Price Rigidity in Slovakia: Some Facts and Causes

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Abstract

This paper examines the price adjustment patterns, at the store level, in a transition economy. Empirical estimates of the extent of price rigidities are provided for selected final goods and services in Slovakia, and are compared with similar estimates from selected developed economies, namely the eurozone countries and U.S. The patterns of price changes found in Slovakia are somewhat similar to what was found for the western developed economies. Survival time analysis is employed to identify the effects of various macroeconomic indicators on the price change probabilities. Results show that variables such as productivity, wages, currency value and oil prices play important roles in the price adjustment process in Slovakia.

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1. Motivation

Marketplace and its price system are the institutions of the free market economy and the ability of prices to adjust to changes in market conditions indicates efficiency of such an economy. It is known that prices adjust with a delay to changes in economic conditions and this phenomenon has been referred to as price rigidities. Though diverging in their results and implications, there is one common conclusion that the price-setting models derive - markets with price rigidity behave differently than markets with flexible prices. It is therefore crucial to understand how, why and when prices change or alternatively, how, why and when they do not.

Earlier studies in the area of price rigidities typically presented the reader with evidence that price stickiness is significant. For example Cecchetti (1986) presents evidence that a magazine's frequency of price change is always larger than once per 1.8 years and smaller than once per 10 years. Similarly, Kashyap (1995) reports that price changes of mail-order catalogue goods are unchanged for a period slightly more than a year. Also, Bils and Klenow (2002) use large individual-price data from the US Bureau of Labor Statistics to find that for about a half of their sample, prices do not change for more than four months. Similarly, Lach and Tsiddon (1992) give evidence on staggered foodstuff prices in Israel.

Some of the papers dealing with price rigidities considered specific products; so their results only provided limited evidence on price rigidities at the aggregate level. For example, Cecchetti (1986) used data collected on 38 newsstands. Genesove (1999) documented a high rate of nominal rigidity among housing rents in the United States. However, several studies appeared which were better suited to judge the actual extent of the price rigidities as they used sets of data compiled from a blend of products. For example, Bils and Klenow (2002) use a large individual-price data from the US Bureau of Labor Statistics. Dhyne et al. (2006) use 50 products selected from the consumer basket to represent five main product categories and Alvarez and Hernando (2005) cover 12 distinct sectors: four groups of manufacturing industries, energy, three trade groups and four aggregates of other services. Kashyap (1995) uses twelve selected retail goods. These authors pointed to the fact that there are significant differences in the price changing patterns across different goods and suggested aggregating over product categories rather than over a large heterogeneous sample.

The empirical literature examining the price setting patterns is, however, relatively limited when it comes to covering the transition economies. Coricelli and Horvath (2006) provide estimates of price setting behaviour, covering the period of 1997-2001, which was characterised by nearly double-digit inflation. However, although the economy was in transition in that period, the EU accession-related direct, as well as indirect, effects can be better measured from data from later periods, which are closer to the actual integration (May 2004). Furthermore, the data used in this study only covers about 57% of the CPI and lacks the store identifier; so the nature of the analysis is different from what has been done in Dhyne et al. (2006) and Bils and Klenow (2002), which are the main comparison studies to this work. Copaciu, Neagu and Braun-Erdei (2009) used a unique survey to capture the price-setting patterns in Romania to find that prices are only set as mark-up over costs in about 43% of the cases as opposed to adopting the market price, which is a low figure when compared to the developed western economies.

The aim of this paper is to contribute to the literature dealing with the transition economies and assess the price-setting behaviours in a transition economy in order to provide qualitative and quantitative results which can be compared to similar results

obtained for the developed economies and thus provide an indication on how effective the transition to a free market economy in such countries has been. Also, such results could be further used in calibrating the existing or developing new models for economies in transition which can then provide the base for the macroeconomic policy development, especially related to the European Union accession or the common currency introduction. In order to better judge the actual extent of the price rigidities, we aggregate over product categories rather than over the whole heterogeneous sample. We use data from the period of 2002-2007, so our sample is well suited to identify the direct and indirect effects that the EU integration has had on the economy. Our data also contains the store identifier – so we can compare our results to the results of store-level analyses from the selected western developed economies. However, the analysis in this paper is not limited to this. Although most of the articles cited above use the method of averaging in order to obtain the mean and median values for the price changing frequency or duration, the theoretical concept of price rigidity is defined as the extent of the ability of prices to adjust to the changes in the economic environment (Andersen, 1994). While the former captures the stagnation of prices, regardless of whether economic conditions stagnate or change, the latter arises if prices fail to change (fully) in reaction to changes of the underlying economic conditions. Indeed, firms are reluctant to adjust prices every time economic conditions change due to price adjustment (menu) costs, input costs, implicit contracts, etc. and it is of especial economic interest to identify these patterns and forces behind them.

During the sample period analysed in this paper, January 2002 – December 2007, some major changes were experienced by the Slovak economy. The inflation was successfully brought down from almost two-digit values to values below 3%. The country joined the EU on May 1, 2004 and also went through parliamentary elections. A flat tax-rate of 19% was introduced and the country was preparing for the introduction of the Euro. Price setting consequences of these events cannot be clearly captured if the data is pooled, but can be better identified using the survival time analysis of the price spells through examination of their lengths as a response to changes in the economic variables, as Copaciu, Neagu and Braun-Erdei (2009) and Nakamura and Steinsson (2008) also suggest.

The main difference between the standard averaging method and the analysis of the casual effects, and the biggest reason why we argue the latter is necessary to complement the former, is the fact that the former aggregates are over large-scale data; thereby disregarding dynamic properties of the sample. The survival time analysis offers a remedy to this problem by allowing capturing the extent of the response of the price adjustments to the changes in the underlying economic conditions.

In general, duration analysis constitutes a practical tool for answering certain types of questions related to price adjustments – such as how many prices will most probably change in the next period, how various macroeconomic indicators influence this number or whether prices that have recently changed are more likely than others to change again. Answers to such questions have not only the potential to be of interest to the consumers who face the prices and build their purchasing strategies based on such answers, but may, just as well, be attractive to the price-setters who modify their price-adjustment strategies based upon such information. Such information then constitutes a valuable base for further analysis with the focus on general monetary policy as well as industry level policy making and is therefore crucial, especially for countries in earlier stages of transition or aspiring to access the European Union or the common currency zone.

The structure of the paper is as follows: In Section 2 we describe our data set. In Section 3 we report the results of the descriptive statistics analysis which uses the simple and weighted averages as a method of estimation. In Section 4 we turn to the survival time analysis of the hazard rates using various economic covariates. In the end we conclude.

2. Description of the Data

We use store-level data on price quotes of monthly frequency provided by the Slovak Statistical Office (SSO). It contains four-dimensional panel data on all the Slovak CPI products, which are used by the Slovak Statistical Office for computing the national consumer price index. The four dimensions are *product code, price quote, time* and *place*, where place consists of a geographical area and store code. We use the sub-sample which starts from January 2002 when SSO started using the store identifier. The last data available are from December 2007.

The price quotes are collected around the 20th of each month in a typical store for each given product. The data collectors are to collect their price quotes in the same store for each given product, unless the store closes down. Altogether data was collected from 17,937 stores. A store identifier is unique only within a geographic area, i.e. same identifiers may be used in different regions, but in this case they denote different stores. Therefore, to uniquely identify a store, we use the region identifier together with the store identifier. From the total of 735 final goods and services, 113 have a regulated price; whereas, the prices of the rest are collected from stores from 38 distinct geographical areas.

Table 1. Product Categories in the Slovak CPI

General Category (COICOP group)		Number of products		Weight in CPI		Number of Stores
		Regulated	Total	Regulated	Total	
1	Food and Non-Alc. Beverages	0	138	0	158,032	722
2	Alc. Beverages and Tobacco	0	12	0	45,219	369
3	Clothing and Footwear	0	101	0	43,610	2,121
4	Housing, Water, Fuels	19	49	143,774	282,971	1,727
5	Furniture, House Equipment	0	93	0	54,189	2,665
6	Health Services	39	39	25,729	25,729	658
7	Transportation Services	19	81	22,080	94,818	1,493
8	Postal Service and Telecom.	12	22	11,262	37,152	145
9	Recreation and Culture	2	77	6,312	79,864	3,020
10	Education	4	7	7,597	15,134	473
11	Hotels and Restaurants	5	44	14,547	69,452	1,553
12	Other Goods and Services	13	72	8,262	93,830	2,991
	Total	113	735	239,562	1,000,000	17,937

Source: Statistical Office of the Slovak Republic and author's calculations

Each product is collected in several stores in each region depending on the availability of the product and size of the region. The number of stores varies, from the minimum of 1 to as many as 20 stores per region per product, with the average being 4.2.

We structure the data according to the Classification of Individual Consumption by Purpose (COICOP), as shown in Table 1. The reason for such a classification is to avoid the assumption of all products being homogeneous in favour of assuming homogeneity only within a product category, which is also justified by the results of Canneti et al. (1998), who finds systematic differences by industry but no significant differences therein.

There are two features of this database that are worth mentioning: sales are not marked as special price quotes and there are 113 regulated products out of the total of 735 final goods and services present in the sample. We address the question of sales indicator in the Appendix. As for the regulated products, as can be noted in Table 1, there are some regulated products in almost all product categories except: 1. Food and Non-Alcoholic Beverages, 2. Alcoholic Beverages and Tobacco, 3. Clothing and Footwear and 5. Furniture and Household Equipment. Although the price-setting strategies of the price regulator can be reasonably expected to be different from those driven by the free-market forces, we do not omit these products from our database in order to provide an overall, general picture of the price adjustment processes in the transition economy of Slovakia. Indeed, if the extent of price rigidities is driven by the administered prices, then such a finding documents the level of transition of an economy as well. If we omitted the prices which were not set by the market movements and only considered those which were, our results could easily be biased towards a successful free market functioning while no such success would be genuinely present.

3. Static Unconditional Analysis of Price Changes

In this section we focus on simple descriptive statistics on the frequency and size of price changes, as well as their decomposition into positive and negative price changes. The main reason to decompose the price changes into price increases and price decreases is that prices have been found to adjust asymmetrically. Indeed, it has been shown by Toolsema and Jacobs (2007) that the response of the mortgage rate is stronger if the cost increases than if it decreases and by Peltzman (2000) that prices rise faster than they fall.

We define that a price did not change in two consecutive periods if the *store code*, the *product code* and the *price quote* are equal for two subsequent periods, i.e. months. A price spell is defined as the continuation of equal price quotes. In this data set SSO does not distinguish a sale from regular price change; so we consider any sale as a regular price change. For a discussion on sales indicator, refer to the Appendix.

In what follows we present our results on five main indicators to provide a basic insight and to characterise the price setting patterns in Slovakia. These five indicators are:

- frequency of price changes,
- average duration of price spells,
- frequency of price increases and decreases,
- share of price increases and decreases, and
- average size of price increases and decreases.

We present the aggregate results in Table 2 for each of the twelve categories separately and give a short commentary to each. The percentages represent the probability of a price

change happening in a given month, or in other words the percentage (share) of all the products which undergo a price change in a given month. In case of sizes, the percentages represent the average percentage size change in a given month.

Frequency of Price Changes

The highest frequency of price changes is observed in category *1. Food and Non-Alcoholic Beverages*; where more than one third of prices change in a given month. One fourth of prices of *2. Alcoholic Beverages and Tobacco* change in a given month and *3. Clothing and Footwear* together with *5. Furniture and Household Equipment* experience less than one fifth of price changes in a given month. *4. Housing, Water, Fuels* as well as *8. Postal Services and Telecommunication* and *10. Education, 11. Hotels, Restaurants and 12. Other Goods and Services* all exhibit one-digit price change frequency, which is generally interpreted as rigid prices in these industries.

As can be noted from Table 2, it is services where prices change with a lower probability while final goods such as food products exhibit relatively high probability of undergoing a price change. This is a phenomenon observed in other countries as well and is most often attributed to non-substitutability and non-transportability of services when compared to final goods.

For a comparison, in the eurozone prices in the *Non-energy industrial* and *Services* sector change relatively rarely (the corresponding frequencies are 9% and 6% respectively), but values for the U.S. show smaller price rigidity there (22% and 15% respectively). Similarly, in the U.S. the food products exhibit a higher probability of a price change in a given month (48% in *Unprocessed food* category and 27% in *Processed food* category) than is the case for the eurozone (28% and 14% respectively) and Slovakia (around one third of all food prices change in a given month).

Table 2. Aggregate Results

Product Category (COICOP group)		Frequency of price changes	Duration of price spells	Frequency of price increase	Frequency of price decreases	Share of price increases	Share of price decreases	Size of price increases	Size of price decreases
1	Food and Non-Alc. Beverages	38%	3.8	21%	17%	57%	43%	13%	11%
2	Alc. Beverages, Tobacco	24%	6.1	14%	10%	52%	48%	8%	7%
3	Clothing and Footwear	18%	9.2	10%	8%	53%	47%	15%	12%
4	Housing, Water, Fuels	8%	17.5	6%	2%	71%	29%	20%	14%
5	Furniture, House Equipment	16%	10.7	8%	8%	49%	51%	13%	10%
6	Health Services	14%	15.0	9%	5%	64%	36%	27%	15%
7	Transportation Services	36%	11.2	18%	17%	51%	49%	11%	16%
8	Postal Services and Telecom.	2%	34.4	1%	2%	8%	92%	61%	28%
9	Recreation and Culture	14%	17.3	7%	7%	57%	43%	17%	12%
10	Education	4%	30.0	3%	0%	76%	24%	52%	18%
11	Hotels and Restaurants	5%	23.7	4%	1%	69%	31%	18%	14%
12	Other Goods and Services	8%	21.8	5%	3%	60%	40%	35%	20%
	Total	17%	15.0	10%	7%	59%	41%	19%	14%

Source: Author's calculations

Average Duration of Price Spells

On average a price of *1. Food and Non-Alcoholic Beverages* lasts less than four months, which means relatively flexible prices. At the same time, prices of *2. Alcoholic Beverages and Tobacco* last slightly longer than half a year and are followed by *3. Clothing and Footwear* where prices change every three quarters. Prices of *5. Furniture and Household Equipment* and *7. Transportation Services* remain unchanged for almost one year. In the rest of the categories prices exhibit strong rigidities as they change every 1.5 years or more. For comparison, the overall price duration in the eurozone is 13 months and in the U.S. 6.7 months; so prices in Slovakia, with the overall price spell duration of 15 months, are relatively rigid.

Interesting to mention here are the results from Canneti et al. (1998). The authors find that there are systematic differences by industry, specifically that services adjust most slowly and trade sector most rapidly. Additionally, they find that the median price change frequency of the U.S. firms is 1.4 times per year, with a strong mode at 1 (annual price changes are by far the most frequent). They also find that 78% of the GDP is re-priced quarterly or less, 10% less than once per year and the same amount more than weekly. They also find that more than 1% of products are re-priced more than once daily. These results show that reporting pure means may be less informative than might be desirable, and it might be more interesting to examine the distributions of price changes. This conclusion is in line with our reasoning that it is reasonable to complement the descriptive results with the survival time analysis in order to better identify the patterns in the price adjusting process.

Frequency of Price Increases and Decreases

We find that generally price increases are more frequent than decreases – which goes in line with the results of many past studies using data from various selected markets (gasoline, agriculture products, mortgage prices (Toolsema and Jacobs, 2007; Peltzman, 2000). The most cited reason behind this phenomenon is inflation, though menu costs or rational inattention are also examined in this context.

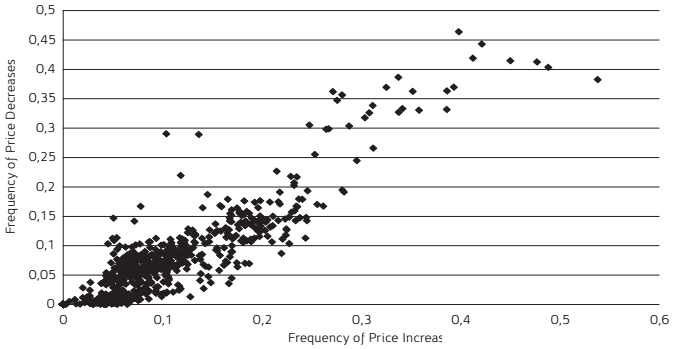
We observe relatively high frequency of price increases for the product category *1. Food and Non-Alcoholic Beverages, 2. Alcoholic Beverages and Tobacco, 3. Clothing and Footwear and 7. Transportation Services.* Remarkably, the frequency of price decreases for these categories also reaches the highest values and is comparable in size with the frequency of price increases. A similar pattern can be observed for the low values of price increases. If we plot the two frequencies against one another, we indeed see that where price increases are frequent, price decreases are frequent too and vice versa. This can be seen in Figure 1 in which every dot represents a single product and it corresponds to the frequency of price increases (the horizontal axis) and the frequency of the price decreases (the vertical axes) of this product. This regularity is very similar to what was found for most of the eurozone economies in Dhyne et al. (2006). It captures a pattern which can be summarised as "what goes up must go down" and means that if prices rise, they will also drop.

Share of Price Increases and Decreases

Consistently with the previous findings, we find that the share of price decreases point to the fact that price decreases are not uncommon. In more than half of the product categories, price decreases take up over 40% of all price changes, very commonly occurring in *8. Postal Services and Telecommunication* (92%). However, even in the remainder of the product categories, price increases are not purely dominant and price decreases occur relatively

often. This phenomenon could be attributed to the introduction of the flat tax rate of 19%, which generated some space for the price-setters to be able to off price discounts keeping the level of their profits at the desirable level.

Figure 1. Correlation of Frequencies of Price Increases and Price Decreases



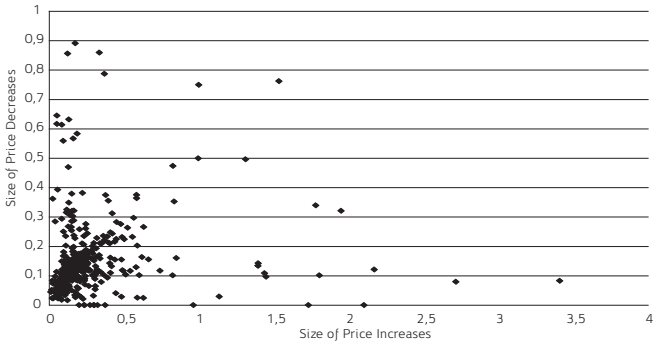
Source: Author's illustration

Average Size of Price Increases and Decreases

The price increases are sizable compared to the prevailing inflation rate, which was 4.9% on average during the period in question. We observe the largest price increases for the *product category 10. Education* and *8. Postal Services and Telecommunication*; where these average up to more than 50% of the price. Besides *2. Alcoholic Beverages and Tobacco*, all the categories exhibit double-digit values of sizes of price increases and the same is true for the sizes of price decreases. We can also notice that where price increases are large, price decreases are larger, and vice versa. A similar pattern could be observed for the frequencies, though in case of sizes, the correlation relationship only seems to be stronger for the lower values and the higher values are rather dispersed (see Figure 2).

This regularity is very similar to what was found for most of the eurozone economies in Dhyne et al. (2006) and it captures a similar pattern than what was observed for frequencies. If prices rise slightly, they also drop slightly. Similarly, if they rise considerably, they fall considerably; although this correlation seems less apparent and the data is more dispersed for the larger values.

Figure 2. Correlation of Sizes of Price Increases and Price Decreases



Source: Author's illustration

In this section we examined five different types of descriptive statistics of store-level prices in Slovakia. We found, that the prices of final goods go through more frequent adjustment than services do. We also saw that price decreases are not uncommon and even relatively sizable. Furthermore, we saw that the price changes' patterns are similar to those of some developed countries, although in absolute terms differences could be observed.

In what follows we turn to an alternative approach of examining the extent of the price rigidities. While the above was based on simple or weighted averaging over sub-samples, the following sections will instead analyse the price adjustment in relation to various exogenous variables. This approach ensures that information captured in the trends of the price setting is not lost by pooling over a relatively large sample.

4. Survival Time Analysis of Price Changes

The theoretical concept of price rigidity, as defined in Andersen (1994), is the extent of the ability of prices to adjust to the changes in the economic environment. Although much of the empirical evidence on the extent of the price rigidities uses the method of averaging in order to obtain the unconditional means of price changing frequency and duration, this approach captures stagnation (or the lack thereof) of prices regardless of whether economic conditions stagnate or change.

In this section we employ survival time analysis in order to analyse the patterns of price adjustments in Slovakia as responses to the changes of the underlying economic environment. Such an approach enables us to identify the extent of the price stagnation as a consequence of prices failing to change (fully) in reaction to the changes of the underlying economic conditions.

A more sophisticated method (as opposed to the fully empirical, non-parametric Kaplan-Meier (1958) method) is offered by the fully-parametric or semi-parametric models which assume that the hazard function can be scaled depending on some covariates which reshape the baseline hazard as estimated by the Kaplan-Meier estimator (semi-parametric models are due to (Cox, 1972) or even re-specify the baseline hazard and re-shape that (fully-parametric models). The former ones are referred to as the proportional hazards models (PH models), the latter ones as accelerated failure time models (AFT models). Unlike the PH models, the AFT models assume that the effect of a covariate is to multiply the predicted event time by some time-varying effect, rather than a constant; so they can show effects of variables in the short-term as well as in the long-term.

However, by imposing too much structure on the data, the AFT models often over-parameterise the data and thus distort the estimated hazard rates. This is not the case with the PH models which analyse the effect of covariates on the hazard rate using a parametric specification, but leave the baseline hazard of unspecified form and determine it from the data using fully empirical, non-parametric estimates. Due to such specification, the PH models can be viewed as a compromise between the non-parametric and fully-parametric approaches. They have the ability of adjusting for the explanatory variables by including them in the model while imposing fewer restrictions and hence not over-parameterising it. Using the semi-parametric Cox's model specification we attempt to explain the price change hazard rates by various exogenous macroeconomic variables; such as wage, productivity, currency value, oil prices, market competition level, etc. This approach allows us to leave the

baseline hazard of unspecified functional form, and focus on estimating the effects of the covariates on the underlying hazard rates. In addition, unlike most of other model specifications, the estimated effects from the Cox specification can be readily interpreted as hazard ratios without the necessity of any further transformation.

4.1 Exogenous Macroeconomic Indicators Affecting the Underlying Price Level

Wages directly influence the costs of a price-setter, so intuitively they are expected to increase the positive price changes and decrease the negative ones so as to off-set the incurred costs by the price-setter. However, price-setters may be aware of the fact that with decreasing their prices the demand will increase and the resulting profits may be larger. Hence, the expected effect is ambiguous.

Oil prices directly influence the costs of the price-setters, but whether their increases reflect in the price changes positively or negatively, again depends on the strategy of the price-setter, specifically whether they prefer to off-set the incurred costs directly by increased prices or indirectly by stimulating the demand.

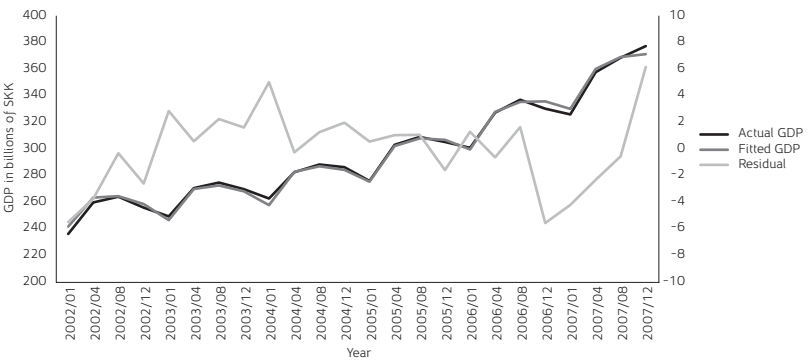
Currency value has an effect on imports through revaluation, which affects the demand quantity and through this the price. Also, devaluation increases the relative costs incurred by the price-setters; while revaluation decreases them – so if the currency value goes up, prices increase by lower amounts. We measure currency value using a currency blend set by the National Bank of Slovakia as the exchange rate of SKK to USD and EUR weighted by 40% and 60%, respectively.

Productivity as such is a variable not available so it needs to be approximated. We proxy it by the ratio of *GDP* to *employment*. It is expected to have a straightforward effect on the costs and through these on the probabilities of price changes. However, although employment is available in monthly frequency, *GDP* is only available as quarterly data. So in line with Allison (1982), we proxy the missing monthly values by fitted values from regression of the quarterly GDP. The best fit is reached by the least-square method on the following model:

$$GDP = \alpha + \beta t^2 + \gamma_1 d_1 + \gamma_2 d_2$$

where t is time in months and d_1 is a dummy variable for the first quarter in a year and d_2 is a dummy variable for the last quarter in a year (the data seems to be strongly seasonal). All the coefficients are strongly significant and the *R-square* is 0.994127. The fitted values and residuals are plotted in Figure 3.

Figure 3. Actual and Fitted Values of GDP



Source: Author's illustration

GDP Gap is considered as an exogenous macroeconomic indicator affecting the underlying price level due to the basic tenet of the sticky-price model that the higher the deviation of the output from the natural rate, the higher will be the deviation of the actual price from the expected price. As stated above, the frequency of the GDP data is quarterly, so we use the fitted values from the above regression to construct the *GDP Gap* variable.

In line with Carlton (1986) who found strong correlation between the frequency of price changes and the average absolute price change, the price-setters are hypothesised to put strong weight on the *absolute size of the last price adjustment* when deciding on whether or not to change their prices. However, this result is at odds with the findings of Klenow and Malin (2009) who find that for the U.S. consumer prices, the size of price changes is largely unrelated to the time between price changes. As the authors suggest, this fact points to state-dependent rather than time-dependent pricing. If price spell length is exogenous, more shocks should accumulate and make for bigger price changes after longer price spells. Under state-dependent pricing, longer price spells reflect stable desired prices rather than pent-up demand for price changes.

We use the price lag in accordance with Eckstein and Wyss (1972), who used lagged prices as important explanatory variables of current prices even when all those variables which explain the desired prices were included. Specifically, higher values of price level in the previous period are expected to be associated with lower positive price adjustments and larger negative price adjustments, meaning that if prices were low before, they will go up in the following time period and vice versa.

Interest rates are a business cost; so if they rise, an increase in costs is generated which needs to be absorbed or else it puts pressure on prices which then rise. We therefore include this variable as a strong macroeconomic indicator affecting the underlying price level and the probability of its shifts.

Market Competition is reported to play a significant role in affecting the price adjustments (Caglayan, Filiztekin and Rauh (2006), Gerardi and Shapiro (2007) and Copaciu, Neagu and Braun-Erdei (2009) show a strong correlation between price dispersion and market competition). Based on an intuition that in competitive markets price setters compete more vigorously over the consumers, higher density of market competition is associated with larger absolute adjustments for both price increases and decreases.

Due to imperfect competition price, dispersion exists and forces the price-setters to adjust their prices towards the average in order not to lose their shares of the market. Hence, an individual firm's price-setting strategy is an increasing function of the average price in the market. We capture the extent of the local price dispersion by the *deviation from the average price in the region.*

In October 2003, a new tax reform law was passed in the parliament which meant a major change in the taxing procedures once effective and thus influenced the expectations of the price-setters regarding the future costs. This law was vetoed by the President in November 2003, but then passed in the parliament again in December 2003. Therefore we include two *tax law dummies (Tax Law Passed and Tax Law Vetoed)* in order to capture the expected influence of the new tax law and the expectations stemming from it on the probabilities of the price changes.

The date of entrance of Slovakia into EU (May 1, 2004) is the date of many new laws becoming effective regarding various social spheres; hence we include a dummy variable of *EU entrance* into the second-hurdle equation to capture the influence on costs, the influence

of the expectations and through these the influence of the EU integration on the probabilities of the price changes.

4.2 Survival Time Analysis – Estimation of the Hazard Rates

In this section we employ the survival time analysis in order to explain the price change hazard rates by various exogenous macroeconomic variables. The main reason why we complement the analysis above with the survival time estimations is the fact that the former aggregates are over large-scale data; thereby disregarding dynamic properties of the sample, while the latter offers a remedy to this problem by allowing to capture the extent of the response of the price adjustments to the changes in the underlying economic conditions.

In our analysis we proceed separately for each product category as they were defined above. Altogether we have 12 product categories and in each product category we have a different total number of products. In each product category we have a different total number of observations. Each observation consists of the following:

- Duration time of a spell.
- An indicator which takes on value 1 for uncensored observations and 0 for the censored observations.
- An indicator which corresponds to the event type in which the price spell finished. It takes on value 1 if the observed price change is a price increase, value 2 if it is a price decrease and 0 if the price spell never terminated but was censored[1].
- Vector of covariates x_i which affect the probability of a price change.

We employ the basic Cox's model specification under which the hazard rate is assumed to follow the following relationship:

$$log\, h_{ij}(t_i, x_i) = \alpha_j(t) + \beta_{1j}\, x_i(t) + \beta_{2j}\, x_i(t\text{-}1)$$

where $x_i(t)$ are the covariates to affect the price change probability. The term $x_i(t - 1)$ is the first lag of $x_i(t)$ and it holds that $x_i(t) = x_i$ if the covariate is time-invariant. In this specification the regression constant $a_j(t)$ represents the baseline hazard, i.e. the hazard corresponding to all covariates' values equal zero and it holds that $h_{0j}(t) = e^{aj(t)}$ where $h_{0j}(t)$ is the baseline hazard. The baseline hazard is assumed different for each event type and product category to allow for some level of heterogeneity.

We use the maximum likelihood method in order to estimate the hazard rates which we adjust in order to fit the nature of our data. With two possible ways of termination of a spell, namely a price increase and a price decrease, the maximum likelihood derivation must account for the competing-risks model which we do in the standard way, i.e. we consider every observation which finished in one event to be censored with respect to the alternative event. The reasoning behind this approach is that if the observation had not finished in the event it did, it could have finished in the alternative event in the following period.

Additionally, our data allows for the repeated events, i.e. more price changes can be

[1] Left-censored observations are excluded from the analysis. As noted in Giannelli (1996):"If the censoring mechanism is random (i.e. the parameters of the censoring mechanism do not contain any information on the parameters of the duration model) discarding left-censored spells implies only a loss of efficiency in the estimation of the parameters." However, with large samples, such as ours, the loss of efficiency becomes minimal so it is safe to exclude the left-censored observations from the analysis.

observed for a given product in a given store. This gives rise to a so-called gap-time model approach, which allows not only to condition the duration of price spells on the underlying covariates, but also to account for the time point at which the price spell terminated.

The maximum likelihood function is then derived in the standard way developed for the discrete-type of data with left-censored observations, multiple events and competing risks. The model is estimated using the STATA 10.0 package using the *st* group of commands which are specifically designated for the estimation of the survival times.

4.3 Results

In Table 3 we present the estimated coefficients of the explanatory variables on the price changing hazard rates. We report the results separately for price increases and price decreases for all twelve product categories. The numbers correspond to the percentage change in a probability of a price change after a one-percent increase in a variable value. If the variable is an index, such as e.g. *Market Competition*, the numbers correspond to the percentage change in the hazard rates after a one-unit increase in this variable's value.

It can be seen that the estimated effects are generally strongly significant with insignificance occurring typically where regulated products are present, specifically in the product categories: *8. Postal Service and Telecommunication, 9. Recreation and Culture* and *10. Education.* This result is interesting to notice because it points to the fact that the administered prices are set in a different way than the market prices, most probably as a consequence of the welfare maximising strategies on the part of the regulator but individual optimisation strategies on the part of the market participants. Such a finding is important for the development of theoretical price-setting models that need to take into account the differences stemming from the character of the corresponding price setters and possibly model their optimisation strategies accordingly.

As can also be noticed, the sign of the estimated effects is not typically opposite for the price increases and for the price decreases. This finding justifies the separation of the two – were the effects opposite, the analysis could be simplified to focus on price changes as such.

The magnitude of the estimated effects is predominantly below 1.0% and not rarely too small to be reported (though still significant, cf. values *0.0* or *-0.0* which refer to estimated coefficients smaller than |*0.01*| after rounding to one digital value). Although this may seem too small, these values actually represent a quite strong effect of the underlying explanatory variables: For example the effect of wages on *1. Food and Non-Alcoholic Beverages* to see that a one-percent increase in this variable raises the probability of a price increase of food products by 0.1% and decreases it in the case of the price decreases by 0.1%. This means that if wages double (a 100% increase), the probability goes up by 10% for price increases and down by 10% for price decreases – so the estimated effects are in fact rather large.

This kind of interpretation cannot be applied to index-type variables such as *Market Competition*. In this case the estimated effects correspond to a one-unit increase as opposed to a one-percent increase. In the case of this variable, hence, the probability of a price change drops by up to 5% as a result of market competition index growing by 10 units in any of the twelve product categories. To demonstrate, note that this index ranges from 3.9 to 8.7 for seven out of eight regions of Slovakia and is equal to 84.9 for the capital Bratislava region. This means that (ceteris paribus) the effect of the market competition intensity on prices is such that prices change relatively much more frequently in seven out of eight regions of Slovakia, but are relatively much more stable in the region of the capital.

Table 3. Hazard Rates Estimates, Product Categories 1-3

Product Category: / Explanatory Variables:	1. Food and Non-Alcoholic Beverages		2. Alcoholic Beverages, Tobacco		3. Clothing, Footwear	
	Price Increases	Price Decreases	Price Increases	Price Decreases	Price Increases	Price Decreases
Wage	0.1***	-0.1***	-0.2***	-0.2**	-0.2***	-0.7***
Wage(-1)	-0.2***	-0.2***	-0.2**	0.2***	0.9***	1.0***
Oil Price	-0.0	-0.0	-0.0	-0.0	0.1***	0.0
Oil Price(-1)	0.1***	-0.0	0.1***	-0.0	-0.2***	-0.3***
Currency Value	1.5***	0.6***	0.1	1.5***	3.8***	4.3***
Currency Value(-1)	-1.7***	-0.9***	0.3	0.2	-1.2***	-1.3***
Productivity	-3.5***	-3.0***	-2.3***	-3.7***	- 0.3	2.4***
Productivity(-1)	2.4***	2.4***	1.6***	5.1***	1.2*	0.5
GDP Gap	2.6***	2.1***	2.0***	4.1***	0.4	-2.0***
GDP Gap(-1)	0.6***	-0.1	0.3*	-0.4*	0.3	-0.5**
Last Price Adjustment	-0.2***	0.0	-1.4***	-0.0	0.0	-0.1***
Price Lag	-0.1***	-0.1***	-0.4***	-0.9***	-0.0***	-0.0***
Interest Rate	2.0***	2.9***	1.7***	0.7	4.0***	1.3
Market Competition	-0.1***	-0.2***	-0.3***	-0.2***	-0.4***	-0.3***
Neg. Dev. From Avg.	0.3***	0.3***	0.8***	0.5***	-0.0	0.0
Neg. Dev. From Avg.^{2}	-0.0***	-0.0***	-0.0***	-0.0***	0.0**	0.0
Pos. Dev. From Avg.	-0.3***	-0.3***	1.1***	1.3***	0.1	-0.3**
Pos. Dev. From Avg.^{2}	0.0***	0.0**	-0.0**	-0.0	0.0***	0.0***
EU Entrance	7.0***	-0.6	-16.7***	-9.2***	-10.9***	-8.7**
Tax Law Passed	1.8**	-0.3	13.4***	14.0***	-18.2***	-26.2***
Tax Law Vetoed	1.9	-1.8	8.8**	17.0***	-3.5	-4.4
Number of Observations	754,663		130,006		94,699	
Log-likelihood	-3,120,920	-2,533,076	-585,397	-423,327	-289,429	-242,164
LR Chi$^2_{20}$	6,004	5,633	2,594	1,283	1,527	1,573
Prob > LR Chi$^2_{20}$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: ***denotes significance at 99%, ** at 95%, *at 90%

Source: Author's calculations

An intuitive explanation for this finding is that the price setters are reluctant to deviate from the equilibrium market price if the surrounding competition is fierce in order to keep their demand stable. This finding goes in line with the results of Caglayan, Filiztekin and Rauh (2006) and Gerardi and Shapiro (2007) who find negative correlation between price dispersion and market competition.

The price-setters are estimated to put strong weight on the *absolute size of the last price adjustment* when deciding on the extent of their price adjustment because generally the estimates are strongly significant. We find that the larger the last absolute price change, the larger the probability of a price increase or a price decrease (by at least 1% after rounding)

only in the case of *5. Furniture, House Equipment* and *8. Postal Services and Telecommunication*. For the rest of the product categories a large price adjustment in the past is associated with a smaller probability of another price change and hence with smaller price dispersion.

Table 3 continued. Hazard Rates Estimates, Product Categories 4-6

Product Category: / Explanatory Variables:	4. Housing, Water, Fuels		5. Furniture, House Equipment		6. Health Services	
	Price Increases	Price Decreases	Price Increases	Price Decreases	Price Increases	Price Decreases
Wage	0.9***	0.5***	0.3***	0.3***	1.2***	0.7***
Wage(-1)	-0.8***	0.8***	-0.3***	0.1	-1.5***	-2.4***
Oil Price	0.4***	0.1***	0.2***	0.2***	0.6***	0.0
Oil Price(-1)	-0.0	-0.1*	-0.2***	-0.2***	0.1*	0.1*
Currency Value	3.7***	5.0***	0.9**	0.3	-3.9***	-2.6**
Currency Value(-1)	-1.8***	-1.5*	0.5	0.8**	-0.1	-0.5
Productivity	5.6***	-5.6***	0.1	-2.4***	-5.7***	3.3***
Productivity(-1)	-9.1***	4.9***	-0.5	2.0***	-2.0**	-5.4***
GDP Gap	-7.8***	5.8***	0.2	2.6***	3.9***	-4.6***
GDP Gap(-1)	-0.1	0.9*	0.5**	0.0	1.7***	1.5***
Last Price Adjustment	-0.1***	0.0	-0.0	0.1***	-0.2***	-0.1***
Price Lag	-0.0**	-0.0	-0.0***	-0.0***	0.0***	0.0**
Interest Rate	9.8***	6.5***	4.2***	6.1***	13.0***	4.9***
Market Competition	-0.2***	-0.1**	-0.4***	-0.3***	-0.3***	-0.3***
Neg. Dev. From Avg.	-0.2***	-0.6***	-0.0	0.0	-0.4***	0.5*
Neg. Dev. From Avg.^{2}	0.0***	0.0***	0.0	0.0	0.0*	-0.0*
Pos. Dev. From Avg.	0.7***	-0.7***	-0.2	-0.8***	1.5***	0.1
Pos. Dev. From Avg.^{2}	-0.0	0.0**	-0.0	-0.0	-0.0***	-0.0
EU Entrance	0.2	-5.8	-5.8	5.0	-20.4***	0.5
Tax Law Passed	-13.9***	13.7*	-0.6	-13.2***	-15.0**	-55.2***
Tax Law Vetoed	-14.0**	-0.9	-4.4	-4.6	-41.8***	-59.9***
Number of Observations	52,260		97,840		30,555	
Log-likelihood	-193,559	-61,116	-294,448	-286,008	-94,785	-60,905
LR Chi^2_{20}	3,024	487	1,375	1,568	1,076	776
Prob > LR Chi^2_{20}	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: ***denotes significance at 99%, ** at 95%, *at 90%

Source: Author's calculations

Table 3 continued. Hazard Rates Estimates, Product Categories 7-9

Product Category: / Explanatory Variables:	7. Transportation Services		8. Postal Service, Telecommunication		9. Recreation, Culture	
	Price Increases	Price Decreases	Price Increases	Price Decreases	Price Increases	Price Decreases
Wage	0.2***	0.2***	0.8	-0.1	0.3***	0.1*
Wage(-1)	-0.3***	0.3***	-1.8	-0.4	-0.4***	-0.3***
Oil Price	0.2***	0.0	-1.4***	-0.2	0.2***	0.2***
Oil Price(-1)	-0.1***	0.0	1.6***	0.4**	-0.2***	-0.2***
Currency Value	2.4***	0.7***	5.0	-1.4	1.1**	0.2
Currency Value(-1)	-1.8***	-0.2	-0.5	2.8	1.8***	1.2***
Productivity	-0.3	-7.4***	4.8	-1.1	0.4	0.8
Productivity(-1)	0.7*	7.8***	-2.2	1.3	-0.0	-0.7
GDP Gap	0.1	7.2***	-6.5	-0.2	-0.1	-0.4
GDP Gap(-1)	-0.6***	0.5***	0.4	-0.3	-0.4*	0.1
Last Price Adjustment	-0.4***	-0.6***	0.6	0.3*	-0.0	0.0
Price Lag	0.0***	0.0***	-0.0**	0.0	-0.0***	-0.0***
Interest Rate	1.4***	1.0*	-13.8	2.4	0.1	2.4***
Market Competition	0.0***	-0.0	0.1	-0.2	-0.2***	-0.3***
Neg. Dev. From Avg.	-1.2***	-1.3***	0.8	0.0	0.0	0.1
Neg. Dev. From Avg.^{2}	0.0***	0.0***	-0.0	0.0	-0.0	-0.0
Pos. Dev. From Avg.	-3.0***	-3.2***	0.8	-1.8	0.5***	-0.2
Pos. Dev. From Avg.^{2}	0.0***	0.0***	-0.1	0.0	-0.0	-0.0**
EU Entrance	1.2	-5.7	86.1	6.1	-5.0	-7.0*
Tax Law Passed	-22.0***	11.4***	57.0	31.2	6.2*	-4.1
Tax Law Vetoed	-3.1	19.1***	144.8	15.2	4.7	0.3
Number of Observations	272,944		1,579		82,710	
Log-likelihood	-1,706,118	-1,199,097	-2,334	-6,864	-230,524	-290,752
LR Chi$^2_{20}$	2,749	2,232	68	46	936	1,577
Prob > LR Chi$^2_{20}$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: ***denotes significance at 99%, ** at 95%, *at 90%

Source: Author's calculations

In light of Klenow and Malin (2009), our findings can be interpreted as partly suggesting time-dependent pricing due to significant negative coefficients for price decreases in most of the product categories, but partly as state-dependent pricing due to significant negative coefficients for price increases. All in all, the pricing strategies in the economy analysed in this study seem to be a mixture of the two types of pricing.

This effect might be capturing a general preference of the price-setters to adjust their prices by smaller amounts but more often, or alternatively, by larger amounts but less often. This would be in line with Carlton (1986) who found a negative correlation between the frequency of price changes and the average absolute price change. The result for *5. Furniture,*

House Equipment says that the larger the last price adjustment, the larger the probability of a price increase, which could be interpreted as a tendency of the price setters to compensate instable prices in one period by decreasing them on the next occasion. The finding in the case of *8. Postal Services and Telecommunication* is counter-intuitive and can most readily be attributed to the fact that in this product category more than half of the products have regulated prices.

Table 3 continued. Hazard Rates Estimates, Product Categories 10-12

Product Category: / Explanatory Variables:	10. Education		11.Hotels and Restaurants		12. Other Goods and Services	
	Price Increases	Price Decreases	Price Increases	Price Decreases	Price Increases	Price Decreases
Wage	-2.6**	-5.6	-0.2*	-1.2***	0.4***	0.3***
Wage(-1)	1.0	0.5	0.6***	-0.2	0.0	0.1
Oil Price	0.5	0.8	-0.0	0.5***	0.0	0.0*
Oil Price(-1)	-0.3	-1.2	-0.0	-0.0	-0.2***	-0.1***
Currency Value	19.9**	-4.8	3.8***	-3.5**	1.9***	2.1***
Currency Value(-1)	-9.2	14.9	-0.9	5.9***	1.0**	0.4
Productivity	7.4	-16.8	-10.4***	-11.8***	-1.9***	-1.3
Productivity(-1)	-4.2	31.1	9.7***	8.3***	2.8***	1.6**
GDP Gap	-14.8	18.0	8.3***	13.4***	2.6***	1.0
GDP Gap(-1)	-15.2**	-10.8	-0.1	4.1***	-0.8**	-0.5*
Last Price Adjustment	-0.2**	-0.7**	-0.1***	-0.3***	-0.6***	-0.1***
Price Lag	0.0*	-0.0	0.1***	0.0**	0.0***	-0.0
Interest Rate	8.5	-25.9	16.1***	17.6***	-2.1**	4.0
Market Competition	-0.4**	-1.0	-0.6***	-0.4***	-0.3***	-0.2***
Neg. Dev. From Avg.	-0.2	-2.7	-0.2***	0.5**	-0.0	0.1
Neg. Dev. From Avg.^{2}	-0.0	0.0	0.0	-0.0	0.0	-0.0
Pos. Dev. From Avg.	-0.0	-1.1	-0.7***	-0.9**	-0.2	-0.4***
Pos. Dev. From Avg.^{2}	0.0	0.0	0.0**	0.0**	0.0	-0.0
EU Entrance	40.89***	-	5.4	-32.7**	0.3	13.3***
Tax Law Passed	-38.8	54.8	19.3**	-3.6	-2.5	-7.1**
Tax Law Vetoed	-	-	72.2**	54.2***	10.1**	-8.7
Number of Observations	1,198		32,248		75,934	
Log-likelihood	-2,719	-307	-113,977	-27,648	-258,772	-179,226
LR Chi$^2_{20}$	235	62	4107	1,408	1,683	1,202
Prob > LR Chi$^2_{20}$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: ***denotes significance at 99%, ** at 95%, *at 90%

Source: Author's calculations

The estimated effects on productivity are strongly significant in the case of all product categories except *8. Postal Services and Telecommunication, 9. Recreation and Culture* and *10. Education*, which are product categories with many regulated products. This finding shows that the price regulation system does not follow the trends of productivity and ceteris paribus applies – stable (i.e. rigid) prices strategy. For the rest of the product categories both the size and the sign of the coefficients at this variable vary across the product categories, but it can be stated that, in general, they are large; so the price-setters seem to be productivity-sensitive and adjust their prices in accordance with the productivity shocks.

Coefficients at wages, oil prices and currency value are estimated to have strongly significant effects on the probabilities of price changes for most of the product categories. As before, *8. Postal Services and Telecommunication* and *10. Education*, are the least sensitive to these exogenous macroeconomic indicators, and their prices are estimated not to react in response to these variables.

Also here it can be noted that for the rest of the product categories both the size and the sign of the coefficients at these variables vary across the product categories, but the size is generally smaller than what was estimated in case of productivity. This finding suggests that the extent of the price rigidity depends on how it is measured (i.e. in relation to what) because, as can be seen, prices are more rigid when it comes to reaction to shocks to wages, oil prices and currency value reaction, than they are when it comes to reaction to shocks to productivity.

Interest rate is estimated to have generally a large significant effect on the probabilities of price increases for all categories with a lower number of regulated products, which goes in line with the fact that higher interest rates pose pressure on the price-setters in the form of increased costs and thus push prices upwards. This finding is somewhat supported by the fact that the estimated coefficients on the interest rate in case of price decreases are insignificant in almost half of the product categories; so changes in the interest rates do not seem to affect the downward price changing. However, almost for the whole rest of the product categories the effects are estimated positive, which is counter-intuitive and might be explained as a result of over-parameterisation of the model.

Very large effects are also estimated for the *tax law dummies* and the *EU entrance dummy*. They are not significant for all the product categories, but where they are, they suggest a very strong response to the political, economic and social changes associated with the flat tax-rate introduction and the EU entrance in the context of the price adjustment. The most intuitive explanation is the direct and indirect effect on the underlying costs the price-setters incur stemming from these shocks.

At odds with the findings of Eckstein and Wyss (1972), who used lagged prices as important explanatory variables of current prices, even when all those variables which explain the desired prices were included, the price lag, although significant, is estimated to have a very small effect on the probabilities of the price changes for all the product categories except for the non-durables. This means that only in the case of these products does the price level affect the variation of the prices and through this its extent of rigidity.

The extent of the local price dispersion, captured by the *deviation from the average price in the region*, is estimated to have a small and often insignificant effect on both price increases and decreases across the product categories. It seems to be an exceptional case for the price-setters to adjust their prices towards the regional average and it only holds (to some extent) for *1. Food and Non-Alcoholic Beverages, 2. Alcoholic Beverages and Tobacco, 4. Housing, Water and Fuels* and *11. Hotels and Restaurants.*

This result suggests that the extent of competition among the price-setters is not too large and the prices instead respond to direct or indirect underlying costs for most of the products and are only competition-sensitive in the case of the above mentioned non-durables, housing products and services. A similar result was found in Copaciu, Neagu and Braun-Erdei (2009), who identified that forty-three percent of the Romanian firms set their price as a mark-up over costs. However, as they point out, this is a rather low figure when compared with similar estimates from other areas, such as the eurozone or the U.S. Therefore, the prices in Slovakia seem to follow a pattern of mark-up pricing over costs to a larger extent than they do in Romania; as opposed to simply adopting the market price, although apparently there exists some imperfections in the level of the information flow in Slovakia among the price-setters, due to which the price-setters are not able to generate a fully adequate response to changes in the competition prices.

5. Conclusions

In this paper we empirically estimated the price-setting patterns of final goods and services at the store level in the Slovak republic. We applied two approaches, a standard method of averaging and the survival time analysis. The main reason to perform the first one was to be able to compare the price-setting patterns of a transition economy with those of developed economies as most of the existing literature on this topic employs this method. However, as the period in our analysis is relatively large and the Slovak economy underwent various economic and political changes during this period, simple averaging could result in loss of some information present in the data in the form of a varying trend or in the form of a different reaction to different types of shocks. Survival analysis provides a relatively simple tool to identify and estimate the extent of price rigidities without incurring the above mentioned information losses.

Indeed, results from the two methods differ and point to the fact that deeper estimation of the extent of price rigidities reveals more about the underlying patterns than the standard method of averaging. Using the latter we obtained the following results. First of all, frequency of price changes varies across product categories with one third of food prices changing in a given month, with less than one fifth of prices changing in a given month in case of clothes, footwear and household industry. As for services, less than ten percent of prices change per month. This pattern is roughly the same in the eurozone and U.S., though prices are slightly more flexible there. Frequency of price increases is comparable to the frequency of price decreases and although price decreases are typically smaller than price increases, they exhibit the same order of magnitude.

Applying the survival time analysis we found that the prices move to a different extent in response to different types of shocks. More specifically, the prices are competition-sensitive to a limited extent while they significantly react to shocks affecting the incurred costs such as wages, productivity, oil prices or currency value as well as such a strong shock as changes in the tax-policy or in the political environment. This means that while prices may seem rigid from the point of the competition density, they are far from performing so when it comes to their ability to react to changes in the underlying costs. Furthermore, the extent of these types of rigidities varies across the product categories in a different way than we saw when using the averaging method. In particular, we saw that prices are far more rigid for

services than they are for non-durables, while no such general result could be derived using the survival analysis in which we identified the causal effects.

The findings in this study are relevant from Slovakia's inner policy point of view as well as from a broader point of view, especially in the context of the EU and the common currency area integration. Slovakia as a transition economy and at the same time a country which entered the EU (and for that matter, later the common currency zone) serves as a very good source for analysis and as an excellent example in order to learn from the information that can be extracted from its price-setting patterns and the extent of its price rigidities. Indeed, since the ability of prices to adjust to changes in market conditions indicates efficiency of a free-market economy, findings of such an analysis play an important role from the monetary, social and economical policy point of view, both on the national and international level. Therefore, these findings can provide valuable information to use to derive conclusions on the monetary and macroeconomic performance of new entrants in the context of the EU and common currency area accession criteria.

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Appendix. Sales indicator

In our data no sales indicator is available; so we cannot control for the influence of sales on our results. At the same time, though, there is no reason to believe sales are uncommon in Slovakia. To see how strongly sales affect the price change probabilities, we proxy the sales in the following way: we define a price quotation as *sales price quotation* if it is by at least 10% lower than the preceding price quotation and at the same time the price quotation of the preceding and the succeeding periods are equal.

We then recalculate frequency of a price change and duration of a price spell, marking all sales price quotations as regular price quotations. The results are reported in Table 4. As we can see, the effect of sales price quotations is minimal. We can only see difference in the statistics in the first two product categories and even there it is minor. The overall values for the full sample do not change after accounting for the sales proxy.

This small difference in the aggregate results suggests that the lack of sales indicator in our data is not a drawback and does not need to be specially treated. This result goes in line with Canetti et al. (1998); where the authors find that 80% of the firms rarely or never offer discounts and 11% do so in minority cases.

Table 4. Frequency and Duration of a Price Spell after Proxying Sales

Product Category (COICOOP group)		Raw Data		Proxied Sales	
		Frequency of price change	Duration of price spells	Frequency of price change	Duration of price spells
1	Food and Non-Alc. Beverages	36%	4.0	36%	3.8
2	Alc. Beverages, Tobacco	23%	6.2	24%	6.1
3	Clothing and Footwear	18%	9.2	18%	9.2
4	Housing, Water, Fuels	8%	17.5	8%	17.5
5	Furniture, House Equipment	16%	10.8	16%	10.7
6	Health Services	14%	15.0	14%	15.0
7	Transportation Services	36%	11.2	36%	11.2
8	Postal Service and Telecom.	2%	34.4	2%	34.4
9	Recreation and Culture	14%	17.3	14%	17.3
10	Education	4%	30.0	4%	30.0
11	Hotels and Restaurants	5%	23.7	5%	23.7
12	Other Goods and Services	8%	21.8	8%	21.8
	Total	17%	15.0	17%	15.0

Source: Author's calculations