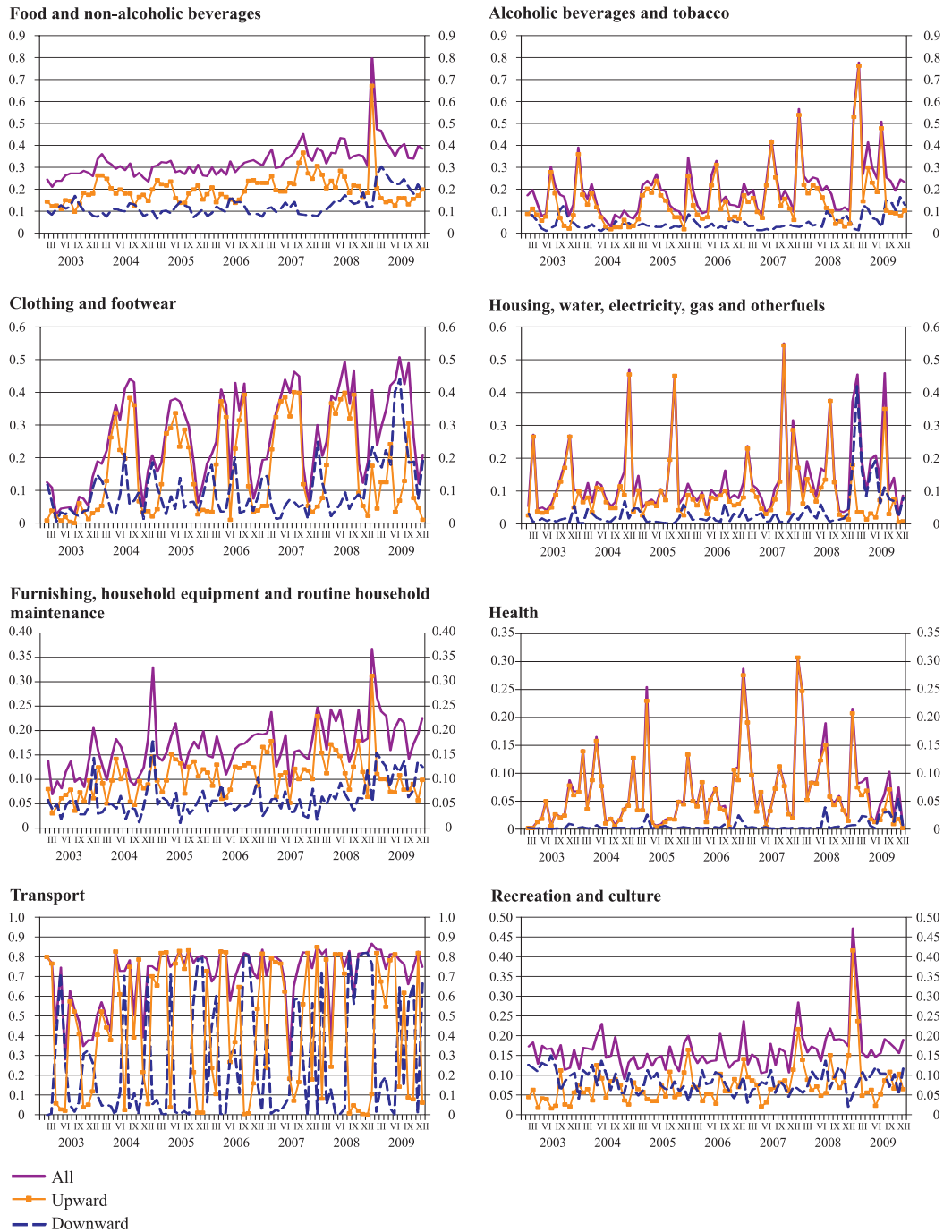
Figure A3
Distribution of frequencies of upward and downward price changes by individual product in different sub-periods



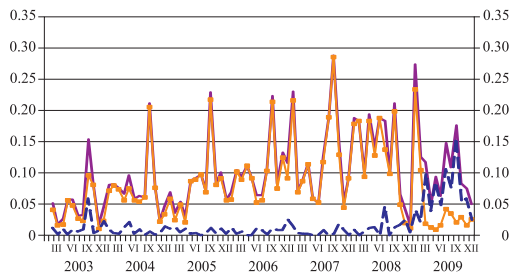
Sources: CSB and authors' calculations.

Notes: Frequency shows the average share of prices that are changed during one month, equation (4). Vertical axis denotes the share of individual products within particular frequency interval.

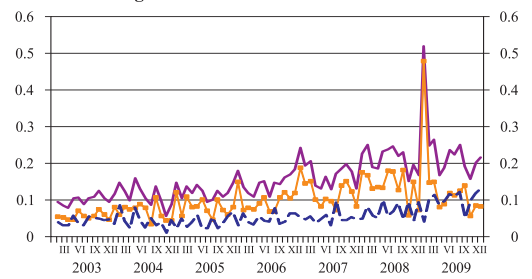
Figure A4
Frequency of price changes over time



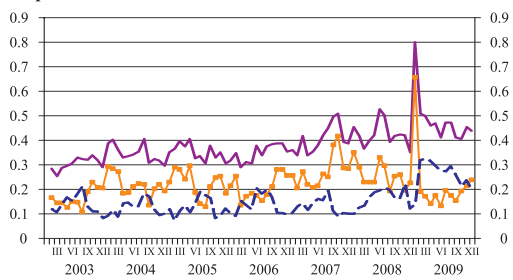
Restaurants and hotels



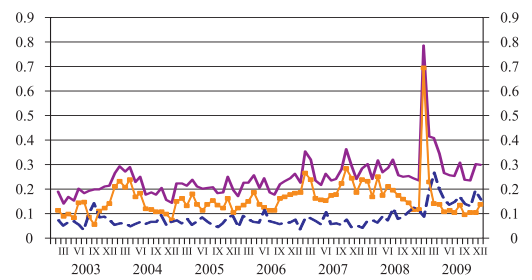
Miscellaneous goods and services



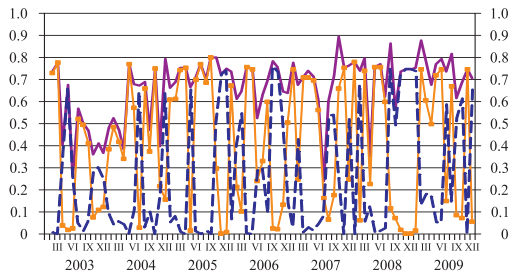
Unprocessed food



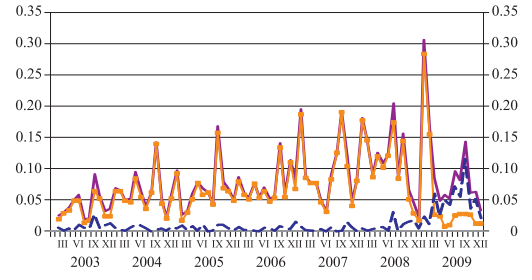
Processed food



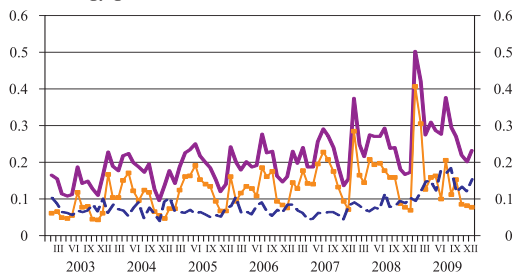
Energy



Services



Non-energy goods

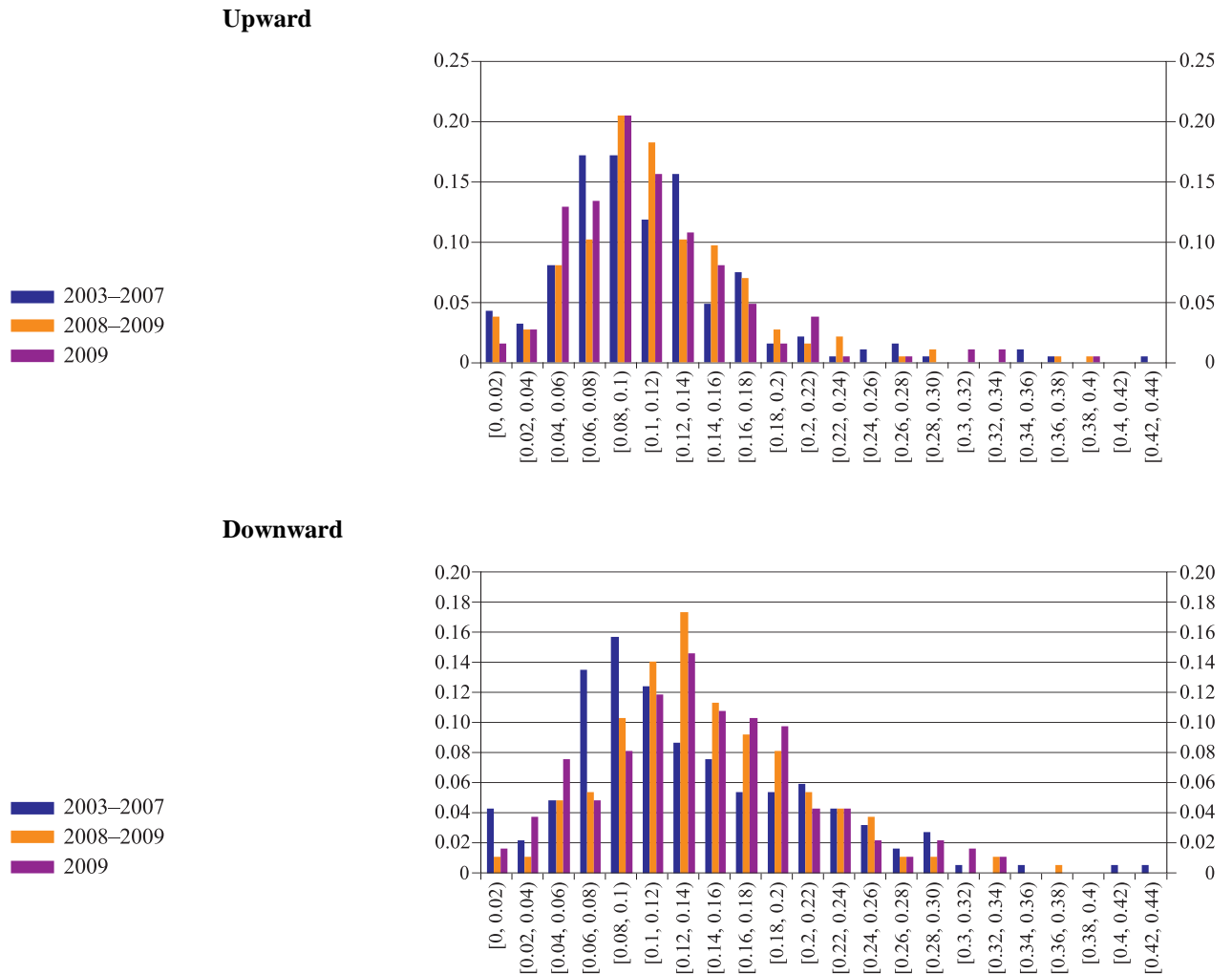


— All
— Upward
— Downward

Sources: CSB and authors' calculations.

Note. Frequency shows the average share of prices that are changed during one month, equation (5).

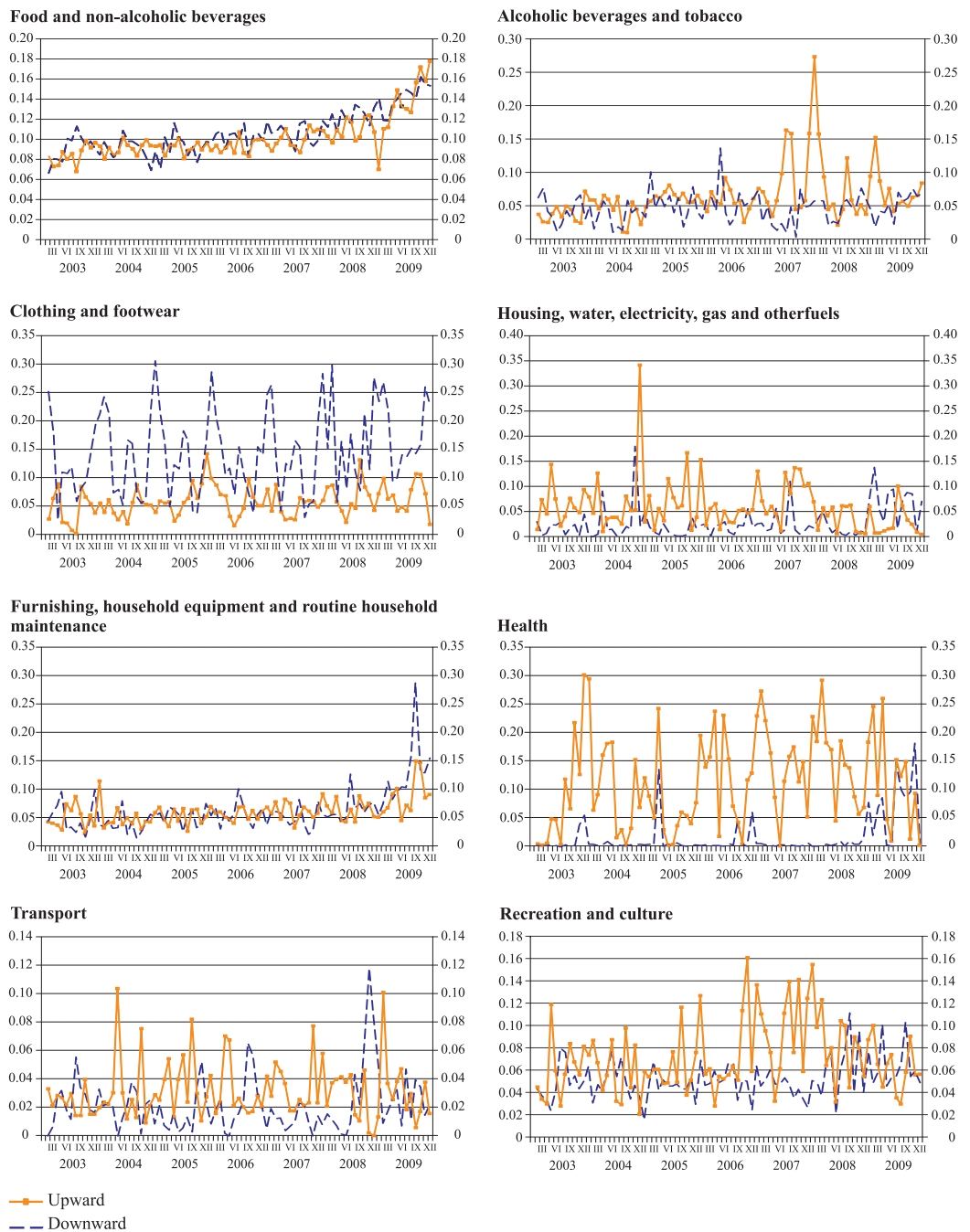
Figure A5
Distribution of size of upward and downward price changes by individual product in different sub-periods



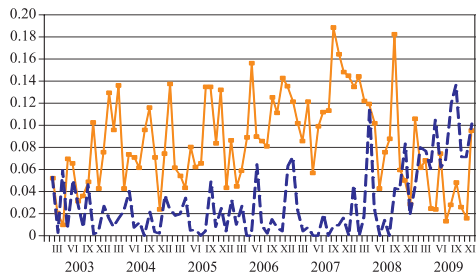
Sources: CSB and authors' calculations.

Notes: The size of price changes shows the average logarithmic change of prices, equation (10). Vertical axis denotes the share of individual products within particular size interval.

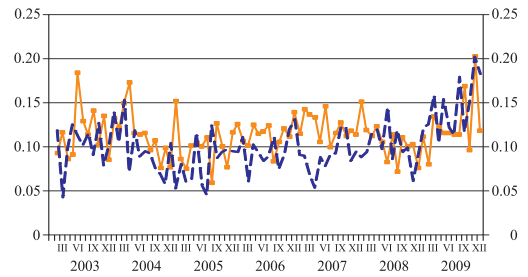
Figure A6
Size of price changes over time



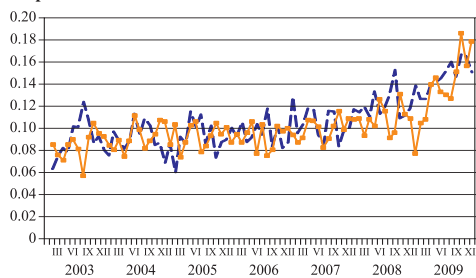
Restaurants and hotels



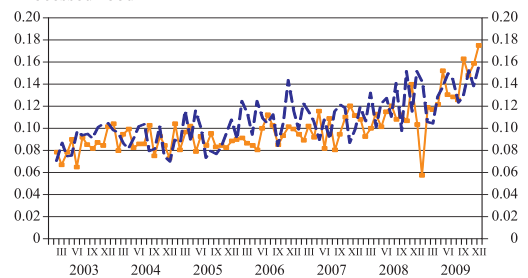
Miscellaneous goods and services



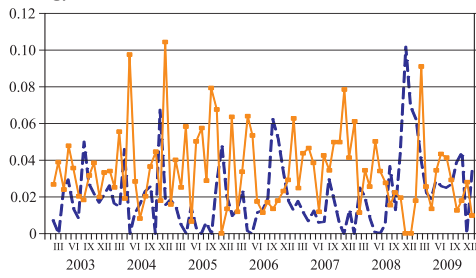
Unprocessed food



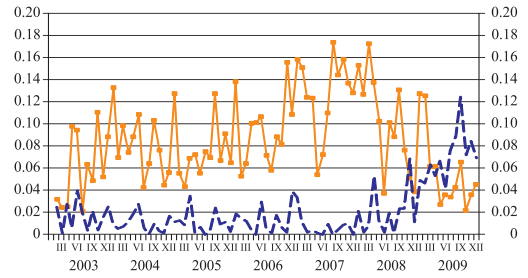
Processed food



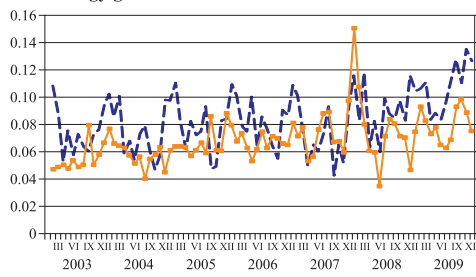
Energy



Services



Non-energy goods



— Upward
- - Downward

Sources: CSB and authors' calculations.

Note: The size of price changes shows the average logarithmic change of prices, equation (10).

BIBLIOGRAPHY

1. AJEVSKIS, Viktors, VĪTOLA, Kristīne (2009) – *Advantages of Fixed Exchange Rate Regime from a General Equilibrium Perspective*. Latvijas Banka Working Paper, No. 4.
2. ÁLVAREZ, Luis J., DHYNE, Emmanuel, HOEBERICHTS, Marco M., KWAPIL, Claudia, LE BIHAN, Hervé, LÜNNEMANN, Patrick, MARTINS, Fernando, SABBATINI, Roberto, STAHL, Harald, VERMEULEN, Philip, VILMUNEN, Jouko (2005) – *Sticky Prices in the Euro Area: A Summary of New Micro Evidence*. European Central Bank Working Paper Series, No. 563, December.
3. AUCREMANNE, Luc, DHYNE, Emmanuel (2004) – *How Frequently do Prices Change? Evidence Based on Micro Data Underlying the Belgian CPI*. European Central Bank Working Paper Series, No. 331, April.
4. AUCREMANNE, Luc, DHYNE, Emmanuel (2005) – *Time-dependent versus State-dependent Pricing: A Panel Data Approach to the Determinants of Belgian Consumer Price Changes*. European Central Bank Working Paper Series, No. 462, March.
5. BAUDRY, Laurent, LE BIHAN, Hervé, SEVESTRE, Patrick, TARRIEU, Sylvie (2004) – *Price Rigidity: Evidence from the French CPI Micro-data*. European Central Bank Working Paper Series, No. 384, August.
6. BAUMGARTNER, Josef, GLATZER, Ernst, RUMLER, Fabio, STIGLBAUER, Alfred (2005) – *How Frequently Do Consumer Prices Change in Austria? Evidence from Micro CPI Data*. European Central Bank Working Paper Series, No. 523, September.
7. BILS, Mark, KLENOW, Peter J. (2004) – Some Evidence on the Importance of Sticky Prices. *Journal of Political Economy*, University of Chicago Press, vol. 112, No. 5, October, pp. 947–985.
8. CALVO, Guillermo A. (1983) – Staggered Prices in a Utility-maximizing Framework. *Journal of Monetary Economics*, vol. 12, issue 3, September, pp. 383–398.
9. CAPLIN, Andrew S., SPULBER, Daniel F. (1987) – Menu Costs and the Neutrality of Money. *Quarterly Journal of Economics*, vol. 102, issue 4, November, pp. 703–725.
10. CECCHETTI, Stephen G. (1986) – The Frequency of Price Adjustment: A Study of the Newsstand Prices of Magazines. *Journal of Econometrics*, vol. 31, issue 3, April, pp. 255–274.
11. DHYNE, Emmanuel, ÁLVAREZ, Luis J., LE BIHAN, Hervé, VERONESE, Giovanni, DIAS, Daniel, HOFFMANN, Johannes, JONKER, Nicole, LÜNNEMANN, Patrick, RUMLER, Fabio, VILMUNEN, Jouko (2005) – *Price Setting in the Euro Area: Some Stylized Facts from Individual Consumer Price Data*. European Central Bank Working Paper Series, No. 524, September.

12. DIAS, Daniel A., MARQUES, Carlos Robalo, SANTOS SILVA, João M. C. (2006) – *Measuring the Importance of the Uniform Nonsynchronization Hypothesis*. European Central Bank Working Paper Series, No. 606, April.
13. DIAS, Daniel A., MARQUES, Carlos Robalo, SANTOS SILVA, João M. C., NEVES, Pedro Duarte (2004) – *On the Fisher-Konieczny Index of Price Changes Synchronization*. Banco de Portugal Working Paper, No. 7, June.
14. DOTSEY, Michael, KING, Robert G., WOLMAN, Alexander L. (1999) – State-Dependent Pricing and the General Equilibrium Dynamics of Money and Output. *Quarterly Journal of Economics*, vol. 114, No. 2, May, pp. 655–690.
15. DOTSEY, Michael, KING, Robert G. (2005) – Implications of State-dependent pricing for Dynamic Macroeconomic Models. *Journal of Monetary Economics*, vol. 52, issue 1, January, pp. 213–242.
16. FISHER, Timothy C. G., KONIECZNY, Jerzy D. (2000) – Synchronization of Price Changes by Multiproduct Firms: Evidence from Canadian Newspaper Prices. *Economics Letters*, vol. 68, issue 3, September, pp. 271–277.
17. FOUGÈRE, Denis, LE BIHAN, Hervé, SEVESTRE, Patrick (2005) – *Heterogeneity in Consumer Price Stickiness: A Microeconometric Investigation*. European Central Bank Working Paper Series, No. 536, October.
18. GOLOSOV, Mikhail, LUCAS, Robert E., Jr. (2007) – Menu Costs and Phillips Curves. *Journal of Political Economy*, vol. 115, pp. 171–199.
19. HOFFMANN, Johannes, KURZ-KIM, Jeong-Ryeol (2006) – *Consumer Price Adjustment under the Microscope – Germany in a Period of Low Inflation*. European Central Bank Working Paper Series, No. 652, July.
20. HORVÁTH, Roman, CORICELLI, Fabrizio (2006) – *Price Setting Behavior: Micro Evidence on Slovakia*. CEPR Discussion Papers, No. 5445, January.
21. JONKER, Nicole, FOLKERTSMA, Carsten, BLIJENBERG, Harry (2004) – *An Empirical Analysis of Price Setting Behaviour in the Netherlands in the Period 1998–2003 Using Micro Data*. European Central Bank Working Paper Series, No. 413, November.
22. KAUFMANN, Daniel (2008) – *Price-Setting Behaviour in Switzerland: Evidence from CPI Micro Data*. Swiss National Bank Working Papers, No. 15, August.
23. KAUFMANN, Daniel (2010) – *The Timing of Price Changes and the Role of Heterogeneity*. Swiss National Bank Working Papers, No. 2, November 2009.
24. KLENOW, Peter J., KRYVTSOV, Oleksiy (2005) – *State-Dependent or Time-Dependent Pricing: Does It Matter for Recent U.S. Inflation?* NBER Working Paper, No. 11043, January.
25. KLENOW, Peter J., KRYVTSOV, Oleksiy (2008) – State-Dependent or Time-Dependent Pricing: Does it Matter for Recent U.S. Inflation? *The Quarterly Journal of Economics*, MIT Press, vol. 123(3), August, pp. 863–904.

26. KURRI, Samu (2007) – *Price Changes in Finland: Some Evidence from Micro CPI Data*. European Central Bank Working Paper Series, No. 728, February.
27. LANCASTER, Tony (1990) – *The Econometric Analysis of Transition Data*, Cambridge University Press, Cambridge (UK).
28. LÜNNEMANN, Patrick, MATHÄ, Thomas Y. (2005) – *Consumer Price Behaviour in Luxembourg: Evidence from Micro CPI Data*. European Central Bank Working Paper Series, No. 541, November.
29. MEĻIHOVS, Aleksejs, ZASOVA, Anna (2007) – *Estimation of the Phillips Curve for Latvia*. Latvijas Banka Working Paper, No. 3.
30. TAYLOR, John B. (1980) – Aggregate Dynamics and Staggered Contracts. *Journal of Political Economy*, vol. 88, issue 1, February, pp. 1–23.
31. VERONESE, Giovanni, FABIANI, Silvia, GATTULLI, Angela, SABBATINI, Roberto (2005) – *Consumer Price Behaviour in Italy: Evidence from Micro CPI Data*. European Central Bank Working Paper Series, No. 449, March.