Price Flexibility in an inflationary Economy: Case Venezuela

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1. INTRODUCTION

Over the last 25 years, Venezuela has gone through a chronic inflation process; that is, price variation rate has remained in the neighborhood of two digits. Given this circumstance, agents have devised formal and informal indexation mechanisms. This process, in turn, might be linked to credibility problems, in terms of economic policies, or to the maintenance of imbalances in the economy. These factors could be a reason for the persistence of the behavior of price variation over time, which is common in cases of chronic inflation and has been present in the Venezuelan case (Álvarez et al., 2002; Dorta et al., 2002).

The study on price duration provides us with a mechanical way of looking at this phenomenon. Price rigidity, combined with the overlapping of their adjustments, results in a highly persistent inflation rate, especially if those adjustments are made under time-dependent price setting rules (Taylor, 1999). As a consequence, estimating how long a price could last provides relevant information in terms of formulation of the monetary policy, especially in a context in which price adjustment frequency is also positively associated with inflation rate.

Even though literature on the topic of price duration has been nurtured with new references over recent years, this topic has not been dealt with in Venezuela. An important part of the literature on rigidity assessment comes from the Eurosystem Inflation Persistence Network Project,

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in which the European Central Bank, along with central banks of Continental Europe, was involved. The results of the project have been already summarized in Álvarez et al. (2006), and Dhyne (2006). Furthermore, similar studies with US data (Bils and Klenow, 2004; Klenow and Kryvtsov, 2008; Nakamura and Steinsson, 2008), the United Kingdom (Bunn and Ellis, 2009) and Brazil (Gouvea, 2007) have been carried out. In general, this research project has found that prices in Europe are more rigid than in the USA. For instance, median duration in the first case is 13 months, whereas in the second case is eight months.

With the purpose of knowing the rigidity degree of prices in an inflationary economy, in this paper we analyze the variation frequency of consumer prices in Venezuela with the information contained in the database used to estimate the Consumer Price Index (CPI) of the Caracas Metropolitan Area (CMA). The study covers the period running from January 2000 through December 2007, which is characterized by an average monthly inflation rate of 1.5%, equivalent to 20% per year. The database contains a total number of observations that is close to three million prices observed in more than 34,000 individual products with 80% coverage of CPI. Those items in which imputations play a major role and which are administered by an Executive authority, such as underground transportation rates or gasoline, are excluded from this analysis.

In contrast with the results obtained in other countries, consumer prices in Venezuela show a higher degree of flexibility. In this regard, the estimated duration of a price in Venezuela is 3 months as per the direct method and 2.6 months by the indirect method. This contrasts with the results for Europe (13 months) and the USA (8 months). Likewise, our results show that, in 50% of the items, prices change every 1.9 months, at most, on average.

An aspect that is similar to other international results is the heterogeneity of price duration. In fact, service prices tend to be less flexible than other prices in the CPI basket, which may be indicative of cost rigidity, especially wage costs, presence in these activities. For instance, prices of hospital, preschool, basic, secondary and higher education services remain constant at least for six months. However, prices of those good for which imports are a major component of overall supply tend to be the most flexible ones, as shown by home textile products, vehicles and telephone equipment, which last less than two months, on average.

This paper also presents the hazard rate estimate, showing that it is not constant in time. In fact, probability of a change of price, give that it

has not previously changed, increases with the number of months during which the price has remained fixed. This could be explained by the presence of inflation inertia or heterogeneity in price adjustment mechanisms.

The work is divided into the following sections: introduction; section 2 that describes data that will be used in the assessment of price rigidity. The main results, together with a brief methodology description, will be commented in section 3. With the aim of being exhaustive in the estimate, both the direct and indirect methods are applied.

In section 4, the question of whether price duration is the same for all goods in the average consumer basket is answered. The main message of this section is that the highest duration of prices is associated with services and price controls. Section 5 deals with estimating the probability of change in a conditional price as of the date of the last change, that is, hazard rate. Finally, conclusions and remarks are presented in section 6, outlining that the main contribution of this work is the identification of stylized facts relative to price formation in Venezuela, which should be a part of the macroeconomic models adapted to the Venezuelan reality.

2. DATA

Information required to estimate price duration in this work is taken from the database of prices used to calculate CPI in the CMA.[1] The sample period includes price observations since January 2000 through December 2007. However, not all of the items in the CMA-CPI were included in this research.[2] The *rentals for housing* group and the *insurance* subgroup do not belong to this study, since imputations are used for the calculation of their respective indices. Likewise, prices of items that are administered by any government level, either national, regional or local. These correspond to housing services (refuse collection, water supply, electricity, etc.), gasoline and land passenger transportation rates (extra-urban,

[1] The base CMA-CPI basket was changed as from January 2008. A few months later, a new indicator was introduced to measure inflation in Venezuela, i.e. the National Price Consumer Index, which included CMA-CPI as an input data for the calculation. However, the calculation methodology of the indicator for the Caracas Metropolitan Area was not modified with the introduction of the new index.

[2] The 1977's base CMA-CPI basket includes 287 items, which are the most detailed components of goods and services measured by this indicator. These items are classified into 13 groups, which, in turn, are divided into 38 groups.

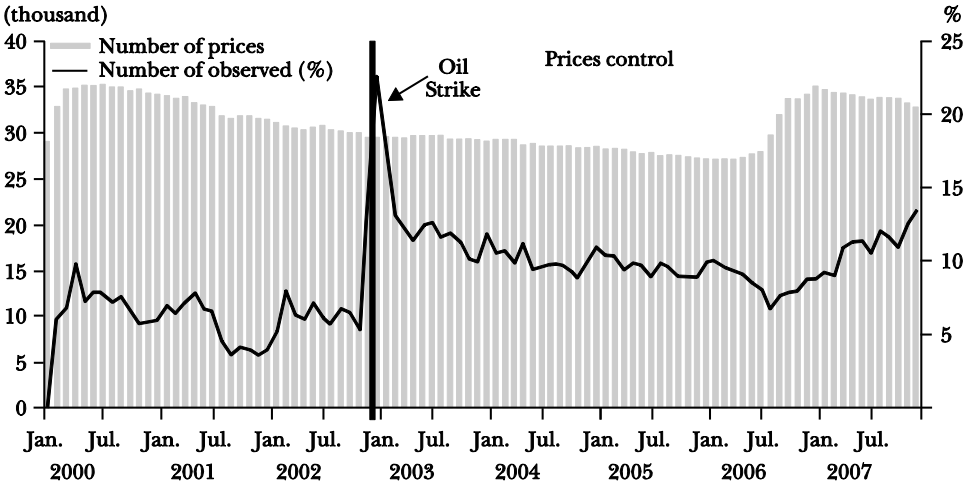
urban, trunk routes, etc.). However, price-controlled items are covered by our study, because prices of these goods and services are not necessarily set at regulated levels in the market.

The database to be used contains the following information: *1)* a field that identifies the specific product, including to which group, subgroup, class, subclass and category this product belongs; *2)* a field that identifies the type of store and another field that identifies the area where the store is located; *3)* the exact current price of the product at time *t; 4)* the month and year when the price was recorded; *5)* an identifier if the price is imputed; and *6)* the date when product follow-up ended.

In general, a potential of almost three million of price observations, of which a few more than 260,000 correspond to non-observed data, have been gathered. Figure 1 shows how potential data and non-observed data are distributed in time. The most outstanding characteristic seen in the figure is the drop in the number of prices within the sample in the period between July 2000 and April 2006, from 35,000 to 27 thousand prices. This decrease can be attributed to methodological changes that were incorporated along with the new base year and to the usual observation loss resulting from erosion of qualified informants. Up until November 2002, the percentage of absences or non-observed prices did not exceed 10% in any of the months.

In December 2002, the political instability climate in Venezuela led to a strike in the oil sector and part of the private sector. As usual in this type

FIGURE 1. OBSERVED AND NON-OBSERVED PRICES, 2000-2007



of situations, a significant level of absence in observed prices occurred, reaching a maximum of 23% of potential observations in January 2003.

In response to the severe economic situation brought about by the political crisis, the National Executive implemented price controls, among other measures. Up until now, price controls have not been lifted, although modifications have been introduced. Prices of almost half of the items of the CPI basket are controlled and this has been associated with an increase in non-observed data. In this regard, the absence of prices reached an average of 10% since February 2003, although it exhibited an increasing trend towards the end of the study period, reaching a maximum of 13% in December 2007. Precisely, due to difficulties in gathering information on prices at the stores' level, the sample size was increased in April 2006.

Non-observed prices were imputed through different methods with the aim of estimating CPI. While these methods are suitable to follow up inflation, they may not be as suitable to estimate price duration. For instance, one method to carry out these corrections is by replacing a non-observed price with an average price taken from data gathered from similar stores. However, this does not necessarily reflect the price that the store would have set if it would have had the missing product available for sale. In this regard, for the purposes of this study, only data truly gathered at the outlet level were used. Furthermore, in this work, non-observed prices, which were in the middle of two prices, were imputed by the carry-forward method. This method consists of allocating the value of the price in the previous month to the non-observed price. The consequence of this decision is that duration could be slightly overestimated. For the effects of this study, this would not be very significant given the size of the sample.

The database used in this paper contains a total over two million and a half observed prices that correspond to more than 82,000 specific products, with 80.3% coverage of CPI, as shown in Table 1. This Table presents the number of prices available for the analysis, divided per CPI group, as well as their share in total prices within the sample and average weighing corresponding to each price in the basket. Almost half of the individual data belong to the *food and nonalcoholic beverages* group, which is the one with the highest weighing in the price indicator and presents the maximum variety of items. Furthermore, the *communications* group has the least amount of observed prices because in Venezuela, residential telephone service is provided by a single company and mobile phone, by three firms.

TABLE 1. PRICE DISTRIBUTION PER GROUP

Group	*Number of prices*	*Percentaje*	*Weighting PCI*
Food & nonalcoholic beverages	1,302,749	47.17	24.38
Alcoholic beverages & tobacco	67,897	2.46	1.43
Clothing & footwear	203,511	7.37	4.41
Home equipment	257,927	9.34	5.54
Health	171,568	6.21	5.56
Transportation	127,675	4.62	13.06
Communications	21,832	0.79	5.24
Recreation & culture	142,603	5.16	4.18
Educational services	50,016	1.81	6.18
Restaurants & hotels	173,066	6.27	6.98
Miscellaneous goods & services	242,894	8.79	3.36
Total	*2,761,738*	*100.00*	*80.31*

NOTE: The number of prices corresponds to actually observed prices and to those obtained by the *carry-forward* method, as explained in the text. CPI weighing is the average of monthly weightings between January, 2000 and December, 2007, used to calculate the index value.

3. DURATION

In this paper, price duration is estimated through two methods: direct and indirect. The direct method estimates how long it takes for a price to change, using duration distribution, which can be calculated using the information contained in the panel data set. The second method estimates duration based on the frequency with which prices change every month, hence its name indirect. This section presents the results of both methods, preceded by a brief description thereof.

3.1 Direct Method

The starting point of the direct method is a sample of price episodes, which are defined as a sequence throughout which prices remain unchanged. Each episode has a duration associated with it; that is, a period that extends from the beginning through the end of the episode. Duration will be expressed by Tj,k,i, where j, k and i refer to the specific good, the store and the episode, respectively. A specific good j purchased at a k[3] store will be referred to as particular product. With this information, we

[3] A specific good corresponds to the observation unit in the price survey, which means a good or service of a specific brand, physical features and determined quality.

are able to estimate direct duration as the simple average of times in each episode; that is:

$$\bar{T} = \frac{\sum_{j=1}^{J}\sum_{k=1}^{K_j}\sum_{i=1}^{N_{j,k}} T_{j,k,i}}{\sum_{j=1}^{J}\sum_{k=1}^{K_j} N_{j,k}}, \tag{1}$$

where $N_{j,k}$ is the number of episodes observed per particular product.

A fact that emerges from the calculation of the simple average is that lower durations tend to be given more weight, since products with prices that change more frequently will provide more observations of $T_{j,k,i}$. To avoid this problem, averaging durations per category and then applying a weighing scheme has been suggested. In the case of this work, a weighted average of duration is estimated using the following formula:

$$\alpha_{j,k,i} = \sum_{j=1}^{J} w_j \bar{T}_j = \sum_{j=1}^{J}\sum_{k=1}^{K_j}\sum_{i=1}^{N_{j,k}} \alpha_{j,k,i} T_{j,k,i}\ , \tag{2}$$

where w_j is the weight of the corresponding item in the CPI and $\bar{T}_j$ is the simple average of durations in category j (Baudry et al. 2007). The second member of (2) indicates that this average can be obtained directly from the distribution of durations that have been weighted as follows:

$$\alpha_{j,k,i} = \frac{w_j}{\sum_{k=1}^{K_j} N_{j,k}},$$

that is, by dividing the item's weight by the number of episodes corresponding to it.

Table 2 presents some descriptive statistics as to the distribution of durations estimated through the direct method. In the first column, the reference population corresponds to episodes; that is, without applying any type of weighing. In this case, the sample size is close to 1.2 million observations. First, it can be seen that a price in Venezuela remains unchanged for 2.4 months, on average. It is clear that this calculation is influenced by extreme values; for instance, maximum duration is 96 months, or the entire sample period. Second, when we see a central trend measurement, which is affected in a lesser degree by these high values, it is found out that at least 50% of these prices change from one

month to the other and that only 25% of these prices last two months or more.

TABLE 2. PRICE DURATIONS DISTRIBUTION

Population	*All episodes*	*Average per item*	*Weighed episodes*
Average	2.35	2.99	2.99
Median	1.00	2.44	1.00
Standard deviation	2.97	1.86	3.94
Minimum	1.00	1.04	1.00
Maximum	96.00	10.30	96.00
First quartile	1.00	1.90	1.00
Third quartile	2.00	3.09	3.00
Number of episodes	1,177,33	270	1,177,338

NOTES: The number of prices corresponds to actually observed prices and to those obtained by the *carry-forward* method, as explained in the text. CPI weighing is the average of monthly weightings between January, 2000 and December, 2007, used to calculate the index value.

The second column in Table 2 contains an estimate of price duration distributions obtained by averaging per items and weighing them based on their respective weight in the CPI basket. As expected due to the reasons described when the methodology was explained, the weighted average of duration (3 months) is slightly higher than the simple average shown on the first column. On the contrary, a significant difference is observed in the median, because in this new distribution, prices of 50% of the items last at least 2.4 months.

The third column of the table presents the results of the price durations estimated by using weighing per episode, instead of item. It is obvious that the price duration average is similar to that in the previous case. However, at least 50% of the prices remain unchanged for only one month, like in the case of the non-weighted episodes. Even with the new weighing scheme, duration distribution is slightly different to that presented by the two previous columns. For instance, the third quartile corresponds to three months, unlike the two-month non-weighted durations and 3.1-month weighed duration estimated by the simplest method.

3.2 Indirect Method

One of the criticisms raised about the direct method has been that longer episodes have a higher probability of being censored toward left or right; therefore, their duration could be underestimated when this method

is applied.[4] To avoid this problem, some authors have proposed to use the indirect method instead. This method starts by defining indicator $I_{j,t} = 1$, if $P_{j,t} \neq P_{j,t-1}$ and $I_{j,t} = 0$ in the opposite case.[5] Identifying the size of the indicator sample as $I_{j,t}$ per item Γ_j, we can estimate the average frequency of price change per item using the following formula:

$$F_j = \frac{1}{\Gamma_j} \sum_{t=1}^{\Gamma_j} I_{j,t} \ .$$

Therefore, the total average frequency of price change can be obtained by the formula below:

$$F_j = \frac{1}{Q} \sum_{j=1}^{J} \sum_{t=1}^{\Gamma_j} I_{j,t} \ ,$$

where Q is the total number of observations; the weighted average of these frequencies will be computed as follows:

$$F^W = \sum_{j=1}^{J} w_j \bar{I}_j \ .$$

Finally, a time series of price change frequencies can be estimated by obtaining the weighted average of the series in the month t through the following formula:

$$F_t = \sum_{j=1}^{J} w_j I_{j,t} \ .$$

Then, price duration can be estimated in an indirect fashion using the information provided by price change frequencies; this is also known as implicit duration. Assuming that changes occur continuously throughout a month, duration is estimated using the following formula:

$$\bar{T}^F = 1 \Big/ \ln(1-F) \cdot \tag{3}$$

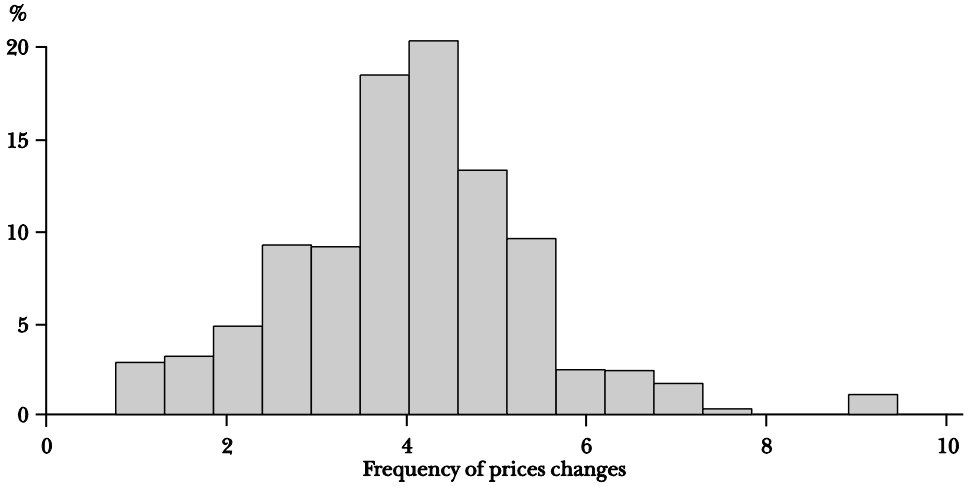
[4] Duration of the initial episode of each price is leftward censored, because the first month of that episode is generally not observed due to how data collection is designed. Durations of final episodes, in turn, are also censored, but in this case rightward, because the particular product is out of the sample or because the end of the data collection period has been reached.

[5] We have avoided the store index so as not to render notation more complicated.

This formula can be applied to any of the frequencies previously defined, by substituting *F* with the corresponding frequency.

Calculations performed according to the formulas described above reveal that distribution of price variation frequencies is slightly skewed toward the left, around the value of 0.4, as shown in Figure 2 that also presents the histogram of these frequencies, averaged by item. According to the same figure, 35%-50% of prices change every month in most items. On the other hand, very few items exhibit a high flexibility degree; that is, their frequency is close to one; whereas, for items with a higher rigidity degree, average price variation frequency is about 10%.

FIGURE 2. DISTRIBUTION OF THE FREQUENCY OF PRICE VARIATIONS



The characteristics of the distribution of the price variation frequencies for each item are summarized in Table 3, which also presents the results of the estimate of implicit price duration. It can be observed that 41% of prices change every month, on average. Therefore, a price remains constant for an average period of 2.6 months. It is worth highlighting that this value is slightly lower than the one computed using the direct method with weighing. Likewise, an asymmetry similar to that seen in direct duration is observed, because prices of 50% of items last less than 1.9 months, on average. Furthermore, prices of goods and services have a quite long duration; this fact that can be verified because the market value of 25% of items remains unchanged for at least 2.7 months.

TABLE 3. DISTRIBUTION OF PRICE VARIATIONS FREQUENCIES AND IMPLICIT DURATIONS

Frequency of price changes (weighed)	
Mean	0.412
Median	0.412
5th percentile	0.106
25th percentile	0.308
75th percentile	0.519
95th percentile	0.677
Number of items	270
Indirect durations (months)	
Mean	2.600
Median	1.884
5th percentile	0.886
25th percentile	1.365
75th percentile	2.712
95th percentile	8.928

NOTES: This table reports the distribution of average frequencies per item, weighed per their corresponding weight within CPI. Indirect durations were calculated using the formula $-1/\ln(1-F)$, where F_j is the item's average frequency.

3.3 Results Robustness

To conclude this section, a number of estimates carried out to asses robustness of the results described above are presented. In this regard, Table 4 presents the results of several calculation exercises of direct and indirect duration. The first two rows include the same information as that shown in Tables 2 and 3, so that it can be easily assessed. The first of these exercises consists of excluding those paths that only had two observations. In this case, we can see that direct durations are not practically impacted, even though indirect durations are slightly higher.

The next exercise consisted of estimating durations only through the direct method for two-year periods starting in January 2000. To perform these calculations, all episodes that started on a date falling within the corresponding two-year interval were included in the average, regardless of their final date. As expected, estimated durations are longer in inflation deceleration periods, i.e. 2000-2001 and 2004-2005. On the contrary, the period with the shortest estimated duration, 2006-2007, is not precisely the most inflationary one.

In addition, durations were estimated excluding price temporary discounts, which are defined as price decreases that last only one month. Some authors argue that price rigidity should be estimated without including this kind of offer due to their transient nature. Since the database

does not have any field that allows us to directly identify offers and sales, it was necessary to use a filter that we described as temporary cutbacks. When a temporary cutback occurs, the price is replaced with that of the previous month; whereas in the case of frequencies, it was considered a non-observed data. As expected, estimated price duration is higher when price temporary cutbacks are not taken into account. In the case of direct duration, it is estimated that prices change every 3.1 months and in the case of indirect duration, 2.8 months.

TABLE 4. ROBUSTNESS ANALYSIS

	Number of episodes/items	*Mean*	*Median*	*Standard deviation*	*25th percentile*	*75th percentile*
Baseline						
Direct duration	1,177,338	2.99	1.00	3.94	1.00	3.00
Indirect duration	270	2.60	1.88	2.21	1.37	2.71
Excluding two-month duration paths						
Direct duration	1,170,640	3.00	1.00	3.94	1.00	3.00
Indirect duration	270	2.70	2.01	2.27	1.37	2.92
2000m01-2001m12						
Direct duration	329,383	3.26	1.00	4.28	1.00	4.00
2002m01-2003m12						
Direct duration	288,182	3.04	1.00	4.49	1.00	3.00
2004m01-2005m12						
Direct duration	245,565	3.12	1.00	3.90	1.00	4.00
2006m1-2007m12						
Direct duration	294,686	2.56	1.00	2.83	1.00	3.00
2000m01-2006m12						
Direct duration	1,019,562	3.13	1.00	4.14	1.00	3.00
Non-censored						
Direct duration	1,025,943	2.72	1.00	3.52	1.00	3.00
Excluding temporary decreases						
Direct duration	1,015,976	3.13	1.00	4.08	1.00	4.00
Indirect duration	270	2.73	2.12	2.20	1.49	2.90

NOTES: This table reports distributions of direct and indirect durations for several cases. The baseline corresponds to the results shown in tables 2 and 3. For direct durations corresponding to specific periods, the date when the episode starts was taken as a reference. For instance, the estimated direct duration for the 2000m01-2000m12 period includes all episodes starting within that period. Non-censored episodes are those for which their start and end are observed. Temporary decreases are those that last only one month. For the calculation of direct episodes, the price of the prior month when a temporary decrease takes place is replaced. For the calculation of indirect duration, the change indicating variable was treated as a non-observe data. All values are weighed per their corresponding price.

4. HETEROGENEOUS NATURE OF DURATIONS

As determined for other countries, price duration in Venezuela is heterogeneous among the different types of products. In general, rates and prices of services tend to remain unchanged longer, particularly, education and health; the same happens with price-controlled products. The more flexible goods and services are those which prices are associated with the exchange rate, as well as others that due to their nature are highly volatile in terms of prices, such as unprocessed food.

4.1 Descriptive Statistics

Table 5 presents estimates of direct durations, price change frequencies and implicit durations per subgroups. We are going to focus on implicit durations only, because both types of durations are the same from a qualitative point of view. The main finding taken from these results is that average price duration is heterogeneous, as stated previously, with durations associated with some services being longer. In this regard, subgroups in which prices appear to be more rigid belong to the *educational services* group. In fact, the three subgroups exhibiting the longer duration are registration fees in secondary education (11 months), in higher education (8.5 months) and in preschool and basic education (8.4 months). This can be attributed to the fact that implicit contracts between educational service providers and their corresponding users prevail, in addition to the institutional characteristic that educational prices have a legally set duration.

Besides those mentioned above, one of the subgroups with the highest price stability is related to health, including hospital services with duration of 5.9 months, on average. Likewise, prices of social services (nursery rates) and telephone and telefax services tend to remain stable, relatively speaking (4.1 months and 3.6 months, respectively). The longest price duration in services mentioned herein can also be related to the high share of labor costs in total costs of these activities. In the Venezuelan case, average wage is very close to the minimum wage that changes twice a year, at most. Therefore, it is not surprising that prices in subgroups associated with hospital and social services are more rigid, with price adjustments practically occurring with the same frequency as that of minimum wage.

The most flexible prices correspond to those of goods and services in which imported supply is significantly high or the prices of which are set

TABLE 5. DIRECT AND IMPLICIT DURATION PER GROUP

	Direct					*Indirect*			
Groups and	*Number of episodes*	*Mean*	*Median*	*Standard deviation*	*First quartile*	*Third quartile*	*Price frecuenc.*	*Average duration*	*Median duration*
Food & nonalcoholic beverages									
Food	554,860	2.09	1.00	2.57	1.00	2.00	0.50	1.56	1.45
Nonalcoholic	51,467	2.29	1.00	2.64	1.00	2.00	0.44	1.77	1.62
Alcoholic beverages &									
Alcoholic	19,230	2.40	1.00	2.60	1.00	3.00	0.43	1.83	2.03
Tobacco	5,690	3.64	2.00	4.23	1.00	5.00	0.27	3.22	3.22
Clothing & Footwear									
Clothing	61,351	2.42	1.00	3.09	1.00	2.00	0.40	2.00	1.97
Footwear	21,527	2.39	1.00	3.08	1.00	2.00	0.41	1.97	2.22
Home equipment									
Furniture, accessories, decorations & carpets	8,308	2.31	1.00	2.58	1.00	2.00	0.45	1.82	1.56
Home textile	10,929	1.91	1.00	2.47	1.00	2.00	0.53	1.36	1.14
Home equipment	17,391	2.42	1.00	3.43	1.00	3.00	0.45	1.94	1.43
Home equipment	2,081	2.27	1.00	2.38	1.00	2.00	0.44	1.74	1.74
Goods & services for home maintenance	76,914	2.59	2.00	1.99	1.00	4.00	0.39	2.06	2.31
Health									
Medicines and therapeutic equipment	27,281	2.52	1.00	3.02	1.00	3.00	0.40	1.96	1.88
Medical and paramedical services	19,913	3.95	1.00	5.85	1.00	4.00	0.25	3.56	3.50
Hospital	3,610	5.81	3.00	7.71	1.00	8.00	0.16	5.90	6.40
Transportation									
Vehicles	7,429	1.66	1.00	1.37	1.00	2.00	0.61	1.06	1.06
Use and maintenance of personal and transportation equipment	29,011	3.46	2.00	4.26	1.00	4.00	0.31	3.08	3.17
Transportation	12,933	2.29	1.00	2.88	1.00	2.00	0.59	1.69	0.70

Communications									
Telephone and telefax	2,728	1.68	1.00	1.31	1.00	2.00	0.60	1.10	1.10
Telephone and telefax services	4,785	3.61	3.00	2.79	1.00	5.00	0.26	3.58	3.19
Recreation and culture									
Audiovisual, photo and processing equipment & accesories	15,925	2.18	1.00	2.35	1.00	2.00	0.46	1.73	1.61
Recreation items and equipment	18,324	3.69	2.00	4.95	1.00	4.00	0.30	3.38	2.60
Recreation, cultural and sports services	4,700	3.37	2.00	4.30	1.00	4.00	0.26	3.55	3.30
Newspapers, books and stationery	13,252	3.04	1.00	4.07	1.00	3.00	0.33	2.65	3.14
Vacations	2,479	1.40	1.00	0.90	1.00	2.00	0.74	0.75	0.75
Educational									
Preschool and basic education	3,733	7.94	7.00	6.60	2.00	12.00	0.11	8.37	8.93
Secondary	779	9.68	9.00	7.81	4.00	12.00	0.09	11.02	11.97
Higher	1,233	8.18	7.00	5.04	5.00	12.00	0.11	8.54	8.95
Another	1,680	3.88	3.00	3.87	1.00	4.00	0.25	3.46	3.46
Restaurants & hotels									
Restaurants	66,510	2.60	1.00	2.95	1.00	3.00	0.39	2.08	2.30
Hotels	1,696	2.70	1.00	3.44	1.00	3.00	0.36	2.24	2.24
Miscelaneous goods and services									
Personal care	96,408	2.22	1.00	2.90	1.00	2.00	0.47	1.66	1.62
Personal effects	6,733	2.68	1.00	3.82	1.00	3.00	0.37	2.25	2.39
Social services	490	4.47	3.00	3.90	2.00	6.00	0.22	4.10	4.10
Other	5,958	2.42	1.00	3.75	1.00	2.00	0.60	1.87	2.28
Total	*1,177,338*	*2.99*	*1.00*	*3.94*	*1.00*	*3.00*	*0.41*	*2.60*	*1.88*

NOTE: Frequency is the fraction of prices that change in a month. Indirect duration is calculated by the formula $-1/\ln(1-F)$. Weighings used for the calculation of direct durations are indicated in the text; whereas in the case of frequencies, they correspond to weights of items in the PCI basket.

in foreign exchange or are directly impacted by variations in exchange rate. Examples of the latter case are prices of vacation packages, which present the shortest average duration (0.8 month). Likewise, subgroups with the shortest duration include vehicles (1.1 month), telephone and telefax equipment (1.1 month), home textile products (1.4 month) and personal care (1.7 month) including toiletries. The food subgroup, which also has a shorter duration than the average (1.6 month), deserves special attention. This fact is due to the presence of vegetables and fruits in the subgroup, which due to their seasonal character experience frequent price changes.

In addition to services, another group with a higher rigidity degree is that of products with government-mandated price controls, as shown in Table 6. Focusing on duration estimated according to nature, it can be observed that prices of administered goods and services last almost one month longer than the average. This value is lower than expected taking into account that prices of many of the goods covered by this regulation have been subject to official adjustments once a year. Therefore, prices of these goods and services are more rapidly adjusted than the value indicated by the frequency of official authorizations.

Confirming our comments on the duration of prices in the food subgroup, unprocessed groups have an estimated duration of just 1.7 month (the shortest). It is important to note that this group includes vegetables and fruits, which, due to their perishable and seasonal nature, exhibit high price volatility.

4.2 Multinomial Logit Regression

To conclude this section, the results of a multinomial logit regression are presented. In this regression, the dependent variable is a categorical variable that indicates if the price of the particular product was reduced, remained constant or increased from one month to another. As explanatory variables the following were included: a set of indicators based on the nature of the good or service; a year and a month dummy; a set of dummies to identify the month when the value added tax aliquot was changed. A dummy that identifies observations over the six months prior to monetary reconversion; some identifiers of the type of store; and the exchange rate variation, both contemporary and that of the three previous months, were added. Finally, monthly inflation corresponding to the subgroup to which the product belongs was taken into account. The sample includes

TABLE 6. DIRECT AND IMPLICIT DURATION ACCORDING TO THE PRODUCT NATURE

	Direct durations						*Indirect duratios*		
Nature	*Number of episodes*	*Mean*	*Median*	*Standard deviation*	*First quartile*	*Third quartile*	*Price variation frecuency*	*Implicit duration mean*	*Implicit duration mean*
Processed food	221,307	2.39	1.00	2.77	1.00	3.00	0.43	1.88	1.62
Unprocessed food	132,214	1.65	1.00	1.69	1.00	2.00	0.62	1.08	1.00
Industrial goods except food and textile	136,174	1.94	1.00	2.15	1.00	2.00	0.54	1.39	1.06
Administered goods and services	498,237	3.74	2.00	4.94	1.00	4.00	0.36	3.47	1.98
Non-administered services	104,942	2.98	2.00	3.25	1.00	4.00	0.35	2.58	2.30
Textile and clothing	84,464	2.36	1.00	3.04	1.00	2.00	0.41	1.93	1.97
Total	*1,177,338*	*2.99*	*1.00*	*3.94*	*1.00*	*3.00*	*0.41*	*2.60*	*1.88*

NOTE: Frequency is the fraction of prices that change in a month. Indirect duration is calculated by the formula $-1/\ln(1-F)$. Weighings used for the calculation of direct durations are indicated in the text; whereas in the case of frequencies, they correspond to weights of items in the PCI basket.

all observed values of the dependent variable, regardless of the period; in other words, the panel structure was not considered. The reference price is a non-administered service, marketed at the supermarket in January 2000.

Table 7 presents the estimated coefficients and conditional probability of the model described in the previous paragraph. First, a lower degree of flexibility toward price decrease than price increase is observed. In this regard, estimated probability of a price increase for the reference case is 0.31, whereas probability of a decrease is just 0.08. In other words, in an average month, 80% of price variations correspond to increases, whereas the rest corresponds to decreases. This seems to indicate that higher evidence of downward price rigidity is observed in a moderately inflationary economy, especially compared with Europe and the USA, where over 40% of price variations correspond to decreases.

Second, price duration is heterogeneous and the same happens with the rigidity degree. In effect, unprocessed food exhibits a higher downward flexibility that results from the fact that estimated probability of a price reduction is 11 percentage points higher in this category than in the base case. This result makes sense due to the more volatile and seasonal nature of prices of this type of products, including vegetables and fruits.

Concerning price increases, products with a higher frequency of upward adjustments are those belonging to the reference category; in this case, non-administered services. On the contrary, prices of administered goods and services and textile and clothing are the least flexible, with the remaining factors being constant. In the case of the first ones, as expected and given the type of regulation, probability of a price increase from one month to another is 18%, which is in contrast with the reference case (31%). In the case of the second ones, the difference is slightly higher; probability of a price increase in this category is 17%.

Third, the fact that supermarkets offer products with a shorter price duration, such as vegetables and fruits, may result in a lower probability towards price increase and a higher tendency to price decrease in comparison with others. In fact, the estimated marginal effects seem to confirm the above, because wholesale stores, hypermarkets and department stores show the highest price increase frequency. Precisely, the conditional frequency of price increases in these types of stores can easily double that of supermarkets. Furthermore, it is precisely in supermarkets where price reductions are observed more frequently, which can be confirmed by the negative sign of marginal effects.

Fourth, price increase frequencies do not appear to exhibit a clear seasonal behavior. In general, price decrease or increase frequencies are clearly modified throughout the year.

With regard to variations in the value added tax (VAT) rate, during the study period, the national government modified this eight times. The first took place in August 2008, when it was cut back from 15.5% to 14.5%, so as to encourage consumption and investment. In May 2002, given the impact of the severe political crisis on fiscal revenues, it was decided to modify VAT aliquot from 14.5% to 16%, starting from September 2002. Once the crisis was overcome, the VAT aliquot was reduced by one percentage point as from September 2004, so as to promote aggregated demand. Later, the significant inflow of oil resources made it possible to further reduce VAT aliquot, to 14%, as from October 2005; to 11% in March 2007 and 9% in July of that same year.

Estimates presented in Table 7 seem to verify that changes in VAT aliquots have an immediate effect on price levels. More precisely, when VAT rate applied to products is higher, the frequency of a price increase is also higher, and vice versa. Unfortunately, it is not possible to draw a general conclusion based on the results obtained in this work in terms of increases, because only one episode is observed. However, the fact that 9% of prices were upward adjusted in the month when the rate went from 14.5% to 16%, besides the 31% that is normally introduced, is quite suggesting. In relation to VAT rate decreases, we can develop more solid conclusions, because five of these decreases took place between 2000 and 2007. Prices decrease in all of them. In fact, the percentage of prices that were reduced rose from the average of 7% to 12% in 2000; to 25% in 2004; to 23% in 2005; to 22% in March 2007; and to 17% in July 2007. On the other hand, this tax policy does not appear to be associated with any variation in frequency of price increase.

Concerning exchange rate, it can be observed that depreciation of this indicator has a positive impact on frequency of price increases, but no effect on the price decrease frequency. However, this effect does not seem to be immediate. More precisely, the impact of exchange rate variations has no significant effect contemporaneously, but it does have it in the following month, when the change of a standard deviation in the exchange rate variation produces an increase of the probability of a price increase by one percentage point.

Finally, monthly inflation rate of the subgroup to which the item belongs has a possible positive incidence on price increase frequency, although

TABLE 7. CONDITIONAL PROBABILITY OF PRICE INCREASES AND DECREASES: MULTINOMIAL LOGIT MODEL

		Price decrease				*Price increase*			
Category	*Variable*	*Coefficient*	*Standard error*	*p Val*	*Marginal effect*	*Coefficient*	*Standard error*	*p Val*	*Marginal effect*
	Intercept	−1.118	0.026	*		−0.495	0.016	*	
Nature	Processed Food	−0.351	0.019	*	−0.014	−0.507	0.011	*	−0.092
	Unprocessed Food	0.990	0.019	*	0.110	−0.123	0.014	*	−0.059
	Industrial goods except food and textile	0.136	0.018	*	0.015	−0.188	0.011	*	−0.042
	Administered goods and services	−0.139	0.013	*	0.004	−0.615	0.007	*	−0.124
	Textile and apparel	−0.453	0.027	*	−0.016	−0.808	0.017	*	−0.138
Type of store	Street vendors	0.057	0.019	0.003	−0.030	1.221	0.012	*	0.290
	Corner stores	−0.587	0.015	*	−0.040	0.322	0.010	*	0.084
	Department store	0.355	0.042	*	−0.025	1.508	0.027	*	0.349
	Hipermarket	0.721	0.033	*	−0.009	1.633	0.024	*	0.363
	Local market	−0.052	0.013	*	−0.012	0.349	0.010	*	0.079
	Mission	−0.026	0.055	0.631	−0.039	1.391	0.030	*	0.334
	Others	−0.966	0.084	*	−0.059	1.026	0.034	*	0.264
	Wholesaler	0.716	0.105	*	−0.034	2.239	0.066	*	0.481
	Services	−1.274	0.015	*	−0.076	−0.577	0.009	*	−0.091
	Specialized store	−0.084	0.012	*	−0.011	0.220	0.009	*	0.050
Year	2001	−0.220	0.017	*	−0.011	−0.184	0.011	*	−0.033
	2002	−0.160	0.020	*	−0.011	−0.017	0.013	0.186	0.000
	2003	−0.237	0.019	*	−0.014	−0.082	0.012	*	−0.012
	2004	−0.478	0.019	*	−0.028	−0.088	0.012	*	−0.009
	2005	−0.269	0.019	*	−0.017	−0.036	0.013	0.004	−0.002
	2006	−0.684	0.019	*	−0.039	−0.094	0.011	*	−0.007
	2007	−0.684	0.036	*	−0.037	−0.192	0.020	*	−0.027
Month	2	0.140	0.020	*	0.010	0.014	0.012	0.221	−0.001
	3	0.190	0.021	*	0.012	0.097	0.012	*	0.016
	4	0.142	0.023	*	0.009	0.072	0.013	*	0.012
	5	0.146	0.020	*	0.009	0.072	0.012	*	0.012

	6	0.148	0.019	*	0.013	−0.059	0.011	*	−0.016
	7	0.084	0.020	*	0.009	−0.104	0.012	*	−0.024
	8	0.003	0.022	0.893	0.001	−0.029	0.013	0.026	−0.006
	9	0.110	0.024		0.006	0.092	0.014	*	0.017
	10	0.139	0.023	*	0.010	0.035	0.014	0.011	0.004
	11	−0.262	0.023	*	−0.014	−0.172	0.013	*	−0.030
	12	−0.246	0.021	*	−0.016	−0.026	0.012	0.028	0.000
VAT changes	VAT cutback August 2000	0.655	0.032	*	0.053	0.201	0.025	*	0.022
	VAT cutback September 2000	−0.114	0.037	0.002	−0.003	−0.236	0.026	*	−0.046
	VAT cutback October 2000	−0.260	0.038	*	−0.012	−0.236	0.025	*	−0.043
	VAT increase September 2002	0.356	0.043	*	0.014	0.452	0.024	*	0.092
	VAT increase October 2002	−0.053	0.042	0.202	−0.003	−0.035	0.025	0.149	−0.006
	VAT increase November 2002	−0.025	0.043	0.559	0.000	−0.058	0.025	0.021	−0.012
	VAT cutback September 2004	1.482	0.036	*	0.177	0.216	0.028	*	−0.022
	VAT cutback October 2004	0.212	0.040	*	0.019	−0.077	0.026	0.003	−0.021
	VAT cutback November 2004	0.403	0.043	*	0.037	−0.080	0.025	0.002	−0.028
	VAT cutback October 2005	1.277	0.033	*	0.157	−0.053	0.028	0.061	−0.061
	VAT cutback November 2005	0.325	0.041	*	0.031	−0.143	0.027	*	−0.038
	VAT cutback December 2005	−0.064	0.043	0.144	−0.001	−0.136	0.025	*	−0.027
	VAT cutback March 2007	1.365	0.043	*	0.152	0.259	0.030	*	−0.005
	VAT cutback April 2007	0.254	0.051	*	0.020	0.028	0.029	0.328	−0.001
	VAT cutback May 2007	−0.137	0.055	0.012	−0.008	−0.058	0.028	0.041	−0.009
	VAT cutback July 2007	1.096	0.037	*	0.106	0.299	0.028	*	0.021
	VAT cutback August 2007	0.326	0.044	*	0.025	0.056	0.027	0.039	0.003
	VAT cutback September 2007	0.069	0.045	0.123	0.004	0.063	0.026	0.017	0.012
	Reconversion	0.345	0.038	*	0.025	0.100	0.020	*	0.012
Exchange rate variation									
	t	0.061	0.070	0.381	0.004	−0.002	0.041	0.968	−0.002
	t−1	−0.042	0.074	0.571	−0.018	0.636	0.043	*	0.136
	t−2	0.888	0.071	*	0.052	0.481	0.043	*	0.081
	t−3	−0.515	0.081	*	−0.032	−0.201	0.048	*	−0.030
	Inflation	−0.049	0.002	*	−0.007	0.150	0.001	*	0.033

NOTE: The number of observations is 2,538,278. Verisimilitude is 911,190; L = 128,919.31; p-val ((126 gl) <0.001. The reference price is a non-administered service, marketed at a supermarket in January, 2000. Average monthly inflation is 1.7%. For the reference case, estimated probability of a price decrease is 0.078 and of a price increase is 0.308.

an economically significant impact on price decreases is observed. In this regard, an increase of one percentage point in the price variation rate of the corresponding subgroup is associated with a jump of 3.3 percentage points in the frequency of an increase. On the contrary, the frequency of price decreases drops only by 0.8 percentage points.

5. HAZARD RATE

This section presents the results in terms of the estimates of the survival and hazard functions carried out using direct duration data, by means of non-parametric methods. This is done in order to study their shapes through graphic methods.[6] The main finding is that duration of prices in Venezuela is time-dependent; that is, the probability of a price changing in the following period is not uniform; first, it decreases and reaches a maximum around the tenth month.

From a methodological point of view, in the variation models used in this work, the variable to be explained is the time during which a price remains constant. In other words, we are focusing on price episodes just as they were defined in section 3. The starting point is that the duration of each one of them is governed by an unconditional distribution function, $F(t)=Pr(T\leq t)$; although, in fact, for our purposes, its complement is more useful, i.e. $S(t)=1-F(T>t)=Pr(T>t)$. This latter is known as survival function. The other key notion to analyze this type of data is the hazard rate, which is defined as follows:

$$\lambda(t)=\lim_{h\downarrow 0}\frac{P(t\leq T<t+h\,|\,T\geq t)}{h}=\frac{f(t)}{S(t)},$$

where $f(t)$ is the density function. This rate may be interpreted as the probability that the price changes immediately after it has lasted a period *t*.

Both reliability function and hazard rate can be estimated by means of non-parametric methods. To explain how this is done, the following notation is introduced: assuming d_j as the number of episodes ending in time t_j, m_j as the number of episodes censored in the interval (t_j,t_{j+1}) and r_j as the number of episodes that have not still changed in time t_j an estimator of hazard rate is given by:

[6] See Cameron and Trivedi (2005), for a description of the method employed and of the terminology used in this section.

$$\hat{\lambda}_j = \frac{d_j}{r_j}.$$

Likewise, the reliability function estimator, known as Kaplan-Meier estimator, is:

$$\hat{S}(t) = \prod_{j|t_j \leq t} \frac{r_j - d_j}{r_j}.$$

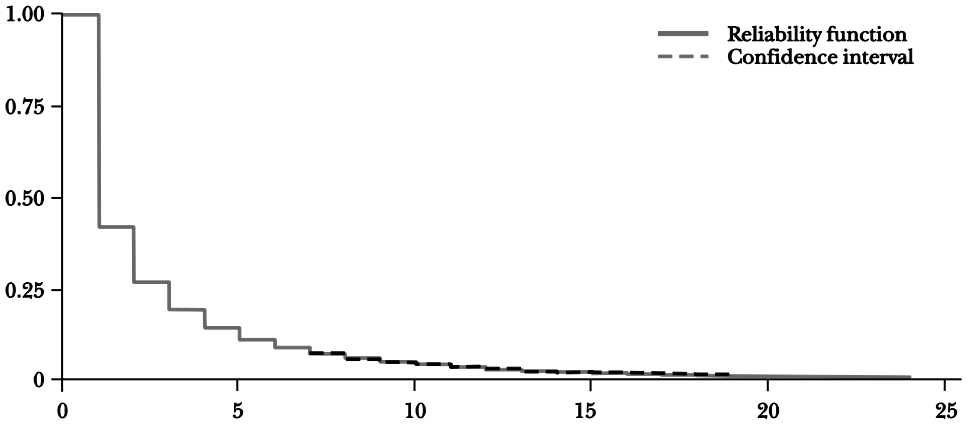
There is direct correspondence between the main assumptions used to incorporate price formation into macro models and the shape how hazard rate. For instance, Calvo (1983) and Taylor (1980) models, that is, time-dependent models, bring about hazard rates that are constant in time. On the other hand, models based on the state of the economy produce duration dependence; that is, hazard rate would increase or decrease with price duration. If marginal costs are not stationary, especially in an environment with intermediate or high inflation, hazard rate would exhibit a positive slope with respect to time. If, on the contrary, marginal costs are stationary but they are subjected to transient shocks, hazard rate could have a negative slope over time.

Figure 3 shows the survival function estimated with the Kaplan-Meier method. This figure is consistent with the results presented in section 3, in the sense that only a little more than 30% of prices remain unchanged after the first month. Likewise, only 10% of prices remain unchanged for more than six months.

Apart from the fact that prices tend to change very rapidly, they also show a positive dependence on duration in the short term, as presented in Figure 4. The estimated hazard rate follows a positive slope until reaching a peak in the tenth month. As mentioned before, this result can be consistent with the inflationary character of the Venezuelan economy and, therefore, with the non-seasonal nature of marginal costs along with frequent imbalances in favor of demand in relation to supply.

An alternative explanation is that when a hazard rate is estimated for all prices, heterogeneous durations are combined. When these heterogeneous durations are aggregated into a single duration, they behave as if they had temporary dependence (Fougère al., 2007). Figure 5, in which hazard rates per group are presented, provides data that support this hypothesis. Therefore, the lack of homogeneity in the shape of this rate among products making up the CPI basket is verified. More specifically, it

FIGURE 3. RELIABILTY FUNCTION OF PRICES DURATION



can be said that there are two groups for which the shape of this rate confirms the dependence on the status, in this case, food and nonalcoholic beverages, and communications. In both cases, hazard rate reaches a peak in around 10 months.

The remaining groups, in turn, exhibit price setting rules that may be described as time-dependent. In particular, alcoholic beverages and tobacco, health, and educational services appear to exhibit a price formation process with a hazard rate that is constant with their duration. On the other hand, both long average duration and the lack of dependence on duration exhibited by the hazard rate in the case of the two last prices could be associated with rigidities in wage formation, as previously noted.

FIGURE 4. HAZARD RATE OF PRICES DURATION

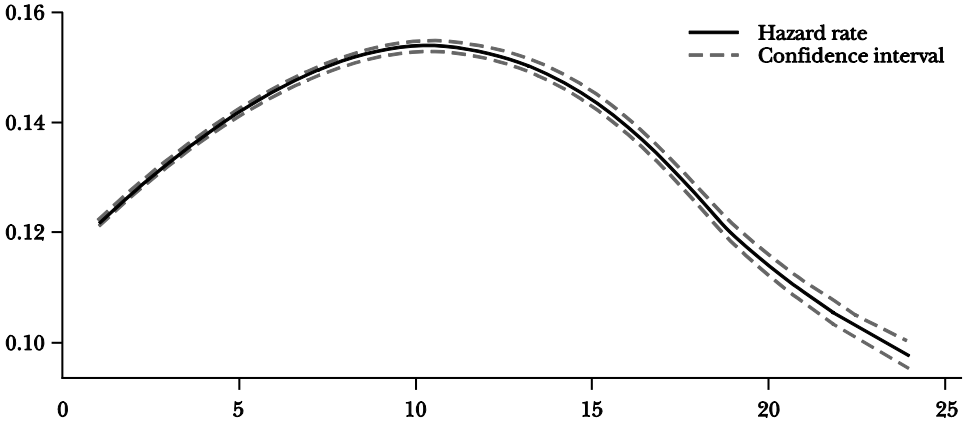
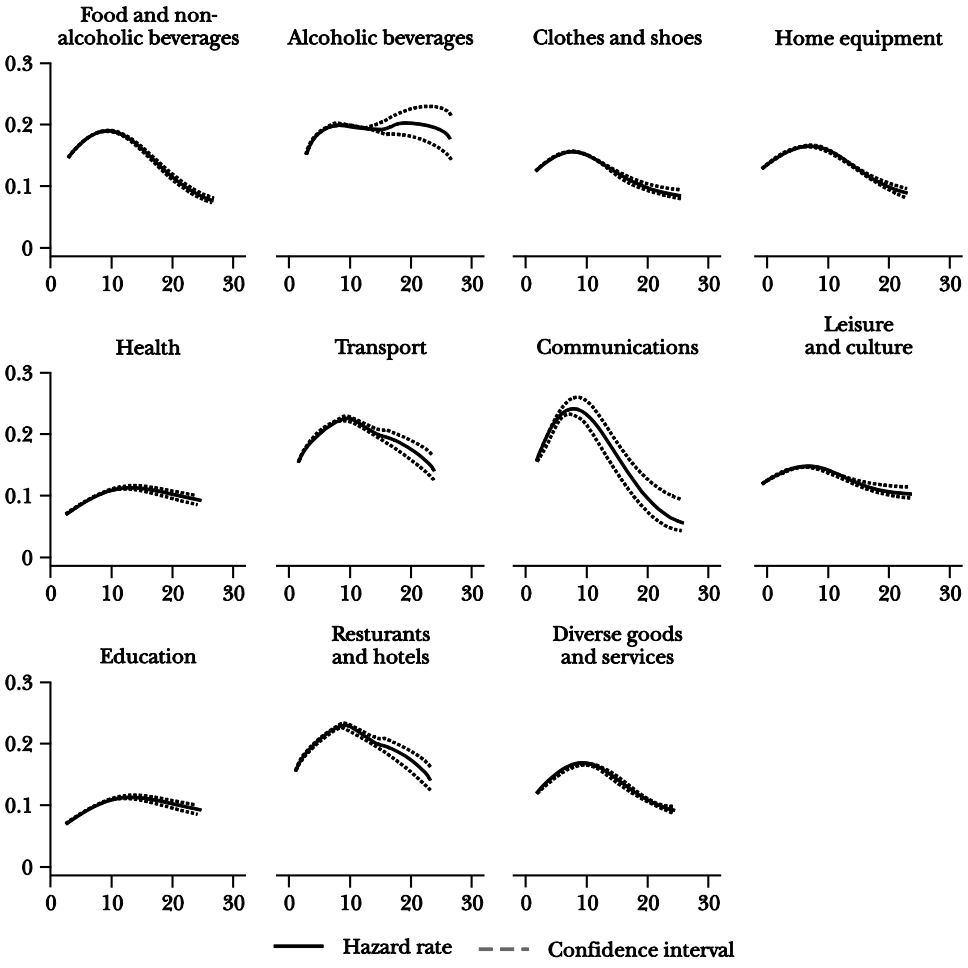


FIGURE 5. SMOOTHED HAZARD ESTIMATES BY GROUP



6. CONCLUSIONS

This paper assesses how rigid prices in Venezuela are, using the information contained in the database used to estimate CPI for the Caracas Metropolitan Area in 2000-2007. The Venezuelan case is interesting, given the relatively high level of inflation experienced throughout the period of study. This work is based on the same methodology applied for USA and Europe, extended for other countries as well. Specifically, average price duration estimated using the direct and indirect method is presented.

Likewise, durations are differentiated based on several categories so as to demonstrate the heterogeneity degree existing in times during which prices remain unchanged. Finally, several hazard functions are estimated by means of non-parametric method.

The main result of this study is that prices in Venezuela change more rapidly than in other countries; i.e. 2.6 months, on average, with a median of 1.9 month. An aspect that is not dealt with in this work is the breakdown of the price variation process into size and frequency, which will be addressed in future research. However, the results obtained at least allow us to infer that a significant component of the inflationary process is expressed in a higher frequency in price variation. If this is so, according to the approach of the new Keynesian school, along with this results, it can be inferred that monetary policy would have a lesser or shorter effect on the product than on prices. It would be interesting to use these durations to calculate the transmission period of an expansive monetary policy over real variables for the Venezuelan case, so that this proposal can be empirically demonstrated.

Furthermore, like in other research works, it has been found that price durations are heterogeneous. Rates in the services sector, especially education and health, tend to be more rigid than prices in the remaining goods. This can be explained by the existence of implicit contracts, in particular those for which it is important to maintain long-time relations with the customers. Another possible reason is the high share of labor costs, which, along with their corresponding little variability throughout the year, results in a less flexible price setting. This heterogeneity would also justify the need to develop models with multiple sectors, which make it possible to better explore the effects of monetary policy on the real economy. It is worth highlighting that the presence of these heterogeneities can bring about non-linearities in the behavior of macro variables, as well as asymmetric impacts by shocks experienced by the economy.

A topic that is related to the point above is that of the relation between price rigidity and heterogeneities found here and the inertia or persistence present in inflation in Venezuela. The existence of overlapped contracts, together with relative price duration, may bring about dependence of today's inflationary rate on values taken by it in the past (Taylor, 1980). This is equivalent to the fact that price adjustment is impacted not only by future expectations, but also by past information, including the observed inflation rate. This is the reason why chronic and moderate inflationary

processes are so difficult to eliminate, even in contexts of highly credible policies (Dornbusch and Fischer, 1993).

Quite interestingly, prices in Venezuela exhibit lower downward flexibility, which contrasts with results in other places. The ordinary notion that prices can only move in one direction, in this case, upwards, seems to be right. In the presence of menu costs, an increasing price trend results in prices reaching close to the possible lowest limit. This leads to an asymmetry in how prices respond to shocks in the economy, with prices being more sensitive to the positive than to the negative shocks of demand (Tsiddon, 1993).

Another significant aspect, especially in a context of an anti-inflationary policy, would be to know the impact of a monetary contraction on the frequency of price adjustment and, therefore, on the real effect of a policy of this kind. This would also explain the possible costs that measures in this context may have. These costs appear to be higher when the activity level is close to or over its potential level (Caplin and Leahy, 1991).

Lastly, the estimated hazard function could point to the presence of inflationary inertia at almost all levels, and the little number of rules to set time-dependent prices, except in services. This can be seen especially in the positive temporary dependence exhibited by this rate. However, it would still be necessary to verify how this is related to the heterogeneity found previously.

This work has developed two additional paths to be followed in our research: the study of price duration, but one step back in the commercialization chain, that is, assess price rigidity at the wholesalers' level using the database of the wholesale price index. The second path consists of researching price formation through a direct survey at stores' level. Finally, a future project to be developed would consist of including the results obtained in this work into a dynamic general equilibrium model for Venezuela. This model should start from the duration estimated here and its heterogeneous character.

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