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Price Rigidity in Turkey: Evidence from Micro Data[1]

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Abstract

In this study we investigate the duration of consumer price spells and price change patterns for Turkey by employing a comprehensive micro price data covering around 6000 items over four years. In detail, we analyze how long typical price spell lasts and we investigate the size, frequency, distribution and synchronization of price changes. Compared to advanced economies, a higher frequency of price changes is estimated. Findings suggest substantial heterogeneity among sub-groups in terms of frequency and synchronization indicators. The mixed evidence of both state and time-dependent pricing is also relevant for Turkey, an emerging market economy.

JEL Classifications: C41; D40; E31; E50

Keywords: consumer prices; price spell duration; price rigidity; distribution of price changes; state and time dependent pricing

[1] The views and opinions presented in this study belong to the authors and do not necessarily represent those of the Central Bank of the Republic of Turkey or its staff.

1. Introduction

Assessment of the level of price stickiness is important for understanding the nature and the effects of monetary policy. Price stickiness, which enables monetary policy to have persistent effects, is a key concept in macroeconomic theory (Taylor, 1999). In the presence of rigid prices, monetary policy can have real effects as prices fail to fully adjust to monetary shocks in the short run. Frequency of micro level price changes determines the degree of aggregate price stickiness under New Keynesian framework, where lower frequency of price changes indicates higher price stickiness. In addition, cross-sectional distribution and time series properties of frequency of price changes matter for a better understanding of inflation dynamics. Exploration of sectoral heterogeneity in stickiness and a more detailed treatment of characteristics of price changes provide information on issues that standard theories do not take into account. Theories explaining the price rigidity provide several testable implications. In this perspective substantial interest in the analysis of price stickiness by employing micro data has built a strand of literature recently. Bils and Klenow (2004) and Nakamura and Steinsson (2008) document stylized facts on US price stickiness, and Dhyne et al. (2006) summarize the vast amount of research on the subject for the Euro Area. Following this line of literature, this study is an attempt to describe the dynamics of consumer price changes in Turkey.

The novelty of this study is that we analyze the behavior of consumer prices with an extensive coverage of items. We use a unique and comprehensive micro price dataset covering around 6000 items, which matches about 75% of the official Consumer Prices Index (CPI), over four years. The data combines CPI-type micro data with scraped data. Main advantages of the data are that it is more frequently available than official CPI data; scraped part is not limited only to supermarket items while the overall CPI item coverage rate is substantially high compared to the studies in the literature. Thus, it provides more frequent information without incurring a tradeoff for coverage. Moreover the data captures the dynamics of the official inflation figures successfully as well.

In the study, we specifically analyze how long a typical price spell lasts; how this duration differs across subgroups; how large the size of the changes are and the dynamic features of price changes including synchronization of price changes. Our main findings are as follows: The mean duration of a price spell is about 2 months. Price changes are most frequent in food group while, the prices of services stay unchanged longer than other groups. Price spells mostly exhibit negative time dependence. In general price changes display a bi-modal distribution, and price cuts are frequently observed. The median size of price change for the entire sample is 3.5%. In addition, at monthly frequency, about 27% of the prices change on average.

The results of study are mixed in the sense of fitting stylized facts regarding the pricing dynamics, summarized by Klenow and Malin (2010). Most striking finding is the high frequency of price changes compared to previous studies, which implies that prices are more flexible in Turkey compared to the developed economies. This result is in line with relatively lower estimates of price stickiness in the literature studying emerging markets. Second, although Turkey is among countries with lower level of price stickiness, price change synchronization in aggregate subgroups is substantially low compared to other countries with less price rigidity. Third, bi-modality observed in the distribution of price changes supports the existence of considerable menu costs. Fourth, our finding of non-increasing hazard function is in line with the stylized facts. Finally, we document evidence of substantial heterogeneity in pricing behavior across sub-groups, suggesting that low-degree of price stickiness in Turkey is primarily driven by certain groups of consumer goods and services.

The low duration of prices indicates that shocks are reflected into prices quite often in Turkey. This has two important policy implications regarding the conduct of optimal inflation analysis and the power of monetary transmission. First, tracking changes in the micro prices can offer more relevant information about inflation to the policy makers in high-frequency countries such as Turkey compared to the countries where prices are substantially less flexible. Monitoring price rigidity related measures of frequency, synchronization and dispersion of price changes could be a

useful guide for understanding the underlying inflationary process. This micro redefinition of trend inflation concept can also increase the effectiveness of communicating monetary policy actions in an environment of frequently changing prices. Second, the fact that even more rigid subgroups' prices not being as sticky as they are in developed countries suggests that real effects of monetary policy through price stickiness channel last for a shorter period in Turkey in comparison to developed countries.

Rest of the study is organized as follows: The next section provides an overview of the theories explaining price rigidity, the empirical framework and the inflation in Turkey. In Section 3, data, model and the empirical analysis are presented. Section 4 discusses the implications of the results and Section 5 concludes the paper.

2. Overview of Literature, Methodology and Inflation in Turkey

2.1. Overview of the Theories Explaining Price Rigidity

The earlier theoretical literature on price rigidity builds around the time-dependent models of Calvo (1983) and Taylor (1980), where price stickiness is exogenously determined.[2] Following strand of studies proposes theoretical models where price stickiness is endogenously generated. The most popular of these models are menu-cost models. The idea of costly price adjustment is modelled by Sheshinski and Weiss (1977), where firms set the price of a perishable good in an environment characterized by monopolistic firms and constant inflation. They show that optimal pricing policy for price setting firms is of the (s, S) type and firms do not change the price if the cost shocks remain in that interval. This standard model has been extended by other studies (Sheshinski and Weiss (1983), Danziger (1983, 1984), Bénabou (1989)). The recent literature stresses the importance of information costs in addition to adjustment costs as a barrier to price flexibility. Mankiw and Reis (2002) propose that updating information about the state of the economy is costly and only a fraction of firms are able to process the updated information set and to change the price.

[2] Dhyne et al. (2009) provide a comprehensive review of theories of sticky prices.

Meanwhile, other theories focus on psychological aspects. Kashyap (1995) offers attractive pricing as a source of rigidity, while Rotemberg (2005, 2011) proposes a theory based on consumer anger.

2.2. Overview of the Methodology

The empirical aim of the study is to understand how price spell durations differ for different groups of the CPI, and how duration length depends on time. In this respect, survival analysis is the suitable approach to employ. Survival (duration) analysis specifically deals with modeling time-to-event data, i.e. the time elapsed within a specific state, probability of exiting this state at any given time, changing of a price in our context.[3] Survival analysis is widely used in analyzing micro level price durations.

In the context of analyzing time-to-change of price data, survival analysis has several advantages compared to alternative methods. First of all, survival analysis deals with the interval censoring inherit in the non-continuous nature of price collection. Second, it provides the estimates of hazard rates –probability of a price being changed. Third, survival analysis takes into account the time dependence of the price spells. Survival analysis also presents a framework to statistically test for the differences in the price spell durations of different groups of items.[4]

In survival analysis, continuous and discrete time models are used depending on the nature of the data. We observe prices at discrete time intervals of every two weeks. However, in a discrete interval prices may change at any time instance. Therefore, survival occurs in continuous time, even though prices are observed in discrete intervals. In this context of interval-censored discrete time survival data, we proceed with the complementary log-log model in the empirical part of the study.

[3] Van den Berg (2001) presents a technical treatment of the duration analysis. Jenkins (2008) provides a rich discussion of duration analysis along with a guide for empirical application.

[4] Duration analysis is widely used in the literature to analyze the behavior of price spells, although mostly within a narrow context of the shape of hazard functions. Few studies extensively use duration analysis. Fougère et al. (2007) use it to document the heterogeneity in price stickiness at a disaggregated level. We use duration analysis also to formally test for the heterogeneity of price spell durations at aggregated groups like food and energy.

2.3. Overview of Inflation in Turkey

The Turkish economy experienced a period of normalization following the structural reforms in macroeconomic policy framework starting with 2002. Being hit by a major financial crisis, Turkey took steps in pursuit of a healthy functioning financial and banking system. In addition, major policy reforms took place focusing on central bank independence and elimination of fiscal dominance.[5] Thanks to this policy framework, inflation averaging 52% between 1970 and 2002, came down to single digits by mid-2004. Inflation mostly remained in single digits for the following years and averaged 8.4% between 2004 and 2012. Several important shocks have affected inflation over the period in consideration: Exchange rate shocks in 2006 and 2008; the hike and reversal of international oil prices; rapidly rising international food prices and considerable changes in administered prices.

Sources of inflation can be traced through the lens of a Philips curve relation. In the New Keynesian Phillips curve, inflation is related to expectations and economic activity.[6] In addition, exchange rate and international prices also reflect on domestic inflation. In a recent study, Öğünç and Sarıkaya (2011) estimated a New Keynesian Phillips curve for Turkey. Following their analysis, it can be said that the role of forward looking expectations is lower compared to backward looking components; the effect of 1 percentage points higher output gap on inflation is 0.18 in one quarter; and the pass through of exchange rate and foreign prices on inflation is high (about 20%) over the sample period.

Previously, several studies were undertaken regarding the pricing behavior in Turkey using micro data. Caglayan and Filiztekin (2006) estimate that nominal prices stay for 3 months on average, using data from Istanbul Chamber of Commerce for the calculation of a cost of living index for wage earners in Istanbul. Caglayan et al. (2008) show that the mean price duration

[5] Ersel and Özatay (2008) discuss the need for and effects of new economic program, especially focuisng on fiscal dominance and monetary policy.

[6] The Phillips curve is a suitable tool to analyze inflation in Turkey. Önder (2004) shows that Phillips curve relation produces better inflation forecasts than univariate or VAR models.

depends on the market structure. While these results are similar to our findings, their data falls short of consumer price coverage (around 25% of the cost of living index). Meanwhile an extensive survey on pricing behavior of producers in manufacturing industry for Turkey is conducted by the Central Bank of Turkey (CBRT) and the main findings are reported by Karadaş et al. (2006). Using this survey, Şahinöz and Saraçoğlu (2008) estimate the mean duration of producer prices in manufacturing industry as 3 months. Our study differs from the earlier examples for Turkey in the way that we provide evidence directly for consumer prices, rather than producer prices; and we consider a much higher coverage of the CPI, suggesting stronger external validity.

3. Empirical Analysis

3.1. Data

The data used in this study covers item level prices of around 6000 goods and services at a bi-weekly frequency for Turkey. This is a quite detailed micro level data set covering about ¾'s of the CPI basket. The time period is from October 2006 to January 2011.

3.2. Compilation methodology

Main approaches

In the micro level studies of price spells, generally three different types of data are used. Traditionally, item-level prices of the CPI compiled by the statistical agencies are used.[7] While this approach makes use of the official prices, those prices are generally available once a month only. Additionally CPI-type data deals with representative goods by construction. For instance, not all the prices of entire brands of milk available in one store are collected. Instead, prices of representative brands of milk which can be found in most stores across the country are collected. Therefore trading off nation-wide availability for increased number of items considered might increase the efficiency of the analysis.

[7] Examples of studies using CPI data: Klenow and Kryvtsov (2008) for the US, Dhyne et al. (2006) for Euro Area, Saita et al. (2006) for Japan. Gagnon (2009) for Mexico and Medina et al. (2007) for Chile are examples from emerging market economies.

From the efficiency perspective, scanner data is used as an alternative. This type of data is usually gathered from registry records (or scanner readings) of supermarkets or like, mostly on weekly basis, and includes quantity information along with the price. Hawkes and Piotrowski (2003) report the benefits of scanner as more data and less variance; better data and less bias; and better methods. Indeed, with this approach it is possible to analyze all the information available, not only those regarding the representative goods. The availability of pairs of price and quantity enables researchers to analyze the relative weights of the items and the market shares of goods as well. Even though more frequently available than CPI data, the scanner data is usually limited to certain type of goods and services. It is generally available in several developed countries and mostly provided by market research companies.[8]

A third type of data recently available for the price spell duration studies is the so called scraped data. This type of data is collected from online sources by searching the websites for a unique product identification code and then by recording various product characteristics, including the price. Major advantage of scraped data is that it is available in real time. However, the major drawback is that it covers a relatively low portion of the official CPI.[9] Another type of data is the surveys on firms about their pricing behavior. These surveys generally ask for how frequently prices are reviewed and changed. By construction, they mainly contain the decision of firms, which determines the producer prices, but not the consumer prices.[10]

Our approach

The data used in the study is collected within the CBRT as a part of a project regarding dynamics of consumer prices. Major part of the data is the scraped data collected from several online resources. In addition to that, an experienced team of collectors visit several stores and collect prices. They collect the price of same goods at a regular basis. The goods and services, whose prices

[8] For example, Nakamura (2008) and Campbell and Eden (2010) use the database of AC Nielsen.

[9] Among the major studies using scraped data, Cavallo (2010) states that, for the sample in his study, scraped supermarket data covers about 40% of the CPI in Latin American countries.

[10] Blinder et al. (1998) is among the pioneers of such studies and Karadaş et al. (2006) is an example from Turkey.

are collected, are chosen in accordance with the practice and coverage of official CPI. Our methodology combines CPI type data with scraped data. First, even though we do not use the official disaggregated CPI data, we collect the prices of some items as they are done in the CPI. The CPI type data includes items whose prices are publicly announced and that are mostly administered in nature, i.e. electricity, fuel oil, postal services, public university fees, etc. Those prices are collected from public resources. Second, we use scraped data from several online sources. These sources are the websites of retailers, i.e. supermarkets, automobile distributors, furniture outlets, airline companies, etc. Thus, our coverage of scraped data is not only limited to supermarkets for food and household goods prices, but also includes other goods and services prices like airfares, household appliances, automobiles, household appliances. Third, prices of some items are also collected in person from the stores.

The CPI type data and scraped data do not overlap in our study, while scraped data constitutes a higher proportion of the data. For food items, however, both scraped data and data collected manually are available. We treat each commodity separately in the study. In the data, there is not much variation in terms of the size of corresponding retailers. The major variation is in the case of supermarkets where some of them are of a larger size. Yet, the duration of prices do not differ much between supermarkets.

The data does not include bargain prices coming from temporary reductions. Our definition of bargain sales is in line with the CPI manual. The data collection experts monitor and maintain the data. Once a price change is observed, they check the following periods. If the price returns to its previous value in the next or the second period, we do not consider that price change as a real change and keep the initial price unchanged. If the price change is not reversed, or price changes to a new value, we keep the new price and record that move as a price change.

The major groups whose prices are not available in this study are clothing, rents and restaurant and hotel services. Clothing prices change frequently and the items in the basket are replaced quite often. On the other hand, rents may be considered as asset prices responding to macroeconomic

fundamentals. Finally, clothing, rents and restaurant prices are very heterogeneous across different regions and not very reliable data sources are available to track the effective prices correctly. Therefore, in terms of the purpose of the study, the non-availability of these prices does not undermine the external validity and the generalizability of the conclusions to be drawn on the micro level pricing behavior. A final remark for the representativeness of the services prices should be made. The majority of the services in our sample are transport and communication services whose prices are more flexible. Discarded services of mainly rents and restaurant and hotel services are likely to have more rigid prices, thus omitting them could only bring a downward bias on the durations observed for services.

Our data collection approach has several advantages. First it is more frequently available than the official CPI, so we can observe price changes within a month. Second, the scraped portion of the data is not only limited to mainly food items. Third, bargain sales are not considered. Fourth, our data covers around ¾'s of the CPI, which is quite high for a study not using the official CPI data.[11] Finally, to our best knowledge, there is no previous study combining scraped with CPI type data. Our mixed approach enables us both to get closer to official CPI with a high level of coverage and to make better inference on duration with higher frequency of the data.

3.3. Price Spell Durations

In the literature, price spell durations are mainly calculated by two approaches. First one is the direct approach where each observed complete and censored spells are recorded as single durations for an item. Second one –frequency approach- is an indirect approach which takes into account the number of price changes observed for an item over a period and the number of possible time intervals in that period where the price of that item might have changed. These two approaches are

[11] The coverage of our basket is very high (around 75%), even in comparison with the studies using official CPI data. For instance, Aucremanne and Dhyne (2004), Baudry et al. (2004), and Gouvea (2007) use a dataset covering 68, 65 and 85 % of the CPI respectively. Those studies using scraped data cover only a lower part of the official CPI basket, on the other hand. For instance, Cavallo (2010) uses a scraped data set covering around 40 % of the basket for Argentina, Brazil and Colombia.

intrinsically related; lower frequency of price changes refer to longer price spell durations, and thus to more rigid prices. In the direct approach we calculate the duration of an individual price spell for all items by counting the number of periods in which a price remains unchanged.[12] Frequency approach first computes the frequency of price changes and then calculates the implied durations from these frequencies. Specifically, for each product category i, the frequency of price change, F_i, is computed. F_i gives the average frequency for all the items in i^{th} category over the entire sample. Considering the intrinsic discrete nature of observed data, allowing for continuous time intervals for price changes between two collection dates, and assuming exponential distribution for the spell durations, we may compute the simple average implied durations as $T_i = (-1)/\ln(1 - F_i)$.

Considering the direct approach we have 144,004 individual price spells. The mean duration of the spells is 1.9 months (Table 1). It is informative to see the descriptive statistics of the price spells with respect to different groups within data.[13] The implied durations from frequency approach are also similar to actual durations.

[Insert Table 1 around here]

An initial inspection of the descriptive statistics reveals that in fact the duration of price spells within consumer prices is not homogeneous. Food prices on average stay for shorter periods than the overall consumer prices, while services prices, on average, stay longer. As expected, unprocessed food prices have the lowest mean duration. When all items are considered and weighted by subgroups, the average duration is 2.5 months. This finding is similar to figures reported for emerging economies and is lower than those for developed economies (Table 2). Given that the mean duration of prices is low, the prices are more flexible in Turkey compared to developed countries.

[Insert Table 2 around here]

[12] When calculating spell durations, we employ a detailed strategy. As we have a large number of spells for individual items, we discard the right censored spells at the end of the sample.

[13] List of items is available in Özmen and Sevinç (2011) Appendix 2.

Another important issue is that for the entire sample, almost half of the prices last for only one period. Overall, 90 percent of the spells are completed within 9 periods, in less than 5 months. One general issue to observe is that studies using more frequently collected data find shorter durations. Our collection frequency of enables us to account for changes within the month. Also, the distribution of spell durations is similar to the ones reported by studies using daily data.[14]

Given that durations for sub groups from direct and frequency approach are similar in our context, we will use the durations from direct approach in the survival analysis; while frequency approach will be used for analyzing the time varying nature of price spell durations.

3.4. Analysis of Duration of Price Spells

For the case of interval-censored discrete time survival data, we proceed with the complementary log-log model. Substituting the clog-log hazard function, specifying the functional form of the duration dependence and with no right censored observations the corresponding log likelihood function is as follows:

$$l = \sum_{i=1}^{n} ln\left(\frac{h_j}{1-h_j}\right) + \sum_{i=1}^{n}\sum_{k=1}^{j} ln\,(1-h_{ik})$$

where h_j is the interval hazard rate indicating the probability that a price spell lasted for *j-1* period is changed in the j^{th} interval.[15]

3.4.1 Estimation Results of Survival Regressions

In order to estimate a discrete time duration model, functional forms of the hazard rate and the duration dependence must be specified. We use the clog-log specification for the functional form of the hazard rate. For the specification of duration dependence, we employ both parametric and non-parametric methods. The non-parametric method introduces period dummies individually in order to capture the hazard rate at every period. Parametric methods, assume an explicit functional form

[14] See Cavallo (2010).

[15] The basic concepts of the discrete time proportional hazard model and the clog-log specification are summarized in Özmen and Sevinç (2011) Appendix 1.

of duration dependence in duration time (logarithmic time or squared time). In order to estimate the clog-log model, the first thing to do is to expand the duration data into item-period format and, thus, to transform it to a binary duration variable.

We present the results of the discrete time clog-log survival regressions in Table 3. The first point to notice is that we find negative duration dependence, as the (exponentiated) coefficients in Spec (1) and Spec (4) are less than 1. The negative duration dependence refers to the fact that the hazard rate is decreasing in duration time. In other words, the probability that a price spell ends (the price is changed) decreases as time passes. This finding is not surprising when we consider the frequency of price spells previously discussed. Almost half of the durations in the sample last for only one period. Indeed, the probability of a price changing after staying for one period is quite high, and thus, the probability of a change in subsequent periods is relatively less than that.

[Insert Table 3 around here]

Descriptive analysis has already showed that the duration of price spells is not homogeneous across sub groups of consumer prices. In order to statistically test this heterogeneity, in Specs 2 and 5, we introduce group dummy variables to the survival regression. The clog-log is inherently a proportional hazard specification. Therefore, keeping one of the categories as the base category, the coefficients of the remaining categories are readily interpretable hazard rates relative to that of the base category. In Spec 2 and 5, we see that food, energy, and goods excluding food and energy categories are significantly more likely to experience failure than services category. In other words, their durations are more likely to end at any given period, and so they have shorter durations compared to services. One may interpret the coefficients of the clog-log model as follows: For instance, in Spec 2, food prices are on average 73% more likely to change than prices in services category in any period.

Next, we decompose the food category into two: processed and unprocessed food. As expected, unprocessed food prices have the highest probability to change in a period. In Spec 3, we see that processed food prices are 164% more likely to change compared to services, while processed food

prices are only 32% more likely to change than services. Overall, results of both parametric time assumptions point to the same direction. Finally, Spec 7 of Table 3 reports the results from the clog-log model with non-parametric time specification. Here, period dummies for each possible spell length are introduced into the model. The plotted coefficients of time dummies reveal that the negative duration dependence is supported also by hazard rates from non-parametric specification.[16]

The general finding of declining hazard rates might be a result of aggregation rather than a general behavior. To check, we pursued the same analysis for individual commodities at item at store level. As an example, take rice in the food category. The disaggregation level refers to "baldo rice sold at store A". Item level analysis indicates that there is no aggregation bias in hazard rates coming from combining commodities. On the contrary, for majority of the items (2/3s) hazard rates are declining. Yet, in only about 2% of the cases, we find significantly increasing hazard rates. Overall, the declining hazard rate is a dominant feature of the data.

3.5. Analysis of Price Changes

A natural extension of the price spell duration analysis is the inspection of the characteristics of individual price changes. This type of analysis is useful in terms of determining whether prices are flexible also downwards; what the average size of price changes is; and whether the size of the change and the length of the duration are related.

3.5.1. Distribution of price changes

Looking at the histograms of price changes, first thing to note is that price cuts are common as well as price increases for all categories (Figure 1). It is generally argued that services prices display downward rigidity, however, for the services in our study there is no evidence of that. Price changes in food and services categories display a bi-modal distribution, while those of goods

[16] A set of robustness checks and detailed figures are available in Özmen and Sevinç (2011).

excluding food and energy display a more symmetric distribution.[17] Also, the distributions of price changes for different categories are slightly right-skewed, as previously documented for Turkey.[18]

[Insert Figure 1 around here]

One interesting point to note is that the histogram of price changes shows spikes at various different rates. The magnitudes of price changes at which spikes occur are the following rates: -50%, -40%, -33%, -30%, - 25%, -20%,…, 20%, 25%, 30%, 33%, 40%, 50% and like. These spikes turn out to be informative as they suggest that when prices are changed, major portion of them are changed at non-odd ratios. We argue that this might be an indicator of store level pricing and information costs. If it is too costly to evaluate the optimal price for each commodity, the firm may choose to change the prices of all commodities at a specific -perhaps average- rate. This might induce firms to set price changes at "smooth rates". Yet, this may also reflect the presence of non-optimizing firms.

3.5.2. Size and sign of price changes

The price decreases and price increases occur almost equally likely. For the consumer prices in general, 56% of the changes are in the direction of increase (Table 4).The presence of two-way flexibility of prices has been reported by other studies as well. For instance, Nakamura and Steinsson (2008) report that about 40% of the monthly CPI price changes are decreases in the US, while, Bunn and Ellis (2009) and Dhyne et al. (2006) report similar findings for the UK and the Euro Area respectively. The presence of declining prices differs across sectors. Generally it is not very common to observe declining prices in services sector, however, this largely depends on the coverage of the items. In our case the share of price declines in services is 41%, which is very similar to, for instance, what Kaufmann (2009) reports for Switzerland (38 % over 1993-2000 period). As discussed in the data section, the services prices collected in our study are mostly

[17] We employ Hartigan and Hartigan (1985) dip test for unimodality for the price change distributions of sub groups where we find that for all groups, but energy, the distributions are rejected to be uni-modal.

[18] As reported in Atuk and Özmen (2009).

communication, transportation and several public services. Main excluded items are restaurants and rents, which are known to exhibit upward flexibility only. However, for our coverage of services, price cuts are also common given the competitive nature of the transport and communication services. In a similar fashion, Kaufmann (2009) excludes prices of hospital and medical services, postal services and rents for instance. Therefore, the findings on services prices are prone to the coverage. Meanwhile, for other sectors, evidence of two-way flexibility is more prominent as the exchange rate and international prices are important determinants of the inflation in Turkey and changes in those prices occur frequently in both directions. The highest proportion of increases is for energy category with 63%, where electricity and natural gas prices are only upward flexible in our case.

[Insert Table 4 around here]

The median size of change in absolute terms is slightly higher for price decreases than price increases (Table 4). The magnitude of the changes seems to be high, however, when considered together with the average frequency of change and duration information by categories they turn out to be plausible. Given median size and number of price changes, we see that price increases are slightly more common (only 10 percent more than price reductions), yet with relatively lower absolute size.

An additional finding relates to a level effect, where we observe that the rate of change also differs with the level of the price itself. In other words, cheaper goods and services are subject to a higher percentage change. In our sample when we consider the price increases, for instance, goods which are cheaper than 10 TL are subject to increase of 21.2% on average; while prices higher than 100 TL increase by about 8% on average in the sample period.[19] For the case of the link between price level and the size of increase, we argue that two motives are in play: rounding and illusion of cheap commodities. Assume that the price of an item is 5 TL. Once the price is changed, it is not

[19] At the time of writing, 10 TL was equivalent to about 6 USD. A detailed table is available in Özmen and Sevinç (2011).

increased to 5.72 or 5.84 TL for instance, but most probably to 6 TL. This common upside rounding is more prominent for cheaper commodities. The illusion occurs at this stage. With the new price of 6 TL, the price setter argues that the price increase is only 1 TL, which is very small in nominal terms. However, it corresponds to 20% in percent-change terms. Therefore, due to these two effects, price changes are higher for goods with lower prices. This sort of pricing behavior can have important implications on the grounds of average income and price level, and by income distribution. If cheap items (mostly food) constitute a higher share in a consumer's basket, then that consumer faces a higher level of inflation in comparison to another consumer consuming a basket of expensive goods. This would have distributional effects as the inflation faced by the poorer consumers is higher under such circumstances.

3.5.3. Duration of price spell and the size of change

Given that some prices are adjusted infrequently, ex-ante, we expect the absolute change in long-lasting prices to be higher than short lasting prices. However, the data reveals that the correlation between duration length and size of change is negative for consumer prices. Yet, on the ground of sub groups, this relation is negative only for food prices and for goods excluding food and energy group.[20] In order to check whether this negative relation reflects heterogeneity across commodities, we pursued a detailed analysis at item at store level for these two groups. The results reveal that on the domain of significant duration and size relations, in about ¾'s of the cases the relation is negative, while in ¼'s of the cases it is positive. This suggests that the negative duration and size relation is the dominant structure for those two groups.

On the other hand, the direction of the relation is as expected for services and energy groups, which reveals that prices with longer durations are adjusted with higher magnitude. Issues like menu costs or seasonal pricing behavior might be the driver in services prices. Alternatively, in the energy group, administered prices of electricity and natural gas -which are kept constant for a while and then increased considerably- are the main driver of the result. We also consider the average size

[20] For a detailed table, see Özmen and Sevinç (2011).

of price changes at each duration time. The analysis suggests that the size of increase is high at earlier durations, however, it settles around 10% at longer durations. Interestingly, for price decreases, the average size is duration independent. At each price spell length, the average size of decrease is around 15%.

3.5.4. Frequency of price changes by time

Frequency of price changes in a period refers to the share of goods and services whose prices changed in that period. The mean frequency of price changes per period for the entire sample is 22%. Food prices change more frequently than the rest. Each period on average 27% of the food prices change, meanwhile only 16% of the non-food item prices change each period. The frequency of price changes is not constant over the sample period as it responds to changes in the economy (Figure 2). In the pre-2008 period, initially, due to flat course of import prices in domestic currency, frequency of price changes followed a stable path, while, later frequency of price changes picked up given increasing import prices and stronger domestic demand. In the next period, Turkish economy contracted from second quarter of 2008 until the first quarter of 2009. In that period, given the slowdown in the economy, frequency of price changes decreased initially and remained on a smooth track later on. The start of the mild recovery period coincided with the decrease in import prices and appreciation of the Turkish lira, where import prices in domestic currency came down considerably. Hence, in that period of normalization, frequency of price changes decreased as well[21]. Starting with the third quarter of 2009, however, import prices once again climbed, yielding frequency of price changes to increase. Over 2010, given the sable course of import prices in domestic currency and mild recovery in domestic demand, frequency of price changes once again stabilized.

[Insert Figure 2 around here]

3.5.5. Synchronization of price changes

[21] The pricing behavior of the firms changes with the state of the economy. For instance, Doğan (2013) shows that firms in the manufacturing industry sector respond differently to exchange rate shocks during recessions.

An important dynamic implication of price changes is the degree to which those changes are synchronized. In a staggered price model theoretically no synchronization of price changes is expected. Based on this point, distance from perfect staggering (or conversely full synchronization) can tell about the effectiveness of state-dependent pricing in consumer prices. We employ the measure suggested by Fisher and Konieczny (2000), the synchronization ratio (SR), which proportionally compares time variation of frequencies. SR takes the value of 0 under perfect staggering and 1 under perfect synchronization. SR figures are reported in in Table 5. Although there is heterogeneity in level of synchronization across subcategories, overall the SR is low for all the groups. Energy and services groups have a relatively higher degree of synchronization. For the case of services, the number of firms in the communication and transport services being much smaller compared to the number of firms providing goods increases the probability of synchronization.[22]

[Insert Table 5 around here]

Time varying features of the pricing behavior can be traced in other dimensions as well. For this, in addition to frequency and synchronization of price changes, Özmen and Sevinc (2012) introduce high frequency micro indicators including diffusion, size and volatility of price changes. Those indicators could help disentangle inflationary process based on micro level pricing behavior.

4. Discussion of the Implications for Price Rigidity

4.1. Theoretical Implications: Time versus State Dependence

Time-dependent pricing (TDP) models assume that price changes are basically determined by the duration since the previous change. In TDP models prices change either in every time period randomly with a given probability or only at given time periods with a fraction of firms updating their prices. State-dependent pricing (SDP) models are built on the opportunity cost associated with updating current prices. The source of rigidity is the existence of adjustment costs, often referred to

[22] Over the sample period we also observe declining levels of synchronization, which suggests that price changes are becoming more staggered during the period of analysis. See Özmen and Sevinç (2011).

as menu costs. In order for a firm to change an ongoing price, gains from updating a price should be sufficiently large enough to meet the adjustment costs. There are also mixed models which combine the information cost of time-dependence and the adjustment cost of state-dependence.[23]

Results of our investigation are mixed in terms of the predictions of models outlined above. However, this is not surprising as emphasized by other studies attempting to link micro price facts to the theory.[24] We discuss three dynamic features: distribution of size of price changes, shape of hazard function and synchronization of price changes.

TDP models do not specifically suggest a distribution for the size of price changes. However, if cost shocks are independent and randomly distributed, it is natural to expect a unimodal distribution of price changes. On the other hand, SDP models imply that small price changes are ignored in the very short term. Thus, accumulation of shocks on prices is not expected to lead to a uni-modal size distribution. In this respect, the bimodal distributions found for the majority of prices (for consumer prices, food and services groups) support SDP model. Energy and goods excluding food and energy prices on the other hand, display distributions that are in line with the expectation of TDP models in terms of size distribution.

Hazard functions of price durations implied by theoretical models differ in their shapes. TDP models predict two kinds of hazard rates: Calvo (1983) assumes a constant hazard rate for all periods. This is because the probability of a price change is constant in every period. Also, some models predict hazard rates which present price changes as spikes at given moments. This reflects an economy where firms update their prices at exogenously determined periods of time. Whereas, SDP models assume upward sloping hazard functions. Since firms face a problem of charging optimal price subject to adjustment costs, incentive for a price change increases with time as marginal cost shocks accumulate. Our results do not reflect any of these predictions at first glance.

[23] Examples are Taylor (1980) and Calvo (1983) for TDP; Caplin and Spulber (1987) and Dotsey et al. (1999) for SDP; and Woodford (1999) for mixed models.

[24] As a recent example, Hofstetter (2010) shows that both state and time dependent elements are effective determinants of price change patterns for newspaper and magazine prices in Colombia.

We found a downward sloping hazard for consumer prices such that the slope gets smaller and hazard functions flatten over longer horizon. This finding supports the stylized facts in the literature. Also, very little evidence is found towards upward sloping hazard rates as SDP models suggest. Hazard rates also show a pattern of jump around one-year. This suggests a clustering of sticky price firms that update their prices once a year, which can be interpreted in TDP context.

Another aspect about which models have different interpretations is price change synchronization. If timing of price changes often coincides, TDP models imply that this reflects the weakness of staggering in the economy. Hence, low degree of synchronization increases the price rigidity in terms of the persistence of monetary policy effects. In SDP models, synchronization does not directly affect price rigidity. Rather, it is a reflection of firms producing close substitutes. In this paper, our focus is on measuring synchronization in a more aggregate manner. As shown, the level of synchronization is considerably low in general; Calvo type uniform staggering hypothesis is rejected. The highest level of synchronization is registered at energy and services prices though the figures are still low. This finding emphasizes the staggered nature of pricing in the economy. Although prices change frequently, low level of synchronization imposes considerable rigidity.

Findings on the size of price changes also provide evidence in support of recent theories focusing on information costs and psychological issues regarding the pricing behavior. The presence of "smooth" price change rates can be an indication of high information cost of updating each price separately in a multiproduct firm. Meanwhile, cheaper commodities being subject to higher inflation points to the illusion of consumers and price setters towards the price level and inflation.

4.2. Heterogeneity

One important finding regarding the frequency of price changes is the heterogeneity between and within groups. This makes it difficult to conclude whether prices are sticky in general. On the other hand, the implications of heterogeneity on aggregate rigidity can be substantial. Carvalho (2006) shows that heterogeneity increases the macro rigidity implied by micro frequency of price changes

three times more than that is observed in an economy characterized by identical firms. Carvalho (2006) proposes two mechanisms to explain the effects of heterogeneity. The frequency composition effect is given by the dominance of slow adjusting firms following a shock. This effect causes the adjustment process to slow down over time in the presence of relatively stickier pricing firms. Second is the strategic interaction which is effective when there are strategic complementarities in the economy. Slow adjusting firms disproportionately affect the pricing decision of firms which change their prices relatively more frequently. As a result, a high degree of heterogeneity observed for Turkey may imply a longer period for aggregate adjustment process than what is suggested by high levels of average individual frequency estimates.[25]

5. Concluding Remarks

In this study we explored the evidence of price rigidity in Turkey by making use of an extensive micro level price dataset. The data set is unique in the sense that it combines scraped data with CPI type data. This study differs from the existing studies on Turkey that uses micro level data both in terms of the focus on consumer prices and in terms of the high level of coverage of CPI items. We also provide a cross country comparison of price rigidity.

Our findings, first, point to a great degree of heterogeneity between subgroups of the consumer prices in terms of mean price duration; frequency and synchronization of price changes; shapes of hazard functions; as well as distribution, size and sign of price changes. Second, the results suggest that there exists a mixed pricing strategy which is a combination of time and state dependent pricing. Such evidence is generally reported for developed economies, but we show that this empirical regularity holds also for an emerging market economy. Although the prices in Turkey are very flexible, as is the case for developing economies, the level of synchronization being rather low potentially separates Turkey from its high-frequency peer countries.

[25] Another source of heterogeneity relates to the time varying nature of frequency and synchronization figures. Özmen and Sevinc (2011) provide a detailed analysis of these dynamic issues. Moreover, Özmen and Sevinc (2012) introduce high frequency indicators that could help disentangle inflationary process based on micro level pricing behavior.

The aim of this study is to document the micro level stylized facts of consumer prices in Turkey. Analysis of pricing behavior using micro price data has important implications for determining the level of price stickiness in a country, which is crucial in formulating monetary policy. In terms of price stickiness, our findings reveal that level of micro price rigidity is low in Turkey. Compared with other studies, the level of stickiness is in line with other emerging markets and it is significantly below advanced economies. On the other hand, the extensive heterogeneity observed increases the level of stickiness implied at the macro level.

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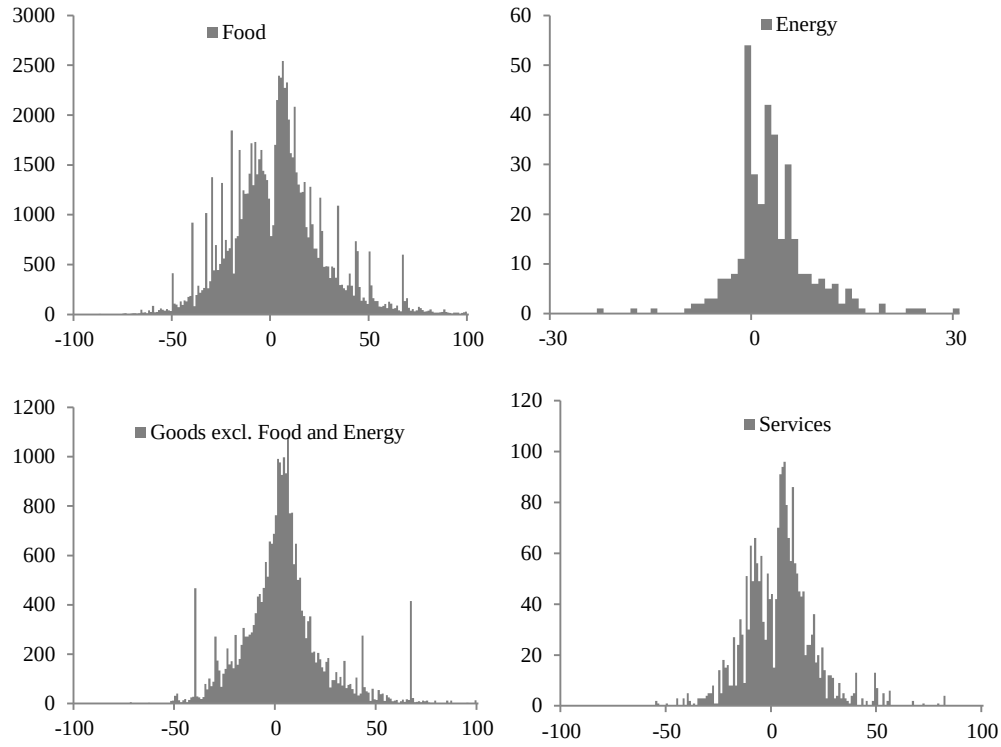
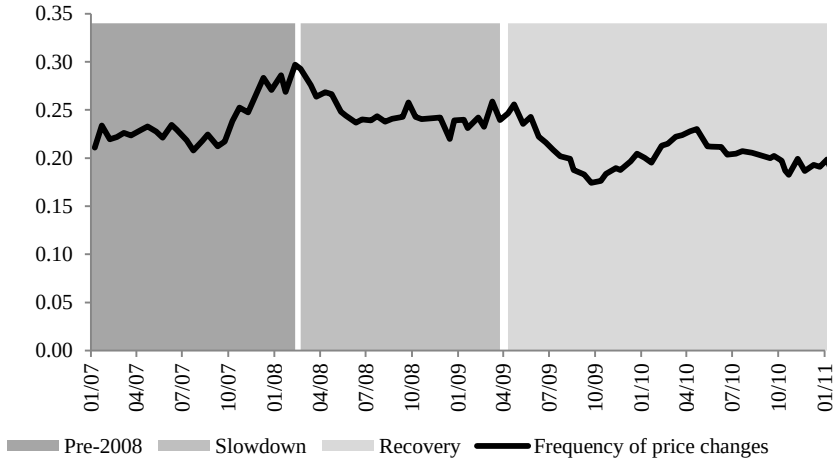
Figures and Tables

Figure 1: Distribution of the Size of Price Changes (%) by Sub Groups



Notes: Vertical axis shows the number of observations, while horizontal axis shows the size of price changes.

Figure 2: Frequency of Price Changes over Time



Notes: The frequency is the share of price changes at each period. 3-month-average frequency of price changes is plotted.

Table 1: Price Spell Durations (Months)

	Direct Approach (Actual)			Frequency Approach (Implied)
Group	No. of Obs.	Mean	Std. Dev.	Mean
Consumer Prices	144004	1.9	2.8	1.6
Food	108757	1.6	2.4	1.3
Unprocessed Food	57626	1.0	1.4	0.7
Processed Food	51131	2.2	3.0	2.0
Services	2461	3.6	5.5	3.4
Energy	435	2.3	4.1	2.0
Goods exc. Food & Energy	32351	2.6	3.5	2.4

Notes: The mean values refer to unweighted averages.

Table 2: Duration of Consumer Prices in Selected Countries

Study	Country	Mean Duration
Nakamura and Steinsson (2008)	US	7-9 months
Kaufmann (2009)	Switzerland	4-6 quarters
Álvarez and Hernando (2004)	Spain	6-7 months
Bunn and Ellis (2009)	UK	5.3 months
Fabiani et al. (2006)	Italy	10 months
Baudry et al. (2004)	France	8 months
Vilmunen and Laakkonen (2005)	Finland	6-9 months
Lünnemann and Mathä (2010)	Luxemburg	8 months
Gouvea (2007)	Brazil	2.7-3.8 months
Medina et al. (2007)	Chile	1.6-2.5 months
Gabriel and Reiff (2010)	Hungary	4.2 months
Coricelli and Horváth (2006)	Slovakia	2.6-5.9 months

Authors' calculation, when mean duration is not explicitly given in the study.

Table 3: Discrete Time Survival (Clog-log) Regressions

Dependent var.:	Binary Spell Duration						
Time assumption:	Logarithmic time			Squared time			Non-parametric
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Time Dependence (Log Time)	0.5181***	0.5325***	0.5702***				
	(0.0016)	*(0.0016)*	*(0.0018)*				
Time Dependence (Squared Time)				0.9976***	0.9978***	0.9983***	
				(0.0000)	*(0. 0000)*	*(0. 0000)*	
Food		1.7269***			2.0424***		
		(0.0354)			*(0.0418)*		
Unprocessed Food			2.6412***			3.5496***	2.6939***
			(0.0550)			*(0.0736)*	*(0.0562)*
Processed Food			1.3187***			1.4376***	1.3565***
			(0.0273)			*(0.0298)*	*(0.0282)*
Energy		1.4316***	1.4552***		1.5590***	1.5738***	1.4673***
		(0.0751)	*(0.0762)*		*(0.0814)*	*(0.0821)*	*(0.0769)*
Goods excl. Food & Energy		1.1399***	1.1615***		1.2083***	1.2294***	1.1931***
		(0.0239)	*(0.0244)*		*(0.0253)*	*(0.0258)*	*(0.0251)*
Services		base	base		base	base	base
# of obs.	531612	531612	531612	531612	531612	531612	531335
log-likelihood	-282492	-279995	-273972	-302513	-298355	-287835	-273147

Notes: Standard errors in parenthesis. Exponentiated coefficients are reported. Time dependence refers to the coefficient of the parametric time variable. In Specifications 2-7, the base category is the "services" category. Specification 7 is the non-parametric specification where period dummies for each possible duration length are included in the regression. *** Significant at 1 % level.

Table 4: Quantity and Median Size of Price Changes

	Increase			Decrease		
	Number of Observations	Share in Changes (%)	Median Size of Change (%)	Number of Observations	Share in Changes (%)	Median Size of Change (%)
Consumer Prices	68180	56%	11.76	52887	44%	-13.54
Food	50959	56%	13.07	40514	44%	-14.52
Services	1292	59%	9.38	888	41%	-9.09
Energy	218	63%	3.40	129	37%	-1.64
Goods exc. Food & Energy	15711	58%	8.70	11356	42%	-10.05

Table 5: Synchronization Ratios for Consumer Prices and Sub-groups

	Consumer Prices	Food	Unprocessed Food	Processed Food	Energy	Goods exc. F&E	Services
SR	0.14***	0.13***	0.18***	0.15***	0.29***	0.20***	0.25***

Notes: Synchronization ratios are calculated following Fisher and Konieczny (2000).*** denotes that when compared with χ^2 critical values the test statistic $Q=(NT)SR^2$ is significant at 1 percent level.