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PRICE SETTING BEHAVIOUR IN PAKISTAN: Stylized Facts from Micro SPI Dataset[a]

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Abstract

The study analyzes the consumer price behavior by employing the micro-level price data for Pakistan. Substantial heterogeneity in the price setting behavior is observed across various products. The study finds that on an average, 15.8 per cent of prices change every week, with mean (median) duration of 5.8 (4) weeks of price spell. For most commodities, price increase is found more often than the price decrease. On an average, prices are increased by 8.1 per cent and reduced by 7.2 per cent. It reveals a broad spectrum of synchronization across cities ranging from partial staggered to perfect synchronized pricing behavior. The sticky nature of regulated commodities in case of Pakistan is confirmed in the study. Highly significant estimates in the regression analysis proves the existence of elements of both, the state dependent as well as the time dependent factors in determining frequency of the price change in Pakistan.

Key Words: Price Level, Aggregate Prices, Commodities, Price Rigidity.
JEL Classification: E31, E30, Q020, D43.

I. Introduction

An established and decisive fact in macroeconomics states that price of goods and services do not necessarily change immediately in response to changing economic conditions; rather, it evidence an interlude of unadjusted period. For existence of such rigidity in the price adjustment process, numerous reasons are identified in literature, depending on the nature of commodity and the prevailing economic conditions. For instance, regulations imposed by the government on price adjustments, cost involved in immediate price alterations, legal agreements with consumers, coordination failure, delayed information, etc.[1] Thus, the study aims to investigate the price change mechanism considering the above stated interlinked issues, in case of Pakistan. The literature

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[1] See, Blinder, et al. (1994) for a comprehensive list of theories.

explaining the price adjustment mechanism started developing, since evolution of the issue. Since then, theoretical as well as empirical attempts were started in most of the developed nations; thus it explains the real impact of monetary policy in presence of the price rigidity. Recognizing significance of the issue of price stickiness, the researchers of developed economies dedicated much resource towards the empirical findings.[2] The large literature on U.S.A. and the European countries shows that the degree of price stickiness issue is substantial.

Despite the progress on nominal rigidities in advanced countries, most of the developing countries like Pakistan are lagged far behind. Nominal rigidities, either as time-dependent price adjustment processes, e.g., Calvo (1983), Taylor (1980), (1999), state dependent price adjustment processes [Caplin and Spulber (1987)], or the process that combine the elements of both [e.g., Dotsey, et al. (1999)] were left unexplored in the case of Pakistan. Empirically, there exists only one important study carried out by Choudhary, et al. (2011) for Pakistan. The study conducted 1189 structured interviews about the price-setting behavior of formal firms of the manufacturing and service sectors, and found that frequency of price change is considerably high in Pakistan; thus, lowering the impact of monetary policy. Hence, this study is the first attempt in Pakistan which directly measure the price-setting behavior using micro-level price data in Pakistan; and describe the price setting behavior across the large cities by employing micro-data from the retail price survey, conducted by the Pakistan Bureau of Statistics, for the purpose of constructing sensitive price index (SPI). Thus, the aim is to fill the gap of scarce empirical literature on the issue of price stickiness.

The main objective of this study is therefore, to investigate the individual price dynamics using the micro-data of consumer prices. The first specific objective is to identify and present the stylized facts that characterize the setting of product prices by retail outlets in various large cities of Pakistan. This includes an analysis of indicators, such as the frequency of price change, the duration of price change, the average size of price change, and the direction (increase or decrease) of price change. All these indicators are calculated at product category and the city level; and are then aggregated at national level. Secondly, the study is aimed to observe the synchronization of price change among various cities of Pakistan. Third objective of the study is to estimate the panel fixed effect model (LSDV) to analyze various time dependent, state dependent and other factors influencing the price setting behavior of various commodities in 17 major cities of Pakistan.

The descriptive nature of the analysis presented in this study, reveals some astounding facts about the price setting behavior; and it was found that on an average,

[2] To name a few studies; Cecchetti (1986), Carlton (1986), Kashyap (1995), Blinder et al. (1998), Taylor (1999), and more recently Bils and Klenow (2004), Klenow and Kryvtsov (2008), Alvarez, et al. (2005), Aucremanne and Dhyne (2004), Baudry, et.al. (2004) Fougere, et.al. (2007), Baumgartner, et.al. (2005), Dias, et.al. (2004), (2005), Hoffmann and Kurz-Kim (2005), Jonker, et.al. (2004), Lunnemann and Matha (2005), Veronese, et.al. (2004), Fabiani, et al. (2006), Nakamura and Steeinsson (2012).

15.8 per cent of prices change every week with the mean (median) duration of 5.8 (4) weeks of price spell. However, the results show highly heterogonous length of price duration when analyzed at the product level. In analyzing the direction of price change, price increase is found more often than the price decrease for most of the commodities. However, exceptions are found for most of the government controlled energy products. For these products, price decrease emerges more frequently than the price increase. Although, the frequency of price decrease is more common for most products, the size of price change is another important phenomenon to analyze the exact situation of price behavior. On an average, price is increased by 8.1 per cent and reduced by 7.2 per cent. The study reveals a broad spectrum of synchronization across cities ranging from partial staggered to perfect synchronized pricing behavior. The computed synchronization of each product across cities ranges between 24 to 100 per cent. The Panel fixed effect model (LSDV) employed in the study, confirms the sticky nature of regulated commodities for the case of Pakistan. Highly significant impact of monthly average inflation and inflation volatility is found on the frequency of price change; hence, it proves the importance of state dependent factors in determining the pricing mechanism. Strong seasonal pattern is found in determining the frequency of price change, and thus, it also proves the existence of time dependent element in price adjustment process. The remaining part of the study is organized as follows. In Section II, data sources and coverage are described. Methodology and empirical results of the study are presented in detail, in Section III. Each indicator described in Section I is computed by employing a distinctive methodology; hence, results of each indicator are analyzed right after description of the methodology for the sake of ease. Finally, Section IV conclude the study.

II. Data Description

In this study, the Retail Price Survey conducted by the Pakistan Bureau of Statistics, Government of Pakistan, was used for the purpose of calculating Sensitive Price Index (SPI). SPI is based on the prices of 53 items collected on weekly basis, which prevailed in 17 major cities. In the retail price survey, items were surveyed at various outlets in each city. The number of outlets surveyed in each city varied as high as, 13 outlets in Karachi city, and as low as 1 outlet in each small city like, Gujranwala, Sialkot, Sargodha, Bahawalpur, Larkana, Bannu and Khuzdar.[3] Thus, the study employs 53 items[4] to analyze the price-setting behavior in major cities of Pakistan. The data is on city average of individual price across the outlets. Therefore, average price data is taken for each item of each city per week. For example, the price of 10 kg of wheat was surveyed at 4 different outlets of Islamabad. The bureau averaged four prices and published the

[3] Appendix 1 describes the coverage of cities and the number of markets surveyed.

[4] The table describes the list of all commodities included in the study (Appendix 2).

city average price of 10 kg of wheat. Thus, the data at individual outlet is not available. The dataset employed in the study is from 3rd week of October, 2013 till 4th week of September 2016. Weekly dataset of the above mentioned three years is employed in the study, as it was the most recent dataset updated on the website of Pakistan Bureau of Statistics. In this way a total of 134,249 observations are included in the study.

III. Methodology and Empirical Results

1. Pattern of Price Adjustment over the Time

The first objective of this study is to evaluate the price adjustment process in Pakistan, over the time period under study at product level. The pattern of price change of each product is evaluated on the basis of various indicators.[5] For instance, the duration of price spells, the frequency, direction and average size of price change along with the degree of synchronization across cities. The methodology and results of each indicator is described below.

a) Price Duration and the Frequency of Price Change

Prices are considered as flexible (rigid), if they exhibit a high (low) frequency of the price change, and thus, have a smaller (longer) duration. The literature identifies two inter-connected methods, for categorization of various products' pricing mechanism. The first method is recognized as 'Frequency Approach', whereas, the other is the 'Duration Approach'. In the first approach, frequency of price adjustment is computed, which derives an implied duration of price spells of various products. However, in the second approach, the duration of price spells are directly computed as number of weeks of fixed prices, and then the implied frequency is calculated as its inverse. Prices having low (high) frequency of price adjustments, thus have a longer (shorter) duration, and are characterized as rigid (flexible). Both approaches and results are illuminated in the subsections below.

- *Implied duration of Price Spell via the frequency Approach*

The frequency approach is significant, as it utilizes the entire possible information available in the dataset. For instance, it incorporates all uncensored and censored spells in the computation. However, both the duration and frequency approach exhibit similar results only for the uncensored spells of the dataset. In this methodological approach, average frequency of price adjustment is calculated as ratio of non-zero price change observation, to all price observation of the selected sample. For instance, in context to the

[5] Summary statistics of all the indicators are presented in Appendix 3.

current study, frequency of price change for a specific product '*j*' sold at a particular city '*k*' over time period '*T*' would be calculated as:

$$F_{jk} = \frac{\sum_{t=2}^{T} X_{jkt}}{T_{jk}-1} \tag{1}$$

where, T_{jk} is the total number of weekly price observations, P_{jk} over the sample period, and X_{jkt} is the binary variable indicating the price change in *t*.

$$X_{jkt} = \begin{cases} 1 \text{ if } P_{jkt} \neq P_{jkt}-1 \\ 0 \text{ otherwise} \end{cases} \tag{2}$$

The aggregated frequency of price change at the product level is calculated by averaging over all cities '*k*' for the same product category '*j*'.

$$F_j = \frac{\sum_{k=1}^{17} F_{jk}}{\bar{K}} \tag{3}$$

Given the frequency of data available it is assumed that price changes, once within a given week. The implied average and median duration of a price spell can be derived using the aggregated frequency of price change at the product level. The implied duration of price spells could be calculated as inverse of frequency of the price changes:

$$D_j = \frac{1}{F_j} \tag{4}$$

In this computation, homogenous observations are in cross-section, which are thought to provide the consistent results. However, considering that price changes across different cities the possibility of different price setting behavior across cities could exist. Another issue is that, discrete time period is considered in this study, i.e., prices are assumed to be altered only once in a week. Hence, implied average duration for continuous time period is also calculated by taking the logarithmic value of $(1 - F_j)$.

$$D_j^{mean} = \frac{-1}{ln\,(1 - F_j)} \tag{5}$$

The implied median duration is calculated as,

$$D_j^{med} = \frac{ln\,(0.5)}{ln\,(1 - F_j)} \tag{6}$$

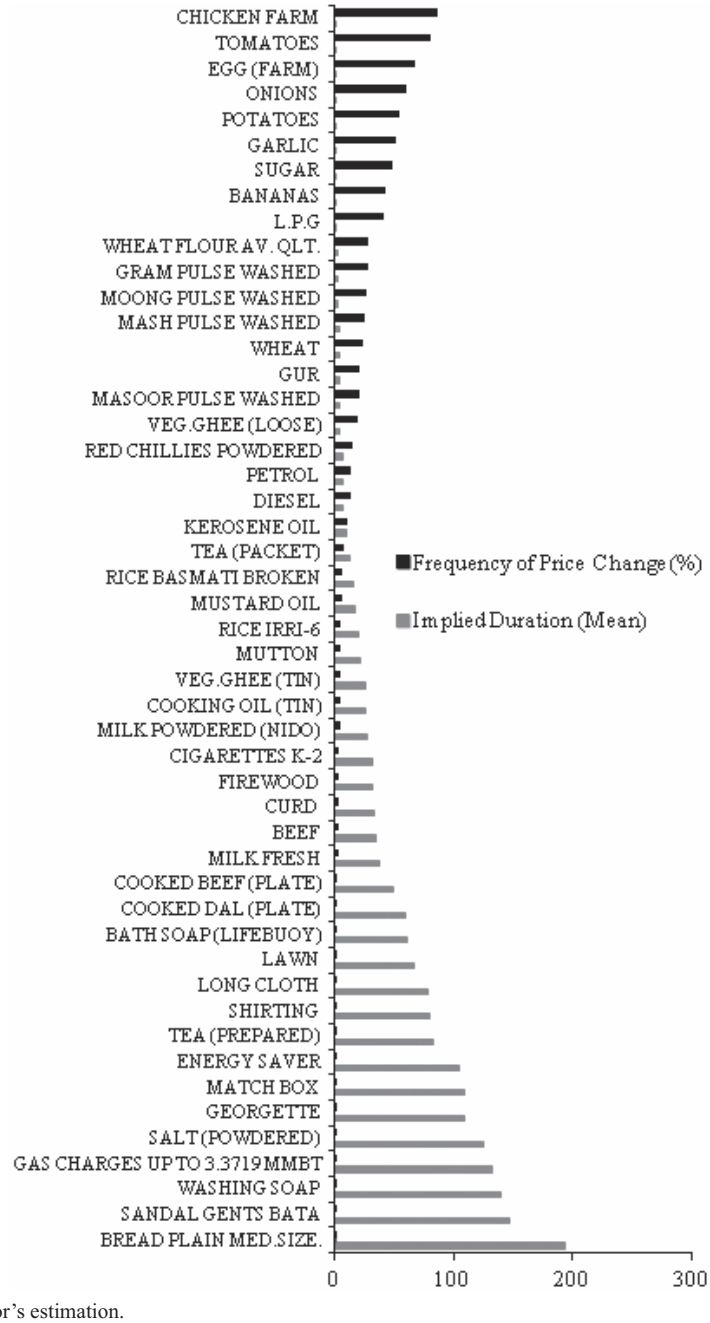
Equations (5) and (6) are unbiased estimators of mean and median implied duration for continuous time period [Baumgartner, et al. (2005) and Baudry, et al. (2004)]. Figure 1 presents an average frequency of price change and the corresponding implied duration derived from frequency approach for 49 various products, out of 53.[6] Four products, namely, slippers (Chappal spring Bata), electricity charges, sandal ladies (Bata) and telephone (local calls) are excluded from Figure 1, as the frequency of price change of these products is very low (less than 0.1 per cent on an average) and thus, reveals very high implied duration of weeks.

Price rigidity computed by frequency of price change and implied duration reveals considerable variation among various products. During the period under study 15.8 per cent of prices change every week, on an average: and imply the mean (median) duration of 5.8 (4) weeks of the price spell. Within these products, all the unprocessed fruit and vegetables (for instance, banana, garlic onion, potato and tomato) and some of the dairy products (for instance, farm chicken and eggs) proved to have the most flexible prices. Averaged at the city level, the price of farm chicken changes most frequently (86.2 per cent) and thus, imply a shorter duration of 0.5 weeks of price spell. Similarly, frequency of price change of eggs is 66.2 per cent, and thus it corresponds to an implied duration of 0.9 weeks on an average. Among the unprocessed fruit and vegetable, price of tomato is most flexible. The price of tomatoes changes by 80.6 per cent and corresponds to a mean (median) duration of 0.6 (0.4) weeks, during the period under study. Similarly, price change of onion, potato, garlic and banana is also very frequent. For instance, it is 58.9 per cent for onion, 53.9 per cent for potato, 51.1 per cent for garlic and 42.1 per cent for banana. These frequencies correspond to the shorter implied durations of 1.1, 1.3, 1.4 and 1.8 weeks of spells, respectively.

Price of other staple food items, for instance, sugar, pulses and wheat also provide apparent evidence of relatively frequent adjustments. Price of sugar changes most frequently, which is about 47 per cent on an average, during this period; thus; it imply a lesser mean (median) duration of 1.6 (1.1) weeks spell. Whereas, wheat and wheat flour shows relatively moderate price adjustment with the implied mean (median) duration of 3.8 (2.7) and 3.2 (2.2) weeks spell, respectively. Similarly, it imply mean (median) duration of pulses ranging from 3.2 (2.2) to 4.6 (3.2) weeks of price spells. Within energy products, the highest price change is found for L.P.G., with 1.9 (1.3) weeks of mean (median) implied duration. Other energy products like petrol, diesel and kerosene oil, also show relatively, the modest implied duration; for instance, it is 7.6, 7.7 and 9.9 weeks of price spell, respectively.

In contrast, there exists a range of other goods as well; in our data-set that proves the rigid price behavior. Among these, the most evident category of goods is clothing and footwear; for instance, chappals (slippers), ladies and gents sandals exhibit very low frequency of price change with a mean (median) implied duration of more than

[6] Appendix 4, portrays the results of mean and median weeks of duration implied from frequency approach.



Source: Author's estimation.

FIGURE 1

Frequency and Implied Duration of Price Change

147 weeks of price spell. Similarly, clothing category have georgette, lawn, long-clothes and shirts; and all these products imply a moderate duration of not less than 67 weeks of price spell on an average. Several other products with administered prices also display a longer implied duration of price spell, like electricity charges, gas charges and local telephone call charges. Duration of price spell of electricity and telephone is more than 149 weeks as data of these products is double censored for each city.

The above analysis proves that there is a range of products which are characterized by flexible price (less than a week); several other items shows moderate durations of price spell, while other features have a highly sticky price behavior (more than 149 weeks). Several other studies like, Bils and Klenow (2004), Aucremanne and Dhyne (2004) provide similar results about existence of highly heterogonous price setting behavior among various products. As mentioned above, the duration of price spell can also be computed directly by the Duration Approach. In the next section, the price behavior of each product is analysed by Duration Approach, and then, it is compared with results of both approaches.

- *The Duration Approach*

In contrast to the frequency approach, duration approach directly computes the duration of spells from the price trajectories. In the duration approach, censored price spells in price trajectories alters the results considerably, as this method directly deals with censoring problem of price spells. However, if all kinds of censored spells are excluded from the dataset, both approaches provide the similar results. The price spell of any specific commodity. (*j*) sold in a particular city (*k*) is the unchanged price observed for any period of time so that $P_{j,k,t} = P_{j,k,t-1}$. However, the price spell ends with a price change, abbreviated as $P_{j,k,t} \neq P_{j,k,t-1}$. The length of price trajectory of any product-city is defined as the time period (weeks), for which the price (Pj,k) was observed.

The average duration of price spell of any particular product-city (*j,k*) trajectory is computed by:

$$ADT_{J,K} = \frac{TL_{J,K}}{NS_{J,K}} \tag{7}$$

where, length of the trajectory and number of spells contained in the trajectory are abbreviated as $TL_{J,K}$ and $NS_{J,K}$, respectively.

At the product level, the average duration is then computed by calculating simple average of the above average durations ($ADT_{J,K}$), across all 17 cities.

$$ADC_J = \frac{\sum_{K=1}^{\bar{K}} ADT_{J,K}}{\bar{K}} \tag{8}$$

As already described the price of 53 products was employed for 17 major cities of Pakistan for 149 weeks from 3rd week of October 2013 to 4th week of September 2016. Total observations of 134,249 accounted for 21,674 price spells. Appendix 5 reveals that for most proportion of the spells (93.6 per cent), prices are not censored and that left censored price spell has almost the same frequency to that of the right censored price spells. Further, only 0.6 per cent of the spells are double censored. It is obvious that longer price spells have more tendencies to censor. In this data set, 120 spells are double censored as their duration is more than 149 weeks.

Figure 2 shows that price behavior calculated from the duration approach reveals an average duration of 6.4 weeks compared to 5.8 weeks from the frequency approach.[7] On comparing the results of duration approach with that of frequency approach, analogous pattern is found across products. The duration of farm chicken price is 1.2 weeks, which is the shortest duration found in the sample; thus, the most flexible price behavior among all commodities in the sample, is proved. Similarly, most of the unprocessed fruit and vegetable proves the flexible price behavior. Likewise wheat, sugar, pulses and some of the energy products (like LPG, kerosene oil, diesel and petrol) also exhibit shorter price durations. The longest spell is found for electricity and local telephone charges as prices of these products remain unchanged throughout the sample period. The prices of footwear are also found rigid during the sample period; while most of the cooked food and clothing products reveal the moderate price durations.

b) The Direction of Price Change

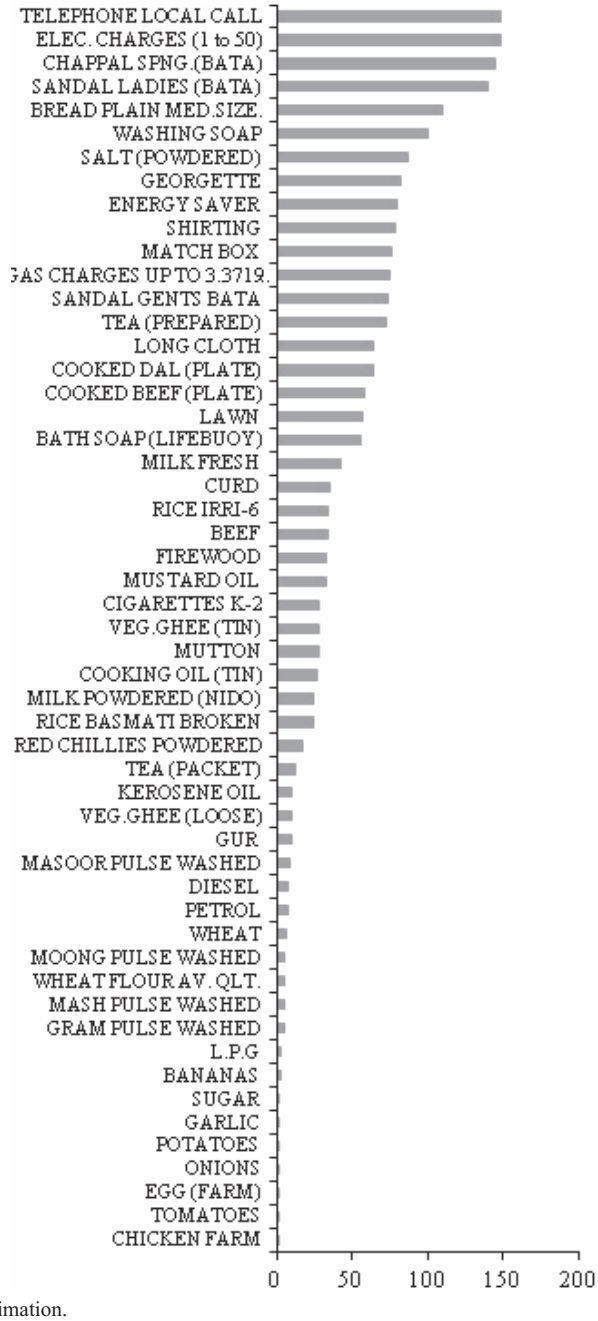
The frequency of price adjustment described above is simply the aggregate of frequency of price increase and price decrease. The pricing mechanism can be investigated more thoroughly if direction of price change is analyzed separately. Examining both directions of price change is useful in identifying the products that displays counteract behavior in response to changing economic conditions. For instance, Klenow and Kryvtsov (2008) illustrate the US rising inflation situation by the frequency of price increases and decreases.

The weekly frequency of price increase for a particular commodity '*j*' at a particular city '*k*' over time period '*T*' is computed as:

$$F_{jk}^{\uparrow} = \frac{\sum_{t=2}^{T} X_{jkt}^{\uparrow}}{T_{jk-1}} \tag{9}$$

where, T_{jk} is the total number of weekly price observation P_{jk}, over the sample period and $X_{jkt}^{\uparrow}$ is the binary variable representing the price increase in *t*.

[7] Difference in the magnitude of average duration is induced by the censored price spells.



Source: Author's estimation.

FIGURE 2

Duration of Price Spell (weeks)

$$X^{\uparrow}_{jkt} = \begin{cases} 1 \text{ if } P_{jkt} > P_{jkt-1} \\ 0 \text{ otherwise} \end{cases} .. \tag{10}$$

Similarly, the average frequency of price decrease is calculated as:

$$F^{\downarrow}_{jk} = \frac{\sum_{t=2}^{T} X^{\downarrow}_{jkt}}{T_{jk-1}} \tag{11}$$

where, $X^{\downarrow}_{jkt}$ is the binary variable representing the price decrease in *t*.

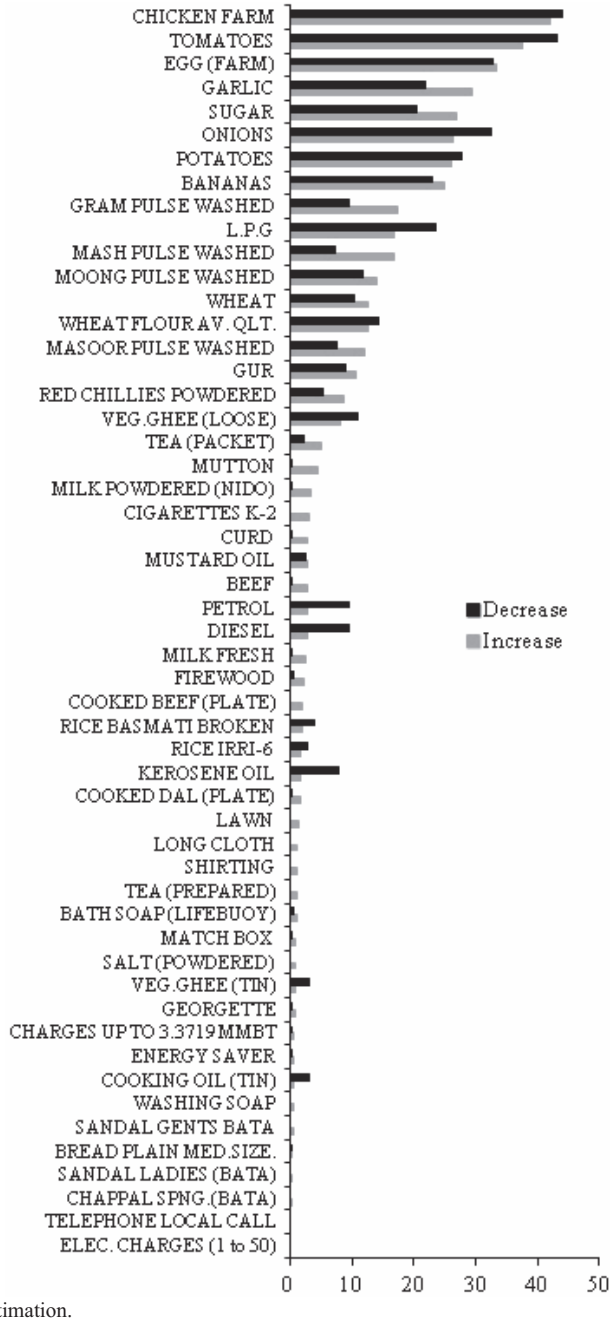
$$X^{\downarrow}_{jkt} = \begin{cases} 1 \text{ if } P_{jkt} < P_{jkt-1} \\ 0 \text{ otherwise} \end{cases} .. \tag{12}$$

The aggregated frequency of price increases (decreases) at the product level is then calculated by averaging over all the cities '*k*' for the same product category '*j*'.

$$F^{\uparrow(\downarrow)}_{j} = \frac{\sum_{k=1}^{17} F_{k}}{\bar{K}} \tag{13}$$

Figure 3 shows the average frequency of increase and decrease of prices. In analyzing the direction of price change, price increase is found more often than the price decrease for most commodities. Appendix 3 shows that an average frequency of price increase is 8.2 per cent as compared to 7.6 per cent of price decrease. The highest frequency of price increase as well as the decrease is found for farm chicken (42 and 44 per cents, respectively). For most of the other processed and unprocessed food items, for instance, eggs, tomato, potato, garlic, banana, onion wheat flour, wheat and sugar, the frequency of both the increase and decrease is found quite often. This proves that although the price increase is usually more widespread, but however, the price decrease is also not very uncommon phenomena, especially for food products.

However, exceptions are found for most of the government controlled energy products. For these products price decrease emerge more frequently than the price increase. For LPG the frequency of price incre ase is about 17 per cent as compared to 23 per cent of the price decrease. Similar patterns are exhibited by petrol, diesel and kerosene oil. The increase (decrease) of 2.8 (9.5), 2.8 (9.5) and 1.8 (7.8) per cents, are found for these products, respectively. Although the frequency of price decrease is more common for these products, but however, the size of price change is another important phenomenon to analyze the exact situation of price behavior. According to Klenow and Malin (2010) the size of price change captures the intensive margin behind inflation, whereas, the frequency measure is indicative of the extensive margin (how often price changes).



Source: Author's estimation.

FIGURE 3

Average Frequency of Price Change (%)

c) Average Size of Price Change

Another important indicator of price setting behavior is the size of price change (increase or decrease). The average size of price increase or decrease at the product-city level is calculated by the following formulas:

$$\bar{\partial}_{jk}^{\uparrow} = \frac{\sum_{t=2}^{T} X_{jkt}^{\uparrow} (lnP_{jkt} - lnP_{jkt-1})}{\sum_{t=2}^{T} X_{jkt}^{\uparrow}} \tag{14}$$

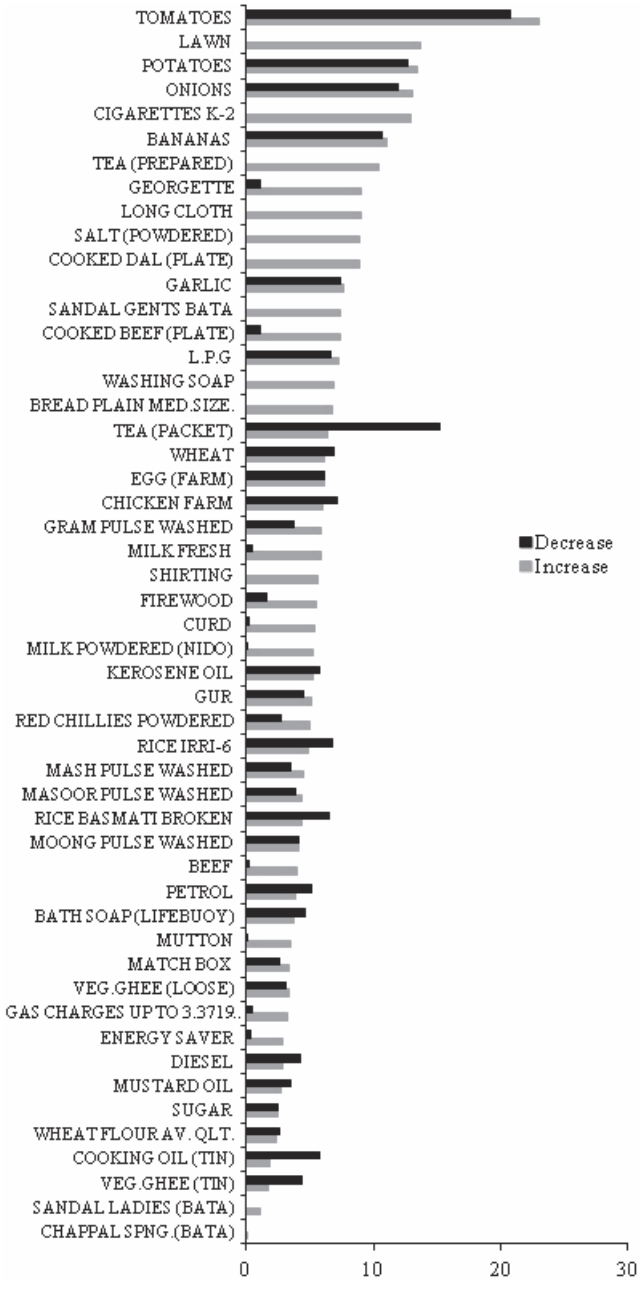
$$\bar{\partial}_{jk}^{\downarrow} = \frac{\sum_{t=2}^{T} X_{jkt}^{\downarrow} (lnP_{jkt-1} - lnP_{jkt})}{\sum_{t=2}^{T} X_{jkt}^{\uparrow}} \tag{15}$$

Figure 4 shows that average size of price increase and decrease, both emerged sizeable for most of the products. However, similar to the indicative of extensive margin (direction of price change), magnitude of price increase is more sizeable than the price decrease. On an average, prices are increased by 8.1 per cent and reduced by 7.2 per cent. Figure 5 shows that for most of the unprocessed perishable food items, the size of price increase and decrease is almost similar. For instance the size of price increase (decrease) for tomato, potato, onion, garlic, banana, farm chicken and eggs is 23.1 (20.8), 13.5 (12.7), 13.1 (11.9), 7.6 (7.4), 11.1 (10.7), 6 (7.1), 6.1 (6.2) per cents, respectively. This result seems to be in line with the demand of these products. It is observed in almost all cities that during the religious occasion or according to the weather conditions, prices of these products are adjusted more intensively.

Analogously, for products like petrol, diesel, kerosene oil and diesel, sizeable increase and decrease of price is detected. However, these products reveal relatively greater reduction in price than the increase. The price changing phenomena operating behind these products is associated more with the international price adjustment of these products. In contrast, almost all clothing's and footwear products show the marked increase in the size of price increase with negligible size of price decrease. Similar trends are also exhibited by various other products, like washing soap, tea, salt, mutton, beef, milk, curd, bread, gas, energy savers and cigarettes.

d) Degree of Synchronization across Cities

In this section, computation and results associated with the synchronization of price change across cities are revealed. The synchronization of price adjustment across cities was computed by the method proposed by Fisher and Konieczny (2000) known as 'Synchronization Ratio'. In this study, the synchronization ratio is based on weekly frequency of price changes. Perfect synchronization of price changes takes place when either the price of a particular commodity, changes simultaneously in all cities of the



Source: Author's estimation.

FIGURE 4

Average Size of Price Change (%)

country or remains same in all cities. Hence, in this case, the proportion of price changes at time *t*, is either equal to 1 or 0. If average frequency of price adjustment for product category *j* is equal to F_j, it means that, in the case of perfect synchronization, the price changes in all cities, simultaneously in F_j per cent of cases. Using the probability of price change, it is thus possible to compute the theoretical value of standard deviation of the proportion of price changes over time, in case of perfect synchronization which is equal to, as follows:

$$SD_j^{max} = \sqrt{F_j (1 - F_j)} \tag{16}$$

This theoretical value is an upper limit for standard deviation of the proportion of price changes. Similarly, in the case of perfect staggering, a constant proportion F_j cities, reported a price change each month, and the standard deviation of the proportion of price changes over time is equal to 0. The observed standard deviation of price change for product category *j* is given by:

$$SD_j = \sqrt{\frac{1}{T\text{-}1} \sum_{t=2}^{T} (F_{jt} - F_j)^2} \tag{17}$$

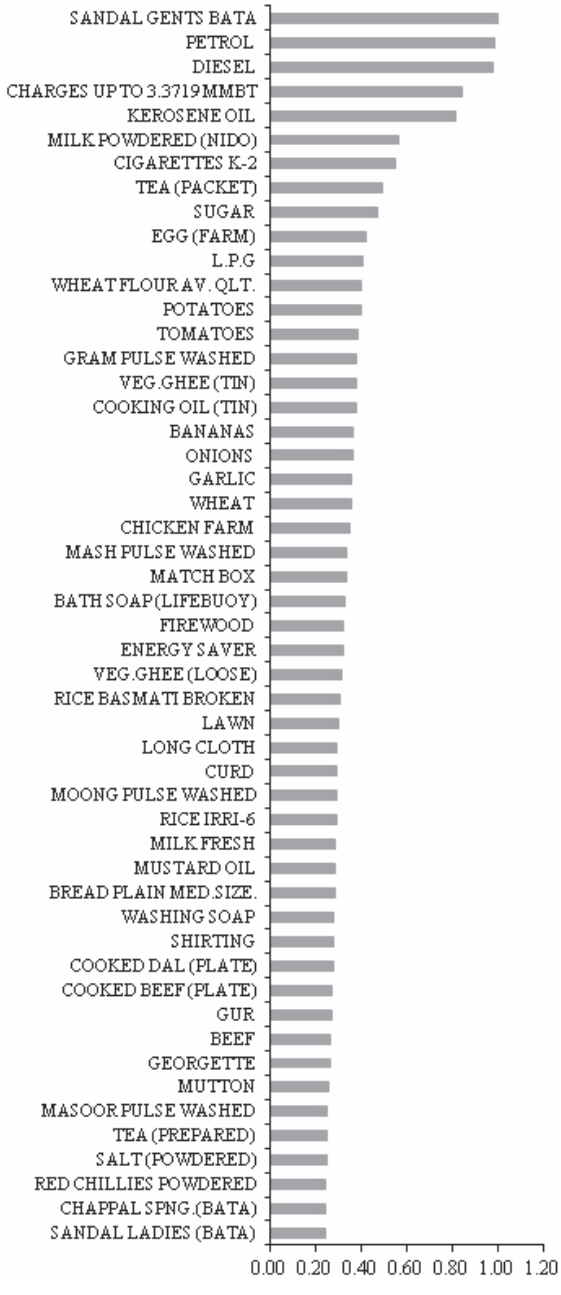
where, *T* is the number of weeks for which prices are included in the study.

The synchronization ratio of product '*j*' is defined as ratio of the observed standard deviation to theoretical maximum standard deviation of the price change.

$$SR_J = \frac{SD_J}{SD_j^{max}} \tag{18}$$

The synchronization ratio would be equal to 1, in the case of perfect synchronization; while, in the case of perfect staggering (complete absence of synchronization) it would be equal to zero. Figure 6 reveals a broad spectrum of synchronization across cities ranging from partial staggered to perfect synchronized pricing behavior. The computed synchronization of each product across cities ranges between 24 to 100 per cent. The prominent category that shows the highest degree of synchronization in price change is the energy products. The degree of synchronization for petrol, diesel, gas charges, and kerosene oil ranges from 82 to 99 per cent, across all 17 sample cities. The pricing behavior for this category is highly synchronized because of the regulated prices by the government.

Few products like eggs, milk, sugar and tea are found to be quasi synchronized ranging between 41 to 56 per cent; whereas, food, clothing and footwear products reveal very low degree of synchronization associated with price change across cities. It is observed that although the price list of food items are released by the government,



Source: Author's estimation.

FIGURE 5

Synchronization Ratio

to maintain the harmonized system, but however, these results proves the lack of proper check and balance across cities.

2. Probability of Consumer Price Change in Pakistan

In the above analysis, it is observed that a substantial heterogeneity exist in the price setting behavior across various products. This section is thus aimed to estimate the fixed effect model for assessing main factors affecting frequency of price change in Pakistan. The balanced fixed effect panel data regression function is of the following form:

$$y_{it} = \beta_0 + \beta_1 \text{regulated}_{it} + \beta_2 \text{inflation\_volatility}_{it} + \beta_3 \text{average\_inflation}_{it} + \beta_4 \text{price\_decrease}_{it} + \beta_{4+m} \sum_{m=1}^{9} \text{prod\_group\_m}_i + \beta_{13+m} \sum_{m=1}^{11} \text{seasonality\_m}_{it} + \beta_{24+m} \sum_{m=1}^{3} \text{year\_m}_{it} + \beta_{27+m} \sum_{m=1}^{16} \text{city\_m}_{it} + \varepsilon_{it} \quad (19)$$

The above fixed effect model is indexed by '*i*' for cross sectional dimension which is a combination of product category '*j*' and cities '*k*', whereas, the time dimension is indexed by '*t*'. In this analysis, average monthly frequency of price change is regressed on several explanatory variables, each of which is described in light of the existing literature. Factors that determine the frequency of price change are mainly distinguished as time dependent or state dependent factors. Time dependent factors are principally defined by Taylor model [Taylor (1980), (1999)] and Calvo model [Calvo (1983)]. Taylor model observes the change in price only, after the completion of fixed contract; whereas, the Calvo model observes a constant probability of price adjustment in each period. However, most other prices and some of the price setting intervals are observed to follow various economic variables, such as inflation rate. Hence, State dependent factors also possess important implications in determining the price setting mechanism. The State dependent models mostly assume constant probability of price change in steady state but may vary in response to various economic shocks.

In this section, various times dependent, state dependent and other factors are identified to explain price setting behavior for the case of Pakistan. Henceforth, all factors employed in the regression framework are discussed in detail. In the literature, regulated prices are considered as one of the important factor that help in characterizing the products to be considered as rigid or flexible. Most studies confirm that prices which are supplied or fixed by regulated authorities show the rigid price behavior compared to other prices. For instance, Lunnemann and Matha (2005) proves that 7.6 percentage point lower the probability of price change for products that are subject to control by regulated authorities for Luxembourg. Similarly, Dhyne, et al. (2006) confirmed that regulated prices reveal 17.9 percentage lower probability of price adjustment than others. Dexter, et al. (2004) proves the presence of inertia in price change because of regulated prices. Hence, the literature suggests stickier nature of price behavior for products which are subject to regulations.

In Pakistan, like some other countries,[8] distinguishing the commodities for which prices are regulated is burdensome as none of the official document is available at the national level that provides the list of regulated commodities. Similarly, to what extent the prices are subject to regulation, may also differ considerably from commodity to commodity. Following, Lunnemann and Matha (2005), the study only consider the prices as regulated, fixed and officially announced by authorities, like energy products.[9]

In the above regression function, variable 'regulated' is a dummy variable that takes the value as equal to 1 for products which are considered as regulated and zero otherwise. Table 3 confirms the sticky nature of regulated commodities for the case of Pakistan. According to the results obtained, these products exhibited 1.8 percentage lower frequency of the price change. The results, thus substantiate the findings of other studies. Contemporary research on the subject suggests a positive relationship between frequency of price change and the level of inflation prevailing in the country. For instance, Woodford (2009) and Baumgartner, et al. (2005) found a positive impact of accumulated inflation on probability of price change at the product level. Similarly, Cecchetti (1986) and Lach and Tsiddon (1992) proved the shorter duration of prices in the periods of higher inflation. Likewise, inflation volatility is also considered to affect frequency of price change, significantly. It is suggested that higher inflation would increase the frequency of price increase, but it lowers the frequency of price decrease. In this study, variables 'Average_inflation' and 'Inflation_volatility' are employed to determine the impact of monthly average inflation and inflation volatility on frequency of price change at product level. Table 1 shows the highly significant impact of both these factors on the frequency of price change in Pakistan. The estimates shows that one percentage point increase in monthly inflation rate and the monthly inflation volatility would lead to about 2.2 percentage and one percentage increase in monthly frequency of price change, respectively. Hence, it proves the importance of state dependent factors in determining the pricing mechanism.

Nature of the previous price change also impact significantly on future price adjustment. For instance, the effect of previous price decrease is expected to affect positively on the frequency of price change, as most of the price reduction which are usually temporary in nature occur for a small period of time because of promotion and discount offers. Such price changes are reversed by mostly the large price increase. Aucremanne and Dhyne (2004) and Baumgartner, et al. (2005) noticed a large price increase after a previous price reduction; and thus, it increase the probability of price change in the case of Belgium and Austria. These finding are however, found consistent with general business practices in the form of end-of-season sale and discount offers on special occasions in most of the countries, including Pakistan. In the regression framework above, the variable 'Price_decrease' is a dummy variable that takes the

[8] Like Luxembourg. For details see, Lunnemann and Matha (2005).

[9] Complete list of regulated price are provided in Appendix 6.

value 1, if there is a price decrease and zero otherwise. The results show highly significant and huge impact of the nature of price change (especially, price decrease) on the frequency of price change. These results confirm the usual pricing practice in Pakistan, where price reduction is usually temporary in nature for a very small period of time and thus, lead to quick and huge reversal.

It is observed[10] that prices of various commodities exhibit seasonal pattern. Figure in Appendix 7, portray the average frequency of price change for each product category for each month, at the aggregated level to determine the seasonal pattern. At the aggregated level, frequency of price change was highest for the month of April. (January is the reference month) In this month, about 11 per cent of all prices were found to be adjusted, followed by May. Approximately 19 per cent of all prices were adjusted in these two consecutive months. The figure reveals that the month of April exhibit about 55 per cent of price reduction compared to 45 per cent of the price hike. However, the month of May exhibit the reversed pattern, i.e, it reveals 44 per cent of the price reduction and 56 per cent of price the increase. Similarly, November, December and January, consecutively show high frequency of the price change. In November, frequency

TABLE 1

Determinants of Frequency of Price Change
Fixed Effect Model (LSDV)*

Independent Variables	β	Robust S.E	P-Value
Regulated	-0.0179	0.0094	0.057
Inflation_volatility	0.0096	0.0037	0.008
Average_inflation	0.0218	0.0061	0.000
Price_decrease	1.1153	0.0088	0.000
**Seasonal Dummies		yes	
**Yearly Dummies		yes	
**Product Categories' dummies		yes	
**City Dummies		yes	
Constant	0.2868	0.0272	0.000
Number of observation = 31535			
F(43, 31491) = 1296.40			
Prob > F = 0.0000			
R-squared = 0.7303			

**Detail results are shown in appendix 8. * Results of the diagnostic F-test for LSDV are presented in appendix 9.

Source: Author's Calculation from PBS Price Data.

[10] Lunnemann and Matha (2004).

of price decrease was less than 44 per cent, whereas the other two consecutive months exhibit more than 55 per cent of price cut. Although, like most other countries the pattern shows 'sales' an important phenomenon in driving the price movements; but however, considering the products included in the data set, and observed behavior of prices and various other factors are important in determining the pattern. For instance, price of most of the perishable food items are observed to rise, considerably when the demand rises, especially during the Holy month of Ramadan and Eid ul Azha.

The months of June and July (figure in Appendix 7) displays a common behavior in most types of products like, staple, perishable food items, meat and dairy products, and the processed food. Not only the aggregate frequency of price change is lowest in these two months but also the frequency of price decrease is observed considerably less, probably because of the new expected adjustments by the official budget announcement of the government. Hence, the simple graphical representation shown in the figure confirms seasonality, as one of the most important determinants of price adjustment. This is also confirmed by various other studies, for instance, Lunnemann and Matha (2005), Baumgartner, et al. (2005) and Veronese, et al. (2004).

In this study, dummies for months are included to capture the effect of seasonality. The result shown in Table 1 proves the significance and existence of time dependent aspect in the pricing behavior. The frequency of price change is highest for the months of April, May, June and July. The results also confirm the above analysis that suggests high frequency of price increase in these months. Yearly dummies are included in the regression framework to capture structural or cyclical patterns. The results suggest that year 2015 was not significantly different from 2013 (of the reference month). However, the yearly frequency of price change was significantly lower in 2014 and 2016. In the above mentioned regression framework, dummies for product categories and cities are included to observe the heterogeneity among products and cities, respectively. Highly significant coefficient estimates for product category dummies indicate substantial heterogeneity among various product types. Table 1 reveals that frequency of price change for perishable food items is highest followed by Meat and Dairy Products and Processed the food Items. However, cross city difference is found relatively less pronounced in determining the frequency of price change. Section IV, suggests some recommendations and conclude the study.

IV. Conclusion and Policy Recommendations

An attempt in this study is made to analyze the characteristic pattern of consumer prices by employing the micro-data collected by the Pakistan Bureau of Statistics, Government of Pakistan, for the purpose of calculating the Sensitive Price Index (SPI). The raw data is collected on regular basis from various outlets of seventeen major cities of Pakistan. The weekly data employed in this study is from 3rd week of October 2013 to 4th week of September 2016. In this way a total of 134,250 observations are included in the study.

The pricing behavior of micro-consumer prices are analyzed on the basis of various indicators like, frequency and duration of price changes, directions and size of price changes; and the synchronization of price changes across these seventeen cities. The descriptive nature of analysis presented in this study reveals some astounding facts about the price setting behavior. The study found that on an average, 15.8 per cent of prices change every week with mean (median) duration of 5.8 (4) weeks of price spell. However, the results show highly heterogonous length of price duration when analyzed at product level. In analyzing the direction of price change, price increase is found more often than price decrease for most commodities. However, exceptions are found for most of the government controlled energy products. For these products price decrease emerge more frequently than the price increase. Although, the frequency of price decrease is more common for most products, but however, the size of price change is another important phenomenon to analyze exact situation of price behavior. On an average, prices are increased by 8.1 per cent and reduced by 7.2 per cent. The study reveals a broad spectrum of synchronization across cities ranging from partial staggered to perfect synchronized pricing behavior. The computed synchronization of each product across cities ranges between 24 to 100 per cent. The prominent category that shows the highest degree of synchronization in price change is the energy products probably because of government's regulations. Few products like eggs, milk, sugar and tea are found to be quasi synchronized ranges between 41 to 56 per cent; whereas, food, clothing and footwear products reveal very low degree of synchronization associated with the price change across cities.

The Panel fixed effect model (LSDV) employed in the study confirms sticky nature of regulated commodities for the case of Pakistan. Highly significant impact of monthly average inflation and inflation volatility is found on the frequency of price change; hence it proves the importance of state dependent factor in determining the pricing mechanism. Strong seasonal pattern is found in determining frequency of price change; and thus, it also proves the existence of time dependent element in price adjustment process. The results show the existence of elements of both are state dependent, as well as the time dependent factors, in determining the frequency of price change in Pakistan.

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APPENDICES

APPENDIX 1

Number of Markets Surveyed per City

S. No.	Cities	Markets	S. No.	Cities	Markets
1.	Islamabad	4	10.	Karachi	13
2.	Rawalpindi	6	11.	Hyderabad	4
3.	Gujranwala	1	12.	Sukkur	2
4.	Sialkot	1	13.	Larkana	1
5.	Lahore	7	14.	Peshawar	3
6.	Faisalabad	2	15.	Bannu	1
7.	Sargodha	1	16.	Quetta	2
8.	Multan	3	17.	Khuzdar	1
9.	Bahawalpur	1	Total		53

Source: PBS, GoP.

APPENDIX 2

List of Commodities

S.No.	Commodities	S.No.	Commodities	S.No.	Commodities
1.	Wheat	19.	Vegetable ghee (loose)	37.	Shirting
2.	Wheat flour	20.	Mustard oil	38.	Sandal gents (bata)
3.	Basmati rice (broken)	21.	Cooking oil (dalda)	39.	Sandal ladies (bata)
4.	Rice irri-6	22.	Potatoes	40.	Chappal sponge (bata)
5.	Masoor pulse	23.	Onions	41.	Kerosene oil
6.	Moong pulse	24.	Tomatoes	42.	Firewood
7.	Mash pulse	25.	Bananas	43.	Energy saver
8.	Gram pulse	26.	Salt	44.	Match box
9.	Beef with bone	27.	Red chilies	45.	Washing soap
10.	Mutton	28.	Garlic	46.	Bath soap (life buoy)
11.	Eggs	29.	Tea packet	47.	Chicken farm
12.	Bread plain	30.	Tea (prepared)	48.	Gas charges
13.	Sugar	31.	Cooked beef (plate)	49.	L.P.G.
14.	Gur	32.	Cooked dal (plate)	50.	Electric charges
15.	Milk fresh	33.	Cigarettes K-2	51.	Petrol
16.	Milk powdered (nido)	34.	Long cloth	52.	Diesel
17.	Curd	35.	Lawn	53.	Telephone Charges
18.	Vegetable ghee (tin)	36.	Georgette		

Source: PBS, GoP.

APPENDIX 3

Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Frequency of price change	901	15.7	23.4	0.0	98.6
Duration of prices	901	42	48.2	1.0	149.0
Frequency of price increase	901	8.2	11.8	0.0	52.7
Frequency of price decrease	901	7.6	12.2	0.0	52.0
Size of price increase	901	6.5	7.9	0.0	69.3
Size of price decrease	901	3.6	5.0	0.0	32.7

Source: Author's Calculations from PBS Price Data.

APPENDIX 4

Implied Duration from Frequency Approach

Commodities	Average Frequency	Implied Duration (Mean)	Implied Duration (Median)
Bananas	42.1	1.8	1.3
Bath Soap (Lifebuoy)	1.6	60.9	42.2
Beef	2.9	34.4	23.9
Bread Plain Med. Size.	0.5	193.0	133.8
Chappal Spng.(Bata)	0.0	a	A
Chicken Farm	86.2	0.5	0.3
Cigarettes K-2	3.1	31.8	22.0
Cooked Beef (Plate)	2.0	49.8	34.5
Cooked Dal (Plate)	1.7	59.4	41.2
Cooking Oil (Tin)	3.8	26.0	18.0
Curd	3.0	33.0	22.9
Diesel	12.2	7.7	5.3
Egg (Farm)	66.2	0.9	0.6
Elec. Charges (1 To 50)	0.0	a	A
Energy Saver	1.0	104.3	72.3
Firewood	3.1	32.2	22.3
Garlic	51.1	1.4	1.0
Gas Charges Up To 3.3719 MMBT	0.8	131.9	91.4
Georgette	0.9	108.9	75.5
Gram Pulse Washed	27.0	3.2	2.2
Gur	19.9	4.5	3.1
Kerosene Oil	9.6	9.9	6.9
L.P.G	40.4	1.9	1.3
Lawn	1.5	67.5	46.8
Long Cloth	1.3	78.1	54.2
Mash Pulse Washed	24.2	3.6	2.5
Masoor Pulse Washed	19.6	4.6	3.2
Match Box	0.9	108.9	75.5
Milk Fresh	2.6	38.2	26.5
Milk Powdered (Nido)	3.6	27.5	19.0
Moong Pulse Washed	25.8	3.3	2.3
Mustard Oil	5.5	17.6	12.2

(Continue.)

APPENDIX 4 *(Contd.)*

Implied Duration from Frequency Approach

Commodities	Average Frequency	Implied Duration (Mean)	Implied Duration (Median)
Mutton	4.5	21.8	15.1
Onions	58.9	1.1	0.8
Petrol	12.3	7.6	5.3
Potatoes	53.9	1.3	0.9
Red Chillies Powdered	14.2	6.5	4.5
Rice Basmati Broken	5.9	16.5	11.4
Rice Irri-6	4.7	20.8	14.4
Salt (Powdered)	0.8	125.3	86.9
Sandal Gents (Bata)	0.7	147.5	102.2
Sandal Ladies (Bata)	0.1	a	A
Shirting	1.2	80.7	55.9
Sugar	47.4	1.6	1.1
Tea (Packet)	7.4	13.0	9.0
Tea (Prepared)	1.2	83.4	57.8
Telephone Local Call	0.0	a	A
Tomatoes	80.6	0.6	0.4
Veg. Ghee (Loose)	19.3	4.7	3.2
Veg. Ghee (Tin)	3.8	25.7	17.8
Washing Soap	0.7	139.3	96.5
Wheat	23.0	3.8	2.7
Wheat Flour Av. Qlt.	27.0	3.2	2.2
Total	15.8	5.8	4.0

a: Implied duration of products contained less than one complete spell are not reported.
Source: Author's Calculation from PBS Price Data.

APPENDIX 5

Type of Spells (Weeks)

Left Censored	Right Censored	# of Spells (Weeks)	Spells (%)
0	0	120	0.6
0	1	627	2.9
1	0	650	3.0
1	1	20277	93.6
Total		21674	100

Source: Author's Calculation from PBS Price Data.

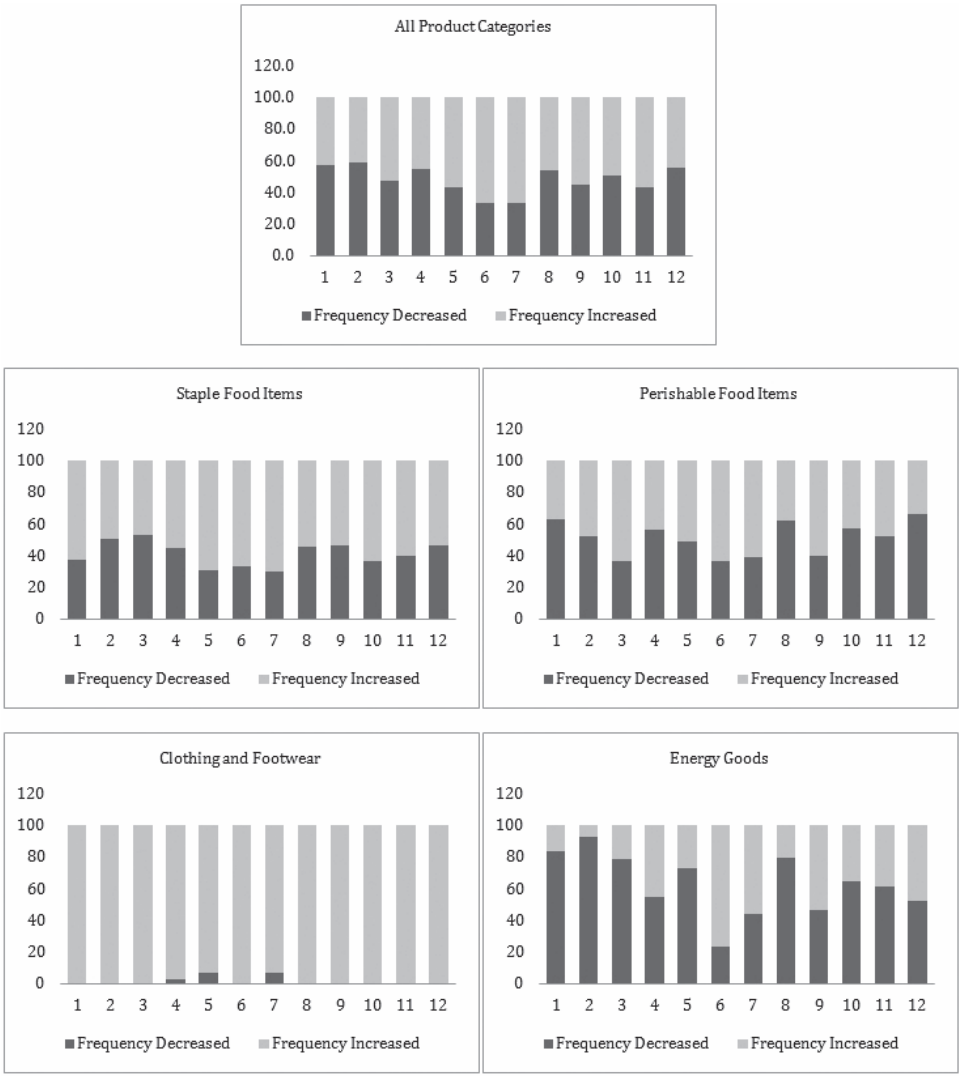
APPENDIX 6

List of Regulated Commodities

S.No.	Commodities
1.	ELEC. CHARGES (1 to 50)
2.	GAS CHARGES UP TO 3.3719 MMBTU
3.	KEROSENE OIL
4.	PETROL
5.	DIESEL
6.	L.P.G
7.	TELEPHONE LOCAL CALL

APPENDIX 7

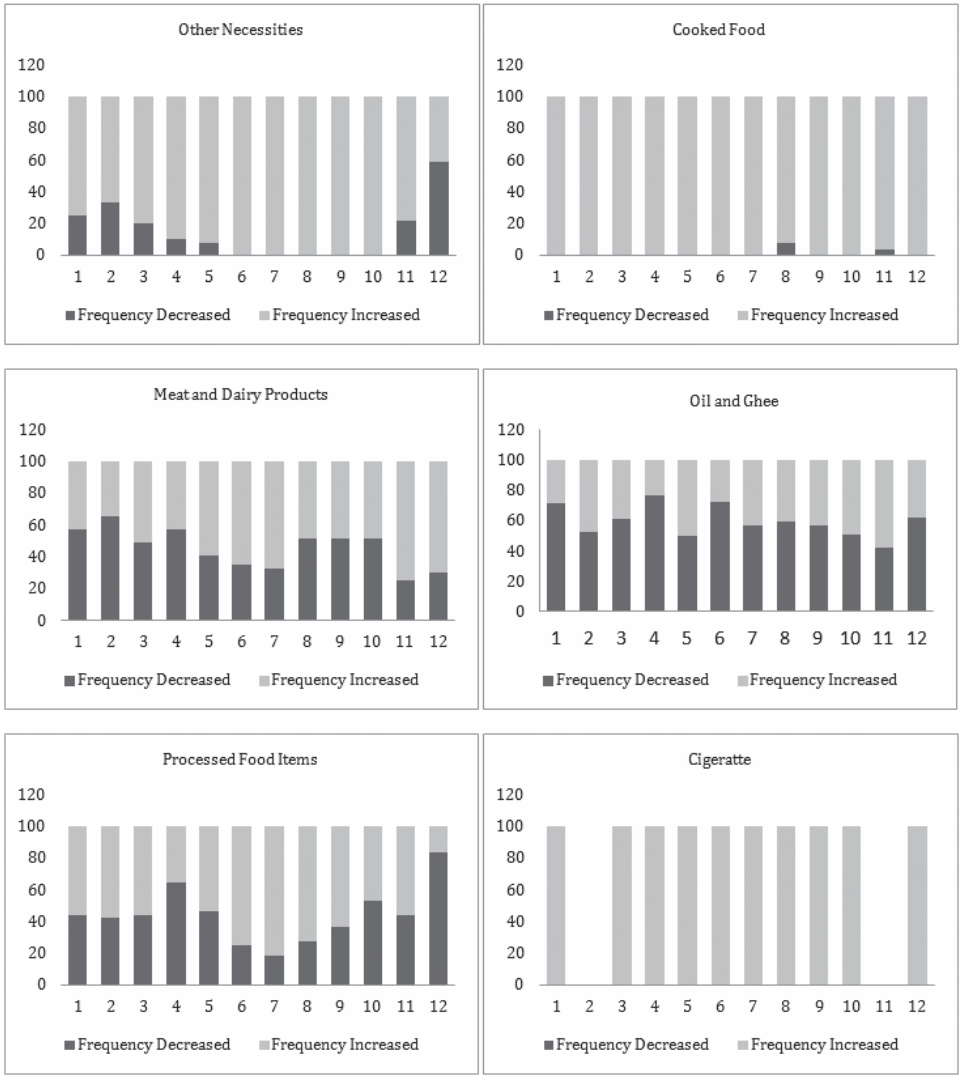
Monthly frequency of Price Change (%)



(Continue.)

APPENDIX 7 *(Contd.)*

Monthly frequency of Price Change (%)



Source: Author's Calculation from PBS Price Data.

APPENDIX 8

Determinants of Frequency of Price Change: Fixed Effect Model (LSDV)

Independent Variables	β	Robust S.E	P-Value
Regulated	-0.0179	0.0094	0.057
Inflation_volatility	0.0096	0.0037	0.008
Average_inflation	0.0218	0.0061	0.000
Price_decrease	1.1153	0.0088	0.000
Month_2	-0.0526	0.0147	0.000
Month_3	0.0558	0.0162	0.001
Month_4	0.0797	0.0171	0.000
Month_5	0.0902	0.0167	0.000
Month_6	0.1585	0.0171	0.000
Month_7	0.1252	0.0179	0.000
Month_8	-0.0008	0.015	0.959
Month_9	0.035	0.0177	0.048
Month_10	0.056	0.0206	0.006
Month_11	0.08	0.0182	0.000
Month_12	-0.0403	0.0212	0.057
Year_14	-0.0564	0.0194	0.004
Year_15	-0.0151	0.0195	0.440
Year_16	-0.0748	0.0207	0.000
Product_2	0.6428	0.0293	0.000
Product_3	-0.3286	0.0109	0.000
Product_4	-0.271	0.0132	0.000
Product_5	-0.3244	0.0132	0.000
Product_6	-0.302	0.0127	0.000
Product_7	0.113	0.0165	0.000
Product_8	-0.2499	0.0135	0.000
Product_9	0.1843	0.0226	0.000
Product_10	-0.2321	0.0173	0.000
City_2	0.1889	0.0212	0.000
City_3	0.0923	0.0198	0.000
City_4	0.0099	0.0186	0.595
City_5	0.0248	0.0187	0.185
City_6	0.0619	0.0197	0.002

(*Continue.*)

APPENDIX 8 *(Contd.)*

Determinants of Frequency of Price Change: Fixed Effect Model (LSDV)

Independent Variables	β	Robust S.E	P-Value
City_7	0.0422	0.0193	0.029
City_8	0.0271	0.0212	0.202
City_9	0.0966	0.0203	0.000
City_10	0.1493	0.0201	0.000
City_11	0.0563	0.0192	0.003
City_12	0.1393	0.0209	0.000
City_13	0.0646	0.0188	0.001
City_14	0.0408	0.019	0.032
City_15	0.0822	0.019	0.000
City_16	-0.0002	0.0181	0.992
City_17	-0.0156	0.0171	0.360
Constant	0.2868	0.0272	0.000
Number of observation = 31535		F(43, 31491) = 1296.40	
Prob > F = 0.0000,		R-squared = 0.7303	

Source: Author's Calculation from PBS Price Data.

APPENDIX 9

Diagnostic F-test for LSDV Model

```
. testparm i.month

 ( 1)  2.month - 0
 ( 2)  3.month - 0
 ( 3)  4.month - 0
 ( 4)  5.month - 0
 ( 5)  6.month - 0
 ( 6)  7.month - 0
 ( 7)  8.month - 0
 ( 8)  9.month - 0
 ( 9)  10.month - 0
 (10)  11.month - 0
 (11)  12.month - 0

       F( 11, 31491) =   28.21
            Prob > F =    0.0000

. testparm i.year

 ( 1)  2014.year - 0
 ( 2)  2015.year - 0
 ( 3)  2016.year - 0

       F(  3, 31491) =   16.51
            Prob > F =    0.0000

. testparm i.prod_cat

 ( 1)  2.prod_cat - 0
 ( 2)  3.prod_cat - 0
 ( 3)  4.prod_cat - 0
 ( 4)  5.prod_cat - 0
 ( 5)  6.prod_cat - 0
 ( 6)  7.prod_cat - 0
 ( 7)  8.prod_cat - 0
 ( 8)  9.prod_cat - 0
 ( 9)  10.prod_cat - 0

       F(  9, 31491) =  600.26
            Prob > F =    0.0000

. testparm i.city_codes

 ( 1)  2.city_codes - 0
 ( 2)  3.city_codes - 0
 ( 3)  4.city_codes - 0
 ( 4)  5.city_codes - 0
 ( 5)  6.city_codes - 0
 ( 6)  7.city_codes - 0
 ( 7)  8.city_codes - 0
 ( 8)  9.city_codes - 0
 ( 9)  10.city_codes - 0
 (10)  11.city_codes - 0
 (11)  12.city_codes - 0
 (12)  13.city_codes - 0
 (13)  14.city_codes - 0
 (14)  15.city_codes - 0
 (15)  16.city_codes - 0
 (16)  17.city_codes - 0

       F( 16, 31491) =   15.69
            Prob > F =    0.0000
```