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New evidence on consumer price rigidity in Poland

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Abstract

Nominal rigidities play a central role in monetary policy transmission, shaping how inflation and real activity respond to various shocks. Using a large longitudinal dataset of granular price data for Poland covering 2000–2024, we contribute to the literature on price stickiness by documenting key features of price-setting behaviour in Poland. First, overall price stickiness in Poland is substantial, with the average (median) implied price duration of four (over six) months. Second, there is considerable heterogeneity and asymmetry present at the sectoral level. Third, the size of price changes is large, underscoring the importance of idiosyncratic shocks in price formation. Fourth, there is little evidence of downward nominal price rigidity outside the services sector, while there is strong evidence that price discounts play a significant role for price-setting. Finally, in recent years the frequency of price changes has increased broadly, indicating strengthened effectiveness of monetary policy in bringing inflation back to target.

Keywords: price rigidity, stickiness, consumer prices, micro data, inflation

JEL: D40, E31

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1. Introduction

We study the nature and evolution of price rigidities in Poland over the period 2000–2024. To this end, we make use of a unique, large-scale dataset of granular consumer prices. We document key patterns in the frequency, size, and duration of price changes across sectors. The analysis also covers the turbulent post-COVID-19 period and the aftermath of Russia's full-scale invasion of Ukraine, which profoundly affected inflation dynamics and price-setting behaviour.

Understanding price rigidity is crucial for assessing how monetary policy and macroeconomic shocks are transmitted to prices and real activity. A widely accepted view in macroeconomics is that monetary policy affects real economic activity in the short run precisely because prices and wages do not adjust instantly (for discussion see Nakamura, Steinsson 2013). Differences in the price-setting behaviour across countries, sectors, and time periods determine the speed and strength of policy effects and the persistence of inflation. Investigating how these mechanisms operate helps to better understand the nature of inflation dynamics and the effectiveness of monetary policy.

These questions are especially interesting in the context of Poland, for at least two reasons. First, Poland has undergone a remarkable economic transformation over the past three decades – from an emerging economy characterized by high inflation and multiple macroeconomic imbalances to the sixth-largest economy in the European Union, with robust growth, low pre-pandemic inflation, and an independent monetary policy framework. Second, it demonstrated strong resilience during the COVID-19 pandemic in terms of growth, but also high sensitivity to the inflationary effects of Russia's full-scale invasion of Ukraine, largely due to its geographic proximity to the war. As such, examining price-setting in Poland offers valuable insights into how an open, fast-growing economy outside the euro area responds to both global and regional shocks. Given these observations, we expect that prices in Poland may have recently become less rigid but still display substantial sectoral heterogeneity. We also assume that recent large external shocks should be reflected primarily in changes in the frequency of price adjustment rather than in a uniform shift across all dimensions of price-setting behaviour.

Our paper contributes to the literature by providing a comprehensive documentation of price-setting behaviour in Poland. We present new evidence on the structure and dynamics of price rigidity in a large European economy outside the euro area. This rich descriptive analysis helps fill an important empirical gap in the literature, which has so far focused predominantly on the euro area and the United States. By shedding new light on price formation, we provide essential information both for the central bank – seeking to understand the degree of price stickiness and thus the potential effectiveness of monetary policy – and for researchers calibrating theoretical and empirical models, such as dynamic stochastic general equilibrium (DSGE) models, where the price stickiness parameter plays a crucial role.

We show that price rigidity in Poland is substantial, with roughly 22% of prices changing each month on average. Depending on whether mean or median statistics are considered, we estimate the implied price duration to be about four or six months. We also uncover substantial heterogeneity across sectors – prices of goods are highly flexible, whereas services prices are very sticky and display downward nominal rigidity. We further show that price discounts are an important factor of price-setting in Poland – they account for a large share of price changes and materially affect frequencies, durations and the distribution of price movements. Finally, we document that most pronounced shifts in the frequency of price adjustments are associated with one-off shocks. Most notably, we show that the frequency of price changes spiked following the onset of the full-scale Russian invasion of Ukraine but has declined markedly since 2022.

Our results have implications for the interpretation of monetary policy transmission. We do not provide a formal evaluation of the effects of monetary policy. Rather, our evidence suggests an interpretative hypothesis. It indicates that shifts in price-setting behaviour may have strengthened the effectiveness of monetary policy in bringing inflation back to target. Specifically, following the surge in the frequency of price adjustments after Russia's full-scale invasion of Ukraine, prices in Poland became more responsive to macroeconomic conditions. Consistent with economic theory, the sensitivity of inflation to interest rate changes should have increased as well. Our interpretation of this result suggests that in such an environment, monetary policy gains traction, as higher adjustment frequencies accelerate the pass-through of policy impulses to consumer prices. As inflationary pressures gradually receded, the elevated frequency of price adjustments increased the effectiveness of monetary tightening. This mechanism helps explain why inflation declined quickly and markedly despite persistent sectoral heterogeneity and why the recent tightening cycle in Poland proved more effective than historical patterns of price stickiness would have suggested.

The remainder of this paper is structured as follows. In Section 2 we briefly review the related literature. In Section 3 we characterize our dataset and outline the methodology for calculating price rigidity. Section 4 provides the discussion of the main results. Section 5 concludes and summarizes our findings.

2. Literature review

There are two major strands of literature on price rigidity. The first relies on extensive datasets of micro-level prices used in the compilation of consumer price indices (such as the CPI or HICP) to examine key features of price-setting. The second focuses on price formation in online markets, comparing the behaviour of online prices with that observed in traditional micro price datasets underlying official consumer price indices.

Our paper fits into the first strand of the literature, which began with the seminal work of Bils and Klenow (2004). Since then, numerous empirical studies have examined price behaviour using micro-level data. For the US, Klenow and Kryvtsov (2008) and Nakamura and Steinsson (2008) provide detailed analyses of price stickiness. In the European context, Álvarez et al. (2006) and Dhyne et al. (2005, 2006) present comprehensive evidence based on harmonised price data.[1]

Klenow and Malin (2010) provide a comprehensive summary of the empirical literature on price rigidity that developed in the early 2000s. Several robust findings have emerged from this body of work:

I. Overall price rigidity is substantial, with average price durations of about one year. This rigidity tends to be more pronounced in the euro area than in the United States.

II. There is considerable heterogeneity and asymmetry at the sectoral level, leading to substantial differences between mean and median price durations.

III. The average size of price changes is large relative to the inflation rate, underscoring the role of idiosyncratic shocks. However, small (non-zero) price changes are also observed.

IV. There is limited evidence of downward nominal price rigidity in most sectors, with the notable exception of services.

[1] The works by Dhyne et al. (2005, 2006) and Álvarez et al. (2006) compile results from the coordinated exercise carried out within the Inflation Persistence Network established by the ECB.

V. Properly accounting for price discounts is essential for measuring price rigidity accurately. Discounts explain a large share of the cross-country variation in results and have significant implications for the calibration of theoretical models.

VI. Price-setting behaviour is affected by a variety of sector-specific factors, but price rigidity tends to be higher in labour-intensive sectors.[2]

VII. The synchronization of price changes is low.

This strand of literature has been more recently extended to different inflationary environments. Alvarez et al. (2019) analyse micro price data for Argentina covering periods of low inflation, high inflation, and hyperinflation.[3] Wulfsberg (2016) investigates price behaviour in Norway during episodes of low and high inflation. Similarly, Berardi, Gautier and Bihan (2015) provide evidence on price-setting dynamics in France during a period of deflation. In parallel with these studies, additional evidence on price stickiness has emerged for various other economies.[4]

Most recently, Gautier et al. (2024) made an important contribution to the study of price rigidity by analysing a comprehensive dataset of granular price data as part of a large-scale harmonized exercise covering 11 euro area countries. This study documents price-setting behaviour during a period of low inflation. The analysis was subsequently updated by Gautier et al. (2026) to incorporate data up to 2024, including the high-inflation period of 2022 and 2023. These studies provide a natural benchmark for our results and can be treated as a reference point in the literature. At the same time, without unifying the methodological approach, direct quantitative comparisons should be made with caution because available estimates differ in country and product coverage, sample periods, treatment of sales, and aggregation procedures. A fully harmonized cross-country comparison is beyond the scope of the present study.

The second strand of the literature examines price formation in online markets. This line of research includes studies by Lünnemann and Wintr (2011), Gorodnichenko and Talavera (2017), Gorodnichenko, Sheremirov and Talavera (2018), and Cavallo (2018). Furthermore, Henkel et al. (2023) analyse the price-setting behaviour during the COVID-19 period, while Strasser et al. (2023) compare price dynamics in online and offline markets, and Stelmasiak et al. (2026) examine price formation around VAT rate changes. While e-commerce has become increasingly pervasive across economies – as documented by Mućk et al. (2025) – price rigidity statistics in online markets may provide a different picture of price-setting, particularly due to the higher sampling frequency of online data, as shown by Cavallo (2018). As such, this strand of literature remains only loosely connected to our work.[5]

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[2] Among others, these include: market structure (i.e. concentration and competition), the business cycle, seasonality, producer price formation, and wage-setting mechanisms.

[3] Gagnon (2009) studies this issue for Mexico.

[4] Contributions on price stickiness for selected economies include Baudry et al. (2007) for France, Hoffmann and Kurz-Kim (2006) for Germany, Macias and Makarski (2013) for Poland, Dixon and Tian (2017) for the UK, and Rudolf and Seiler (2022) for Switzerland. Dhyne et al. (2005, 2006) and Klenow and Malin (2010) provide further references to early, country-level works based on large micro-level datasets. Álvarez et al. (2006) and Dhyne et al. (2006) summarise country-level results for a harmonized sample of 50 goods and services using a unifying methodology described in Dhyne et al. (2005).

[5] Lünnemann and Wintr (2011) find ambiguous outcomes regarding the flexibility of online prices but document large heterogeneity in the frequency of price changes. Gorodnichenko and Talavera (2017) show that prices are more flexible in online markets than in regular stores, more dispersed, change weakly, but are more sensitive to the exchange rate. Gorodnichenko, Sheremirov and Talavera (2018) report similar findings but argue that, despite the small physical costs of price adjustment, price-setting in online markets is characterized by considerable frictions and that by many metrics online prices are as imperfect as offline prices. Cavallo (2018) demonstrates that time-averaging and imputing prices can account for the differences in price rigidity between online and offline markets. Hillen and Fedoseeva (2021) argue that the high flexibility of online prices is also sector-dependent.

3. Data and methodology

In this section, we characterize our micro price dataset. Next, we outline the empirical approach used to calculate price rigidity statistics.

3.1. Data

We conduct the analysis using annual datasets of prices quoted in outlets across Poland. These prices are collected by Statistics Poland and subsequently used to compile the Consumer Price Index (CPI).

In essence, granular data on prices of consumer goods and services are recorded continuously throughout each year. However, every year the composition of the consumption basket is updated. To make the analysis of price rigidities feasible, we first meticulously merge price series for representative products across the entire sample period and manually verify the accuracy of this process. Following this step, we obtain a panel dataset spanning the period from January 2000 to December 2024. Overall, our database contains over 81 million price quotes for up to 2000 representative consumer goods and services, recorded monthly in up to 300 locations, effectively covering the entire CPI basket. This broad coverage is important for the interpretation of our results, as it captures price-setting across product categories and locations rather than within a narrow subset of the consumption basket.

Regarding data cleaning, we first exclude goods and services for which only average prices or price indices are reported, as these do not correspond to individual price quotes.[6] Second, we remove outliers, defined as price decreases exceeding 80% or price increases above 400%.[7] Despite these exclusions, coverage across all elementary CPI groups is preserved.

Our database contains no information on sales, imputations, product substitutions, or quantity- and quality-adjustments. Therefore, we identify promotional prices using filters proposed by Gautier et al. (2024) and Nakamura and Steinsson (2008).[8] As for quantity adjustments, Statistics Poland already controls for changes in the product package size to capture the 'true' price change. Meanwhile, the share of quality-adjusted prices or imputations is relatively small, according to international evidence (Menz, Wieland, Mehrhoff 2022; Gautier et al. 2024), and thus should not materially affect our results.

[6] Such price aggregates are reported for certain products (e.g. the most popular book sold in a given retail chain). Moreover, Statistics Poland also incorporates scanner data and online prices into the CPI calculation. We exclude these observations as well since they enter the database in the form of price indices rather than individual price quotes. Importantly, both Macias, Stelmasiak and Szafranek (2023), and Szafranek et al. (2025) demonstrate that the dynamics of online and traditional retail price indices in Poland are closely aligned, suggesting that the exclusion of these data is unlikely to have a meaningful effect on our results.

[7] This is defined as the monthly rate of change in prices. A total of 5307 price quotes were excluded from the database, representing 0.04% of all recorded prices.

[8] The filter proposed by Gautier et al. (2024) refines the procedure originally developed by Nakamura and Steinsson (2008). We therefore adopt this approach as our baseline specification. Results obtained with the alternative framework are available in Macias et al. (2026). The choice of filter has no material effect on our results.

3.2. Method

We study the price-setting process at the level of individual (unit) prices using the frequency approach, widely adopted in the literature (e.g. Bils, Klenow 2004; Dhyne et al. 2006; Klenow, Kryvtsov 2008; Nakamura, Steinsson 2008; Gautier et al. 2024; Gautier et al. 2026).

In our analysis, an individual price quote refers to the price of a specific good or service recorded by Statistics Poland at a particular point of sale in a given month. Based on these observations, we compute key indicators of price stickiness – the frequency and size of price changes, and the implied price duration. For the first two measures, we also report separate statistics for price increases and price decreases.

All measures are calculated for all the elementary groups, COICOP[9] classes (at the four-digit level) and divisions (at the two-digit level), as well as for several custom groups that we construct (i.e. main disaggregates of the CPI basket), alongside headline and core inflation baskets. When aggregating the results for Poland, we apply the CPI weighting system.

Frequency of price change

Let P_{ijt} denote the price of *i*-th individual product at time *t* assigned to the representative item *j*. First, we generate an indicator variable x_{ijt} equal to one if P_{ijt} and P_{ijt-1} are observed and zero otherwise. Consequently:

$$x_{ijt} = \begin{cases} 1 & \text{if } P_{ijt} \text{ and } P_{ijt-1} \text{ are observed} \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

In practice due to the indicator x_{ijt}, all statistics can be computed starting from $t = 2$. Next, we calculate z_{ijt}. It is a binary variable equal to one if the price of the *i*-th product assigned to the representative item *j* changes between $t - 1$ and *t*, and zero otherwise. Hence,

$$z_{ijt} = \begin{cases} 1 & \text{if } P_{ijt} \neq P_{ijt-1} \ \wedge \ x_{ijt} = 1 \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

To account for price increases and decreases, we make use of two additional binary variables, w_{ijt} and s_{ijt}. They are defined as follows:

$$w_{ijt} = \begin{cases} 1 & \text{if } P_{ijt} > P_{ijt-1} \ \wedge \ x_{ijt} = 1 \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

$$s_{ijt} = \begin{cases} 1 & \text{if } P_{ijt} < P_{ijt-1} \ \wedge \ x_{ijt} = 1 \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

[9] COICOP stands for Classification of Individual Consumption by Purpose. In Poland, consumer expenditures are categorized according to this classification system for the purpose of compiling the Consumer Price Index (CPI).

Using these binary variables from Equations (1)–(4), we calculate the frequency of price changes, increases and decreases. Let f_{jt} denote the frequency of price changes, f_{jt}^{+} that of price increases, and f_{jt}^{-} that of price decreases for the representative item j at time t. We calculate them as in Equations (5)–(7):

$$f_{jt} = \frac{\sum_{i=1}^{n_j} z_{ijt}}{\sum_{i=1}^{n_j} x_{ijt}} \tag{5}$$

$$f_{jt}^{+} = \frac{\sum_{i=1}^{n_j} w_{ijt}}{\sum_{i=1}^{n_j} x_{ijt}} \tag{6}$$

$$f_{jt}^{-} = \frac{\sum_{i=1}^{n_j} s_{ijt}}{\sum_{i=1}^{n_j} x_{ijt}} \tag{7}$$

In all cases n_j denotes the number of individual products assigned to the representative item j at time t.

The measure of the frequency of price changes, increases and decreases for a given time period, 1,..., T^*, is calculated as an arithmetic average. Hence:

$$\overline{f}_j = \frac{\sum_{t=1}^{T^*} f_{jt}}{T^*} \tag{8}$$

$$\overline{f}_j^{+} = \frac{\sum_{t=1}^{T^*} f_{jt}^{+}}{T^*} \tag{9}$$

$$\overline{f}_j^{-} = \frac{\sum_{t=1}^{T^*} f_{jt}^{-}}{T^*} \tag{10}$$

Finally, it should be noted that measures of the frequency of price changes can be interpreted as the probability of a price change, as they represent the (average) fraction of prices that changed, increased or decreased over a given period.

Size of the price change

Having defined measures related to the frequency of price changes, we turn to statistics on the average size of price changes, increases and decreases. Let dp_{ijt} denote the change in the price of the good or service i from $t - 1$ to t, naturally assuming that $x_{ijt} = 1$:

$$\mathrm{dp}_{ijt} = \frac{P_{ijt}}{P_{ijt-1}} \tag{11}$$

We calculate the size of price changes, increases and decreases at time t for the representative item j as follows:

$$\mathrm{dp}_{jt} = \frac{\sum_{i=1}^{n_j} \mathrm{dp}_{ijt} z_{ijt}}{\sum_{i=1}^{n_j} z_{ijt}} \tag{12}$$

$$\mathrm{dp}_{jt}^{+} = \frac{\sum_{i=1}^{n_j} \mathrm{dp}_{ijt} w_{ijt}}{\sum_{i=1}^{n_j} w_{ijt}} \tag{13}$$

$$\mathrm{dp}_{jt}^{-} = \frac{\sum_{i=1}^{n_j} \mathrm{dp}_{ijt} s_{ijt}}{\sum_{i=1}^{n_j} s_{ijt}} \tag{14}$$

where n_j again denotes the number of products assigned to the representative item j at time t.

The average size of the price changes, increases and decreases is computed as a simple average:

$$\overline{\mathrm{dp}_j} = \frac{\sum_{t=1}^{T^*} \mathrm{dp}_{jt}}{T^*} \tag{15}$$

$$\overline{\mathrm{dp}_j^{+}} = \frac{\sum_{t=1}^{T^*} \mathrm{dp}_{jt}^{+}}{T^*} \tag{16}$$

$$\overline{\mathrm{dp}_j^{-}} = \frac{\sum_{t=1}^{T^*} \mathrm{dp}_{jt}^{-}}{T^*} \tag{17}$$

Group aggregation

As a first step, statistics are computed for elementary groups, which represent the lowest units of classification to which Statistics Poland assigns weights. Given that an elementary group typically comprises several representative products, metrics of frequencies and sizes of price changes are derived using an arithmetic average.

$$f_{kt} = \frac{\sum_{j=1}^{J} f_{jt}}{J} \tag{18}$$

$$\mathrm{dp}_{kt} = \frac{\sum_{j=1}^{J} \mathrm{dp}_{jt}}{J} \tag{19}$$

where J denotes the number of the representative items j belonging to the elementary group k at time t.

To arrive at price stickiness measures at the aggregated level, we employ the weighting system used in the compilation of the CPI. This type of aggregation is common in studies on price rigidity (e.g. Dhyne et al. 2006; Gautier et al. 2024; Gautier et al. 2026). It can be described as follows:

$$\overline{f}_t = \sum_{k=1}^{K} \omega_{kt} f_{kt} \tag{20}$$

$$\overline{\mathrm{dp}}_t = \sum_{k=1}^{K} \omega_{kt} \mathrm{dp}_{kt} \tag{21}$$

where ω_{kt} denotes the weight of elementary group k at time t. Conceptually, $\overline{f}_t$ and $\overline{\mathrm{dp}}_t$ measure the frequency and size of price changes for any group at a higher level of aggregation than the elementary-group level at time t.

As already noted, we make use of CPI weights that are consistent with the consumption patterns reported by Statistics Poland.

Time aggregation

The measure of the frequency and size of price changes for a given time period, 1,..., T^* is calculated as an arithmetic average. Hence:

$$\overline{f} = \frac{\sum_{t=1}^{T^*} \overline{f}_t}{T^*} \tag{22}$$

$$\overline{\mathrm{dp}} = \frac{\sum_{t=1}^{T^*} \overline{\mathrm{dp}}_t}{T^*} \tag{23}$$

We compute price-rigidity estimates for the entire sample, as well as separately for the pre-COVID-19 period (January 2000 – December 2019) and at an annual frequency since 2020 (unless stated otherwise).[10]

Duration

A simple rationale would be to calculate the implied duration for any representative item j as the inverse of the average price frequency: $\overline{T}_j = \overline{f}_j^{-1}$. However, this calculation method implicitly assumes that retailers change their prices at most once per month. We follow other contributions (e.g. Bils, Klenow 2004; Baudry et al. 2007; Nakamura, Steinsson 2008) and estimate the implied price duration under the implicit assumption of an equal probability of price change over the course of the month (so that prices are determined in continuous time).[11] Therefore, the average implied price duration is given by:

[10] This division is motivated by our empirical evidence. To preview the results, given their stability across time (cf. Figure 4), mean and median estimates from the first subsample serve as a pre-pandemic benchmark. In turn, due to the pronounced variation in the price-setting behaviour following the outbreak of the pandemic and Russia's full-scale invasion of Ukraine, estimates for the remaining part of the sample are reported annually.

[11] Specifically, we also do not compute direct measures of duration, based on price spells and trajectories. Baudry et al. (2007) discuss why using an indirect (frequency-based) approach offers several advantages over inferring duration directly. Further discussion of the assumptions underlying different duration measures can be found there.

$$\bar{T}_j = -\frac{1}{\ln\left(1-\bar{f}_j\right)} \tag{24}$$

Since for some representative items the average frequency of price change may be zero or close to zero ($\bar{f}_j \approx 0$), leading to extremely large values of implied duration at the aggregate level, we prefer to calculate duration from aggregated statistics, such as the average frequency for the overall CPI:

$$\bar{T} = -\frac{1}{\ln\left(1-\bar{f}\right)} \tag{25}$$

Price synchronization

We assess the degree of price synchronization at any group k using the ratio proposed by Fisher and Konieczny (2000):

$$S_k = \left(\frac{1}{T}\frac{\sum_{t=1}^{T}\left(f_{kt}-\bar{f}_k\right)^2}{\bar{f}_k \times \left(1-\bar{f}_k\right)}\right) \tag{26}$$

This measure is bounded between 0 (perfect staggering) and 1 (perfect synchronization).

4. Results

The behaviour of individual prices exhibits substantial heterogeneity across product categories. We begin with a simple illustration of two extreme cases of price dynamics. On one end of the spectrum are fuel prices, which are highly flexible and adjust frequently, with price reductions occurring regularly (Figure 1, left panel). At the opposite end are prices for a men's haircut, which are notably sticky and may remain unchanged for several years, with price decreases being virtually absent (Figure 1, right panel). Moreover, for certain products, price changes follow seasonal patterns, whereas for others, sales play a significant role in shaping the observed price dynamics.

In the following part of this section, we present summary statistics describing price-setting behaviour in Poland, accounting for heterogeneity across product categories as well as changes over time. The analysis focuses on the frequency and size of price changes, the degree of synchronization across products, and the importance of sales in driving observed price adjustments.

4.1. Frequency of price changes

Full sample

During the period 2000–2024, an average of 22.1% of prices were adjusted each month, implying that a typical price remained unchanged for approximately 4.0 months (Table 1). The median frequency

of price adjustments was lower, at 14.5%, indicating a higher degree of price rigidity and corresponding to an implied price duration of 6.4 months.

At the disaggregated level, price rigidity exhibits substantial heterogeneity. Prices of goods are notably more flexible than those of services. As expected, energy and food prices are very flexible (with the average frequency of price adjustment at 36.5% and 30.5%, respectively). Non-energy industrial goods are still quite flexible and change on average after roughly five months. In turn, services prices are relatively sticky, with the mean and the median frequency of price changes at only 8.8% and 3.0%, respectively.

For the overall CPI basket, the average frequency of price increases amounts to 12.8%, while price decreases occur at a rate of 9.3%, suggesting that price cuts are nearly as common as price hikes. A similar pattern – both in mean and median terms – emerges across most major product categories (Table 1, Figure 2–3). The services sector stands out as an exception: prices there increase roughly twice as often as they decrease (6.0% vs. 2.8%), likely reflecting the importance of wages in setting prices and their associated downward nominal rigidity.

Overall, price changes exhibit a relatively low degree of synchronization, as indicated by the Fisher-Konieczny ratio of 0.27. This is true for most main disaggregates of the CPI basket, with the notable exception of energy prices, which tend to adjust more synchronously (Table 1). Our evidence suggests that price adjustments are largely staggered across products rather than concentrated in common repricing episodes. Studying how synchronization changes over time and how it interacts with sectoral inflation would require a separate dynamic analysis, which we leave for future research.

Subsample analysis

We now inspect whether price-setting has changed following the outbreak of the COVID-19 pandemic and Russia's full-scale invasion of Ukraine. For that purpose, we split the sample into two parts. For the first one – treated as a pre-pandemic benchmark and covering the period up to 2019 – we report only mean and median estimates across the whole period. For the second one, we provide yearly estimates given their much stronger variation. The results are presented in Table 2 and 3.

The frequency of price changes remained broadly stable between 2000 and 2019, averaging 20.3% (Table 2). During this period, movements in the frequency of price adjustments were largely seasonal in nature. After accounting for seasonal variation (Figure 4), it becomes evident that the most pronounced shifts in the frequency of price adjustments were associated with one-off shocks, such as Poland's accession to the European Union in 2004 and the VAT rate increase in 2011.

In contrast, the recent period of 2020–2024 presents a markedly different picture. The frequency of price changes rose significantly, averaging around 30%, largely in response to external shocks – most notably the COVID-19 pandemic and Russia's full-scale invasion of Ukraine.[12] The frequency of price changes peaked in 2022, before gradually declining in subsequent years, though it has remained elevated relative to the pre-pandemic level. This increase is somewhat more pronounced for the median frequency, indicating that it was broad-based rather than driven by large price movements within a few specific product groups, e.g. amid the fading of regulatory measures (Tables 2–3). While some episodes

[12] Szafranek, Szafrański and Leszczyńska-Paczesna (2024) document the sources of the inflationary episode in Poland using a structural Bayesian VAR model identified through a combination of zero and sign restrictions. They find that these sources are predominantly external.

in 2024 may have been affected by changes in government shielding mechanisms, the evidence points to a broader adjustment of prices across the CPI basket.

Figure 4 further illustrates several distinct spikes in the frequency of price adjustments over this period – corresponding to the reopening of the economy after COVID-19 lockdowns,[13] the shock following the Russian full-scale invasion of Ukraine, and, more recently, the phasing out of government shielding mechanisms for households introduced during the pandemic. Throughout this time, the overall rise in the frequency of price changes stemmed mainly from more frequent price increases.[14]

These empirical regularities are closely related to the distinction between time-dependent and state-dependent pricing. In time-dependent models, including Calvo-type pricing, firms adjust prices according to a calendar or with a relatively stable probability (Calvo 1983). The relatively stable frequency of price changes observed in Poland during much of the pre-pandemic period is consistent with such a mechanism. In state-dependent or menu-cost models, firms reset prices when the gap between actual and desired prices becomes sufficiently large.[15] Large cost or demand shocks should therefore increase the frequency of price changes. Once large shocks in our sample have occurred, the frequency of price changes has increased considerably, indicating a shift towards more state-dependent price-setting. While our frequency-based approach does not formally identify the underlying pricing rule, the evidence suggests that price-setting in Poland displayed features closer to time-dependent pricing in the low-inflation period and more state-dependent behaviour during the recent high-inflation episode. Testing this hypothesis lies beyond the scope of the paper and is an interesting avenue for future research.

4.2. Size of price changes

Typical upward and downward price adjustments tend to be relatively large (Table 1). Both the mean and median size of price increases (13.3% and 6.7%, respectively) and decreases (11.3% and 7.5%, respectively) exceed the observed inflation rate. This finding aligns with Gautier et al. (2024), who interpret such a pattern as evidence that idiosyncratic shocks at the firm level play a more significant role in price resetting than aggregate shocks. This interpretation reflects the fact that, at any given time, price increases and decreases occur simultaneously across products, while a large share of prices remains unchanged.

The substantial gap between the mean and the median results from the prevalence of numerous small price adjustments – half of all price changes fall within the range of -6.3% to 8.7% – as well as from the presence of fat tails in the distribution. Specifically, 10% of prices increased by more than 29.1% or fell by more than 30.6% (Table 4). Moreover, the density of round-number price adjustments rises across the distribution, indicating the importance of sales and psychological pricing behaviour (Figure 5).

[13] In the initial phase of the COVID-19 pandemic, many firms pledged not to adjust their prices. Once the lockdown was lifted, however, the frequency of price changes spiked, indicating that most firms reset their prices in response to various factors, such as higher costs associated with complying with sanitary restrictions.

[14] Figure 4 also shows that when the frequency of price changes spikes, the size of price changes generally remains in line with its previous trend. This suggests that, following a shock, firms tend to adjust prices more frequently by similar – or even smaller – margins, rather than implementing large, one-off price revisions.

[15] In other words, firms might change prices in response to specific economic conditions rather than at fixed intervals.

We find comparable magnitudes of price changes across most product categories. The only notable exception is energy prices, for which both the mean and median of upward (7.2% and 3.4%, respectively) and downward (6.2% and 3.5%, respectively) adjustments are substantially smaller (Table 1). This difference largely reflects the smaller average changes observed in fuel prices, which are also among the most flexible components of the CPI basket.

Over the period 2000–2024, the average size of both upward and downward price adjustments increased. These increases were driven primarily by larger price changes in food and non-alcoholic beverages, as well as in non-energy industrial goods. By contrast, the magnitude of price adjustments for energy and services remained broadly stable throughout the sample period.

4.3. The role of promotions

Promotions play a significant role in the price-setting process in Poland. Over the period 2000–2024, promotional prices accounted for 3.4% of all recorded prices (Table 1).[16] Their share is even more pronounced in the context of price adjustments. On average, 4.7% of prices change each month as a direct result of sales. Consequently, as much as 21.3% of all price changes can be attributed to sales,[17] of which 24.1% reflect downward and 19.2% upward adjustments associated with the end of sales.

The sizable contribution of promotions implies that excluding them from the analysis would substantially alter key measures of price rigidity. The average frequency of price changes would decline from 22.1% to 18.0% (median: from 14.5% to 11.1%), while the implied average price duration would extend from 4 to 5 months (or from 6.4 to 8.5 months when considering medians). Similarly, the frequency of both upward and downward price adjustments would fall to 10.7% and 7.3%, respectively.

The average size of promotional price changes is comparable to that of regular price adjustments. As a result, when promotions are excluded, the average upward adjustment equals 12.5%, compared with 13.3% when promotions are included, while the average downward adjustment amounts to 11.0%, compared to 11.3% with promotions. The distribution of regular price changes also becomes slightly more concentrated: roughly 34% of prices change by no more than 3.5%, compared with 28% when promotions are included (Table 4). Furthermore, the distribution exhibits thinner tails (Figure 5). This pattern is particularly pronounced for food and non-energy goods, reflecting the high prevalence of promotions within these categories and – to that extent – the competitive nature of the market.

5. Conclusions

This paper delivers a comprehensive assessment of price rigidity in Poland using a unique, large-scale micro dataset of CPI prices. By documenting the frequency, size, and duration of price changes across goods and services, we contribute to the literature by providing new evidence on an open economy outside the euro area that has undergone rapid structural transformation and recently experienced sizable shocks. Our analysis covers both the relatively stable pre-COVID-19 period and the subsequent

[16] In the paper, we present results obtained using the filter proposed by Gautier et al. (2024). For comparison, results based on the Nakamura and Steinsson (2008) filter are very similar. They are reported in Macias et al. (2026).

[17] For services and energy, sales account for less than 10% of all price changes, whereas for food and non-alcoholic beverages, their share is approximately 25%.

years marked by the pandemic and Russia's full-scale invasion of Ukraine, offering a detailed view of how price-setting behaviour responds to large and overlapping disturbances.

Our empirical results show that overall price rigidity in Poland is substantial. On average, around one-fifth of prices change each month, implying price durations of about four to six months, depending on whether one considers mean or median statistics. Behind these aggregates lies pronounced heterogeneity across sectors: prices of tradable goods – especially energy and food – are highly flexible and adjust frequently, whereas prices in services are very sticky, often remaining unchanged for more than a year and, in many cases, for several years. The large gap between mean and median durations in services indicates that a significant share of prices in this sector is extremely rigid. Promotions play a non-trivial role in shaping observed price patterns, accounting for a sizable fraction of price changes and materially affecting measured frequencies, durations and the distribution of price adjustments.

The post-2020 period reveals a clear regime change in the behaviour of prices. While the COVID-19 pandemic itself had only a limited impact on the price formation process, Russia's full-scale invasion of Ukraine triggered a sharp and persistent increase in the frequency of price changes in Poland, driven mainly by more frequent price increases. In this sense, the post-2020 period differs not only in the level of price adjustment but also in the much greater variation in price-setting behaviour. Although the frequency of price changes has declined from its 2022 peak, it remains elevated relative to the pre-pandemic period, suggesting that the recent high-inflation episode was associated with a higher degree of effective price flexibility. This conclusion is also supported by median statistics, which indicate that the increase was not confined to a few selected CPI components.

Our research suggests that shifts in price-setting behaviour may matter for monetary policy transmission. Coupled with economic theory, our evidence indicates that higher price adjustment frequencies make prices more responsive to macroeconomic conditions. These findings should be interpreted as a hypothesis rather than as a formal estimate of the effects of monetary policy. In the recent Polish disinflation episode, elevated price flexibility may have facilitated a faster pass-through of disinflationary forces once external cost pressures began to recede. However, assessing the strength of this channel and its implications for the output cost of disinflation would require a structural framework, which lies beyond the scope of this paper.

There are several interesting prospects for future research. First, the analysis on price formation could be extended by an investigation of the importance of intensive and extensive margins of price adjustments. Second, given the heterogeneity in the price-setting across sectors, it would be interesting to study the responsiveness of flexible and rigid prices to macroeconomic shocks. Third, a carefully designed international comparison of price formation would provide an important context for the evaluation of price-setting in Poland. Finally, the effects of changing rigidities could be studied through the lens of a dynamic stochastic general equilibrium model to corroborate the substance of our empirical findings.

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Appendix

Table 1
Price stickiness metrics

			Frequency of price			Size of price		Average duration	Share of sales	Price synch.
			change	increase	decrease	increase	decrease			
CPI	Incl. sales	mean	22.1	12.8	9.3	13.3	11.3	4.0	3.4	0.27
		med.	14.5	7.7	4.3	6.7	7.5	6.4	1.7	0.23
	Excl. sales	mean	18.0	10.7	7.3	12.5	11.0	5.0	.	0.26
		med.	11.1	5.9	3.2	6.1	6.9	8.5	.	0.21
By sector										
Core inflation	Incl. sales	mean	14.3	8.6	5.6	15.2	12.6	6.5	2.5	0.26
		med.	8.9	5.3	2.4	7.7	8.3	10.7	1.0	0.23
	Excl. sales	mean	11.5	7.2	4.3	14.7	12.5	8.2	.	0.24
		med.	7.5	4.4	1.9	7.1	8.0	12.9	.	0.20
Food and non-alcoholic beverages	Incl. sales	mean	30.5	17.3	13.2	12.0	11.1	2.7	6.5	0.18
		med.	25.1	13.0	9.4	6.7	7.6	3.5	5.7	0.20
	Excl. sales	mean	22.5	13.2	9.2	10.6	10.3	3.9	.	0.18
		med.	17.1	9.1	5.8	5.6	6.7	5.3	.	0.21
Energy	Incl. sales	mean	36.5	20.7	15.9	7.2	6.2	2.2	1.7	0.46
		med.	12.6	3.7	1.2	3.4	3.5	7.5	0.0	0.40
	Excl. sales	mean	33.6	19.1	14.5	7.2	6.2	2.4	.	0.47
		med.	10.0	3.1	1.1	3.4	3.4	9.5	.	0.35
Non-energy industrial goods	Incl. sales	mean	19.3	11.1	8.2	12.7	10.9	4.7	4.0	0.22
		med.	15.3	8.5	5.3	6.2	7.1	6.0	2.4	0.18
	Excl. sales	mean	14.7	8.7	5.9	11.7	10.5	6.3	.	0.19
		med.	11.5	6.4	3.9	5.7	6.8	8.2	.	0.14
Services	Incl. sales	mean	8.8	6.0	2.8	18.4	14.9	10.9	0.8	0.31
		med.	3.0	2.2	0.5	11.1	10.7	32.8	0.0	0.33
	Excl. sales	mean	8.0	5.5	2.5	18.2	15.0	12.0	.	0.30
		med.	2.8	2.0	0.3	11.1	11.1	35.7	.	0.28

Notes:
The table presents mean and median estimates of price stickiness for all goods and services as well as at the sectoral level for the full sample (i.e. 2000–2024). The share of sales and the results excluding sales are based on the sales filter proposed by Gautier et al. (2024). Price synchronization is calculated as in Fisher and Konieczny (2000).

Table 2

Mean estimates for price stickiness metrics: pre-COVID-19 benchmark and annual estimates for 2020–2024

	Frequency of price			Size of price		Average duration
	change	increases	decreases	increase	decrease	
2000–2019	20.3 (16.6)	11.6 (9.7)	8.7 (6.9)	13.0 (12.4)	11.3 (11.0)	4.4 (5.5)
2020	26.7 (21.0)	15.2 (12.2)	11.5 (8.8)	14.6 (13.4)	11.4 (10.7)	3.2 (4.3)
2021	27.4 (21.8)	18.3 (15.4)	9.1 (6.4)	13.9 (12.5)	11.3 (10.5)	3.1 (4.1)
2022	33.3 (28.0)	21.1 (18.6)	12.2 (9.5)	14.5 (13.7)	11.8 (11.5)	2.5 (3.0)
2023	30.2 (24.2)	16.7 (13.6)	13.5 (10.5)	14.3 (13.2)	11.8 (11.3)	2.8 (3.6)
2024	30.1 (22.7)	17.3 (14.0)	12.8 (8.7)	14.9 (13.4)	12.1 (11.3)	2.8 (3.9)

Notes:
The table presents mean price stickiness measures for the pre-COVID-19 benchmark period (2000–2019) and annual estimates for 2020–2024, when the variation in price-setting became much more pronounced. In parentheses we report measures calculated on prices after excluding sales using the Gautier et al. (2024) sales filter.

Table 3

Median estimates for price stickiness metrics: pre-COVID-19 benchmark and annual estimates for 2020–2024

	Frequency of price			Size of price		Average duration
	change	increases	decreases	increase	decrease	
2000–2019	13.0 (10.1)	7.1 (5.6)	4.2 (3.2)	6.6 (5.9)	7.4 (6.9)	7.2 (9.4)
2020	20.7 (14.1)	10.1 (7.6)	6.2 (3.9)	7.2 (6.1)	7.7 (6.7)	4.3 (6.6)
2021	22.0 (14.9)	12.9 (9.0)	5.3 (3.4)	7.5 (6.4)	8.2 (6.9)	4.0 (6.2)
2022	27.9 (20.6)	16.2 (13.6)	5.5 (3.5)	8.7 (8.2)	8.1 (7.6)	3.1 (4.3)
2023	24.5 (17.1)	12.7 (9.9)	7.0 (4.2)	8.2 (7.2)	8.1 (7.6)	3.6 (5.3)
2024	25.8 (14.0)	12.4 (8.3)	7.7 (3.8)	7.8 (6.7)	8.5 (7.3)	3.3 (6.6)

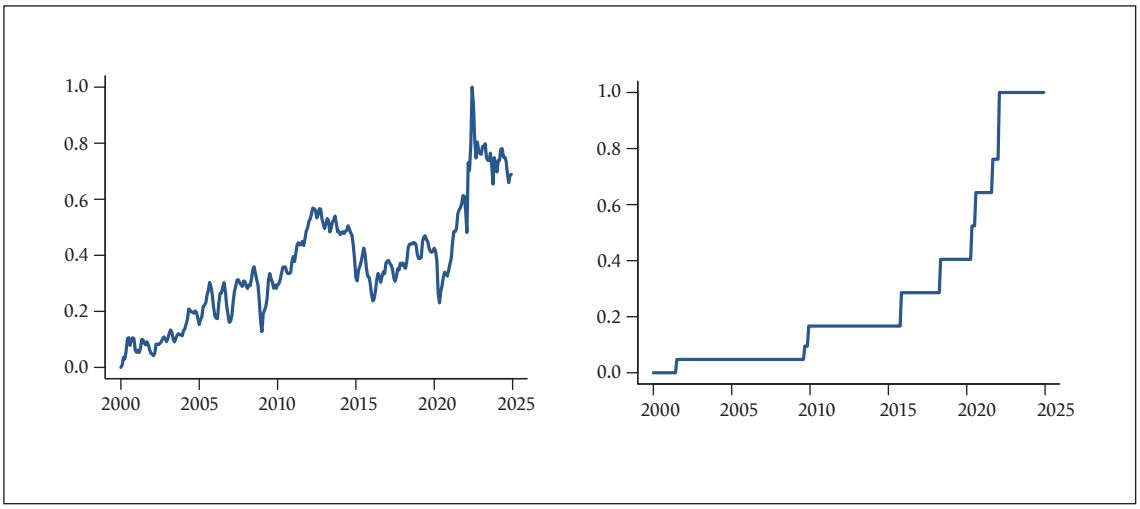
Notes:
The table presents median price stickiness measures for the pre-COVID-19 benchmark period (2000–2019) and annual estimates for 2020–2024, when the variation in price-setting became much more pronounced. In parentheses we report measures calculated on prices following the exclusion of sales with the use of the sales filter by Gautier et al. (2024).

Table 4
Distribution of (non-zero) price changes

	Percentiles (in %)							Percent of $\|dp\| \leq 3.5\%$
	5th	10th	25th	50th	75th	90th	95th	
Including sales								
CPI	-30.6	-19.9	-6.3	2.0	8.7	20.0	29.1	28.3
Core inflation	-28.8	-18.3	-5.5	1.9	8.6	19.2	28.8	31.0
Food and non-alcoholic beverages	-33.8	-22.4	-8.1	2.2	9.5	21.9	30.9	24.6
Energy	-9.0	-5.8	-2.1	1.0	4.0	9.0	14.7	34.2
Non-energy industrial goods	-29.2	-19.0	-5.9	1.5	7.8	18.2	28.7	31.5
Services	-22.5	-13.4	-1.2	5.7	13.3	24.1	35.5	27.4
Excluding sales								
CPI	-29.0	-18.3	-5.2	2.2	8.3	18.2	28.7	34.1
Core inflation	-27.5	-16.6	-4.6	2.2	8.3	18.2	28.6	36.1
Food and non-alcoholic beverages	-33.7	-21.2	-6.7	2.5	8.7	19.6	29.5	31.5
Energy	-9.1	-5.9	-2.0	1.0	4.1	9.3	15.3	35.0
Non-energy industrial goods	-28.4	-17.2	-5.2	1.7	7.4	16.2	26.2	37.4
Services	-22.4	-12.8	-0.8	5.8	13.5	24.5	35.6	28.2

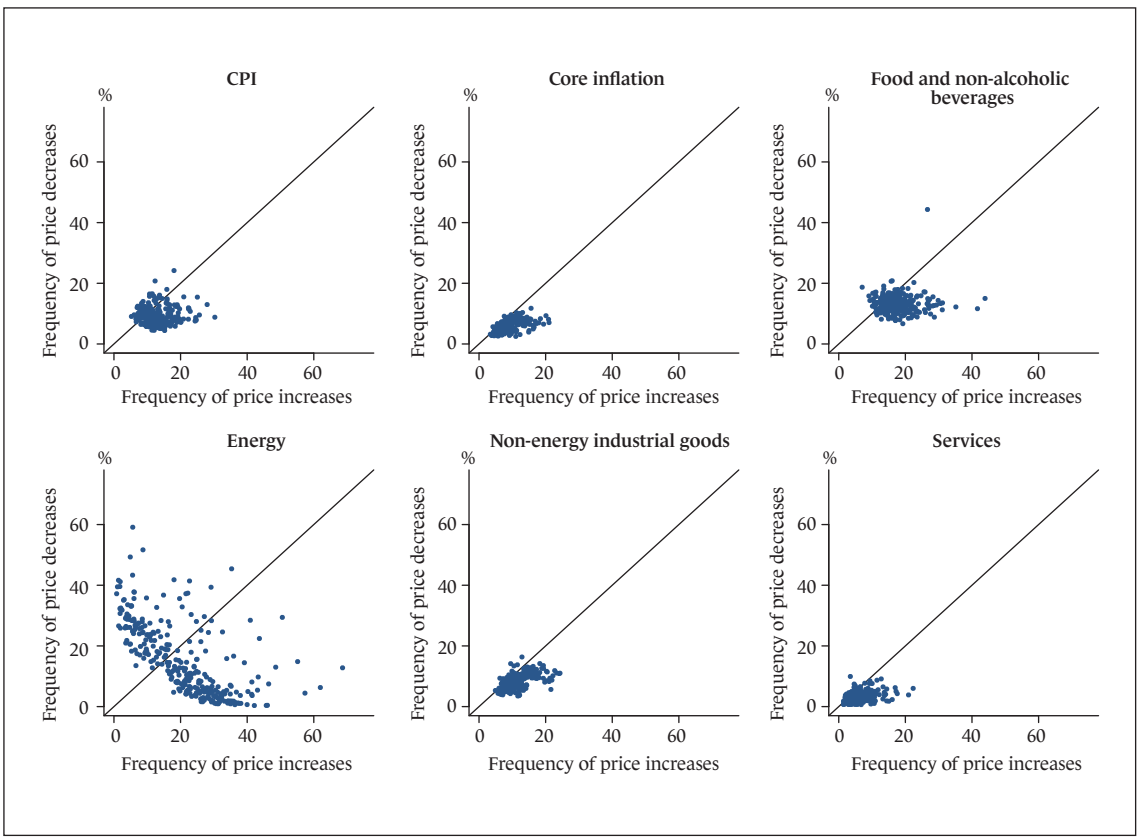
Notes:
The table provides selected percentiles of the size of (non-zero) price changes. Results excluding sales are based on the Gautier et al. (2024) sales filter. The last column denotes the fraction of prices that change by no more than 3.5% in absolute terms.

Figure 1
Prices of fuels (left panel) and men's haircut (right panel) at a random point of sale



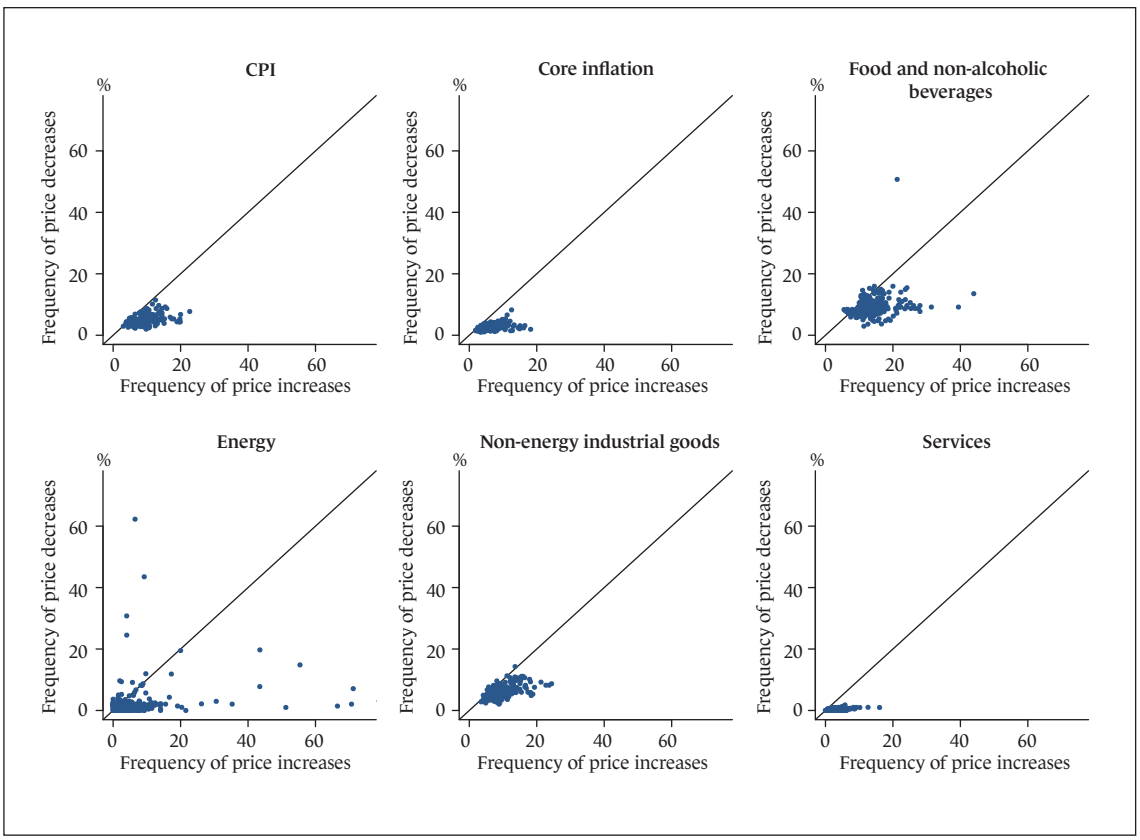
Notes:
The figure shows the prices of two products with a different degree of stickiness at a random point of sale. Fuel price is flexible and changes frequently, while the price for a men's haircut is sticky (rigid) and is adjusted only occasionally. Prices plotted on the figure have been normalized.

Figure 2
Price rigidity metrics at the product level



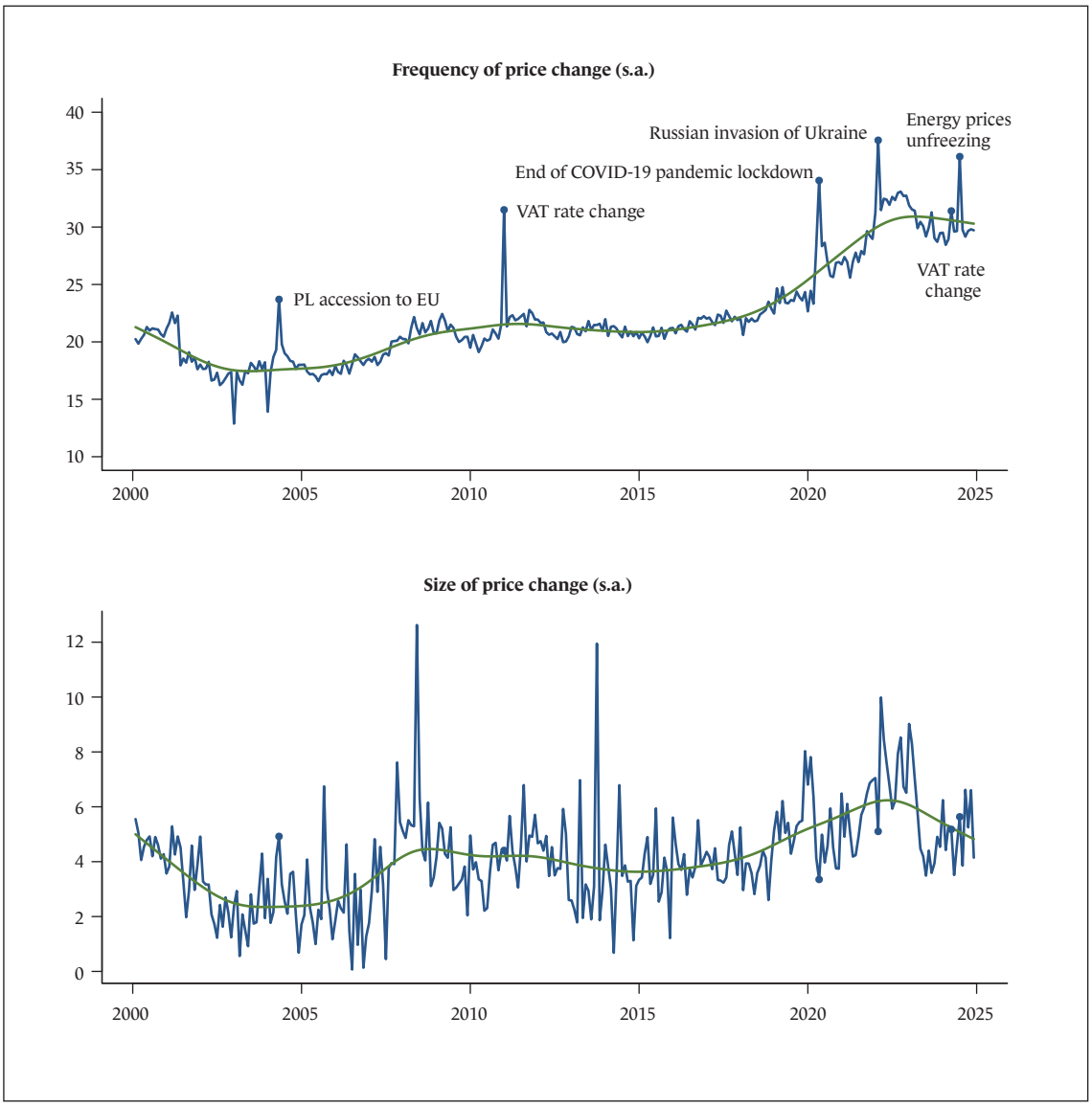
Notes:
The figure shows the frequency of price increases and decreases at the product level. Results are reported for mean estimates for prices including sales.

Figure 3
Price rigidity metrics at the product level



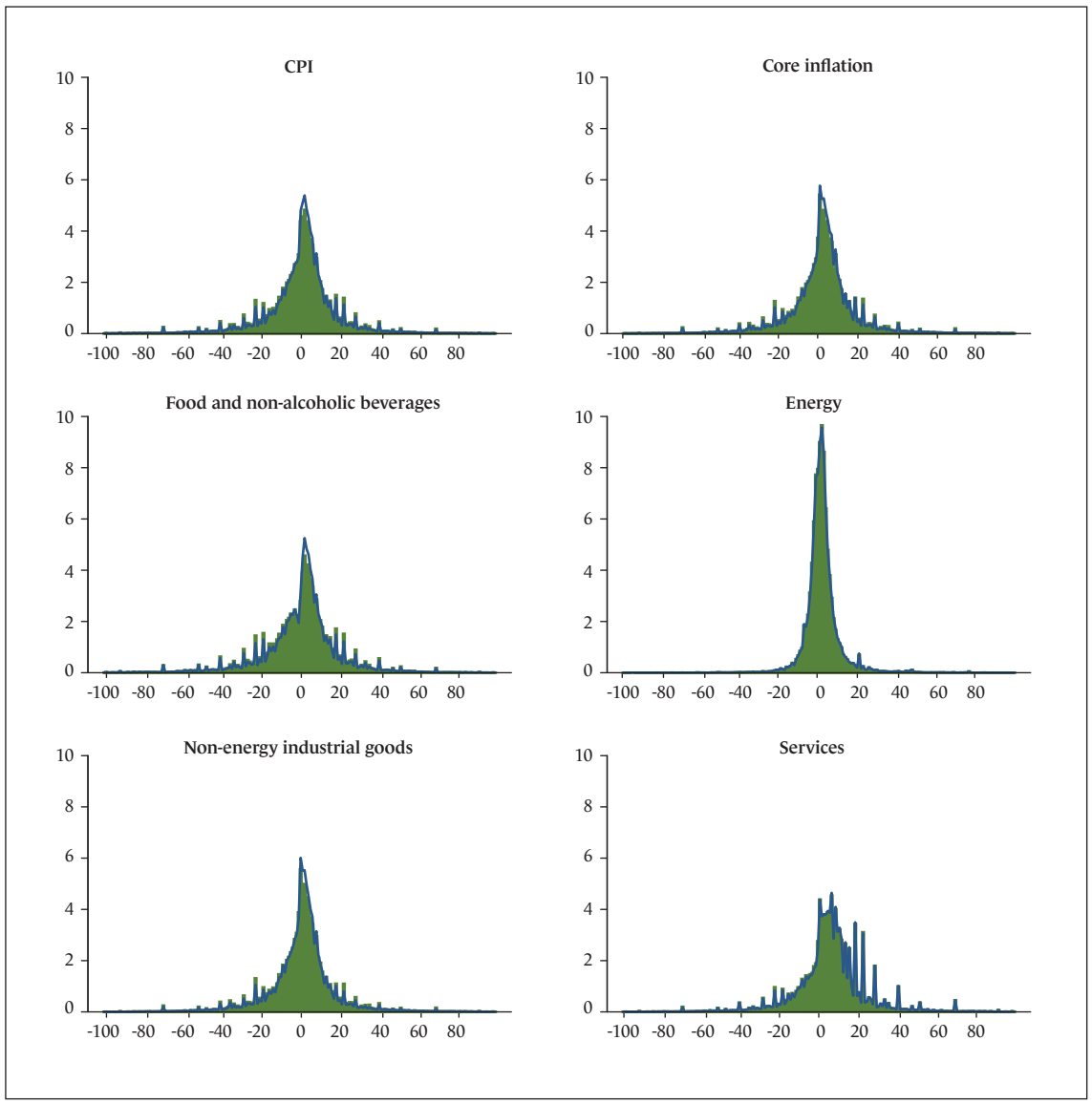
Notes:
The figure shows the frequency of price increases and decreases at the product level. Results are reported for median estimates for prices including sales.

Figure 4
Seasonally adjusted frequency and size of price changes



Notes:
The upper panel of the figure shows the frequency of price changes after adjusting for seasonal patterns along with the trend estimate using the Hodrick-Prescott filter. Dots denote major events shaping spikes in the frequency of price changes. The lower panel shows the seasonally adjusted size of price changes, with dots denoting values corresponding to the events marked in the upper panel.

Figure 5
Distribution of price changes



Notes:
The figure illustrates the distribution of price changes for all goods and services belonging to the CPI basket (upper left panel) as well as at the sectoral level (further panels). Green histograms show the distribution for prices including sales, whereas the blue line represents the distribution of price changes following the exclusion of sales using the Gautier et al. (2024) sales filter.

Nowe wyniki empiryczne dotyczące sztywności cen konsumpcyjnych w Polsce

Streszczenie

W badaniu dokonano pomiaru sztywności cen w Polsce w latach 2000–2024, opierając się na zbiorze danych na temat jednostkowych cen towarów i usług konsumpcyjnych. Przy wykorzystaniu podejścia częstotliwościowego udokumentowano kluczowe stylizowane fakty w zakresie częstotliwości zmian cen, średniej zmiany cen, przeciętnego czasu trwania ceny oraz roli promocji w procesie cenotwórczym, zarówno w ujęciu zagregowanym, jak i sektorowym. W badaniu przeanalizowano również kształtowanie się wskazanych wyżej metryk w okresie pandemii COVID-19 oraz po wybuchu pełnoskalowej inwazji Rosji na Ukrainę.

Ocena stopnia sztywności cen ma zasadnicze znaczenie dla zrozumienia tego, jak polityka pieniężna oraz szoki makroekonomiczne oddziałują na kształtowanie się cen konsumpcyjnych i aktywności gospodarczej. Teoria ekonomii wskazuje, że polityka pieniężna wpływa na realną aktywność gospodarczą w krótkim okresie właśnie dlatego, że ceny i płace nie dostosowują się natychmiast (są lepkie). Wnioski płynące z badania są istotne nie tylko dla banku centralnego, dążącego do lepszego zrozumienia stopnia lepkości (sztywności) cen, a tym samym potencjalnej skuteczności polityki pieniężnej, lecz także dla badaczy kalibrujących modele teoretyczne i empiryczne, w których stopień lepkości cen odgrywa zasadniczą rolę.

Zagadnienia te są szczególnie interesujące w kontekście Polski. W ciągu ostatnich trzech dekad gospodarka Polski przeszła znaczącą transformację i stała się szóstą co do wielkości gospodarką Unii Europejskiej, cechującą się trwałym wzrostem gospodarczym, umiarkowaną inflacją oraz niezależną polityką pieniężną. Analiza kształtowania się cen w Polsce powinna zatem dostarczyć cennych wniosków na temat procesu cenotwórczego w otwartej, szybko rosnącej gospodarce spoza strefy euro.

Z badania wynika pięć głównych wniosków. Po pierwsze wskazano, że ceny w Polsce charakteryzują się istotną sztywnością: przeciętnie około 22% cen zmienia się w każdym miesiącu. Po drugie, w zależności od przyjętej metryki typowy czas utrzymywania się ceny wynosi od czterech do sześciu miesięcy. Po trzecie, proces cenotwórczy różni się pomiędzy sektorami: ceny dóbr są wysoce elastyczne, natomiast ceny usług bardzo lepkie i wykazują przy tym nominalną sztywność w dół. Po czwarte, promocje cenowe stanowią ważny element procesu cenotwórczego w Polsce: odpowiadają za dużą część zmian cen i istotnie wpływają na częstotliwość, czas trwania oraz rozkład zmian cen. Po piąte, wyraźne zmiany częstotliwości zmian cen są powiązane z jednorazowymi szokami. W szczególności częstotliwość zmian cen gwałtownie wzrosła po rozpoczęciu rosyjskiej inwazji na Ukrainę, jednak od 2022 r. wyraźnie się obniżyła.

Wyniki badania mają również znaczenie dla interpretacji transmisji polityki pieniężnej. Przedstawione szacunki nie stanowią formalnej oceny skuteczności polityki pieniężnej. Sugerują jednak hipotezę interpretacyjną, zgodnie z którą wzrost częstotliwości zmian cen mógł sprzyjać szybszemu przenoszeniu impulsów makroekonomicznych, w tym impulsów polityki pieniężnej, na ceny konsumpcyjne. W tym sensie podwyższona elastyczność cen mogła wspierać proces dezinflacji po ustąpieniu części presji kosztowej. Formalna ocena siły tego kanału oraz jego implikacji dla realnej aktywności gospodarczej wymagałaby odrębnej analizy strukturalnej.

Słowa kluczowe: sztywność cen, ceny konsumpcyjne, dane jednostkowe, inflacja