Price rigidity in Romania: evidence based on microeconomic data

Introduction

The topic of price rigidity is highly relevant for central banks, given its influence in terms of monetary policy effects on the real sector. In fact, in macroeconomic modelling, mechanisms such as "price setting a la Calvo" or the Philips curve play a key role in how the economy responds to various kinds of shocks. The origin of these mechanisms lies in prices exhibiting rigidity at microeconomic level, i.e. under the action of different types of costs (menu costs, information costs, costs of damage to customer relations, etc.), firms often choose to keep their prices unchanged, even if those levels do not ensure (any longer) the optimisation of benefits.

The availability of microeconomic data is a major advantage in the study of the aforementioned topic. Caplin and Spulber (1987) showed how different mechanisms acting at the firm level have, under certain conditions, similar implications at the aggregate level. Thus, assessments based solely on macroeconomic data may lead to inaccurate findings, and economic policymakers will find it difficult to anticipate the implications of a change in those conditions. However, the use of information at individual level requires important preliminary processing steps, given the aim to remove developments that are pure "noise" and preserve the economically significant ones.

This analysis sets out to provide some key information regarding domestic price rigidity, based on an extensive dataset covering the prices of goods and services in the CPI basket. Drawing on the literature, the analysis also aims to make a comparison between the local and euro area situations, and hence to provide a useful perspective in the context of Romania's adoption of the single European currency.

Assessment of consumer price rigidity

Description and preliminary processing of data

The analysis of consumer price rigidity was carried out using a monthly database provided by the National Institute of Statistics, covering the period from January 2015 to December 2018 and related to all the goods and services included in the CPI basket. This means approximately 5 million observations, each comprising the month of the observation, the COICOP code[1] of the product, the name, the unit of measurement, the collected price, the anonymised code of the shop and the county in which the shop is located. At the most disaggregated level, there are almost 2,000 product codes and the geographical size covers 742 shops across all counties in Romania.

The first step in data processing was to remove the non-uniquely identifiable items in a given shop in a given month, as there are cases in which these observations

[1] "The classification of individual consumption by purpose" is the standard used to describe household expenditure in order to define the components of the representative basket of goods and services.

contain different prices – for example, if there are several products whose characteristics fit the variety description. The next step was to manage the cases where an item is no longer in the stock of a particular supplier and then becomes available again after a number of months. There are two possibilities: (i) the item is back in stock at the same price, in which case the approach taken was to impute the observed price in the months when the item was out of stock; (ii) the item is back in stock at a different price, in which case the choice was to ignore the change, since the month when it occurred cannot be determined with certainty among the out-of-stock months.

Another important step in primary data processing dealt with addressing situations where discounts are applied. Their presence can be seen essentially as generating volatility and reducing price stickiness, without having a fundamental impact, however, in terms of inflation – the discount is applicable in general for a short, predetermined period and then the price returns to its initial level. The observations covering price discounts were removed via the symmetric "V-shape" filter from Nakamura and Steinsson (2008). The first filtering stage consists in identifying those situations where, following a reduction, the price returns exactly to its initial level within a few months.

The second stage involves replacing the discounted price(s) with the initial one and hence assuming zero price changes through the lens of the fundamental analysis of price rigidity. A 3-month filtering period was chosen for Romania, while longer periods produced marginal changes in results. The symmetric filter – which identifies a discount only if the price returns exactly to its initial level – has the advantage that, for items with volatile prices, it avoids the simple condition of the price going back above the level seen in the discount months, as this could lead to the detection of fake sales if prices fell from inherent causes in that period. The disadvantage of this approach is that sales will not be identified when a price change occurs immediately after the discount months.

Finally, the observations that were outliers in terms of the size of the month-on-month price change, namely those outside the range from the 1st percentile to the 99th percentile of the distribution of non-zero price changes, were removed.

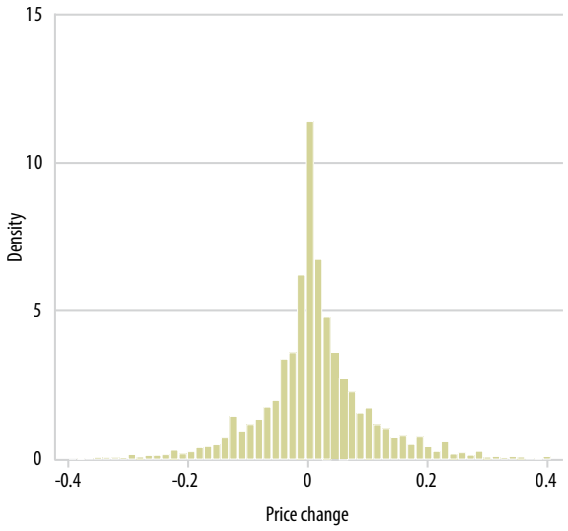
The result was a database of over 4.7 million observations, most of them covering situations where the price

Table A. Descriptive statistical indicators for the distribution of price changes

	Distribution of price changes (both non-zero and zero changes)	Distribution of non-zero price changes
No. of observations	4,735,527	559,741
Average	0.1%	1.1%
Standard deviation	0.035	0.102
Skewness	1.01	0.07
Kurtosis	46.7	5.5
p1	-11.9%	-29.0%
p5	0.0%	-15.4%
p10	0.0%	-10.5%
p25	0.0%	-3.0%
p50	0.0%	0.6%
p75	0.0%	5.0%
p90	0.0%	12.8%
p95	1.4%	18.9%
p99	14.3%	31.8%

Source: NIS, NBR calculations

Chart A. Distribution of non-zero price changes



Source: NIS, NBR calculations

remained unchanged from one month to the next – only about 0.6 million observations include non-zero price changes. Table A comprises some descriptive statistical indicators for the distribution of all price changes (which includes both zero and non-zero price changes), as well as for the distribution of the non-zero price changes; the latter's shape is depicted in Chart A.

Several preliminary findings can be drawn from this information. First, the ratio of the total number of non-zero changes to the total number of observations indicates a roughly 12 percent (unweighted) monthly frequency of price changes, i.e. most of the prices valid at a given moment in time are the same as in the preceding month, changes being reported only in 12 percent of cases, on average. The mean and median of the distribution for non-zero price changes are in positive territory, which implies that price increases are more prevalent than price decreases; however, the 1st quartile is negative, indicating that price cuts also have a relatively high frequency. Moreover, it can be assessed that, relative to the inflation rate, the size of the changes is significant – according to the information in the table regarding the distribution tails, one fifth of the adjustments are either price decreases of more than 10.5 percent or price increases of more than 12.8 percent. By comparison, the monthly CPI inflation rate over the same period ranged between -2.95 percent and 1.3 percent.

Results

The aforementioned average frequency of price changes is calculated by including the VAT rate changes implemented over the period. The time span under review saw three significant VAT rate cuts: the reduction in the VAT rate on food in June 2015 and the lowering of the standard VAT rate in January 2016 and in January 2017. These decisions are good opportunities for identifying the relevant microeconomic mechanisms of the price-setting process, but the significant number of large shocks in a relatively small amount of time may distort assessments about the "typical" consumer price behaviour.

Furthermore, the previous calculations took into account, in an undifferentiated manner, the goods and services in the database. However, one could argue that, for instance, the price rigidity of meat products is more relevant for the overall picture than that of the passport fee, whose share in the CPI basket is less significant. This is all the more relevant as the frequency of price changes is highly heterogeneous across the different components. Therefore, in order to have as accurate a picture as possible of consumer price rigidity at aggregate level, as well as in individual categories, adjustments were made so that the frequency of price changes should take into account the weight of the products in the CPI basket and the influence of VAT rate changes be removed (Table B).

Table B. Frequency and size of price changes for certain categories of products in the CPI basket

	Processed food	Unprocessed food	Energy	Non-food items excl. energy	Services	Total	Adjusted CORE2
Frequency of price changes	21.1	41.0	46.4	15.3	15.4	24.0	16.2
Frequency of price increases	14.3	23.3	27.0	10.4	9.7	14.5	9.8
Frequency of price decreases	6.8	17.7	19.4	4.9	5.7	9.5	6.4
Size of price increases	4.9%	7.5%	4.0%	6.7%	8.1%	6.7%	6.0%
Size of price decreases	-4.7%	-7.3%	-3.6%	-7.1%	-6.5%	-6.3%	-5.6%

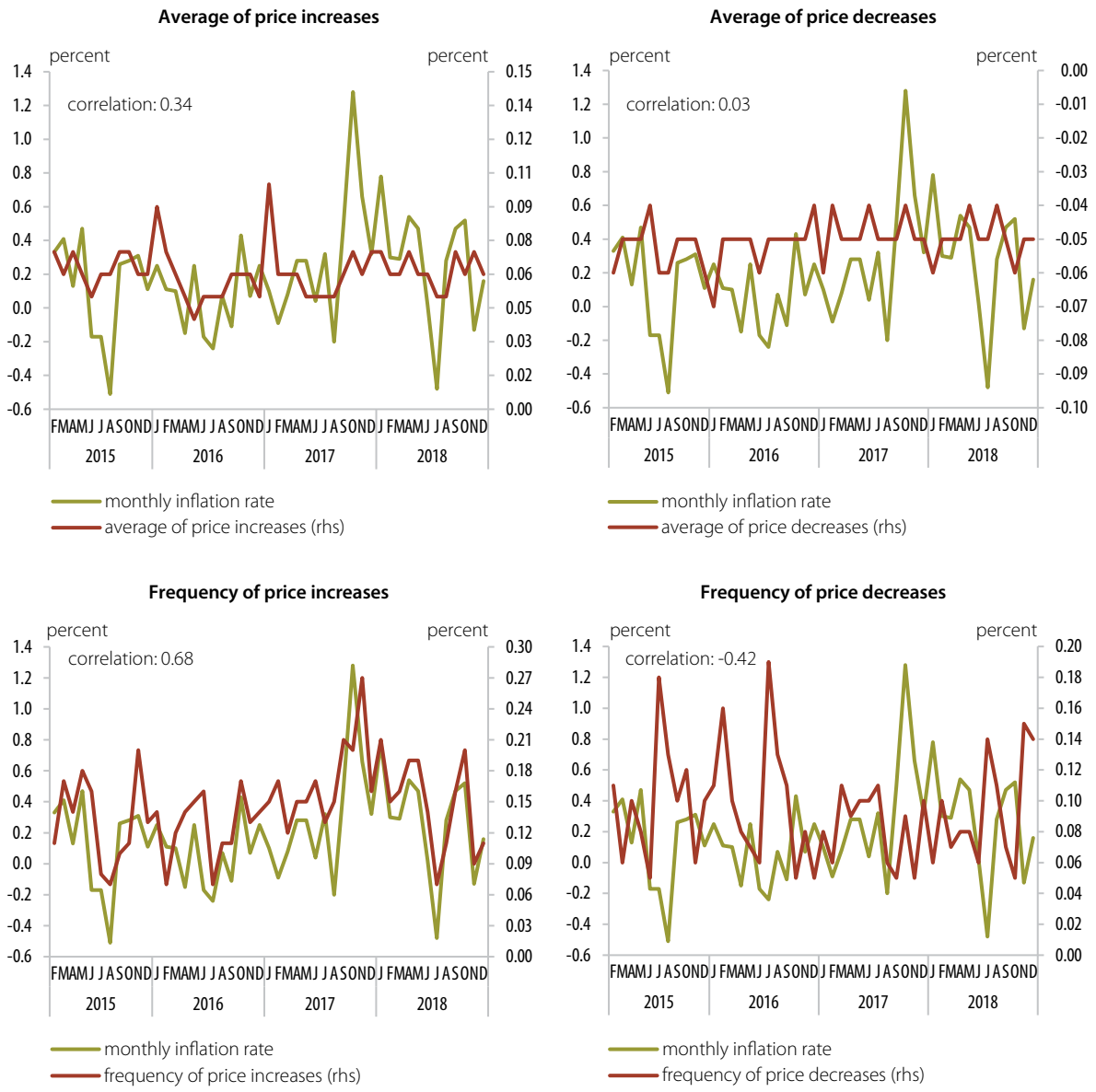
Note: The adjusted CORE2 aggregate is a proxy derived by excluding from the CPI basket food items with volatile prices, energy, tobacco products and alcoholic beverages, as well as services with administered prices, given that, in the latter case, not all categories could be identified precisely.

Source: NIS, Eurostat, NBR calculations

Food items exhibit greater price flexibility, in particular the vegetables, fruit and eggs (VFE) component, which is not necessarily surprising, given that these goods belong to the category of items with volatile prices. The said category also includes fuels, which contributes to accounting for the high level of price flexibility for energy as well. The cases under discussion are notable for the significant influence of commodity prices (including wholesale prices of unprocessed food items) on final prices and the volatility of the former, together with that of the exchange rate, and the specific perishability of the VFE component lend flexibility to consumer prices. Turning to processed food items, the more complex cost structure of the food industry than that of the unprocessed food sector reduces the impact of international commodity price volatility on final prices, their flexibility remaining however quite high in comparison with non-food items (excluding energy) and services. In the latter case, price flexibility would be much lower (6.7 percent frequency) if it were not for the influence exerted by telecom services (an important subcomponent), whose prices are largely indexed to exchange rate movements.
At aggregate level, the significant share of food and energy in the CPI basket leads to higher price flexibility as compared with the corresponding value of the unweighted indicator, the jump being sizeable, to approximately 24 percent. Thus, the structure of the CPI basket may be the source of noticeable differences between consumer price rigidity in two different economies, even though the correspondent business sectors are characterised by similar price-setting parameters.

According to the aforementioned findings, price changes in the available set of data are mostly price increases. Nevertheless, decreases are also fairly widespread, their share (adjusted for the weight of each category in the consumer basket) reaching around 40 percent. This result also holds for the main groups of the CPI basket, which suggests that the market for goods and services operates smoothly as a whole, meaning that there is a competitive environment in which companies have to lower their prices rather frequently for reasons related to market share. In turn, Copaciu *et al.* (2010) and Iordache and Pandioniu (2015) attest to the prevalence of a competitive environment in the domestic economy.

Chart B. Frequency/average size of price changes and the inflation rate



Source: NIS, NBR calculations

Price cuts are fairly common in the case of services as well, even occurring somewhat more frequently than for processed food items or non-food items (excluding energy), which mirrors however, to a great extent, the linking of telecom services prices to the exchange rate. The services sector probably exhibits lower competition intensity, given that some activities cannot be traded internationally.

It is not only the frequency of price changes that influences the inflation rate, but also their size. The breakdown shows large – both upward and downward – movements in the CPI items. Therefore, the inflation rate is the result of numerous opposite contributions, which partially offset each other, this being the case for both CPI and its main components. Given that all four possible combinations of frequency/average size of price increases/decreases appear to be relevant for the headline inflation rate, the question naturally arises as to which of them is the most important (Chart B).

The frequency of price increases has the strongest correlation with the inflation rate. Thus, more than often the pick-up in inflation from one period to another stems from the occurrence of more price increases in the economy.

Chart B also highlights the seasonality of price-setting decisions. July and August typically witness fewer price rises and more price reductions, the opposite situation prevailing in October and November, but also in May. As far as the average size of price changes is concerned, the seasonal impact is less visible. The literature generally underlines the January effect as well. Nevertheless, the available data cover a period in which two standard VAT rate changes occurred, both of them being implemented at the beginning of the year, which limits the possibility of observing the said effect. The influence of the seasonal factor contributes to the time-dependent dimension of price setting. Mention should be made that such approaches intertwine with state-dependent ones – the most obvious case in point for the latter is perhaps the response of most prices under review to a VAT rate change. The two aforementioned papers concerning the price-setting mechanism in the Romanian economy testify, in turn, to the fact that local companies mix time- and state-dependent pricing strategies.

The findings presented above allow to substantiate a comparison between price rigidity in the Romanian and euro area economies. Thus, the price-setting parameters on the domestic front share some similarities with those for the euro area, as shown by comparing the evidence from this analysis with the results obtained by Dhyne *et al.* (2006), who examine the state of affairs in the Member States of the monetary union. According to the above-mentioned paper, in the euro area approximately 15 percent of prices change (weighted frequency) and there are substantial differences between product categories. Just as in Romania, energy prices are the most flexible, ahead of unprocessed food prices. The differences refer to services prices being distinctively stickier in the euro area, while the increased flexibility in the case of Romania comes from the frequent changes in some services prices due to their linking to the exchange rate. Price decreases are relatively common in the euro area as well, both at aggregate level (in around 42 percent of cases) and at the level of individual categories of goods and services. In addition, similarly to the domestic economy, price changes are sizeable compared with the inflation rate.

Conclusions

This analysis offers some coordinates of consumer price setting in the domestic market, presenting a short comparison in this respect between Romania and the euro area.

Thus, the CPI basket exhibits an adjusted average frequency of price changes of approximately 24 percent. This indicator varies quite considerably across different types of goods and services. Specifically, the volatility of international commodity prices lends flexibility to final prices for energy and unprocessed food, whereas prices for other categories of goods and services are stickier.

The breakdown shows that developments in the CPI items are slightly counterintuitive as compared with the headline inflation rate, whose (monthly) values are relatively

moderate and nearly always positive. On the one hand, price cuts occur rather often, which indicates the prevalence of a competitive environment in the domestic economy (a conclusion also reached by other research papers), and, on the other hand, the size of price changes is sizeable. Therefore, in each period, the inflation rate is the result of numerous individual contributions that offset each other. From one period to the next, a step-up/slowdown in inflation most likely stems from the occurrence of a higher/lower number of price increases in the market.

The comparison between price rigidity prevailing on the domestic front and that in the euro area is relevant, given the process of joining the euro area. Different degrees of price rigidity would involve distinct paths of the inflation rate following a common shock, which would subsequently lead to welfare losses, as the decisions of the single monetary authority are calibrated depending on the situation prevalent at the monetary union level. The results obtained show that consumer price rigidity in the two economies has similar features. Even though prices change more often in the domestic economy, the share of price decreases is comparable, while the average size of price increases and price cuts is considerable compared with the inflation rate in both economies. Moreover, price flexibility in the Romanian economy would become lower once the euro is adopted and prices are no longer linked to the exchange rate.

The study of price rigidity based on microeconomic data has important advantages. This analysis provides some key information, a number of issues remaining however to be further examined. Subsequent research work will aim to capitalise on this database also in terms of substantiating some estimators of the pricing parameters in the domestic economy, hence providing a clearer picture of inflation dynamics (the shape of Philips curve respectively), of the monetary policy impact on the real economy and of the welfare costs entailed by price rigidity differences, assuming euro adoption. In addition, the mix of time- and state-dependent price-setting approaches raises questions on the extent to which the use of the Calvo mechanism may distort the response of inflation to economic shocks.

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