

Price Formation and Inflation Dynamics in the Caribbean



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PRICE RIGIDITY FORMATION AND INFLATION DYNAMICS IN THE CARIBBEAN

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PRICE RIGIDITY: A SURVEY OF EVIDENCE FROM MICRO-LEVEL DATA

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ABSTRACT

Over the last decade or more micro price studies have proliferated. In this paper a survey of this literature reveals alternative theoretical explanations of sticky prices: (a) sellers review and change prices only at predetermined intervals (except under extraordinary circumstances), so that any price reaction appears only when that time arrives (referred to as “time dependent pricing”); or (b) prices are always reviewed after a shock or policy move (“state dependent pricing”), but may be altered only if the difference between the actual and the new target price is sufficient to warrant an adjustment. The empirical evidence is that prices take longer to change in developed countries than in developing economies. In addition, the frequency of price movements differs widely across goods and the timing of price changes is not synchronized across sellers.

JEL Classification: E3, L1, C4, D40

Keywords: Price Rigidity; Consumer Prices; Inflation, Survey data

1.0 Introduction

Economists are concerned about inflation because it erodes the value of financial wealth over time. Central banks are asked to keep inflation low in order to protect the value of financial assets. The world over, central banks have committed themselves to this task, but no central bank is able to say that their efforts in this regard have been especially successful. The channels through which central bank policy tools impact on inflation are poorly understood, in theory and in practice. Indeed, there is a small minority of economists who deny that such channels exist. The studies in this volume attempt to shed light on one small piece of this puzzle: why is it that some prices react more quickly to shocks and policy changes – including the policies of the central bank - than do other prices, and why are prices often “sticky”, that is, slow to respond to policy changes?

It used to be the case that issues relating to inflation were researched only at the aggregate level of the consumer price index (CPI) and its components, but more recently investigators have sought insight from microeconomic data, either by way of questionnaires submitted to individual firms, or by analysing changes in the prices of specific items included in the monthly surveys of consumer prices undertaken for the compilation of the CPI. The studies collected in this volume all use the latter approach. The authors set out to discover whether prices are in fact sticky, and to what extent. In addition, they investigate the institutional arrangements and behaviours that might explain this phenomenon.

In the literature the following theoretical explanations of sticky prices are found: (a) sellers review and change prices only at predetermined intervals (except under extraordinary circumstances), so that any price reaction appears only when that time arrives (referred to as “time dependent pricing”); or (b) prices are always reviewed after a shock or policy move (“state dependent pricing”), but may be altered only if the difference between the actual and the new target price is sufficient to warrant an adjustment. For example, there will be no adjustment if the costs of re-labelling items for sale (“menu costs”) exceed the difference between the target price and the actual price. The cost of collecting and processing the information needed to arrive at a new target price is another factor that may inhibit speedy price reaction to shocks. Prices will also react slowly if explicit or implicit contractual arrangements are prevalent. Such contracts cement long term relationships and reduce the uncertainty associated with spot market pricing. Some of the studies in this volume explore the reasons behind price stickiness, and investigate whether prices are as sticky when there are pressures for price reduction, as they are when shocks tend to drive up prices.

An understanding of how changes in relative prices affect aggregate inflation is crucial to the effective development of macro models of inflation used in the design and conduct of monetary policy. Models of inflation are typically based on highly stylized assumptions about firms’ pricing behaviour, as in Calvo (1983) and Taylor (1993), which both in some

way assume price rigidity¹. Alvarez et al. (2005) noted the implications for inflation dynamics and micro price setting when the speed of adjustment of inflation to shocks to the economy is directly linked to the speed of price adjustment of individual agents.

There is a growing literature that uses micro data for assessing the importance of price rigidity [see Dotsey et al. (1999), Blinder (1994), Kashyap (1995), Klenow and Kryvtsov (2005), Kurri (2007), Bils and Klenow (2004), Hoffmann and Kurz-Kim (2005), Baumgartner et al. (2005), Dias et al. (2004), Baudry et al (2004), Aucremanne and Dhyne (2004), Apel et al. (2001), Klenow and Malin (2010)]. However, this considerable body of work does not give conclusive empirical evidence in support of any of the many existing theories. Most studies found that prices at the micro level may remain unchanged for periods that can last up to several months.

This paper surveys the recent literature that uses micro data to assess price setting behaviours around the world. It briefly summarizes the theoretical background to price rigidity in Section 2 and reviews recent literature using micro data to analyze price setting patterns in Section 3. Section 4 makes some general conclusions.

¹ Price rigidity is the idea that prices of most goods and services do not change instantaneously following shocks, but rather remain constant for a certain period of time. Whilst the term price rigidity is widely used there are several complementary names that have been applied, namely, nominal rigidities, price inertia, price stickiness, and price inflexibility.

2.0 Theoretical Background

Individual firms do not continuously adjust their prices in response to shocks to the economy. To model this fact the literature considers mainly two types of pricing behavior: time dependent and state dependent pricing rules. In time dependent models, firms are assumed to alter their prices periodically using either a deterministic (Taylor, 1980) or a stochastic (Calvo, 1983) process of price adjustment. The timing of the price changes is exogenous and does not depend either on the state of the economy or on the timing of shocks.

Firms following state-dependent pricing rules will review their prices in response to a shock to the economy. However, because there are fixed costs of changing prices firms may only alter their prices when the difference between the actual price and the firm's target price is large enough to warrant an adjustment. Alternatively, it may be argued that the main benefit of infrequent price changes is not lower menu costs, but a reduction of the costs associated with information collection and decision-making. Under this rule, the timing of the occasions when prices are reconsidered may be largely independent of current market conditions (see Dias et al (2004)). In this vein, Ball and Mankiw (1994) argue that the most important costs of price adjustment are the time and attention required of managers to gather the relevant information and to make and implement decisions.

Dotsey et al (1999) present a model combining the Calvo (1983) approach with state dependent pricing features and

firms that face random menu costs. Firms with relatively low menu costs choose to adjust prices frequently whereas firms with higher menu costs wait longer before altering their prices. An increase in general inflation speeds up the price adjustment process. Alvarez et al (2005) note that, in addition to menu costs and/or information costs, economic theory has suggested a large number of other potential explanations for the existence of price rigidities, including explicit and/or implicit contracts, cost-based pricing, coordination failure, and pricing thresholds. With explicit contracts, firms aim to build long-term relationships with their customers in order to stabilize their future sales. Customers, on the other hand, are attracted by a constant price because it makes their future costs more predictable and helps to minimize transaction costs (e.g., shopping time). The theory of implicit contracts is based on the idea that firms try to win customer loyalty by changing prices as little as possible.

The suggestion that explicit contracts may be central for price stickiness was first introduced into the economic literature through wage contracts where firms hold prices constant in the face of demand shocks, as they do not want to jeopardize customer relations. This means that prices do not move because other prices (input costs) are constant (see Hall, 1986). Finally, some firms set their prices at psychologically attractive thresholds. This pricing strategy can cause price stickiness because, in face of small shocks calling for small price changes, firms might not react and postpone price adjustments until new events justify a price alteration to the next pricing threshold.

3.0 Micro-Level Findings

3.1 *Pricing in Europe*

Hall et al (1997) report the results of a survey conducted by the Bank of England in 1995 of price-setting behaviour of 654 United Kingdom (UK) companies. The survey revealed that, although market conditions affect the magnitude of price changes, many companies set prices on the basis of cost plus a mark up. There was also evidence of considerable price rigidity, with the average company reviewing its prices once a month, but only changing them twice a year. The authors noted that companies operating in more competitive markets altered prices more often than companies with few direct competitors and firms with long-term relationships with customers appeared not to adjust prices frequently. They further argued that time-dependent pricing rules seemed to be much more widespread than state-dependent pricing rules.

Hall and Yates (1998) checked for the presence of a floor to prices. Using tests for Granger-causality between the mean and skewness of inflation, the paper concludes that on balance there is no convincing evidence of downward nominal rigidity in retail or producer prices in the UK.

Using a random sample of 600 Swedish firms, Apel et al (2001) found that these firms adjusted prices infrequently, with the median firm altering its price once a year. State-dependent pricing was observed to be as common as time-dependent pricing.

Konieczny and Skrzypacz (2005) noted that in Poland, expected inflation had a greater effect on relative price variability than unexpected inflation, and that inflation has a stronger impact on the variability of relative rates of inflation than on the variability of relative prices.

Aucremanne et al (2002) examined the distribution of Belgian consumer prices and its interaction with aggregate inflation over the period June 1976-September 2000. They find no evidence of downward rigidity. These results are in line with the predictions of menu cost models and therefore suggest that this type of friction can be an important factor behind the short run non-neutrality of monetary policy.

Employing monthly data between January 1989-January 2001, Aucremanne and Dhyne (2004) found that price setting is very heterogeneous in Belgium, both across and within product categories. Each month, on average, nearly 17% of the consumer prices change, and the median duration of a price spell was approximately 13 months. The authors noted that whilst a substantial subset of their results was compatible with state-dependent pricing, time dependency also existed. There were more price increases than decreases (except for services), and price changes did not seem to be highly synchronized across price-setters within relatively homogenous product categories.

Baudry et al (2004) used 13 million observations of price records between July 1994 and February 2003 to evaluate price rigidity in France. They found that consumer prices were rather sticky (the weighted average duration was 8 months) and strong sectoral heterogeneity existed. The

authors also noted that prices in the service sector changed once every year compared to the prices of manufactured goods which were adjusted every 4-5 months. The results did not indicate any sign of downward rigidity since price decreases were almost as frequent as increases except for the service sector. Additionally, the data showed that both time and state dependence were present in the country.

For Portugal, Dias et al (2004) utilised micro-datasets comprising 5.5 million prices on 800 consumption items and slightly less than one million prices on 500 items produced by the manufacturing industry, observing that for both consumers and producers, one in every four prices move each month. In the consumer goods category, unprocessed foods prices changed most often, and for producer goods energy price adjustments were the most frequent. Also, there was a considerable degree of heterogeneity in price setting practices at both the consumer and producer level. Consumer goods prices moved more often than consumer services prices; producer goods prices of consumption goods varied more frequently than producer prices of intermediate goods. For comparable commodities, consumer prices change more often than producer prices. In addition, price reductions were common and account for around 40 per cent of total price changes which are sizeable. Finally, the price setting patterns at the consumer level seemed to depend on the level of inflation as well as on the type of business.

Baumgartner et al (2005) analyzed the patterns and determinants of price rigidity present in the individual price quotes collected to compute the Austrian consumer price index. The authors calculated direct and implied estimates

for the average frequency of price changes and the duration of price spells for 639 product categories. They discovered that consumer prices are quite sticky in Austria. Depending on the method used the estimates for the weighted average duration of price spells for all products range from 10 to 14 months. Sectoral heterogeneity is quite pronounced: prices for services, health care and education change rarely, typically approximately once a year or even less frequently. For food, energy, transport and communication, prices are altered on average every 6 to 8 months. Temporal promotions and end-of season sales have a considerable impact on the frequency of price adjustments for food, clothing and footwear. Price increases occur slightly more often than price decreases, except for communication items. The authors noted that on average, prices expand by 11 percent whereas prices are reduced on average by 15 percent.

For Germany, Hoffmann and Kurz-Kim (2005) examined the adjustment of retail prices in a period of low inflation, using individual price data from the CPI, covering the period January 1998 to January 2004. They found that prices of most products change infrequently, but not incrementally. Pricing seems to be neither continuous nor marginal. Also, prices last on average two years, but move by 10 percent on average. The longest price durations are seen in housing rents, which existed on average for four years while at the other extreme the prices of unprocessed food and fuels changed very frequently. There is no evidence of general downward rigidity in prices, except for services. Additionally, there was enormous heterogeneity in price variability across products. There seem to be both time-

dependent and state-dependent elements in price setting in Germany.

Lünnemann and Mätha (2005) used micro-level price data to investigate the behaviour of consumer prices in Luxembourg. They observed that the median duration of consumer prices is roughly 8 months with those for energy and unprocessed food lasting approximately 1.5 and 5 months respectively, while prices of services typically change less frequently than once a year. For some product types, such as non-energy industrial goods and processed food, a relatively large share of the observed price changes is reversed in subsequent periods. With the exception of services, individual prices do not show signs of downward rigidity. On average, price decreases are as large as price increases. Price changes are determined both by state- and time-dependent factors.

Kurri (2007) examines the micro features of the consumer price changes in Finland between January 1997 and December 2004. The dataset comprised approximately 55 per cent of the items in the CPI basket. Kurri noted that price adjustments were infrequent, and on average nearly 80 per cent of the prices quoted in the data set did not move at all between two consecutive months. The subgroups were fairly heterogeneous: in energy only 23 per cent and in unprocessed food 54 per cent of monthly price changes were zeros, while in the other three subgroups the frequency was over 80 per cent. In all cases the distributions were skewed to the right and there were many small price movements. There was more variance in the magnitude of price changes

than in the fraction of products for which prices were altered.

3.2 *Pricing in the US*

Bils and Klenow (2004), using monthly data on 350 product categories from the United States of America (US) retail price index between 1995 to 1997, found that prices tend to change every 4.3 months. The authors further highlighted that goods prices move more frequently than service prices; raw goods had the highest frequency of adjustment, while medical care was least likely to be altered. Goods with more frequent price changes tended to have more serial correlation in inflation as well as higher volatility.

On the other hand, Blinder (1994), employing survey data for 200 randomly selected firms from the US, found that firms tend to alter prices rather infrequently, at most once during an average year. In addition, most firms indicated that on average prices are changed only 3 months after a shock to demand or cost. Kashyap (1995), in a study of the evolution of prices of 12 retail goods over 35 years sourced from the mail order catalogues of three major companies in the US, discovered that nominal prices sometimes stayed fixed for several years before changing a number of times in a given year, by relatively small increments. This stickiness in prices was supported by Clark (2003) who showed that the average persistence of disaggregated inflation is consistently below aggregate persistence.

Klenow and Kryvtsov (2005) examined whether state or time dependent pricing exists for US inflation. For this study micro-data from the 1988–2004 collected by the US Bureau of

Labour Statistics for the CPI were used. They found that price changes are frequent (every 4 to 7 months, depending on the treatment of sale prices) and large in absolute value (in the order of 10 per cent). The size and timing of price adjustments vary considerably for a given item, but the size and probability of a price movement are unrelated to the time since the last price change. Changes in aggregate inflation reflect alterations in the size of price adjustments rather than the fraction of items changing price, because of offsetting movements in price increases and decreases. These findings failed to support models of time dependent and state-dependent pricing.

Boivin et al (2006) estimated the effects of US monetary policy on disaggregated prices after identifying monetary policy shocks using the information from the entire data set. The authors established that most of the fluctuations in sectoral inflation rates are due to sector-specific factors. On average, only about 15 percent of inflation fluctuations result from macroeconomic indicators (17 percent for personal consumption expenditure prices and 13 percent for producer prices). Additionally, sectoral inflation fluctuations are persistent, but this persistence is driven primarily by common macroeconomic components and not by sector-specific disturbances. Furthermore, prices and quantities respond differently to macroeconomic shocks and to sector-specific shocks. Also, most prices react with a significant delay to identified monetary policy shocks. Nath (2004) examines the relationship between inflation and relative price variability for the US and reported that there exists a positive correlation between the two variables in both the short and long run.

3.3 *Pricing in Other Countries*

In the case of Sierra Leone, Kovanen (2006) discovered that the average duration of prices was 2.6 months. The study attributed this finding to the relatively large number of food items included in the CPI basket, the dominance of small-scale enterprises and individual sellers and the level of macroeconomic volatility and inflation uncertainty. In addition to the frequency of price changes a relatively larger proportion of the CPI basket was subject to price movements and high volatility. The author further showed that by containing money growth, officials in Sierra Leone could potentially reduce the rate of inflation and inflation volatility.

Gouvea (2007) analysed the price adjustment patterns in Brazil utilising data covering about 85 percent of CPI spanning 1996 to 2006. The study suggested that average prices remained unchanged for 2.7 to 3.8 months, but there was a large degree of product and sector heterogeneity. Also, there were strong asymmetries between price increases and decreases in that country.

Medina et al (2007) revealed that in Chile, on an aggregate basis, the frequency of price adjustments seems not to be correlated with the inflation level. However, when the frequency of price alterations was decomposed (distinguishing between upward and downward changes), some of the products groups showed correlation. Furthermore, the study reports that downward price movements are not uncommon at the micro level.

4.0 Conclusion

This paper reviews both the theoretical and empirical literature on price rigidity. In theory pricing behavior may reflect time dependent or state dependent pricing rules. In time dependent models, firms are assumed to alter their prices periodically using either a deterministic (Taylor, 1980) or a stochastic (Calvo, 1983) process of price adjustment. The timing of the price changes is exogenous and does not depend either on the state of the economy or on the timing of shocks. On the other hand, firms following state-dependent pricing rules will review their prices in response to a shock to the economy. However, because there are fixed costs of changing prices firms may only alter their prices when the difference between the actual price and the firm's target price is large enough to warrant an adjustment. Alternatively, it may be argued that the main benefit of infrequent price changes is not lower menu costs, but a reduction of the costs associated with information collection and decision-making. Under this rule, the timing of the occasions when prices are reconsidered may be largely independent of current market conditions (see Dias et al (2004)). In this vein, Ball and Mankiw (1994) argue that the most important costs of price adjustment are the time and attention required of managers to gather the relevant information and to make and implement decisions.

Empirically, there is a growing literature that attempts to use micro data for assessing the importance of price rigidity. It reveals that prices take longer to change in developed countries than in developing economies. In addition, the frequency of price movements differs widely across goods

and the timing of price changes is not synchronized across sellers. These findings failed to distinguish between time dependent and state-dependent pricing. In general, they give mixed evidence concerning the validity of time dependent and state-dependent pricing.

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DOES CONSUMER PRICE RIGIDITY EXIST IN BARBADOS?

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ABSTRACT

This paper uses a unique micro data set of price records underlying the Barbados retail price index between 1994 and 2008 to provide a detailed assessment of consumer price rigidity. The major aim is to calculate price durations and the patterns of price-setting across sectors. We also check whether price cuts are as frequent as increases, and whether there is specific downward nominal rigidity. We find that prices in Barbados tend to change relatively frequently, with between 50 and 80 per cent of items in every category reporting a price change every month. While there are regular monthly price reductions as well as increases, the reductions are always smaller and fewer than the increases. The paper also reports no measurable impact of changes in the money supply or national inflation on the frequency of price changes.

JEL Classification: E3; L1; C4, D400

Keywords: Price Rigidity; Consumer Prices; Inflation, Survey data

1.0 Introduction

Inflation is among the most heavily researched topics in Caribbean economics (Coppin, 1993; Cumberbatch, 1997; Downes et al., 1993; Hamilton, 1994; Kwon and Robinson, 2006; Mc Clean, 1997; Sun, 2005; Worrell and Scantlebury-Maynard, 1994), but the results of this work are not often reflected in policy initiatives to combat inflation. For example, recent policies to control inflation in the Caribbean have focussed mainly on fiscal measures, whereas inflation studies have been concerned primarily with monetary policy. The policies have been typically applied at disaggregated levels, and their effects are not captured by research which deals almost exclusively with macroeconomic aggregates.

At the disaggregated or firm level, Blinder (1994) attempted to confront models of price stickiness with real world data using the responses to a series of questions on price formation by managers in charge of pricing. The survey, which solicited responses from 200 randomly selected firms in the United States (US), found that firms tend to change prices rather infrequently, at most once during an average year. In addition, most indicated that on average prices are altered only three months after a shock to demand or cost. Blinder also solicited views on which theories of sticky prices best explained the managers' decision-making process. Of the twelve theories tested, the coordination failure model of Ball and Romer (1991) seemed to best describe the sources of price stickiness. In a similar survey

of 654 United Kingdom (UK) companies, Hall et al. (1997) obtained comparable results in relation to the frequency of price changes, but in their study price stickiness was largely attributed to cost-based pricing and contracts.

In order to bridge the gap between inflation models, inflation policy and the actual practice of price formation in the Caribbean, further research is needed to illustrate and test the process of price formation, the dynamics of inflation and the scope and effectiveness of anti-inflationary policies. The present study makes a contribution to the description and testing of the practice of price formation. We extract information on the frequency and magnitude of price changes from input data for the construction of the monthly retail price index (RPI) over eight, recent years, and test for possible factors affecting the frequency and magnitude of price adjustments.

After the introduction, previous empirical studies are reviewed, followed by the empirical methodology in Section 4. Thereafter, the results are presented and in the final section, conclusions are made.

2.0 Previous Empirical Studies

Several authors have used data on product group trends to investigate the actual characteristics of price formation. Kashyap (1995), in a study of the evolution of prices of 12 retail goods over 35 years sourced from the mail order catalogues of three major companies in the US, found that

nominal prices sometimes stayed fixed for several years before changing a number of times in a given year, by relatively small increments. Kashyap infers that the costs of price adjustment are relatively small. Levy et al. (2002) compare price and cost data for 12 orange juice products, concluding that prices tend to be rigid in response to small and temporary cost shocks and in circumstances where the retailer has limited information about the nature of the shock. Herrmann and Moeser (2006) argue that, in the case of branded goods, psychological factors may also contribute to price rigidity. The prices of branded foods remain unchanged for an average of 19 weeks and as long as 53 weeks.

Levy et al. (1998) track store-level information on the prices at five large supermarkets and one drugstore chain in the US. These stores tend to change the prices of about 13-17 per cent of their products every week. This relatively high frequency of price adjustment was largely attributed to the fierce competition in the supermarket industry, which counteracted the effects of the complexity and cost of altering prices as well as rigidities in the laws governing retail pricing. Weber and Anders (2007) collected weekly retail-scanner data for meat products from 207 retail outlets in Germany, capturing information on prices, discounts, promotional activities and store characteristics. On average, the prices of meat products such as beef can remain unchanged for up to 63 weeks. This high degree of price rigidity was largely attributed to the market power of firms, and their ability to absorb cost shocks by adjusting their

margins, based on inferences from a conjectural variations model that yielded an estimate that market power in the retail industry tends to lead to price distortions of between 0.6 and three per cent. Similar evidence of store level price rigidity is reported for online booksellers (Chakrabarti and Scholnick, 2007), commercial banks (Toolsema and Jacobs, 2007) and gas stations (Davis, 2007; Davis and Hamilton, 2004).

Bils and Klenow (2004), in a study covering a wider variety of goods than described in the last paragraph, use data on 350 product categories from the US retail price index on a monthly frequency from 1995 to 1997. In general, the authors find a higher frequency of adjustment than studies utilising survey data or product group information: prices tend to change every 4.3 months. Bils and Klenow also report that goods prices tend to move more often than service prices; raw goods had the highest frequency of adjustment, while medical care was least likely to change. The persistence and volatility across goods was evaluated by fitting a first order autoregressive (AR (1)) process to the monthly inflation rate for each of the goods. The results suggested that goods with more frequent price changes tend to have more serial correlation in inflation as well as higher volatility.

Recognising the value of these studies for policy-making purposes, researchers have replicated and expanded them, using data from a wide variety of countries. Dhyne et al. (2006) provide a useful summary of this literature for the

euro area: prices in the euro area change less frequently than in the US, tending to remain unchanged on average for 10.6 months compared to 4.6 months in the US. The disparity was largely attributed to differences in: (1) inflation and inflation volatility; (2) market structure; (3) methodologies used by statistical agencies; (4) frequency and size of cost and demand shocks; and (5) types of goods purchased. Moreover, when prices do change, the movements are usually smaller than those for the US: 8.2 per cent compared to 12.7 per cent.

Price rigidity in a developing country was addressed by Kovanen (2006), who investigated the relatively higher rate of inflation and inflation volatility in Sierra Leone. The study found that the average duration of prices was 2.6 months, implying more frequent changes than in the industrial states. Kovanen attributes this finding to a relatively large number of food items included in the consumer price index (CPI) basket, the dominance of small-scale enterprises and individual sellers and the level of macroeconomic volatility and inflation uncertainty. In addition to the frequency of price changes a relatively larger proportion of the CPI basket was subject to price alterations and high volatility. By regressing the fraction of prices changing every month on a time trend, lagged inflation and an indicator of monetary policy, Kovanen shows that by containing money growth, officials in Sierra Leone could potentially reduce the rate of inflation and inflation volatility.

More recently, Sahinoz and Saracoglu (2008) studied the price-setting behaviour of a sample of 999 firms across several Turkish industries. They found that, under normal conditions, the majority of the firms follow time-dependent pricing rules but when significant events occur, a substantial portion of them change their behaviour to state-dependent reviewing. The median Turkish firm reviews its prices every month, but changes its prices four times a year, results very similar to those of Sierra Leone discussed above by Kovanen (2006). Sahinoz and Saracoglu (2008) used probit models to show that price reviews and changes are mainly influenced by market share, price discrimination, customer type, firm size, and the existence of regulated prices.

3.0 Empirical Approach

This section outlines the empirical approach employed to study the issue of price rigidity in Barbados. The index measuring whether or not prices are altered during a particular month is defined as follows:

$$\begin{aligned}
 I_{it} &= 1 \quad \text{if } p_{it} \neq p_{it-1} \\
 &= 0 \quad \text{if } p_{it} = p_{it-1}
 \end{aligned} \tag{1}$$

for $i = 1, \dots, K$ (number of goods) and $t = 1, \dots, T$ (number of periods)

For each good i , the frequency of price movements F_i is calculated as the ratio of observed price changes to all valid price records. The implied duration of price spells can be calculated as the inverse of the frequency of price changes $D = \frac{1}{F}$. This computation, however, assumes that

the price adjustment occurred at the end of the month and price does not move for the rest of the month. To relax this assumption and allow for continuous timing, the implied average and median duration of price spells can be estimated as follows:

$$D_{Average} = \frac{-1}{\ln(1 - F_i)} \quad (2)$$

$$D_{Median} = \frac{\ln(0.5)}{\ln(1 - F_i)}$$

The rigidity of prices can be gleaned from the frequency as well as duration indicators. Prices can be considered rigid if the frequency of price changes is small and therefore relatively price spells are of relatively long duration.

It is also of interest to examine the synchronisation of price changes. Fisher and Konieczny (2000) provide a measure of price synchronisation based on the ratio of the empirical standard deviation of the frequency of price changes for product i to the theoretical maximum standard deviation in the case of perfect synchronisation of price movements:

$$SYNC_i = \frac{\sqrt{T^{-1} \sum_t (F_{it} - F_i)^2}}{\sqrt{F_i(1 - F_i)}} \quad (3)$$

If price changes are synchronised, i.e. the prices of all goods adjust at the same time or not at all, then the ratio should be near 1. This expression is also employed to calculate the synchronisation of price increases and decreases over the sample period.

Related to the issue of price synchronisation is the correlation of monthly price changes, i.e. if prices expanded in the previous month is that change likely to lead to a rise in prices in the current month? An estimate of the correlation between monthly price changes or inflation persistence can be obtained by estimating an equation of the following form:

$$\psi_{it} = \rho_i \psi_{it-1} + \varepsilon_{it} \quad (4)$$

where ψ is the month-on-month adjustment in prices. If ρ is small then this would suggest a relatively low degree of correlation between monthly prices changes.

Menu-cost models of price adjustment suggest that inflation tends to be higher in markets where price alterations are more frequent (see Barro, 1972; Taylor, 1999). To understand the factors that have influenced price changes in Barbados over the last few years an empirical model of the frequency of price movements is estimated over the period 2000 to 2008. The model takes the following form:

$$F_i = \beta_0 + \beta_1 \sum_{i=1}^2 F_{t-i} + \delta_i \sum_{i=1}^2 dM_{t-i} + \theta_i \sum_{i=1}^2 \pi_{t-i} + \mu_i \quad (5)$$

where dM is the month-on-month change in M2 (money plus quasi-money) and π aggregate monthly inflation. Money is included to capture the effects that money creation can have on the demand for goods and services and therefore the frequency of price changes. Similarly, during periods of high inflation, the prices of goods and services should be expected to move relatively frequently as firms attempt to maintain profit margins. Lagged values of money and inflation are included in the regression equation, as

prices cannot be instantaneously adjusted in response to demand pressures or higher input costs.

4.0 Results

The estimated monthly frequency of price changes for each product are given in Table 1 and plotted in Figure 1. The results indicate that between 50 and 80 per cent of prices in each product group tend to move every month. The product groups with the highest frequency of price adjustments were 'fruit' and 'vegetables and other ground provisions', with about 80 per cent of items reporting price changes every month. This finding agrees with the previous literature in the area that suggests commodity prices have a higher rate of fluctuation. 'Animal feeds' have the lowest frequency of price changes, with only half of the number of goods altering prices every month. The frequency of price changes was fairly persistent over time (see Figure 2).¹

The average duration of most goods was between one and two months, with 'animal feeds' and 'cereals, flour and bakery products' on the longer end of this spectrum. After making adjustments to reflect continuous timing of price changes, the implied average and median duration of price spells is less than one month for most goods, with a median duration of about 0.6 months. In the case of 'vegetables and other ground provisions' and 'fruit', prices remain fixed for

¹ The apparent rise in volatility in 2002 may be due to missing observations for some items between 2000 and 2001.

less than half a month. Only animal feeds had a median duration of over one month.

Figure 3 also shows that the relative proportions of these changes due to price increases and decreases were relatively constant. In every month, between 40 and 50 per cent of goods report higher prices while 30 to 40 per cent of goods experience some decline in price. The summary statistics provided in Table 1 suggest that 'fruit', 'vegetables and other ground provisions', 'butter and other cooking fats and oils' as well as 'meat' tended to have the highest probabilities of price expansions during any given month. However, 'fruit' and 'vegetables and other ground provisions' also had the highest probabilities of price declines during a given month.

Figure 4 plots the frequency of price increases/decreases by product group. For most product groups the frequency of price expansions tended to be slightly higher than that for price contractions. The only goods that were more likely to report price cuts than price increases were 'furniture', 'glassware, cutlery and other household supplies', 'clothing' and 'footwear'.

On average the size of these expansions tended to be larger than the price reductions: mean price increases ranged from three to 29 per cent, while average price contractions spanned between one and seven per cent per month (Figure 5). Nine product groups had double-digit average monthly price expansions: (1) milk, milk products and eggs; (2) sugar confectionery and preserves; (3) vegetables and other

ground provisions; (4) meals bought away from home; (5) animal feeds; (6) furniture; (7) household appliances and linen; (8) clothing, and; (9) footwear. 'Household appliances', 'animal feeds', 'sugar confectionery and preserves', and 'milk, milk products and eggs', had the largest average price increases per month at 15 per cent. 'Clothing, footwear and animal feeds' had the greatest average price decreases.

Figure 6, which plots the sizes of these price changes over time, reveals that during a given month price increases are likely to be associated with price reductions. It also shows evidence of five periods of high price volatility, with expansions ranging between ten per cent and over 50 per cent in a month, coinciding with price contractions in double digits in the same month. Apart from these five periods, prices generally fluctuate between +10 and -5 per cent.

The volatility of price changes is not markedly high for any product group. In general, the coefficient of variation for most product groups ranged between 0.2 and 0.4. The product groups with the highest degree of volatility were 'sugar, confectionery and preserves', 'animal feeds', and 'meals bought away from home', with the volatility of 'sugar confectionery and preserves' more than twice that of the next most volatile category.

Table 2 shows only a few product groups where price changes for products within the group tended to be highly synchronised. 'Sugar confectionery and preserves', 'meals

bought away from home' and 'animal feeds' fall into this category, in terms of both price increases and decreases, while 'butter and other cooking fats and oils', 'fruit' and 'furniture' seem to display a degree of synchronisation in relation to price expansions only. These results imply that while some stores do follow closely what their competitors are doing in relation to prices, most stores do not.

The estimated inflation persistence (correlation of price movements with changes in the previous month) is quite low (Figure 8).² Even though price alterations occur relatively frequently on the island, past price adjustments have only a small impact on current changes. In addition, virtually all correlations are negative, implying that price rises are likely to be followed by price reductions. Price changes will therefore dissipate over time. The estimated half life $\left(h = \frac{\log(0.5)}{\log(\rho)}\right)$ of movements in the prices of

'washing soaps and detergents' and 'glassware, cutlery and other household appliances' were the fastest over the period under investigation, with one month needed for a unit shock to prices in these product groups to disperse by half. In contrast, the estimated half life for 'meals bought away from home' was much longer, with the time taken for half of a unit shock to dissipate estimated at over a year.

² This result is similar to the conclusions of studies by Bills and Klenow (2002) and Kovenen (2006).

Estimates of an autoregressive model of the factors affecting the frequency of price change are provided in Table 3. The results suggest that most of the frequency of price adjustment tends to be due to changes over the previous two months. Lagged alterations in the money supply and past inflation had no statistically significant impact on the frequency of price changes.

5.0 Conclusion

Our conclusions may be summarised as follows:

- Prices in Barbados are changed quite frequently; between 50 and 80 per cent of items in every category recorded a price adjustment every month on average;
- In the present decade the frequency of price movements has remained more or less constant;
- There are regular monthly price reductions as well as increases, but the reductions are always smaller and fewer than the increases;
- The magnitudes of expansions and decreases have remained largely unchanged during the current decade;
- Apart from five periods of highly volatile prices, which lasted between one and six months, price changes have fluctuated between contractions of five per cent and increases of ten per cent;
- The price volatility pattern is similar for all product groups;

- However, within product groups price changes are not highly synchronised;
- Price adjustments are not highly correlated with changes in a previous period; correlations are small and negative, indicating a slight tendency for increases to be followed by decreases, and vice versa; and
- There is no measurable impact of changes in the money supply or national inflation on the frequency of price adjustments.

Further research is needed to investigate why prices are altered so frequently, why there is so much volatility (reductions as well as increases), and why prices within product groups are not synchronized. It would be instructive to design a survey of decision makers in order to explore these issues further. Also it will be necessary to revisit tests of the impact of monetary policy and notions of what really drives prices. The fact that inflation appears not to be related to the observed pattern of price changes is also puzzling and deserving of further investigation. Studies of other Caribbean countries, done in a similar vein to this one, would also serve to enlighten this discourse.

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APPENDIX 1

Table 1: Frequency of Prices Changes by Product Group

	Frequency of Price Changes	Average Duration of Price Spells	Median Duration of Price Spells	Frequency of Price Increases	Frequency of Price Decreases	Average Price Increase	Average Price Decrease
Food	0.682	1.467	0.605	0.373	0.309	11.670	-3.592
Cereals, Flour and Bakery Products	0.554	1.804	0.857	0.305	0.249	3.381	-1.368
Meat	0.743	1.345	0.510	0.413	0.331	5.539	-2.354
Butter and Other Cooking Fats and Oils	0.688	1.453	0.595	0.417	0.271	5.212	-2.276
Milk, Milk Products and Eggs	0.629	1.591	0.700	0.348	0.281	21.386	-4.184
Juices and Other Non-alcoholic Beverages	0.669	1.494	0.627	0.356	0.314	5.718	-2.592
Sugar Confectionery and Preserves	0.644	1.554	0.672	0.351	0.292	29.210	-3.690
Vegetables and Other Ground Provisions	0.775	1.290	0.464	0.416	0.360	12.294	-4.450
Fruit	0.782	1.278	0.455	0.430	0.352	8.881	-4.290
Other Food	0.594	1.683	0.769	0.308	0.286	7.585	-3.695

Table 1: Frequency of Prices Changes by Product Group (Continued)

	Frequency of Price Changes	Average Duration of Price Spells	Median Duration of Price Spells	Frequency of Price Increases	Frequency of Price Decreases	Average Price Increase	Average Price Decrease
Meals Bought Away from Home	0.673	1.485	0.620	0.376	0.297	14.247	-5.587
Animal Feeds	0.488	2.047	1.034	0.261	0.228	20.323	-6.707
Furniture	0.690	1.450	0.592	0.342	0.347	12.795	-4.514
Household Appliances & Linen	0.684	1.463	0.602	0.343	0.340	18.573	-4.849
Washing Soaps and Detergents	0.656	1.524	0.649	0.342	0.314	7.157	-3.004
Glassware, Cutlery and Other Household Supplies	0.659	1.517	0.644	0.327	0.333	8.119	-4.049
Clothing	0.573	1.744	0.814	0.286	0.287	12.932	-5.974
Footwear	0.682	1.467	0.605	0.324	0.358	13.789	-7.171

Table 2: Synchronisation Ratio by Product Group

	Synchronisation Ratio of Price Changes	Synchronisation Ratio of Price Increases	Synchronisation Ratio of Price Decreases
Food	0.610	0.345	0.295
Cereals, Flour and Bakery Products	0.523	0.398	0.348
Meat	0.691	0.394	0.324
Butter and Other Cooking Fats and Oils	0.717	0.576	0.480
Milk, Milk Products and Eggs	0.589	0.439	0.424
Juices and Other Nonalcoholic Beverages	0.648	0.461	0.416
Sugar Confectionery and Preserves	0.679	0.576	0.547
Vegetables and Other Ground Provisions	0.764	0.427	0.385
Fruit	0.798	0.532	0.497
Other Food	0.628	0.449	0.447
Meals Bought Away from Home	0.893	0.760	0.725
Animal Feeds	0.724	0.697	0.661
Furniture	0.805	0.502	0.496
Household Appliances & Linen	0.766	0.433	0.433
Washing Soaps and Detergents	0.717	0.452	0.410
Glassware, Cutlery and Other Household Supplies	0.678	0.433	0.430
Clothing	0.802	0.488	0.479
Footwear	0.775	0.451	0.453

Table 3: Determinants of the Fraction of Price Changes

	(1)	(2)	(3)
Constant	0.088 (0.039)**	0.638 (0.040)***	0.631 (0.036)***
Frequency(t-1)	0.550 (0.082)***	-	-
Frequency(t-2)	0.328 (0.082)***	-	-
Inflation(t-1)	-	-	4.454 (5.224)
Inflation(t-2)	-	-	3.184 (5.286)
Money(t-1)	-	1.645 (2.116)	-
Money(t-2)	-	0.447 (2.110)	-
R-squared	0.728	-0.014	-0.002
Sigma	0.155	0.306	0.304
LM Test for Autocorrelation	0.841 [0.359]	60.792 [0.000]	60.577 [0.000]
Breusch-Pagan-Godfrey Heteroskedasticity Test	3.637 [0.030]	1.596 [0.208]	0.530 [0.591]
Observations	99	101	101

Figure 1: Frequency of Prices Changes by Product Group

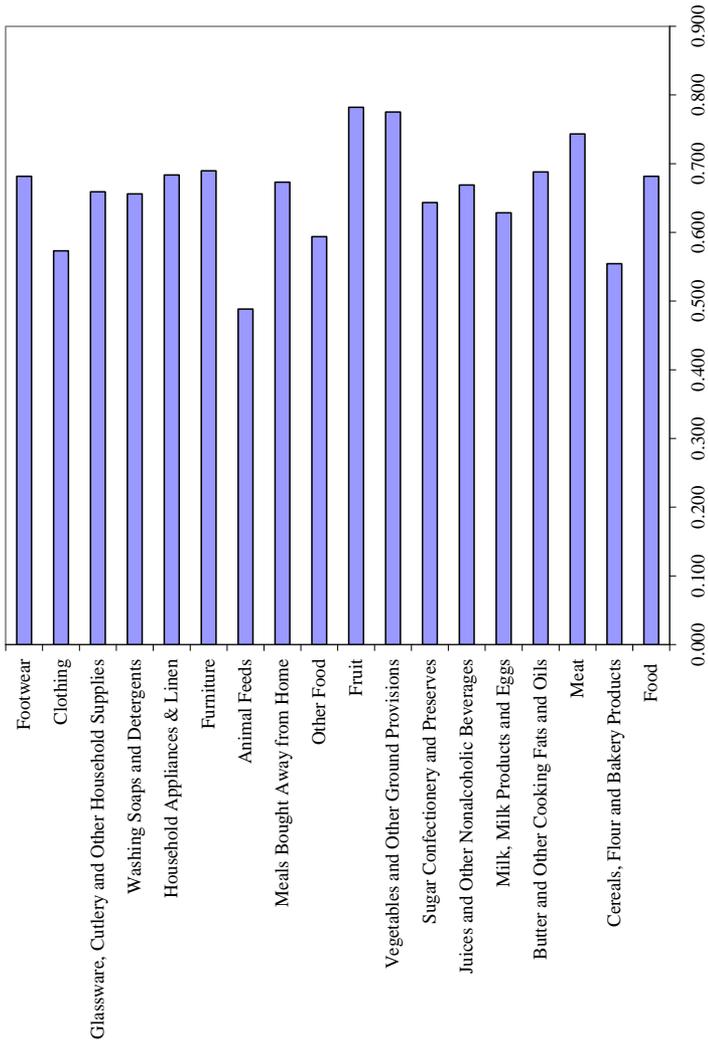


Figure 2: Frequency of Prices over Time

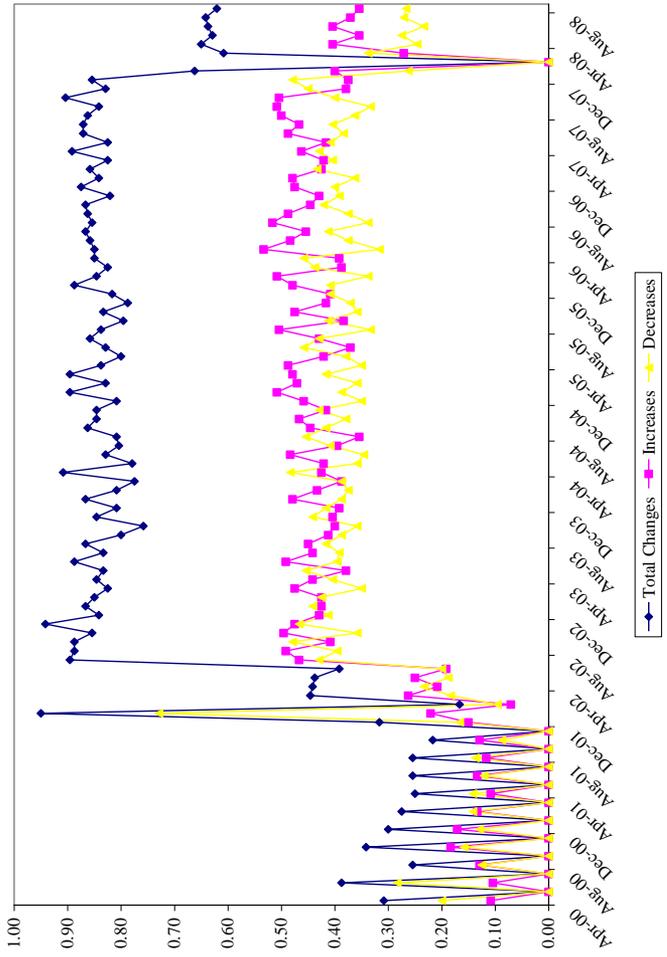


Figure 3: Duration of Prices Changes by Product Group

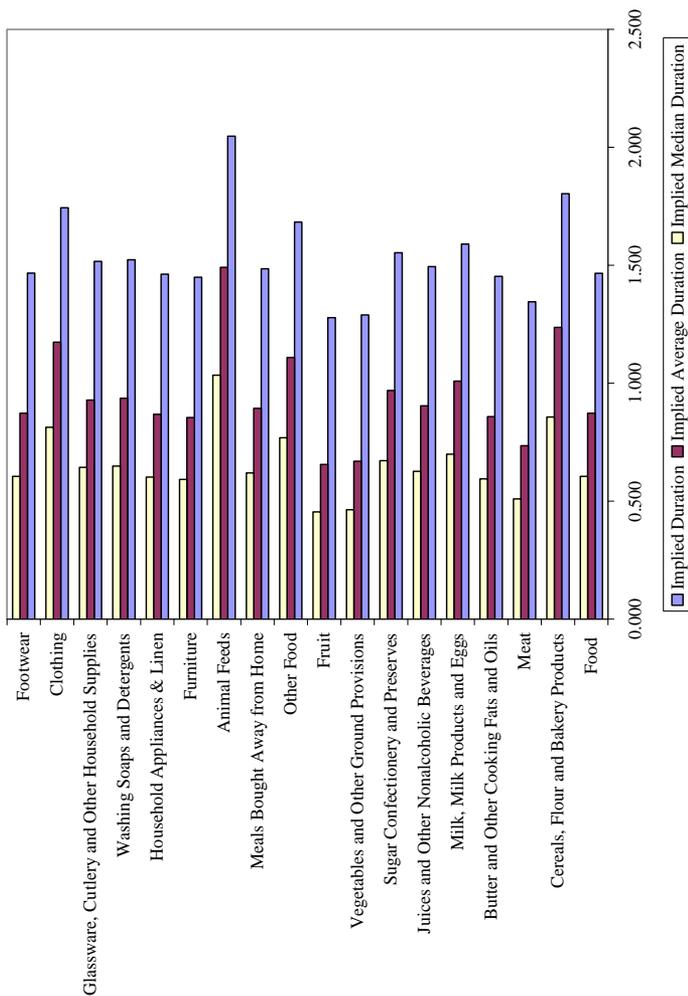


Figure 4: Frequency of Prices Increasing/Decreasing by Product Group (Per Month)

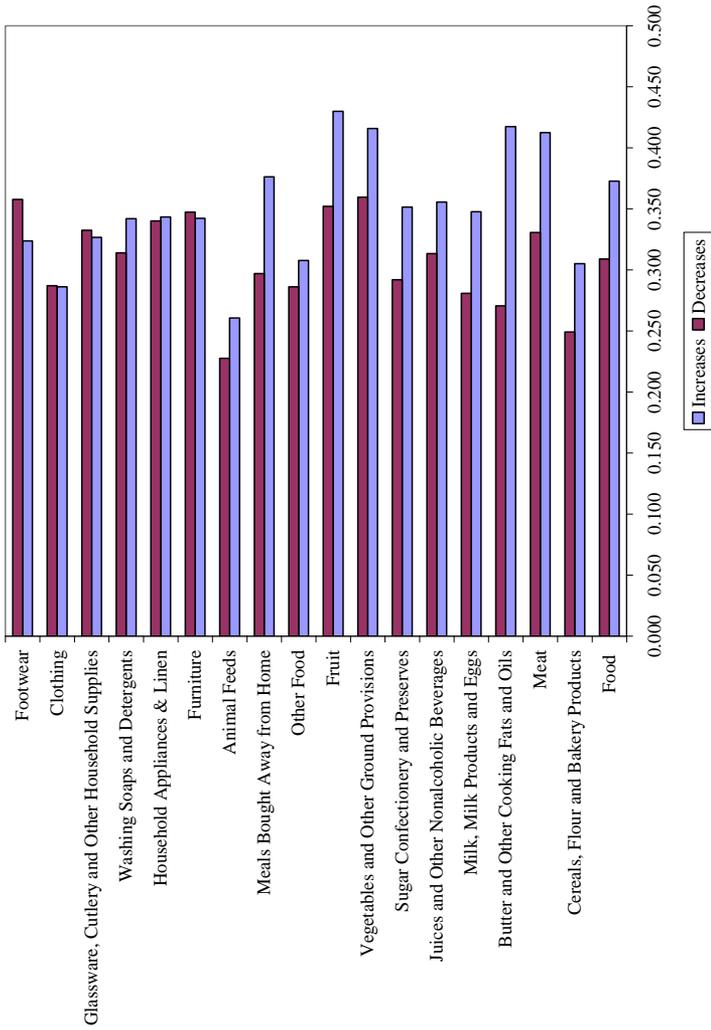


Figure 5: Average Size of Prices Increasing/Decreasing by Product Group (Per Month)

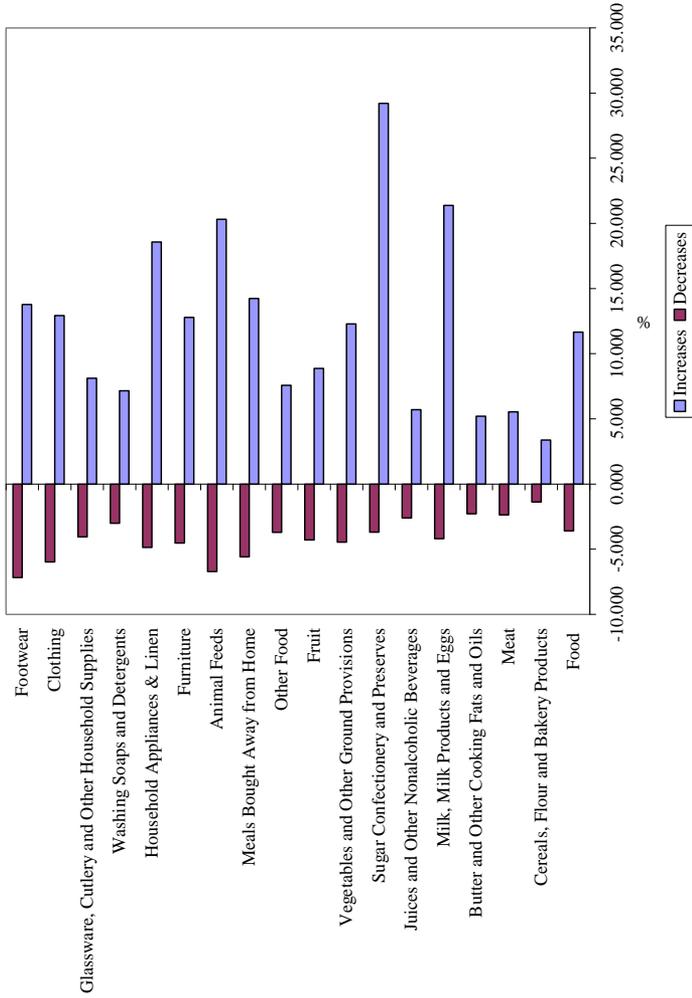
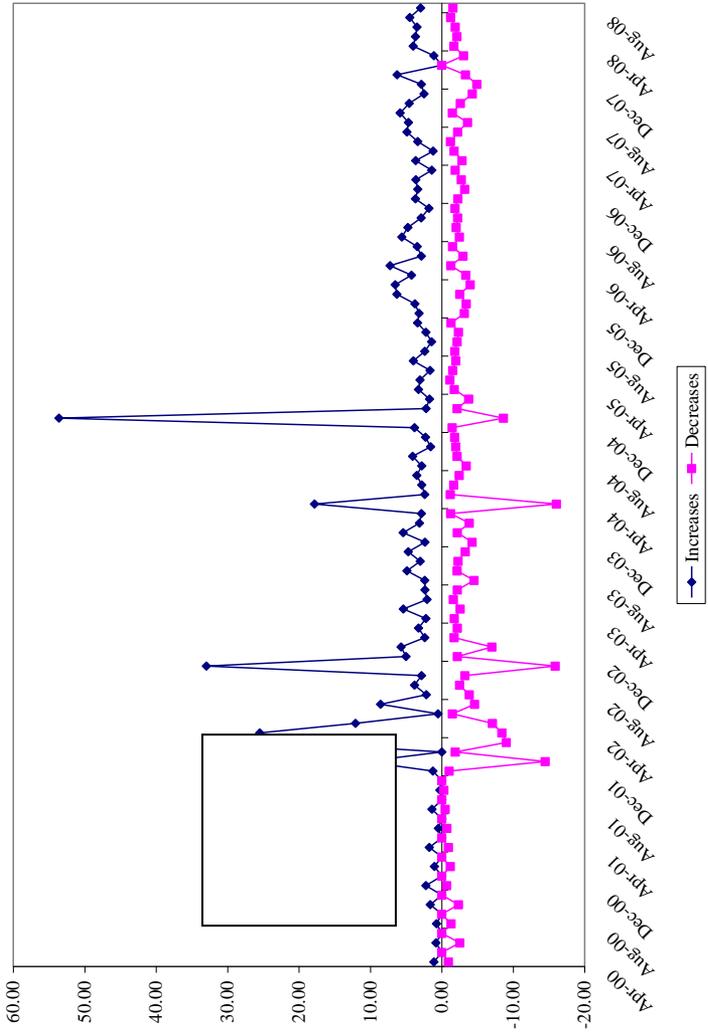


Figure 6: Average Size of Prices Increases/Decreases over Time



**Figure 7: Estimated Volatility of Prices Changes by Product Group
(Coefficient of Variation)**

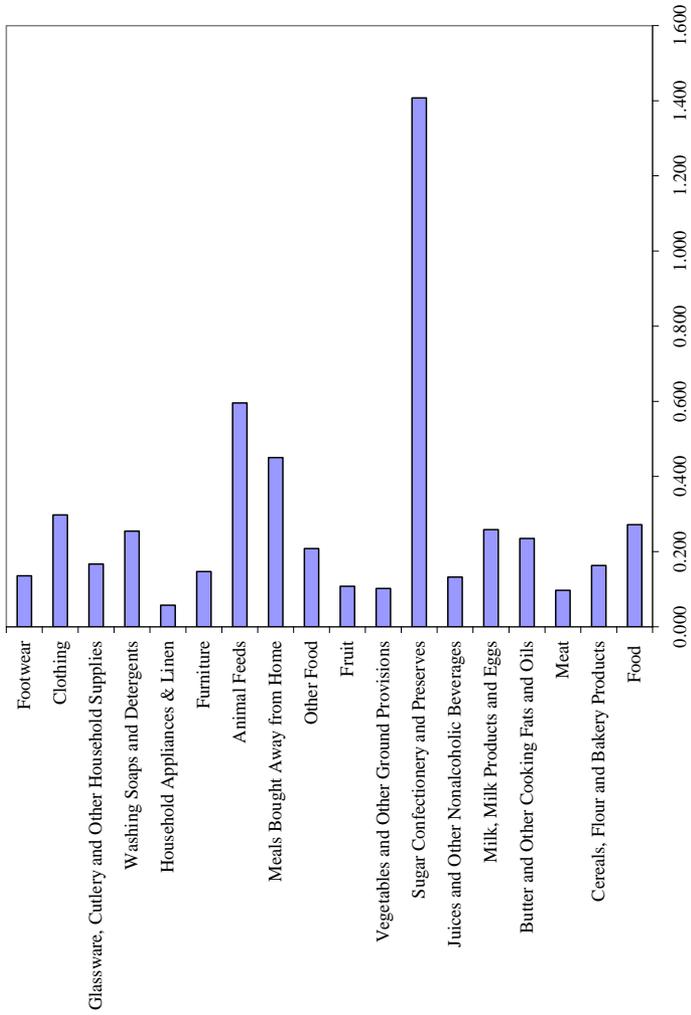


Figure 8: Estimated Inflation Persistence by Product Group

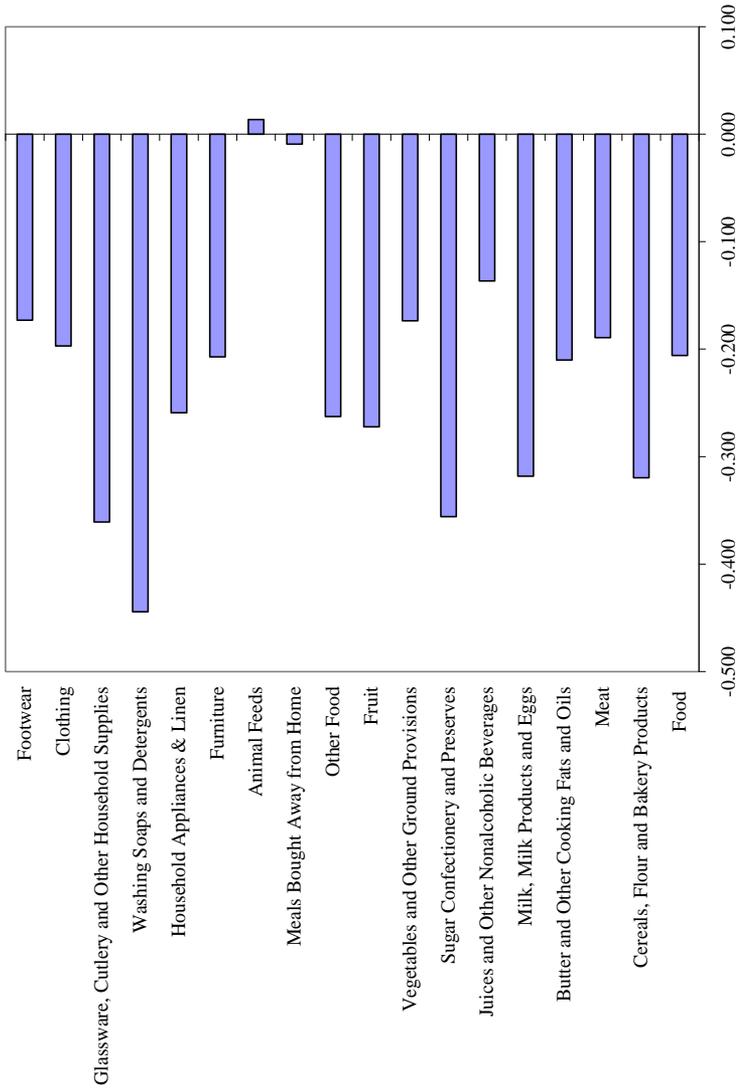


Figure 9: Empirical Survivor Functions by Product Group

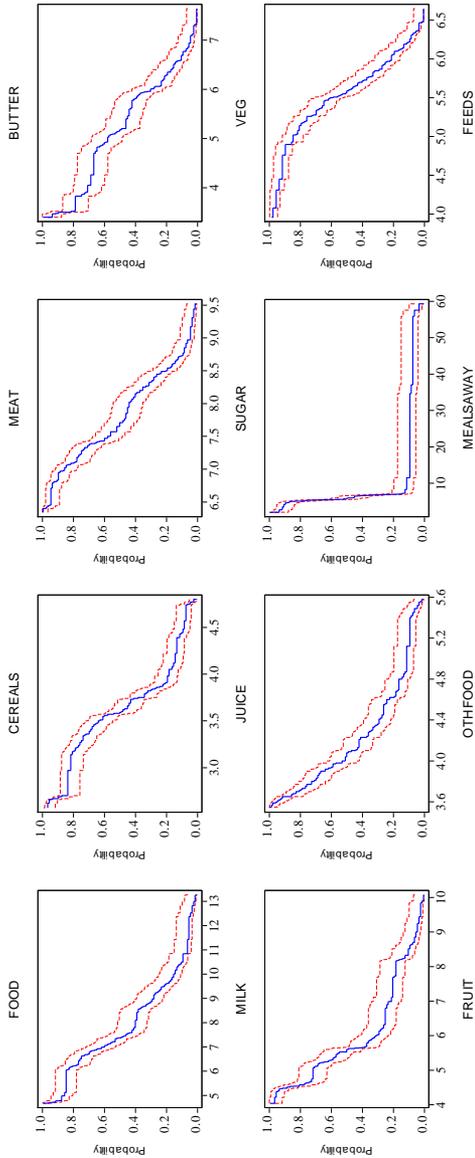


Figure 9: Empirical Survivor Functions by Product Group (Continued)

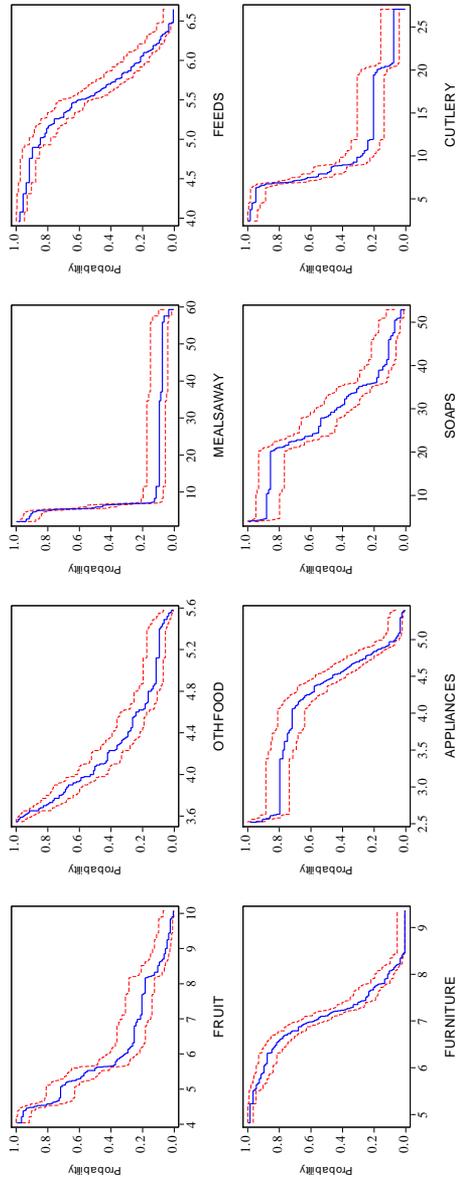
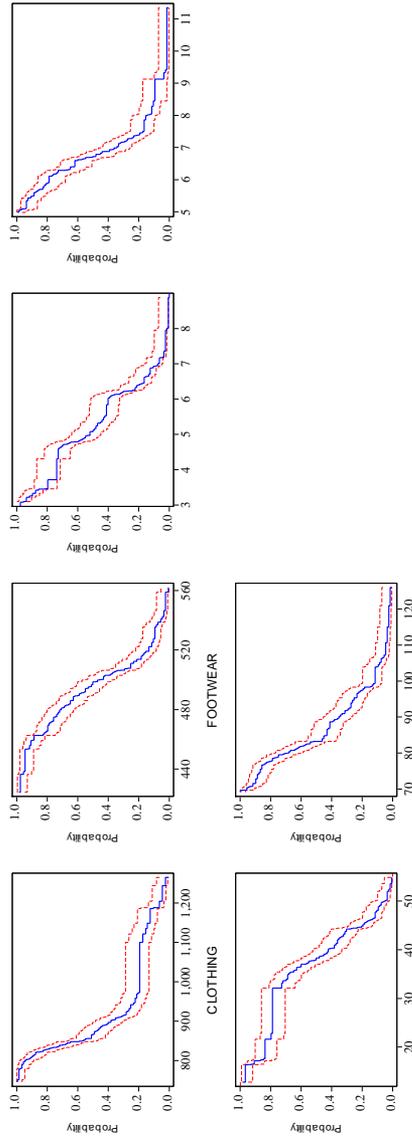


Figure 9: Empirical Survivor Functions by Product Group (Continued)



PRICE RIGIDITY: THE CASE OF TRINIDAD & TOBAGO

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ABSTRACT

This paper assesses price rigidity in Trinidad and Tobago employing price data used in the compilation of the Retail Price Index between 2004 and 2010. The major objective is to compute the frequency and duration of consumer prices across the major sectors of the economy. The study revealed that, excluding prices in the services sector, prices in Trinidad and Tobago change relatively frequently with between 60 per cent and 100 per cent of prices in each category showing a price change every month. Further, on average, price increases tend to be larger than price decreases. The study also indicates that the inflation rate in Trinidad and Tobago has no defined relationship with price movements.

JEL Classification: E3; L1; C4, D400

Keywords: Price Rigidity; Consumer Prices; Inflation, Survey data

¹ The views expressed are those of the authors and not necessarily those of the Central Bank of Trinidad & Tobago.

1.0 Introduction

After several years of relatively low inflation, Trinidad and Tobago experienced a dramatic expansion in prices in 2008. The increase was generally associated with falling local food supplies as well as rising international food prices. However, in 2009 inflation retreated steadily mainly through the delayed impact of lower prices of imported foods. The volatile nature of inflation has partly prompted this inquiry into the rigidity of prices in Trinidad and Tobago. We hope that the study will assist in deepening the understanding of inflation and in developing appropriate policy responses to this phenomenon. Taking inspiration from the growing body of work in this area, the paper adopts a micro economic approach to the examination of price rigidity.

The paper is structured as follows. Section 2 describes recent trends in inflation in Trinidad and Tobago. Section 3 reviews the literature on price rigidity theory and examines empirical studies of the price transmission process in selected economies. Section 4 presents the methodology of the investigation. Section 5 provides a description of the data used while Section 6 delves into the results. Section 7 concludes.

2.0 Inflation in Trinidad and Tobago

In 2003 and 2004, relatively low international commodity prices coupled with sluggish growth in private sector credit resulted in an average headline inflation rate of 3.7 per cent

and 3.8 per cent respectively. Thereafter, headline inflation picked up, rising to 6.9 per cent in 2005 and peaking at 12.0 per cent in 2008 (see Figure 1). The increase in headline inflation in 2008 was mainly on account of food prices, a key component of the Retail Price Index (RPI), which rose on the back of higher commodity prices and severe flooding in Trinidad and Tobago. In 2009, inflationary pressures eased significantly and headline inflation slowed to 1.3 per cent by year end. The key contributory factor to the slowdown was the delayed effect of a fall-off in international commodity prices. However while the inflation rate in the first few months of 2010 showed moderate gains, in June 2010 the inflation rate soared to double digits reaching 13.6 per cent from 9.6 per cent in the previous month. Once again food prices were deemed the culprit in the rise in inflation as weather related issues resulted in higher domestic prices of fruits and vegetables.

The empirical investigation undertaken later in this paper delves deeper into the changes in the prices of items that comprise the RPI, and thus provides some sense of the degree to which the overall direction of the RPI masks changes in individual items.

3.0 Literature Review

3.1 Theoretical Underpinnings of Price Rigidity

According to Dhyne et al. (2009), prices are *rigid* when their immediate adjustment following a change in demand or costs is less than full. Further, *intrinsic price rigidity* occurs when a price does not fully adjust to changes in demand and costs that have significant effects on the optimal price. In contrast, *extrinsic price rigidity* occurs when demand and costs are stable and the optimal price does not vary. Therefore the price is not expected to adjust. Prices which change infrequently due to either intrinsic or extrinsic rigidity are deemed *sticky*. On the contrary, prices which do not move frequently because of intrinsic rigidity are deemed to be *rigid*.

Dhyne et al. (2009) posited that the distinction between *sticky* and *rigid* prices is crucial for policy recommendations. They argue that intrinsic price rigidity is more important from a policy perspective than price stickiness. If there are major obstacles to price adjustment, the firm may not alter its prices despite variations in its optimal price. It is therefore advisable to consider policies that improve price flexibility by reducing these obstacles or increasing incentives to change prices. In contrast, if prices are sticky (moved infrequently because of stable demand and costs) the scope for policy is much more limited.

Price rigidity models fall into two distinct categories: (1) time-dependent and (2) state-dependent. Modern analyses of macroeconomic models with price rigidities start with the

time-dependent set-up based on Taylor (1980). In this framework, the idea of nominal long-term labour contracts was used in order to inject an element of stickiness into the behaviour of nominal wages. Here, nominal prices were fixed by assumption for a certain number of periods. In addition, the duration of nominal prices was postulated to be the same for all firms. It was also posited that price changes were perfectly staggered over time and that whenever the price moved, the value was set optimally. Using these assumptions, Taylor's model purported that a firm will alter its price based on the expected movements in macroeconomic variables. However, past price decisions of other firms affect a newly set price as well, since there may be old prices in an economy based on old information. Since prices are set relative to prices existing in the economy, economic shocks are passed on through consecutive price setting. In light of this, the nominal shocks in the economy affect prices for an extended period of time. Thus, time-dependent models suggest that firms review their prices periodically and the timing of this review is exogenous and does not depend on the state of the economy.

Calvo (1983) is a popular alternative to the Taylor (1980) based models. In this set up, the probability of a price change is constant. In addition, a fixed number of firms are able to alter prices in each period. However, in contrast to Taylor (1980), Calvo (1983) assumes prices were set optimally for an uncertain length of time by firms that were able to change prices. Therefore, Calvo (1983) concludes that

firms review their prices periodically using a stochastic process of price movement.

State-dependent models pose a different argument for price adjustments. Sheshinski and Weiss (1977) stated that firms face costs of price change and so they optimally choose the price bounds, s and S . When a price setter alters its price, it is set such that the difference between the actual and the optimal price equals a target level S . The nominal price is then kept at this level by the economic agent until the difference between the actual and the target level reaches a trigger level, s . Following this, the adjustment in the nominal price level is induced. In other words, firms which follow state-dependent pricing rules review their prices whenever there is a large enough shock. Sheshinski and Weiss (1977) stated that the reason for such price non-adjustment was the existence of a fixed cost of changing prices. Thus, the existence of price adjustment costs in state-dependent models implies that price reviews are likely to be more frequent than price changes, as firms want to be aware of shocks in order to react as fast as possible.

3.2 Review of the Empirical Literature on Price Rigidity

Early studies such as those by Cecchetti (1986), and Levy et al. (2002) focused on changes in the prices of particular items such as American magazines and orange juice. Later research by the Inflation Persistence Network in Europe, as well as Bils and Klenow (2002) concentrated on selected European countries as well as the United States (US) and

employed consumer price index (CPI) data collected by the respective statistical offices.

Bils and Klenow (2002) studied the frequency of price changes for 350 categories of goods and services on a monthly basis for the period 1995 to 1997. The items represented approximately 70 per cent of consumer spending in the US. The paper reported that an average of 26.1 per cent of prices change in a given month. Price movements were more frequent for durables and non-durables (30 per cent) than for services (21 per cent). In particular, transportation prices were most flexible while medical care, entertainment and magazines were most sticky. Products closely linked with primary inputs (raw products) displayed more frequent price changes.

A Euro area study by Dhyne et al. (2005) used monthly price data for the period January 1996 to July 2000. The results of this research indicated that price changes were infrequent with the frequency of price adjustments measured at 15.1 per cent. Further, the average duration of a price spell ranged from four to five quarters. Meanwhile, price alterations across products revealed a distinct degree of heterogeneity. Specifically, approximately 95 per cent of the selected product categories in the Euro area recorded average price spells between one and 31 months. The analysis by Dhyne et al. (2005) also showed no evidence of downward price rigidity in the Euro area with price reductions accounting for approximately 40 per cent of the price changes. In addition, compared to the prevailing

inflation rate in individual member countries, price movements were sizeable.

Meanwhile, studies examining price rigidity in Latin America and the Caribbean have produced consistent findings. Ford (2010) and Gouvea (2007) in analyzing price dynamics in Belize and Brazil respectively found that prices of goods change more frequently than services. Further, results obtained by Carolina (2010) and Polius and St. Catherine (2010) established that price increases were more frequent than price decreases in Curacao and St. Lucia. Studies by Craigwell et al. (2010) as well as Medina et al. (2007) also discovered that the national inflation rate had no measurable impact on the frequency of price changes.

Klenow and Malin (2010) provide a synopsis of the lessons learned from various studies examining price rigidity. The ten lessons identified are:

- Prices change at least once a year;
- Sales and product turnover are often important for micro price flexibility;
- Reference prices are stickier and more persistent than regular prices;
- There is substantial heterogeneity in the frequency of price changes across goods;
- More cyclical goods change prices more frequently;
- Price movements are big on average, but many small changes occur;
- Relative price adjustments are transitory;

- Price changes are typically not synchronized over the business cycle;
- Neither frequency nor size is increasing in the age of a price; and
- Price movements are linked to wage changes.

As indicated previously, the literature on price rigidity continues to grow not only in terms of the number of countries covered but also in terms of the focus of the literature. Recently the literature has also examined the rigidity of producer prices, for example Bunn and Ellis (2010), as well as the pricing decision behaviour of firms, for example (Copaciu et al. (2010)).

4.0 Methodology

The methodology employed in this paper follows in the vein of the papers like Klenow and Kryvtsov (2008) and Craigwell et al. (Chapter 2), and thus examines the frequency, duration, size and direction of price movements.

The price of good i in period t is denoted by p_{it} and the price change indicator is represented by I_{it} , where:

$$I_{it} = 1 \text{ if } p_{it} \neq p_{it-1}, i=1\dots k \text{ (number of items)}$$

$$= 0 \text{ if } p_{it} = p_{it-1}, t=1\dots n \text{ (number of periods)}$$

The frequency of price adjustments for an item can be expressed as:

$$F_i = \sum I_{it} / n \text{ for all } i=1\dots k, \text{ number of items.}$$

According to Craigwell et al. (Chapter 2) while the frequency of price changes can be used to calculate the implied duration of the price spells ($D=1/F$) this implicitly assumes that the adjustment in price occurs at the end of the month. Thus Craigwell et al. (Chapter 2), following in the vein of the recent literature, suggests that to allow for continuous timing that the implied average and median duration of price spells be estimated as follows:

$$D_{average} = \frac{-1}{\ln(1 - F_i)}$$

$$D_{median} = \frac{\ln(0.5)}{\ln(1 - F_i)}$$

Following the literature, the size of the price changes was also calculated using the following:

$$S_i = \sum (p_{it+1} - p_{it} / p_{it}) / n_i \text{ for all } i=1\dots k$$

where S_i represents the size of price change for an item i .

5.0 Description of the Data

Data on consumer prices is collected in Trinidad and Tobago by the Central Statistical Office and used to compile the RPI. The RPI is a weighted average of the proportionate changes in the prices of a specified set or 'basket' of consumer goods and services between two periods of time. In 2003, the RPI

was rebased using data collected from the 1997/1998 Household Budgetary Survey. Consistent with international standards, the RPI espoused the Classification of Individual Consumption by Purpose (COICOP) method.

The current RPI comprises of twelve broad categories which are as follows: food and non-alcoholic beverages; alcoholic beverages and tobacco; clothing and footwear; housing, water, electricity, gas and other fuels; furnishing, household equipment and maintenance; health; transport; education; communication; recreation and culture; hotels, cafes and restaurants and miscellaneous goods and services. Prices of items are collected on a monthly, and in some cases, a quarterly basis at the Central Statistical Office and using site visits to different retailers in different regions. In this paper we use data available at the sub-index level in analysing the rigidity of consumer prices in Trinidad and Tobago. This data is sourced from the index prices of items contained in the “All Items” Index which is utilised to calculate the country’s RPI. While researchers in the developed countries tend to use actual prices, in the few papers that have been undertaken on the topic for the Caribbean, the sub indices were employed. Thus the use of sub-indices data in this paper will therefore allow comparisons across the region. The time period covered in the database is January 2004 to June 2010.

In the examination of the data we do not make any allowances for sales. This is mainly due to two reasons. Firstly, sub indices do not lend themselves to the

identification of a sale. Further, the general literature is somewhat divided on the treatment of sales, with some authors ignoring them, while others such as Klenow and Malin (2010) using a “v” shaped filter to take account of the effect of sales on price changes.

6.0 Results

6.1 *Frequency of Price Changes*

According to Klenow and Malin (2010) factors which have been identified as influencing the frequency of price changes include “(a) the level and variability of inflation, (b) the frequency and magnitude of cost and demand shocks,...(c) the structure and degree of market concentration,... and (d) the price collecting methods of statistical agencies.” Dhyne et al. (2005) found that in the Euro area the frequency of price adjustments was 15.1 per cent, indicating that on average in a given month 15.1 per cent of prices change. Bils and Klenow (2002) estimated an average price frequency of 26.1 per cent. Studies examining the frequency of price movements in developing countries tend to find a higher frequency of price adjustments in those economies when compared to developed countries. Gagnon (2007) calculated that Mexico’s price frequency is 29.8 per cent (January 1994 to June 2002) and 27.8 per cent (July 2002 to December 2004), while Kovanen (2006) found a median frequency of one-third (i.e. the price of a typical item changes once every three months) for Sierra Leone.

In the case of Trinidad and Tobago we expect to observe large differences across sectors in terms of the frequency of price adjustment. In particular, we anticipate relatively frequent price changes for food products as the perceived degree of competition in this sector may be high leading to a higher degree of price movement. Further, we expect unprocessed food to be more flexible than processed food as the unprocessed food sector may be largely driven by supply-side factors related to the seasonal nature of these items. In contrast, prices in the service sector are likely to change relatively infrequently. This is so because the variable costs associated with the provision of services may remain relatively stable, reflecting the intensive use of labour and the infrequent alteration to wages. In particular, prices among regulated industries which are set by the government are projected to have a low frequency of price adjustment.

The frequency of price changes in our sample is 0.54, which indicates that approximately just over 50 per cent of consumer prices move in a given month. The high frequency of price adjustments in Trinidad and Tobago and the other Caribbean countries *vis-à-vis* more advanced economies could be the result of several factors including the significant weight given to the volatile food sector as well as a higher inflationary environment. The results also indicate that prices in the services sector in Trinidad and Tobago are sticky, while those items in the food category change frequently. This heterogeneity is consistent with findings obtained for developed and other developing economies.

More specifically, while less than 40 per cent of prices in the services category change on a monthly basis, between 60 per cent and 100 per cent of prices for non-services items move every month (see Figure 2). The product categories with the highest frequency of adjustment are vegetables, milk and dairy products and fish (see Appendix 3).

Craigwell et al. (Chapter 2) found that fruits and vegetables and other ground provisions had the highest frequency of price change in Barbados, while Polius and St. Catherine (Chapter 4) highlight that in St. Lucia fruits, vegetable and tubers are altered every month. Thus our finding is in line with previous studies that show that the prices of unprocessed foods are less rigid than those of processed foods with higher value added.

6.2 *Duration*

The results from this research also imply that on average price spells in Trinidad and Tobago last just over one month. In addition, an examination of the duration of the price spells indicates that food and beverage prices are not rigid, with spells lasting less than a month in all instances. The items with the shortest price spells were fish and milk and dairy products. At the individual product level, for most items the price spells were at most one month. The flexibility of prices in the food sector may reflect the seasonality of production as well as the pricing policy for perishable products.

In the case of services such as education, recreation and culture and transport, price spells were longer, lasting six, seven, and 13 months respectively. This finding is consistent with those from other studies, for example, Polius and St Catherine (Chapter 4) found longer price spells for communications and services of physicians. Gouvea (2007) believed the higher degree of rigidity for the services sector reflected the importance of labour costs in the sector and the tendency for labour contracts to have fixed wages and long durations. Bils and Klenow (2002) reported that for the US the average duration of a price spell was 4.3 months, while Dhyne et al. (2005) indicated that for the Euro area the average duration of a price was four to five quarters.

In line with our expectations, prices tend to be highly rigid among the regulated industries, such as telecommunication, with price changing only every few years. Meanwhile in the case of other regulated industries such as water and sewerage, prices did not move over the period covered by the study. Price duration in the electricity sector was relatively short with price spells of just over one month. The length of the price spells in the regulated sector coincides with the results from other studies; Bils and Klenow (2002), for example, noted that in the US, the duration spells for the price of electricity was 1.8 months.

6.3 *Direction and Magnitude*

In general, we observe that price increases tend to occur more frequently than price decreases in Trinidad and Tobago. This is particularly true for the food sector where

approximately 61 per cent of the goods experienced price expansions while an average of 35 per cent of the goods revealed price contractions during a given month. Among the various sub-indices, milk and dairy products have the highest probability of a price rise, while vegetables and other ground provisions have the greatest probability of a price cut in a given month. Polius and St. Catherine (Chapter 4) found that in the case of St. Lucia, on average, 62 per cent of prices increased in a given month. In contrast, during a given month, approximately 38 per cent of prices recorded decreases.

As Figure 3 illustrates, on average, price expansions tend to be larger than price reductions in Trinidad and Tobago. Prices increased by an average of 4.03 per cent, while decreases were on average -2.11 per cent. The sectors with the largest jump in prices were transport and recreation and culture. In the case of transport the rise was driven by several one-off large expansions in the costs of items such as driving permits, and wheel alignment balancing. In the case of recreation and culture, the price increases occurred in the area of the cost of hiring musicians and the cost of rental of equipment. While on average the price of food rose by 4.29 per cent, the magnitude of changes within the food index were much greater than in other sectors. Items which had double digit price movements included limes, tomatoes, and celery.

Notably the average price decrease in the food sector was -2.74 per cent. This relatively small size of the price changes is consistent with the findings from some of the other Caribbean islands. For example, Ford (2010) found that for Belize average price increases ranged from 0.7 per cent to 2.7 per cent, while price declines were between -2.3 per cent and -0.4 per cent. Polius and St Catherine (Chapter 4) reported that the average size of price expansions in St. Lucia was 7.9 per cent, while the average size of price contractions was 4.6 per cent. However Gouvea (2007) indicated that in the case of Brazil the average size of the price increases for the overall CPI was 15.99 per cent while the average size of price decreases was -12.57 per cent. Further Dhyne et al. (2005) found for the Euro area that the average size of price expansions was eight per cent, while the average size of price reductions was ten per cent. The difference in the magnitude of the price changes may be a function of the nature of the market, as well the frequency of the price movements.

6.4 *Correlation*

An initial examination of the relationship between the frequency of price changes and the monthly inflation rate showed no correlation between these variables (see Figure 4). Further examination of the correlation between the frequency of prices movements in the food and beverage sector, and in the items that constitute core inflation with the inflation rate also finds no evidence of correlation (see Appendices 4a and 4b).

The correlation test suggests that inflation persistence in Trinidad and Tobago is very low, and this is in keeping with the finding of a high frequency of price changes. Inflation persistence examines the impact of past price movements on current prices. To formally test for inflation persistence we estimate the following equation:

$$\pi_{it} = \rho_0 + \rho_i \pi_{it-1} + \varepsilon_{it}$$

where π is the month-on-month change in prices and the measure of correlation ρ_i defines inflation persistence for

item i . According to Craigwell et al. (Chapter 2) if ρ is small there is a relatively low degree of correlation between monthly price movements. Craigwell et al. found that in Barbados the estimated inflation persistence is quite low, indicating that past price changes have only a small impact on current movements. In Barbados most of the correlations were negative, suggesting that price increases were likely to be followed by price decreases. Ford (2010) also reported that for Belize, inflation persistence is relatively low and negative, with an overall ρ of -0.25. Additionally, Kovanen (2006) observed that for Sierra Leone estimated inflation persistence was generally small and not statistically significant. The estimated overall coefficient of inflation persistence for Trinidad and Tobago is low, -0.032, with the coefficients for the individual categories being small and/or negative (see Figure 5).

These findings suggest that, generally for Trinidad and Tobago past price changes have little impact on current movements. Indeed, in sectors such as transportation, housing, education and communication the effect was not significantly different from zero. As can be seen in Figure 5, two notable exceptions to the general direction of inflation persistence are food and alcohol and tobacco. The positive ρ for these two categories means that price increases among these items are likely to be followed by further price rises in the next month. The lower degree of inflation persistence in the services sector is a feature of many economies as noted in Coricelli and Horváth (2010). Coricelli and Horváth referenced Calvo's model of staggered prices to explain this phenomenon, indicating that the lower degree of competition in the services sector allows prices charged by individual firms to diverge from the average without a resultant loss in market share. Thus, a high degree of inflation persistence would be found in markets that tended towards the perfect competition scenario.

7.0 Conclusion

This initial investigation of price rigidity in Trinidad and Tobago implies that, as in other Caribbean countries, prices are not rigid as they change frequently especially in the food and beverages category. However it was found that the prices of services were altered less frequently than the prices of goods. Further, price increases occur more frequently and are on average larger than price decreases. While inflation

persistence is on average small, a positive and significant relationship is reported in the food and beverage category.

It is the intent of the authors to further enhance this paper by examining movements in the actual prices reported to the Central Statistical Office. This will not only provide for international comparability but also allow for examination of the quality of the inferences gained by the use of sub-indices.

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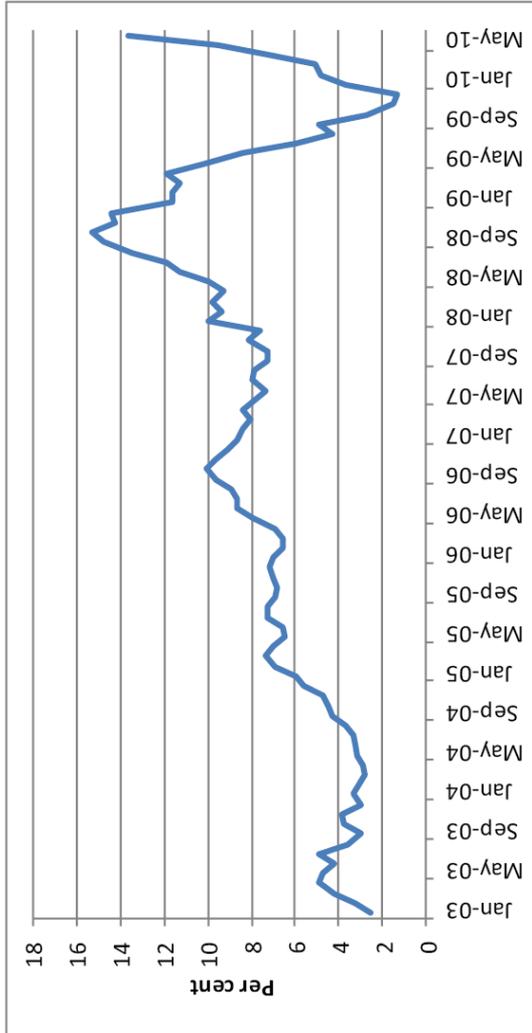
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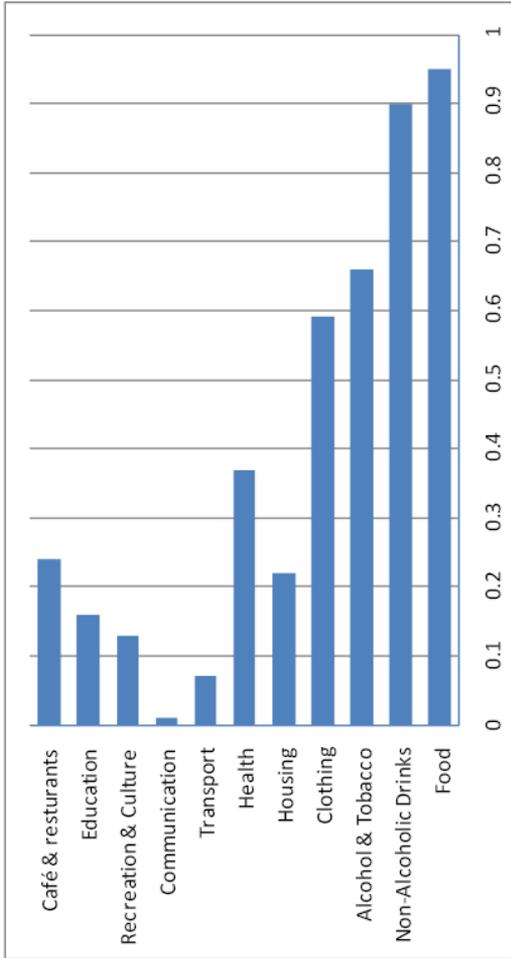
APPENDIX 1

Figure 1: Year-on-Year Percent Change in the Index of Retail Prices



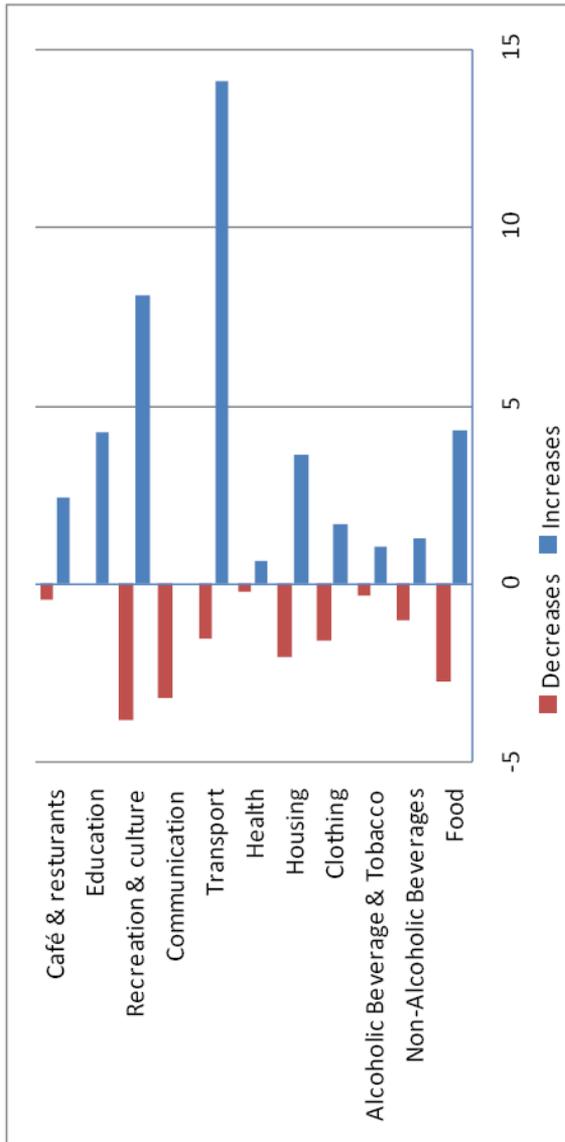
Source: The Central Statistical Office of Trinidad and Tobago (CSO)

Figure 2: Frequency of Price Changes by Product Group



Source: Authors' Calculation Based On CSO Data.

Figure 3: Average Size of Price Increases/Decrease by Product Group /per cent/



Source: Authors' Calculations Based On CSO Data.

Figure 4: Correlation between the Frequency of Price Changes and the Inflation Rate

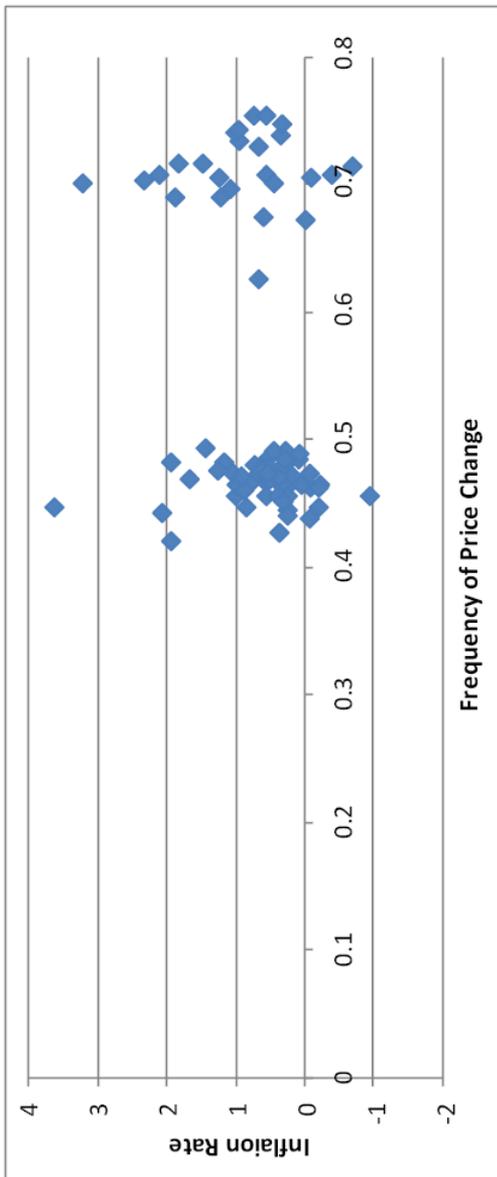
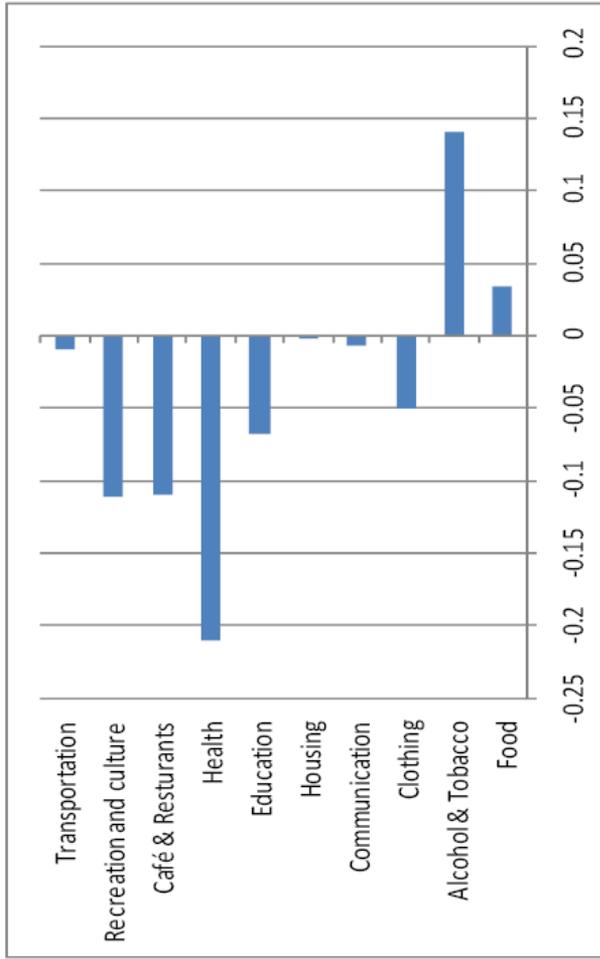


Figure 5: Inflation Persistence by Product Group



Source: Authors' Calculations Based On CSO Data.

APPENDIX 2

Monthly Mean Frequency of CPI Price Changes

Country	Paper	Sample Period	Frequency (%)
Belize ¹	Ford (2010)	1991:02 – 2008:11	99.5
Brazil	Gouvea (2007)	1996:01 – 2006:12	37.0
Barbados	Craigwell, Moore and Worrel (2009)	1994:01 – 2008:12	50.0 - 80.0
Chile	Medina, Rappoport and Soto (2007)	1999:01 – 2005:07	46.1
Curacao ²	Carolina (2010)	1999:01 – 2009:09	30.5
Euro area	Dhyne et al. (2005)	1996:01 – 2000:06	15.1
Hungary	Gábrriel and Reiff (2010)	2001:12– 2007:06	23.9
Italy	Vernose et al. (2005)	1996:01 – 2003:12	10.0
Luxembourg	Lünnemann and Mathä (2010)	1999:01 – 2004:12	17.0
Mexico	Gagnon (2009)	1994:01 – 2004:12	29.4
Sierra Leone	Kovanen (2006)	1999:01 – 2003:04	51.5
Slovakia	Lukácsy and Horváth (2009)	2004:02 – 2006:12	34.5
St. Lucia	Polius and Catherine (2010)	1984:04 – 2007:12	98.0
United States	Dhyne et al. (2005)	1996:01 – 2000:06	24.8

Source: Central Bank of Trinidad and Tobago.

Notes: (1) means data used in this study were compiled on a quarterly basis. (2) means data used in this study were compiled for energy components of Curacao's CPI.

APPENDIX 3

Characteristics of Price Changes for Product Groups (January 2004 to June 2010)

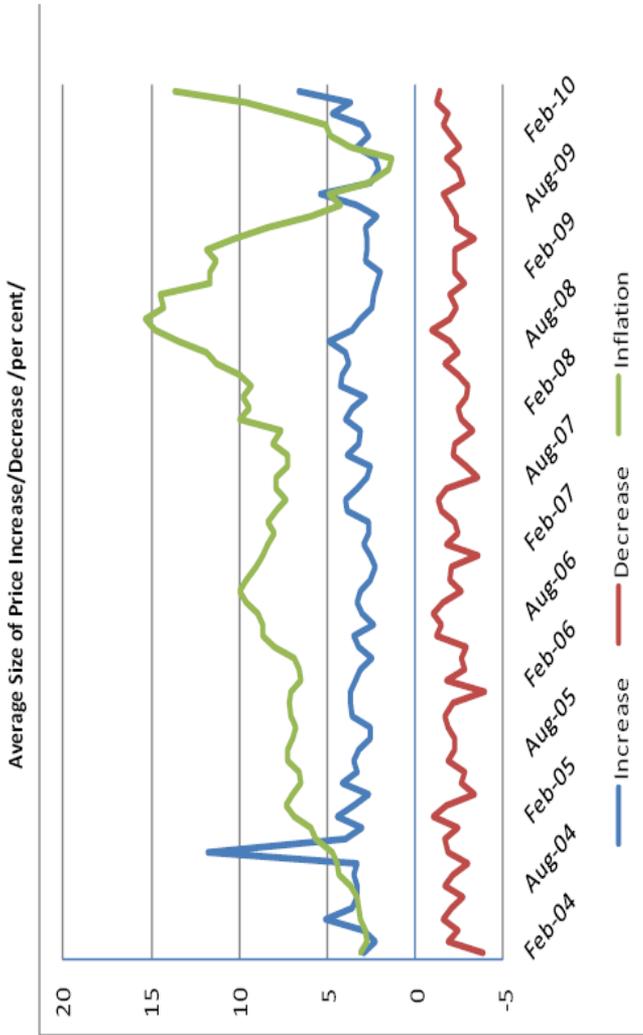
	Frequency of Price Changes	Average Duration of price spells	Median Duration of price spells	Frequency of Price Increases	Frequency of Price Decreases	Average Price Increases	Average Price Decreases
Food	0.95	0.33	0.23	0.61	0.35	34.16	-26.12
Bread and Cereals	0.76	0.70	0.48	0.48	0.28	2.97	-1.80
Meat	0.95	0.34	0.23	0.59	0.36	3.13	-2.25
Fish	0.97	0.27	0.19	0.59	0.39	7.11	-5.74
Milk and Dairy Products	0.98	0.25	0.17	0.66	0.32	2.06	-1.28
Oils and Fats	0.92	0.39	0.27	0.62	0.30	2.44	-1.89
Fruits	0.96	0.32	0.22	0.60	0.36	27.49	-17.76
Vegetables and other ground provisions	1			0.61	0.39	55.90	53.88
Other Food	0.89	0.45	0.31	0.58	0.31	20.86	-14.90

**Characteristics of Price Changes for Product Groups
(January 2004 to June 2010)
(Continued)**

	Frequency of Price Changes	Average Duration of price spells	Median Duration of price spells	Frequency of Price Increases	Frequency of Price Decreases	Average Price Increases	Average Price Decreases
Non-alcoholic drinks	0.90	0.43	0.30	0.58	0.32	1.43	-1.12
Alcohol and tobacco	0.66	0.92	0.64	0.44	0.23	1.32	-0.39
Clothing	0.59	1.11	0.77	0.28	0.31	1.56	-1.50
Housing	0.22	3.97	2.75	0.15	0.08	4.63	-2.54
Health	0.37	2.15	1.49	0.27	0.11	0.86	-0.37
Transport	0.07	12.95	8.89	0.05	0.02	15.39	-1.90
Comm.	0.01	114.99	79.71	0	0.01	0	-2.96
Recreation and Culture	0.13	6.93	4.80	0.08	0.05	7.90	-4.40
Comm.	0.01	114.99	79.71	0	0.01	0	-2.96
Recreation and Culture	0.13	6.93	4.80	0.08	0.05	7.90	-4.40
Café and restaurants	0.24	3.62	2.51	0.22	0.02	3.25	-0.73
Misc.	0.27	3.23	2.24	0.19	0.08	1.65	-1.39

Source: Authors' Calculations Based On CSO Data.

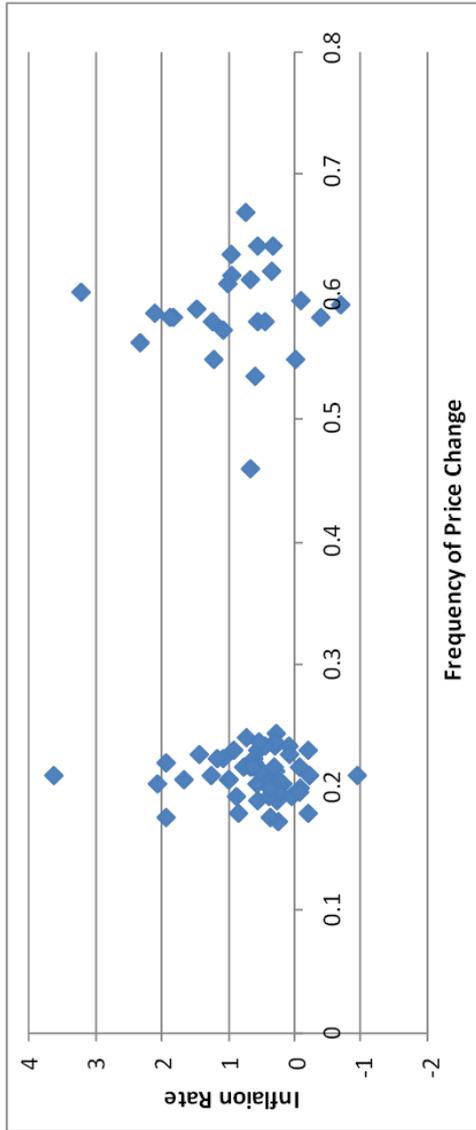
APPENDIX 4



Source: Authors' Calculations Based On CSO Data.

APPENDIX 5B

Correlation between the Inflation Rate and Frequency of Prices Changes in Core Sector



Source: Authors' Calculations Based On CSO Data

PRICE SETTING BEHAVIOUR IN ST LUCIA: EVIDENCE FROM CPI DATA

TRACY POLIUS
EDWIN ST CATHERINE

ABSTRACT

The results of this study reveal a few stylized facts about price setting behaviour in Saint Lucia. First, the data points to price flexibility in the highly weighted sub indices for food, fuel and light and transportation whilst prices in the service sectors (except transportation) such as hotels, restaurants, education and communication exhibited far greater stickiness. The research also demonstrated that a higher level of rigidity is observed for items which are not frequently purchased like clothing and footwear and furniture and fixtures. Third, we find some asymmetry in pricing behaviour, as price increases occur far more often than price decreases. Furthermore, price expansions on average are larger than price declines.

JEL Classification: E3; L1; C4, D40

Keywords: Price Rigidity; Consumer Prices; Inflation, Survey data

1.0 Introduction

The period of inflation, boosted by rising energy and food prices, which preceded the 2008 global economic downturn has provoked renewed interest in issues related to price determination and formation in the Caribbean. Moreover, calls from Caribbean people to their respective governments to implement policies that can assist in halting the inflationary spiral have caused policy makers to turn their attention to price setting behaviour in the Caribbean. Much research conducted in the Caribbean, including Greenidge (2009), Bourne (1977) and Downes (1985), has focused on the macroeconomic determinants of inflation rather than detailed micro analysis of price rigidity and price formation. Craigwell et al. (Chapter 2) stands out as one of the few studies that uses this micro methodology.

Policy makers in the Caribbean have of course been very concerned about the influence that persistent inflation has on the quality of life of its citizenry, especially its poor and indigent. However, the study of price rigidity focuses on the impact of external shocks on inflation in the economy. This analysis of price rigidity in St Lucia may therefore assist policy makers in addressing the potential inflationary effect of international recession and similar external shocks.

The rest of the paper is organized as follows. Section 2 will present some useful information on the dataset used and section 3 will give an outline of the literature. The

methodology is identified in section 4 and sections 5 and 6 will discuss the results and conclusions.

2.0 Description of the Dataset

The dataset employed here is the same as that used for generating the Consumer Price Index (CPI) for Saint Lucia. It therefore respects the international standard classification of individual consumption expenditures which was previously referred to as classification of consumption according to purpose (COICOP). The COICOP is divided into divisions, groups and classes structured as indicated below:

12 divisions (two digits level)

e.g. 01. Food and non-alcoholic beverages

47 groups (three digits level)

e.g. 0.1.1 Food

117 classes (four digits level)

e.g. 0.1.1.1 Bread and Cereals

The CPI for Saint Lucia is based on price information collected for 6,123 item varieties including 1,945 unique item varieties.¹ The current CPI dataset includes 12 item divisions (2 digits), 34 item groups (3 digits), and 64 item classes (5 digits). The twelve divisions include: food and non-alcoholic beverages, alcoholic beverages, tobacco and narcotics, clothing and footwear, housing, water, electricity,

¹ Items are counted more than once when they are priced at more than one outlet.

gas and other fuels, furnishing, equipment and household maintenance, health, transport, communication, recreation and culture, education, restaurants and hotels, miscellaneous goods and services. For the most part, price data is collected for all divisions of the CPI on a monthly basis on site or through central collection agencies. The resulting CPI is therefore a weighted average of the percentage price changes for the specified basket of goods and services between the two months.

The study utilizes the micro dataset of price records produced through Household Expenditure Surveys conducted by the Government of Saint Lucia Statistical Department for the period April 2002 to December 2007. The CPI for Saint Lucia was recently revised with January 2008 as the base period. Thus, this paper employs data from the old dataset which includes ten divisions (2 digits) and 41 item groups (3 digits). It also uses data for the period April 1984 to December 2008, involving the new rebased CPI. The 1984-2008 dataset, though lengthier, is only provided at the two digits level and therefore does not give the level of detail as the database for April 2002 to December 2007. Despite this limitation, it will allow us to examine the trends in price formation for Saint Lucia and provide a comparison with results from the shorter dataset.

3.0 Empirical Studies on Price Rigidity

An analysis of the literature reveals that there has not been significant research attention placed on microeconomic

analysis of price setting and adjustment behaviour in many countries. We will summarize this small literature and where possible, highlight any gaps which need a greater focus.

Much of the work on price rigidity has been done in a developed country context, with some studies now emerging on price stickiness and its implications for macroeconomic policy in developing countries. Baudry et al. (2004) examine CPI monthly data records for the period 1994 to 2003 from France to assess the extent of price stickiness. They found that consumer prices in France tend to be sticky as reflected by weighted average price duration of eight months. The evidence supported heterogeneity in price adjustment across sectors, with price changes being less frequent in the service sectors. Additionally, it revealed that price decreases were almost as frequent as price increases, with price cuts accounting for four out of every ten price movements.

Alvarez et al. (2005) present an analysis of price setting behaviour in the Euro area using micro CPI data, producer price indices and survey data. They found that Euro area prices are stickier than United States (US) prices and price durations are significantly longer than those for the US. Price adjustments tend to be heterogeneous across sectors reflecting greater flexibility for unprocessed foods and energy and less flexibility in service sectors. Survey evidence also allowed Alvarez et al. to conclude that there exist asymmetries in adjustment of prices to cost factors

versus demand factors. Price responses were found to be greater than cost increases versus price declines, and more to a fall in demand in contrast to an expansion in demand.

Bils and Klenow (2004) discuss micro price setting in the context of a developed/industrial country. They examined the frequency of price changes for 350 categories of goods and services, which constitute 70 per cent of the unpublished CPI data for the United States Bureau of Labor Statistics for the period 1995 to 1997, to determine the existence of price rigidities. Their results indicate that prices changed more often than reported in previous studies for the US. The authors found significant variation in terms of the frequency of price movements across different categories of goods. Price adjustments for services for instance were generally less frequent. In contrast raw goods, durable goods and goods with little value added in final production experienced much more price changes.

Herrmann et al. (2005) conducted an analysis of price rigidity in the German Grocery-Retailing Sector using weekly data for the period 1996 to 1999 for 20 branded foods. His research points to the existence of significant price rigidity in grocery retailing for Germany. This is reflected by a mean duration of unchanged prices of 13 weeks across all brands. The results also indicated that that median price rigidity is higher for low elasticity food brands when compared to high elasticity food brands. The author extended the work into identifying determinants of food price rigidity. Psychological pricing and the sale

phenomenon were found to be important determinants of food price rigidity.

One of the studies which address price rigidity for a developing/emerging economy is presented by Gouvea (2007). She undertook an analysis for Brazil using data for 243 product/service categories which represent about 85 per cent of the computation for the CPI for the period 1996 to 2006. Her results suggest that on average prices are more flexible in Brazil than in the US or the Euro area, as evidenced by a frequency of price change of 37 per cent compared to 26.1 per cent for the US. Moreover, mean price duration for Brazil was estimated at 2.1 months compared to 3.8 months for the US. Gouvea also found that the average duration of price spells was reduced when the economy faced uncertainty related to a confidence shock prior to the 2002 presidential elections. The results also reflected evidence of heterogeneity in price adjustment behaviour, reflecting higher rigidity in the service sectors relative to other sectors.

Kovanen (2006) gave an analysis of pricing behaviour in Sierra Leone. His results imply that individual prices change on a more frequent basis relative to comparative prices in industrial countries. Price alterations were very frequent among food items, which were adjusted on average once a month, while transportation, communication, repairs, rates and rents were changed on a less frequent basis. In light of the fact that food represents approximately 60 per cent of the CPI basket, they concluded that the frequent

movements in food prices partly explained inflation volatility in Sierra Leone. They also found that the variance in inflation is largely explained by the proportion of items subject to price changes.

Craigwell et al. (Chapter 2) undertook an evaluation of price rigidity in Barbados using monthly CPI data for the period 1994 to 2008. They reported that between 50 and 80 per cent of items in every product category change on a monthly basis, indicating that prices are relatively flexible in Barbados. Their results were consistent with those of other studies which suggest that prices for raw foods and commodity prices move more frequently. The average duration for most goods was between one and two months, while the median duration of a price spell was estimated at approximately 0.6 months.

The summary of empirical studies on price setting behaviour presented here implies that on average developing economies tend to exhibit greater flexibility in prices than industrial countries. Thus, price spells tend to be of shorter duration in the context of developing countries than the industrial economies. However, most studies revealed the existence of heterogeneity in price adjustment with the service sectors altering prices less frequently than sectors which specialize in commodities and the production of raw food. We find that the few studies within the literature do not focus significantly on the factors that influence price rigidities and those that drive prices up or down.

4.0 Methodology

This section of the paper will outline our approach to evaluating price rigidity in Saint Lucia. The article evaluates the frequency of price movements, the duration of price spells and the symmetry of price changes.

4.1 *Frequency and Duration of Price Changes*

The extent to which price stickiness exists in Saint Lucia can be evaluated by examining both the frequency and duration of price spells. Prices are generally considered rigid when the frequency of price changes is relatively low and when average price spells are long. Some definitions will assist in clarifying the approach. The individual observations within the sample can be classified as individual price records or price quotes for a specific product or service which is sold at a particular outlet. The primary dataset which is used for computation of the CPI contains information on elementary products which are very specific products such as cornflakes from the brand Kellogg's sold at a group of outlets. A product category is defined as all the elementary products which belong to the same broad category e.g. cereals. Enumerators executing the household expenditure survey in Saint Lucia will therefore collect the prices of those elementary products over time. A sequence of price quotes gathered over the sample period is referred to as a price trajectory.

The frequency of price changes F_i measures how often the price quote for a particular product moves when compared

to the full sample of price records or quotes. It is therefore the ratio of observed price record changes to the total number of price quotes. The frequency of price alterations is computed using the indicator variable I_{it} which is defined as follows;

$$I_{it} = 1 \text{ if } p_{it} \neq p_{it-1}$$

$$= 0 \text{ if } p_{it} = p_{it-1}$$

For $i= 1, \dots, K$ (number of goods) and $t = 1, \dots, T$ (number of periods).

A price spell is defined as the time interval between two price changes. Price duration measures attempt to capture the interval length for which the price of a good or service remains constant. The duration of a price spell is therefore the amount of time between two price movements. It can be shown that for large samples the average duration of a price spell can be computed as the inverse of the frequency of a price change.

$$D = 1/ F_i$$

Implied in the computation of the duration of a price spell is the assumption that prices are set in time discrete manner, and that the prices move once within a given month interval. When we posit that prices are set in a time continuous manner, indicating that prices can be altered at any time, the average duration of a price spell is given as follows;

$$D_{average} = 1/ \ln (1-F_i)$$

$$D_{median} = \ln (0.5)/ F_i$$

4.2 *Symmetry in the Direction of Price Changes*

We measure the symmetry between price increases and decreases by computing the share of positive price movements in the total number of price changes and comparing that to the share of negative price alterations in the total number of price movements. This is done for product divisions as well as product groups within the CPI to account for price setting differences across the various sectors. These calculations attempt to assess price setting behaviour and downward price rigidity. The share of overall price increases and price decreases was computed as follows;

$$P^I = N^I / TF$$

$$P^D = N^D / TF$$

where P^I is the proportion of price increases; N^I is the number of price expansions and TF is the total number of price changes (increases and decreases), P^D is the proportion of price declines; and N^D is the number of price cuts.

5.0 Results and Discussion

5.1 *Dataset I: April 2002-December 2007*

Appendix I presents a summary of the analysis on the frequency of price changes, duration of price spells and symmetry of price adjustments for selected product groups and categories which comprise the St. Lucia CPI before the 2008 review exercise. The results suggest that with the exception of the product groups food, fuel and light, transportation and medical, prices in St. Lucia tend to be sticky. However, the weight of food, transportation and fuel

in the CPI is so significant that in aggregate prices they can be broadly classified as flexible in the context of Saint Lucia. Consistent with the evidence of previous studies for developing countries (e.g. Gouvea, 2007) it was found that services such as those of physicians, entertainers, communications and hair care personnel exhibit a very low frequency of price changes, providing support for higher price rigidity in services than in other product categories.

The findings from the dataset for April 2002 to December 2007 demonstrate that approximately 97 per cent of the price records in the overall food category represent price movements, indicating that food prices change almost every month. Our estimates imply that vegetables, fruits and tubers report price alterations every month. This result is similar to that of other studies which suggest that prices of raw foods change more often than prices of processed foods that have higher value added. Sugar, fresh meat and bread and cereals registered the lowest frequency of price movements among the food sub categories. This finding is not surprising given that the price of sugar, fresh meat and bread are subject to price controls in Saint Lucia.

In the fuel and light division, the price of electricity changed on average every month during the sample period, consistent with the fact that the price of electricity varies with the price of petroleum on the international market. Water charges remain constant over the review period reflecting government policy on increasing water rates. Durable goods, furniture and fixtures and clothing and

footwear are among the product groups with the lowest frequency of price movements.

An examination of the duration of price spells for the sub indices suggest a minimal level of price rigidity among essential items such as food, transportation, medical care and fuel and light. However, the data points to the existence of a moderate level of price rigidity among items which are non essential or not purchased on an everyday basis such as beverages and tobacco, clothing and footwear and entertainment services. Evidence was found of long price spells for price controlled products such as sugar and fresh meat (34 months) and water charges (6.9 months). The shortest price spells of less than one month were noted within the food product groups. Longer price spells were observed for durables, furniture, clothing and footwear and communication, services of physicians and other services. This is consistent with the low frequency of price changes associated with these products and services.

Analysis of the symmetry of price movements reveals that generally price increases occur more frequently than price decreases. However, for some product groups some level of symmetry exists in the direction of price changes. Approximately 53 per cent of the price alterations for the fuel and light sub index represent price expansions while 47 per cent constitute price falls. This is consistent with the way fuel is priced in Saint Lucia, where prices are adjusted on an ad hoc basis to reflect movements in international petroleum prices while at the same time satisfying

government's revenue objective. Some level of price change symmetry is detected in the sub index for furniture and fixtures, where 50 per cent of price adjustments represent price increases and the other 50 per cent price decreases. Under the food sub index, fish at the three digit level also exhibits symmetry in price changes, where price expansions signify 58 per cent and price declines account for 42 per cent. This may reflect the effect of seasonality on the pricing of fish. A similar pattern is observed at the three digit level for vegetables, tubers and fruits supporting the impact of seasonality in pricing.

With respect to the magnitude of price changes, the analysis reveals that price rises tend to be generally larger than price cuts. The average price increase for all items which constitute the CPI for the period was 7.9 in contrast to an average price decrease of 4.6. One notable exception is the food sub index where the average price expansion for the period of 2.8 was close to the average price decline of 2.7. This may largely reflect the impact of seasonality in the pricing pattern for highly weighted categories of food within the sub index such as fruits, vegetables, fish and tubers.

5.2 *Dataset II: April 1984-December 2008*

An examination of the results from the longer time period (1984-2008) confirms our initial conclusion that prices in Saint Lucia can be classified as generally flexible. For all items of the CPI, 98 per cent of price records change on a monthly basis. Significant sub indices influencing the performance of the CPI include that of housing, water,

electricity and other fuels and transport. In the category housing, water, electricity, gas and other fuels 96 per cent of price records were altered every month, while for the transport sector 70 per cent of price records over the period moved on a monthly basis. The sub indices of clothing and footwear (39%), education (32%) and hotels and restaurants (36%) exhibited the greatest degree of price stickiness. This result is consistent with the findings from the shorter and more detailed dataset for the period April 2002 to December 2007. However, the shorter dataset reveal even lower frequency of price changes for these three sub indices.

A look at the changes in the price records for food and non alcoholic beverages at the two digit level shows that on average 55 per cent of price records are altered monthly. Given the results highlighted above, this suggests that food prices moved more frequently during the later part of the dataset (2002-2007) than for the earlier period. This finding may be consistent with some level of consolidation which took place among supermarkets during the 2002 to 2007 sub sample.² Approximately 51 per cent of price records associated with the alcoholic beverages and narcotics change every month implying a modest level of price flexibility for this sub index.

² In February 2004; the two largest and major supermarkets merged to form a single entity, resulting in a near monopoly position in the supermarket business in Saint Lucia.

The average duration of a price spell for the CPI over the period is 1.02 months, consistent with the high average frequency of price adjustment for the CPI. Housing, electricity, gas and other fuels, transport, health and food and non alcoholic beverages are the sub indices which registered the lowest duration of a price movement. Education, restaurants and hotels, communication and clothing and footwear reflected high price stickiness as evidenced by price records which do not change for more than three months.

On average a greater proportion of price records for most sub indices register monthly price increases in contrast to price decreases, suggesting some level of asymmetry in the way prices move in Saint Lucia. On average 62 per cent of price records for the CPI registered monthly price expansions in comparison to 38 per cent of price records registering price cuts. This level of asymmetry in price adjustments is particularly reflected in the pricing within the sub indices food and non alcoholic beverages, alcoholic beverages, tobacco and narcotics, clothing and footwear and hotels and restaurants. Approximately 99 per cent of the price movement in the food and non alcoholic beverage sub index are price increases, while 73 per cent of the price alterations for clothing and footwear index are price rises. Similarly price expansions account for 71 per cent and 70 per cent of the price changes respectively for the alcoholic beverages, tobacco, narcotics and the restaurants and hotels sub indices.

In contrast, the sub index of housing, electricity, gas and other fuels exhibits a significant level of pricing symmetry. Approximately 52 per cent of price changes for that sub index are price increases while 48 per cent represent downward adjustments in price. This high level of symmetry in that sub index may be due to the variability of fuel surcharges with respect to electricity consumption as international fuel prices change and adjustments are made to fuel prices at the pump to reflect developments in international markets.

For the longer CPI time series, the difference between average price increases and average price decreases tends to be smaller. The average price rise for all items of the CPI is 0.63 compared to the average decline of 0.63. For the food sub index; the average price increase of 0.11 is far less than the average price decline of 2.14. Similarly, price expansions for hotels and restaurants were on average smaller than price reductions, perhaps reflecting the impact of heavy discounting during periods of downturn such as 2001 and more recently 2007 through to 2009.

6.0 Conclusion

The results of this study reveal a few stylized facts about price setting behaviour in Saint Lucia. First, the data point to the existence of a reasonable level of price flexibility in Saint Lucia. However, this price flexibility is generally limited to the highly weighted sub indices for food, fuel and light and transportation. This result leads to the second

conclusion of significant heterogeneity in pricing behaviour across sectors. Prices in service sectors (except transportation) such as hotels, restaurants, education and communication exhibited far greater stickiness than prices for food, transport and fuel and electricity. The research also demonstrated that a greater level of rigidity is observed for items which are not frequently purchased such clothing and footwear and furniture and fixtures. In contrast, the prices of raw foods such vegetables, tubers and fruits showed significant flexibility. Third, we find some asymmetry in pricing behaviour, as price increases occur far more frequently than price decreases. Further, price expansions on average are larger than price cuts.

In light of those results, one can argue that given the weight of food, fuel and light and transport in the CPI, inflation in Saint Lucia is largely driven by changes in those aspects of the index. Given the absence of monetary interventions to address inflation, any policy measures to address inflation therefore must specifically target those sectors.³ Further research will focus on factors which impact on rigidity in pricing behaviour in Saint Lucia.

³ St. Lucia is a member of the Eastern Caribbean Currency Union and therefore does not conduct independent monetary policy.

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APPENDIX I

Frequency of Price Changes by Product Group (April 2002- January 2008)

	Freq of Price Changes	Avg. duration of price spells	Med. duration of price spells	Freq of Price increases	Freq of Price decreases	Average Price increase	Average Price decrease
Bread and Cereals	0.33	2.47	1.71	0.61	0.39	0.92	-0.54
Fresh Meat	0.03	34.00	23.57	1.00	0.00	0.01	0.00
Preserved Meat	0.70	0.84	0.58	0.71	0.29	1.05	-1.07
Frozen Meat	0.86	0.52	0.36	0.71	0.29	1.41	-1.19
Fish	0.75	0.71	0.49	0.58	0.42	5.09	-5.28
Milk and Dairy Products	0.65	0.95	0.66	0.89	0.35	2.89	-1.20
Oils and Fats	1.00			0.89	0.31	0.98	-0.32
Vegetables	1.00			0.54	0.46	13.47	-13.42
Fruits	1.00			0.59	0.41	10.24	-14.63
Tubers	1.00			0.59	0.41	11.11	-11.90
Sugar	0.03	34.00	23.57	0.50	0.50	0.00	-0.04
Coffee and Cocoa	0.32	2.60	1.81	0.73	0.27	2.61	-0.67
Other foods	0.67	0.91	0.63	0.63	0.37	2.12	-1.24
TOTAL - FOOD	0.97	0.28	0.20	0.60	0.40	2.76	-2.66
Non-Alcoholic Beverages	0.14	6.39	4.43	0.60	0.40	4.81	-0.38
Alcoholic Beverages	0.28	3.10	2.15	0.84	0.16	2.17	-1.00
Tobacco	0.12	8.11	5.62	0.75	0.25	4.57	-0.03
TOTAL - HOUSING	0.14	6.39	4.43	0.6	0.4	4.48	-0.04
TOTAL - FUEL AND LIGHT	0.99	0.24	0.16	0.56	0.43	2.86	-1.76
Household Operations	0.22	4.08	2.83	0.67	0.33	3.14	-0.63
Domestic Services	0.09	10.99	7.62	0.67	0.33	22.78	-0.07
Furniture and Fixtures	0.09	10.99	7.62	0.55	0.45	7.89	-0.01
TOTAL - FURNITURE AND HOUSEH	0.99	0.24	0.16	0.56	0.44	2.79	-1.76
TOTAL - MEDICAL CARE ETC.	0.70	0.84	0.58	0.65	0.35	1.85	-1.26
TOTAL - TRANSPORT AND COMM	0.91	0.41	0.28	0.63	0.37	1.97	-1.64

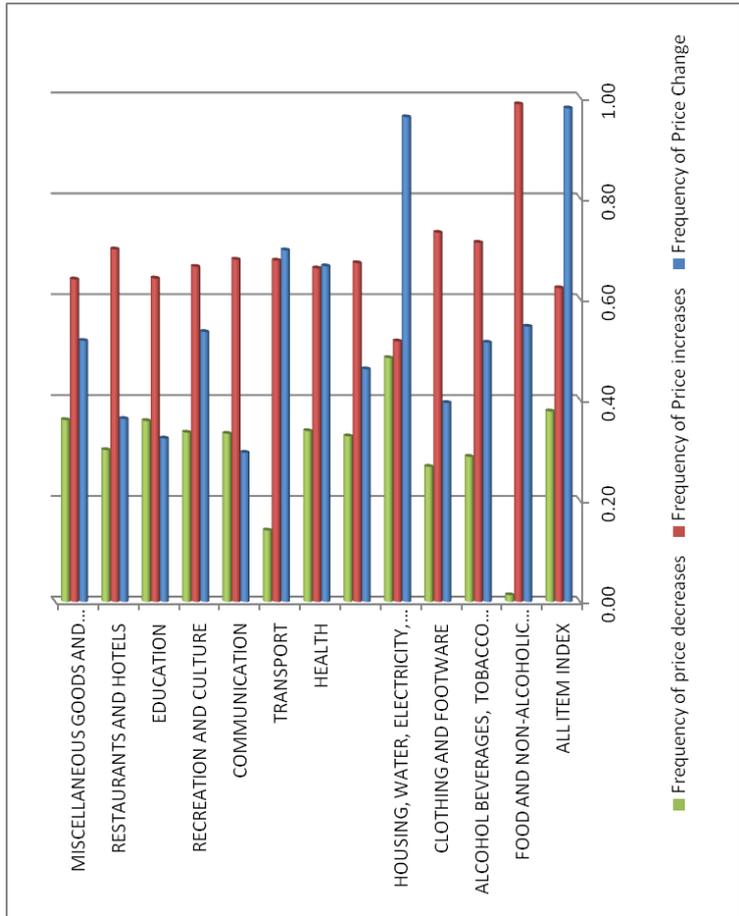
APPENDIX II

Frequency of Price Changes by Product Group (April 1984 - January 2008)

	Frequency of Price Change	average duration of price spells	median duration of price spells	Frequency of Price increases	Frequency of price decreases	Average Price Increase	Average Price Decrease
ALL ITEM INDEX	0.98	0.26	0.18	0.62	0.38	0.63	-0.51
FOOD AND NON-ALCOHOLIC BEVERAGES	0.55	1.27	0.88	0.99	0.01	0.11	-2.14
ALCOHOL BEVERAGES, TOBACCO AND NARCOTICS	0.51	1.39	0.96	0.71	0.29	0.60	-0.40
CLOTHING AND FOOTWARE	0.39	1.99	1.38	0.73	0.27	1.36	-1.36
HOUSING, WATER, ELECTRICITY, GAS, AND OTHER FUELS	0.96	0.31	0.21	0.52	0.48	0.67	-0.48
FURNISHING, HOUSEHOLD EQUIPMENT	0.46	1.62	1.12	0.67	0.33	0.94	-0.66
HEALTH	0.67	0.91	0.63	0.66	0.34	1.02	-0.72
TRANSPORT	0.70	0.84	0.58	0.68	0.14	0.77	-0.60
COMMUNICATION	0.30	2.85	1.98	0.68	0.33	1.58	-2.47
RECREATION AND CULTURE	0.54	1.31	0.90	0.66	0.34	1.15	-0.98
EDUCATION	0.32	2.55	1.77	0.64	0.36	1.60	-0.63
RESTAURANTS AND HOTELS	0.36	2.22	1.54	0.70	0.30	1.21	-1.45
MISCELLANEOUS GOODS AND SERVICES	0.52	1.37	0.95	0.64	0.36	0.77	-0.57

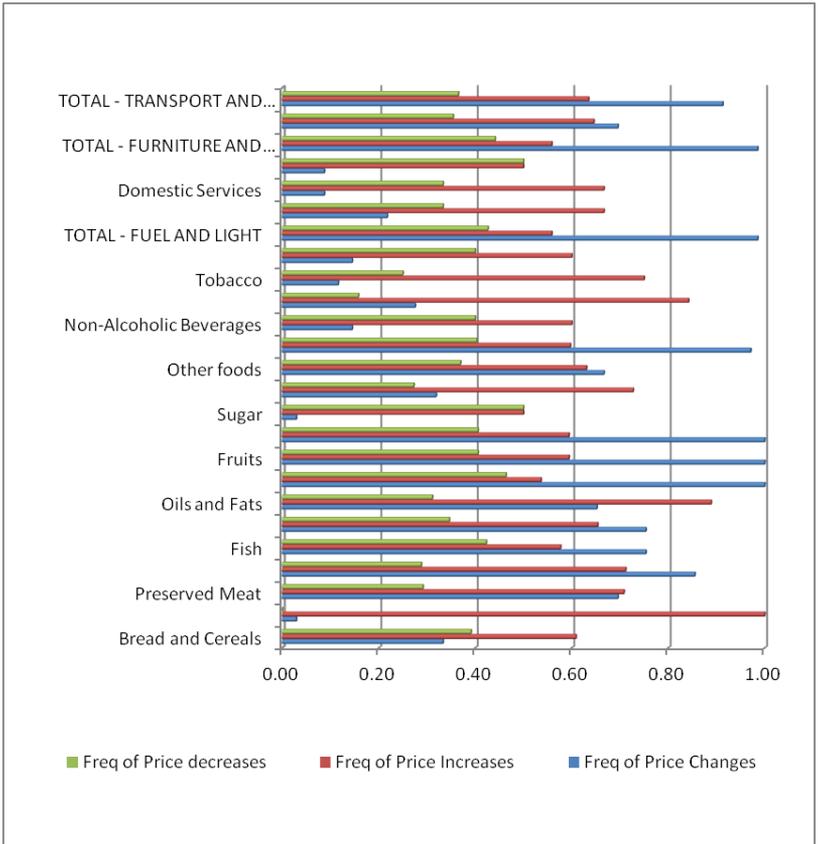
APPENDIX III

Frequency of Price Change by Product Group (1984-2008)



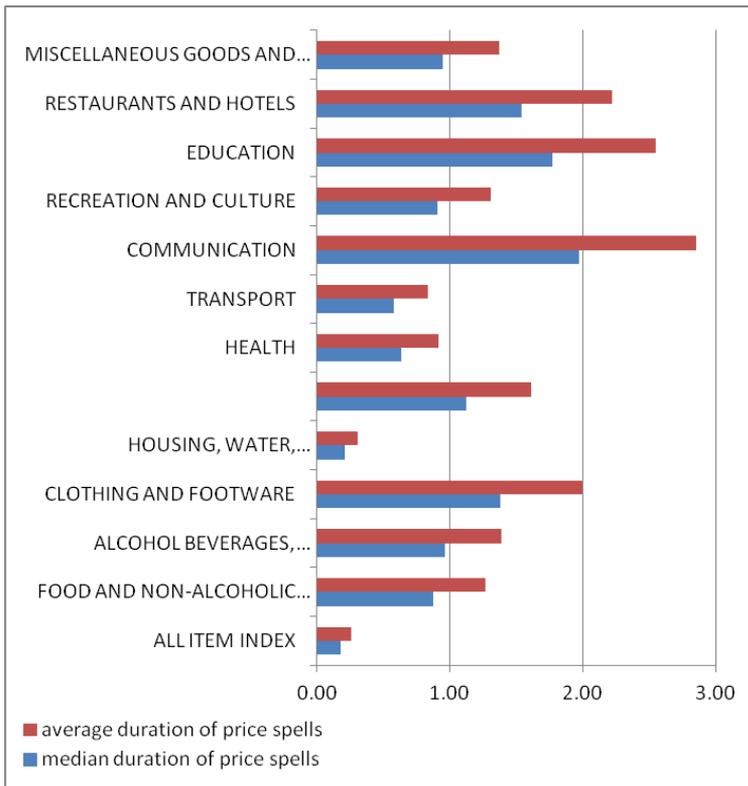
APPENDIX III (B)

Frequency of Price changes for Product Groups (2002-2008)



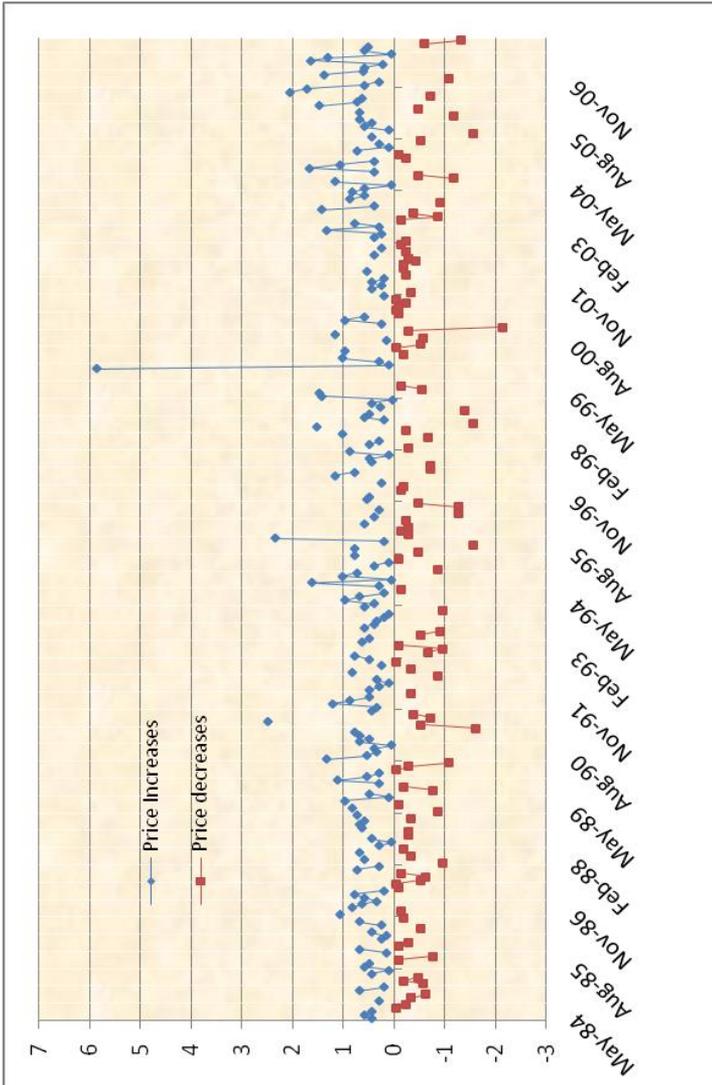
APPENDIX IV

Duration of Price Change by Product Group (1984-2008)



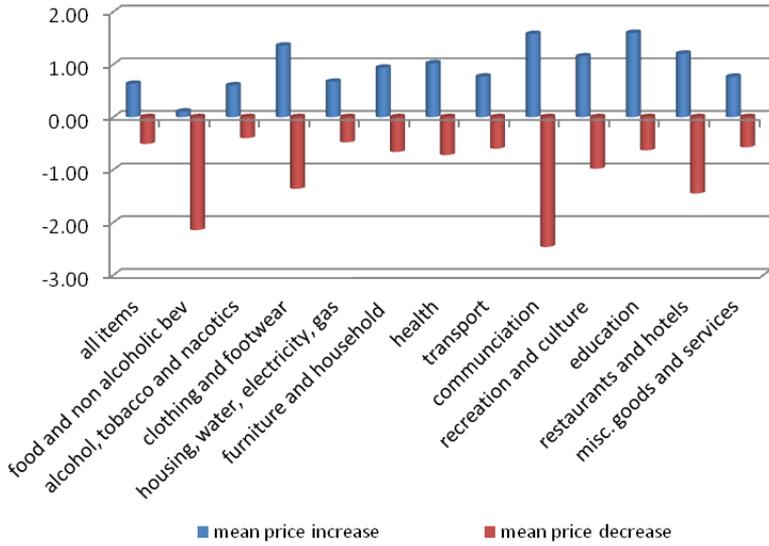
APPENDIX V

Magnitude of Price Changes (All Items Index 1984-2008)



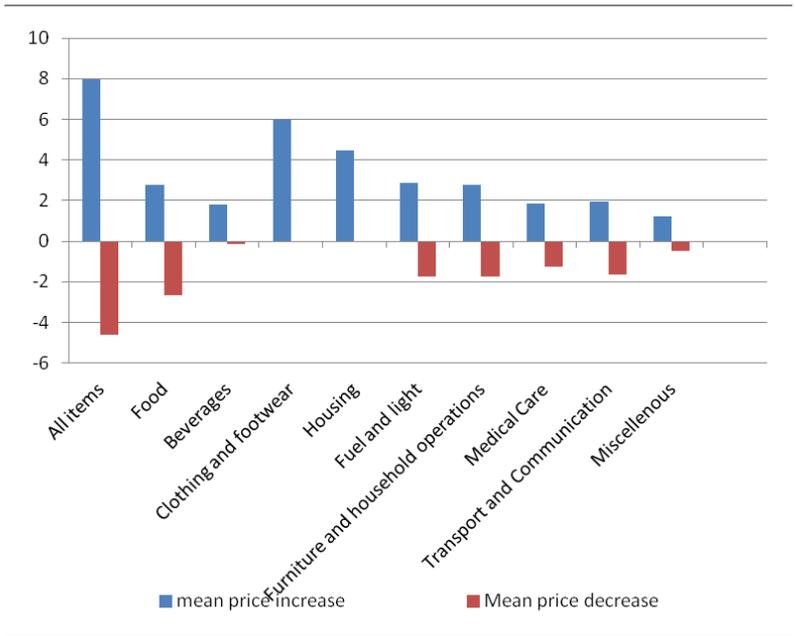
APPENDIX VI (A)

Average Price Increase/Average Price Decrease (1984-2008)



APPENDIX VI (B)

Average Price Increase/Average Price Decrease (2002-2008)



PRICE SETTING BEHAVIOUR IN GUYANA EVIDENCE FROM 1994-2009 CPI DATA

GOBIND GANGA

ABSTRACT

This paper uses monthly micro CPI data to analyse pricing conduct in the Guyanese economy. The results illustrate that prices in Guyana have been altered quite frequently; between 47 and 97 per cent of items in every CPI division recorded a price change every month on average. In addition, the findings also indicate that the frequency of price movements is very heterogeneous across different divisions and products. There are regular monthly price reductions as well as increases, but the contractions are always smaller and fewer than the expansions; therefore price are more sticky downwards than upwards. The results on inflation persistence show that past price changes have very small impacts on current price changes. Finally, the pricing setting behaviour displays an intermediary degree of price synchronization. However, there is heterogeneity as synchronization ranged between four per cent and 53 per cent. Further, the synchronization ratio is higher for price increases than for price decreases.

JEL Classification: E3; L1; C4, D40

Keywords: Price Rigidity; Consumer Prices; Inflation, Survey data

1.0 Introduction

The theories that deal with the impact of monetary policy on output and employment levels often underscore the rigidities of wages or prices. In the presence of nominal rigidities or stickiness, it is expected that output will be affected by monetary policy in the short run: a decrease in the nominal interest rate also implies a fall in real interest rate which increases consumption and investment, implying an expansion in output.

Price setting behaviour therefore provides valuable information to understand the nature of the policy adjustment process in an economy. As such, an understanding of the dynamics involved in the setting of prices by firms at the micro level is necessary for the effective development of monetary and inflation models and in the conduct of monetary policy. In addition, a micro study provides an understanding of different underlying patterns of price changes which are usually hidden in the aggregate inflation rates. The pattern of price movements at the micro-level may also help policy makers to better target policy to groups, such as the poor, which may be affected more than others by inflation.

This paper explores price setting behaviour by utilizing monthly micro level data of the consumer price index (CPI) in Guyana for the period 1994-2009. The structure of the paper is as follows. Section II discusses the theoretical background of price setting and the methodology. Section III

provides an overview of the data associated with the CPI. Section IV gives an outline of the findings on the frequency of price changes, magnitude of price movements, duration of prices, inflation persistence and synchronization. Section V briefly outlines the comparative analysis using price data studies from other Caribbean countries. Section VI makes some concluding remarks.

2.0 Theoretical Background and Methodology

2.1 *Theoretical Background*

There are two types of micro-founded price setting models: the time-dependent and the state-dependent. In the time-dependent pricing models, price changes are exogenous and a function of the time span in between adjustments. It does not depend on the state of the economy and firms might alter their prices periodically such as every n^{th} period or randomly (Taylor 1980; Calvo 1983). In the state dependent model, price changes are in response to movements in economic conditions. The time-dependent model is seen as a situation where firms decide to adjust prices due to the passage of time and then evaluate market conditions whereas in the state-dependent model, there is no routine reviewing of prices but firms evaluate market conditions and then change prices.

Empirical studies in a number of countries showed that a significant number of firms in these economics reviewed their prices following both time and state-dependent rules. The frequency of price reviews and price changes,

consequently, will determine the degree of price stickiness. In highly competitive markets, firms are expected to change their prices more frequently to shocks so as to maintain profitability. Therefore the more competitive the markets the greater prices respond to movements in supply and demand conditions. In addition, the decisions to adjust prices are also likely to be influenced by menu costs. Specifically, firms cannot alter prices every period but only when the benefit of adjusting prices is greater than the menu cost of changing prices. The degree of stickiness of prices has major implications for the effects of monetary policy on the economy and in particular, on output. When nominal prices are sticky, monetary policy can affect output in the short run because it is able to respond to shocks on the economy before adjustment of wages and prices.

2.2 Methodology

Evaluation of price rigidity in Guyana is conducted through the frequency of price changes, duration of price spells and symmetry of price movements. The statistics used are the same as those used by Baumgartner et al. (2005) and are outlined below.

2.2.1 Frequency and Duration of Price Changes

The frequency of price changes (F_i) is computed directly from the data. F_i attempts to examine how often the price quote for a particular product moves when compared to the full sample of price or quotes. It is therefore the ratio of observed price record changes to the total number of price records. The frequency of price adjustments is an average

incorporating movements of all firms. It is computed using the indicator variable I_{it} which demonstrates whether or not prices have changed during a particular month and is defined as follows:

$$\begin{aligned} I_{it} &= 1 \text{ if } p_{it} \neq p_{it-1} \\ &= 0 \text{ if } p_{it} = p_{it-1} \\ &\text{for } i=1 \dots k \text{ (number of goods) and } t=1 \dots T \\ &\text{(number of periods).} \end{aligned}$$

The implied duration of price spell (D) is defined as the time interval between two price alterations. It can be shown that for large samples the average duration of a price spell can be computed as the inverse of the frequency of price changes, i.e., $D = 1/F_i$. Implied in the computation of the duration of a price is the assumption that prices are set in time discrete manner, and that the prices adjust once within a given month interval. When we postulate that prices are set in a time continuous manner, indicating that prices can change at any point in time, the average duration of a price spell is expressed as:

$$\begin{aligned} D_{i \text{ average}} &= -1/\ln (1-F_i) \\ D_{i \text{ median}} &= \ln (0.5)/\ln (1-F_i) \end{aligned}$$

These formulae are unbiased estimator of the mean and median duration of price spells in continuous time under the assumption that the probability of a price change is constant within a month.

2.2.2 *Symmetry in the Direction of Price Changes*

The symmetry between price increases and decreases is computed by the share of positive price changes in the total

number of price movements, compared to the share of negative price changes in total number of price movements. This is done for product divisions as well as product groups within the CPI. The share of overall price expansions and price declines were calculated as follows:

$$P^I = N^I / TF$$

$$P^D = N^D / TF$$

where P^I is the proportion of price increases; N^I is the number of price expansions and TF is the total number of price changes (increases and decreases), P^D is the proportion of price reductions; and N^D is the number of price contractions.

2.2.3 *Inflation Persistence*

Inflation persistence examines the impact of the past price changes on the change in current prices. To measure the level of persistence, monthly inflation for an item is regressed on its own lag, testing the degree to which the current inflation could be explained by the inflation of the previous period. This is represented by the equation:

$$\pi_{it} = \alpha_0 + \alpha \pi_{it-1} + \varepsilon_{it}$$

where π is the monthly inflation rate, i denotes monthly consumer price index (CPI) of a particular good or service and t symbolizes time. The slope coefficient provides the degree of inflation persistence between monthly price changes where a large α suggest relatively high degree of persistence in prices.

2.2.4 Synchronization of Price Changes

The time variation in the frequency of price adjustments is a measure of synchronization in price setting. For each product the synchronization of price changes (SYNC_i) is measured by the approach proposed by Fisher and Konieczny (2000) which is given as the ratio of the empirical standard deviation of the frequency of price movements for product category *i* (numerator) to the theoretical maximum standard deviation in the case of perfect synchronization of price changes (denominator)

$$SYNC_i = \frac{\sqrt{\frac{1}{\tau-1} \sum_{t=1}^{\tau} (F_{it} - F_i)^2}}{\sqrt{F_i(1-F_i)}}$$

where τ is the total number of periods for which the ratio is calculated. Perfect synchronization of price changes occurs when either all firms alter their price at the same time or none of them adjusts its price. Consequently, synchronization of price movements is high if the synchronization ratio is near 1 and low if it is near 0. Analogous expressions are applied for price increases and decreases, with the only difference being in the computation of the frequencies of price expansions and declines where no account is made for product replacements because price changes cannot seriously be divided into price increases and decreases as the new price corresponds to a different product in the case of a product replacement.

3.0 Data Used

This paper uses a large monthly Consumer Price Index (CPI) sample for Guyana for the period 1994-2009. During this period, Guyana's International Monetary Fund/ World Bank (IMF/WB) Economic Recovery Program was entrenched and the economy largely liberalized. Prices of items in the CPI basket were mainly determined by market forces. The CPI basket was formulated through the Household Income and Expenditure Survey (HIES) conducted in 1992/1993 period.

The data set of Guyana's CPI, which is divided into nine divisions and fifty subdivisions, comprises of 9600 price records gathered over a 192 month period. There are 238 goods and services in the CPI basket and are weighted according to their relative importance. The data on prices of the goods and services have been collected weekly from five (5) markets and monthly from seventy six (76) outlets such as supermarkets, stores, gas stations, hospitals, restaurants, etc. The index is then compiled monthly. The data allows for the estimation of the frequency of price changes, frequency of price increases and decreases, magnitude of price expansions and contractions, duration of price spells, inflation persistence and synchronization.

4.0 Results

The unweighted frequency of price changes as well as the mean and the median of the price adjustment frequencies for each group of goods are summarized in Table 1 and shown

in Figure 1. According to the data, the unweighted frequency of price movements over the 1994 to 2009 periods is an average of 98 per cent of price adjustments each month. The CPI divisions with the highest frequency of price changes were food, furniture as well as transport and communication while those of housing as well as medical and personal care move less often. The review of the items within the various divisions showed that prices for services are much more rigid than that of goods. Domestic and financial services as well as communication recorded frequencies below than 10 per cent while vegetables and vegetables products recorded frequency of 100 per cent. The frequency of price changes was also generally persistent over time as shown in Figure 2. Figure 2 also reveals that large price increases were followed by large price decreases.

Figures 3 and 4 show that the relative proportions of changes due to price expansions and contractions vary for all the divisions as well as the goods and services within each division. In every month, between 19 to 58 per cent of goods reveal a decline in prices while 42 to 81 per cent of goods display larger prices. The highest probability of price expansion is in housing, medical and personal care, miscellaneous goods and services as well as food. Clothing has the lowest probability of price increases. Clothing as well as footwear and repairs have the highest frequency of price decreases. Figure 4 plots the frequency of price expansions/declines by product division. For most product divisions the frequency of price rises is higher than that for price cuts. The only goods that were more likely to report

price decreases rather than price increases was clothing. The magnitude of price expansion has been higher than price reduction as shown in Figure 6.

On average, the size of price increases tended to be larger than price decreases with mean price rises for the CPI divisions ranging from 0.20 to 91 per cent, while average price reductions were between -0.12 and -0.55 per cent per month (see Figure 7). All division had double-digit average monthly price expansions. Food, housing, as well as transportation and communication had the largest average price increases per month at over 80 per cent. Footwear and repairs, food and clothing had the greatest average price decreases at above 30 per cent.

The average duration of price change for most goods in all the CPI divisions was between one and two months. The duration of price adjustments of the food division has the lowest at less than a month while that of domestic and financial services was the highest in the range of five to seven months. After making alterations to reflect continuous timing of price changes, the implied mean of the price adjustments frequency for all the division of goods in the database is about 0.24 and its median is 0.17. These figures imply that price spells are less than half of a month for most divisions. A review of the different divisions shows goods have the shortest duration while services have the longest duration. For example, items within the food division tend to be less than a month while those in the divisions of clothing, footwear and repairs, medical and personal care as

well as miscellaneous goods and services had price duration of more than one month.

Inflation persistence for the monthly change in CPI is quite low as shown in Table 2 and Figure 8, ranging from -0.4 per cent to 0.14 per cent. This suggests that because price changes occur frequently, past price movements have a very small impact on current price changes. Three of the CPI divisions, footwear and repairs, housing and furniture correlations are negative implying that price increases are likely to be followed by price reductions. The inflation persistence for miscellaneous goods and services was the largest at 0.14, implying that inflationary prices from the past exert the longest lingering effect of approximately 7 months on current prices for the same.

The results in Table 3 show that the average synchronization ratio of price changes for all products amount to 51 per cent which constitutes an intermediary degree of price synchronization. However, this number greatly masks the heterogeneity the CPI across divisions. There is a wide range from a high of 53 per cent for food to a low of 4 per cent for footwear and repairs. Furthermore, it is observed that the synchronization ratio is generally higher for price increases than for price decreases. This could reflect price changes that are triggered mainly by supply shocks.

5.0 Conclusion

The implementation of effective monetary policy as well as modeling the dynamics of inflation, require an understanding of the price setting behaviour of firms in any economy. This paper attempts to use monthly micro CPI data to analyse pricing conduct in the Guyanese economy. The results illustrate that prices in Guyana have been altered quite frequently. Between 47 and 97 per cent of items in every CPI division recorded a price change every month on average. The frequency of price movements implies that Guyana has a highly competitive market for goods and services. In addition, the finding that Guyana has less rigid price changes suggests that monetary shocks are likely to have smaller and less persistent impact on economic activity.

The results also indicate that the frequency of price movements is very heterogeneous across different divisions and products. Prices for goods are altered more frequently than those for services. Prices of food changed every month while that for financial services remained largely unchanged. There are regular monthly price reductions as well as increases, but the contractions are always smaller and fewer than the expansions; therefore prices are more sticky downwards than upwards.

The results on inflation persistence show that past price changes have very small impacts on current price changes. This seems to be explained by the high frequency of price adjustments as well as the low single digits inflation Guyana

has been experiencing since the early 1990s¹ (see Ganga, 2007). Finally, the pricing setting behaviour displays an intermediary degree of price synchronization. However, there is heterogeneity as synchronization ranged between 4 per cent and 53 per cent. Further, the synchronization ratio is higher for price increases than for price decreases.

¹ The inflation rate in Guyana has declined markedly since 1993, except for 1994 when inflation reached 15 per cent (on an end of period basis). Inflation has been contained at moderate single digit levels during 1993-2006 periods, reaching low of 1.47 per cent in 2001. In 2007, the inflation rate peaked at 13.5 per cent but declined to 6.4 per cent in 2008 and 3.6 per cent in 2009.

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APPENDIX 1

Table 1
Frequency of Price Changes by Division
URBAN CONSUMER PRICE INDEX 1994 = 100

	Price Spells							
	Frequency of Price Changes (Fi)	Average Duration of Price Change D=1/Fi	Daverage = -1/LN(1-Fi)	Dmedian = LN(0.5)/L N(1-Fi)	Freq of Price Decrease (PD)	Freq of Price Increase (PI)	Average Price Decrease	Average Price Increase
ALL ITEMS	0.984	1.016	0.24	0.17	0.22	0.78	-0.12	0.66
(I) FOOD	0.98	1.016	0.24	0.17	0.36	0.64	-0.37	0.91
1 Cereals & Cereals Products	0.97	1.027	0.27	0.19	0.35	0.65	-0.20	0.60
2 Pulses & Pulse Products	0.99	1.011	0.22	0.15	0.46	0.54	-0.88	1.26
3 Meat, Fish & Eggs	0.99	1.011	0.22	0.15	0.39	0.61	-0.44	0.99
4 Milk & Milk Products	0.96	1.044	0.32	0.22	0.30	0.70	-0.22	0.73
5 Oil & Fats	0.96	1.044	0.32	0.22	0.38	0.62	-0.89	13.29
6 Condiments & Spices	0.98	1.016	0.24	0.17	0.46	0.54	-1.41	1.87
7 Vegetables & Vegetables Products	1.00	1.000	0.17	0.10	0.50	0.50	-3.39	4.55
8 Fruits & Fruit Products	0.98	1.016	0.24	0.17	0.49	0.51	-1.86	2.53
9 Sugar, Honey & Related Products	0.82	1.224	0.59	0.41	0.41	0.59	-0.29	0.84
10 Alcoholic Beverages	0.81	1.240	0.61	0.42	0.33	0.67	-0.25	1.01
11 Non-alcoholic Beverages	0.95	1.056	0.34	0.23	0.34	0.66	-0.19	0.66
12 Prepared Meals	0.73	1.364	0.76	0.52	0.31	0.69	-0.14	0.65
13 Tobacco & Tobacco Products	0.71	1.404	0.80	0.56	0.32	0.68	-0.27	1.10
(II) CLOTHING	0.55	1.802	1.24	0.86	0.52	0.48	-0.30	0.20
1 Ready-made	0.50	2.011	1.45	1.01	0.52	0.48	-0.33	0.16
2 Clothing Materials	0.32	3.131	2.60	1.80	0.46	0.54	-0.34	0.29
3 Tailoring	0.14	7.074	6.56	4.55	0.22	0.78	-0.15	0.68
(III) FOOTWEAR AND REPAIRS	0.53	1.891	1.33	0.92	0.47	0.53	0.55	0.45
1 Footwear	0.49	2.032	1.48	1.02	0.50	0.50	-0.45	0.29
2 Repairs to footwear	0.13	7.640	7.13	4.94	0.20	0.80	-0.09	0.58
(IV) HOUSING	0.83	1.201	0.56	0.39	0.22	0.78	-0.17	0.86
1 Rent & Maintenance	0.57	1.752	1.18	0.82	0.08	0.92	-0.07	0.74
2 Fuel & Power	0.73	1.364	0.76	0.52	0.29	0.71	-0.31	1.03
(V) FURNITURE	0.94	1.067	0.36	0.25	0.31	0.69	-0.15	0.45
1 Furniture etc.	0.42	2.358	1.81	1.26	0.40	0.60	-0.17	0.22
2 Household Textiles	0.34	2.984	2.45	1.70	0.41	0.59	-0.34	0.29
3 Household Appliances	0.33	3.032	2.50	1.73	0.44	0.56	-0.10	0.15
4 Glassware, Tableware	0.30	3.351	2.82	1.96	0.47	0.53	-0.11	0.20
5 Cleaning Materials	0.98	1.021	0.26	0.18	0.30	0.70	-0.32	0.75
6 Household Services	0.13	7.958	7.45	5.16	0.29	0.71	-0.46	2.00
7 Domestic Services	0.06	17.364	16.86	11.69	0.18	0.82	-0.01	0.46
(VI) TRANSPORT & COMMUNICATION	0.92	1.091	0.40	0.28	0.34	0.66	-0.23	0.82
1 Personal Transport Equipment	0.79	1.265	0.64	0.44	0.32	0.68	-0.09	0.32
2 Operation/Personal Transport	0.84	1.194	0.55	0.38	0.39	0.61	-0.69	1.26
3 Purchased Transport Services	0.73	1.364	0.76	0.52	0.35	0.65	-0.34	0.82
4 Communication	0.09	11.235	10.73	7.44	0.24	0.76	-0.09	1.37
(VII) MEDICAL & PERSONAL CARE	0.53	1.873	1.31	0.91	0.20	0.80	-0.08	0.65
1 Medical Expenses	0.42	2.358	1.81	1.26	0.21	0.79	-0.12	0.65
2 Therapeutic Appliances	0.10	10.053	9.54	6.62	0.11	0.89	0.00	0.49
3 Medical & Dental Services	0.16	6.161	5.65	3.91	0.23	0.77	-0.14	1.03
4 Hospital/Related Care	0.22	4.548	4.03	2.79	0.21	0.79	-0.11	0.70
(VIII) EDUCN., RECR. AND CULTL. SERVICES	0.74	1.345	0.74	0.51	0.33	0.67	-0.10	0.66
1 Education	0.41	2.449	1.91	1.32	0.33	0.67	-0.13	0.85
2 Books, Newspaper/Is	0.46	2.170	1.62	1.12	0.31	0.69	-0.11	0.81
3 Audio/Visual Equipment	0.42	2.368	1.84	1.28	0.53	0.48	-0.18	0.18
4 Photographic Equipment	0.07	14.692	14.19	9.83	0.38	0.62	-0.03	0.17
5 Other Recreational Goods	0.22	4.548	4.03	2.79	0.40	0.60	-0.19	0.15
6 Recreational & Cultural Services	0.31	3.237	2.71	1.88	0.41	0.59	-0.31	1.18
7 Writing & Drawing	0.13	7.958	7.45	5.16	0.42	0.58	-0.18	0.46
(IX) MISCELL. GOODS & SERVICES	0.91	1.098	0.41	0.29	0.22	0.78	-0.12	0.56
1 Personal Care Services	0.16	6.367	5.85	4.06	0.30	0.70	-0.16	0.83
2 Goods for Personal Care	0.88	1.137	0.47	0.33	0.27	0.73	-0.15	0.56
3 Jewellery, Watches, etc.	0.19	5.306	4.79	3.32	0.33	0.67	-0.20	0.40
4 Other Personal Goods	0.16	6.161	5.65	3.91	0.61	0.39	-0.09	0.16
5 Expenditure in Restaurants, etc.	0.66	1.594	0.91	0.63	0.27	0.73	-0.14	0.63
6 Packaged Tours	0.69	1.458	0.86	0.60	0.34	0.66	-0.19	0.49
7 Financial Services	0.01	95.500	95.00	65.85	0.50	0.50	0.00	0.00
8 Services not elsewhere classified	0.09	10.611	10.10	7.00	0.22	0.78	-0.28	0.93

	ALL ITEMS	$A_{lit} = 0.00482012471361 * A_{lit-1} + 0.532723830832$	0.00482
(I)	FOOD	$F_{it} = 0.0734430571793 * F_{it-1} + 0.500174533889$	0.07344
(II)	CLOTHING	$C_{it} = 0.0236405868016 * C_{it-1} - 0.0980192932694$	0.02364
(III)	FOOTWEAR AND REPAIRS	$FW_{it} = -0.371720635602 * FW_{it-1} - 0.140667464067$	-0.37172
(IV)	HOUSING	$H_{it} = -0.264428145884 * H_{it-1} + 0.872504517732$	-0.26443
(V)	FURNITURE	$FR_{it} = -0.0494353901091 * FR_{it-1} + 0.311222230291$	-0.04944
(VI)	TRANSPORT & COMMUNICATION	$TC_{it} = 0.0477184851289 * TC_{it-1} + 0.553943272911$	0.04772
(VII)	MEDICAL & PERSONAL CARE	$MD_{it} = 0.0103429458123 * MD_{it-1} + 0.568323385171$	0.01034
(VIII)	EDUCN., RECR. AND CULTL. SERVICES	$ED_{it} = 0.0252812412491 * ED_{it-1} + 0.553930171116$	0.02528
(IX)	MISCELL. GOODS & SERVICES	$MSC_{it} = 0.14668272035 * MSC_{it-1} + 0.374626017692$	0.14668

		FK Synchronisation Index of Price Changes	FK Synchronisation Index of Price Decreases	FK Synchronisation Index of Price Increases
	ALL ITEMS	0.509	0.03	0.12
(I)	FOOD	0.529	0.05	0.09
(II)	CLOTHING	0.054	0.05	0.05
(III)	FOOTWEAR AND REPAIRS	0.038	0.03	0.04
(IV)	HOUSING	0.081	0.02	0.07
(V)	FURNITURE	0.240	0.04	0.09
(VI)	TRANSPORT & COMMUNICATION	0.179	0.04	0.08
(VII)	MEDICAL & PERSONAL CARE	0.058	0.03	0.11
(VIII)	EDUCN., RECR. AND CULTL. SERVICES	0.106	0.04	0.09
(IX)	MISCELL. GOODS & SERVICES	0.203	0.03	0.12

Figure 1
Frequency of Price Changes by Product Group

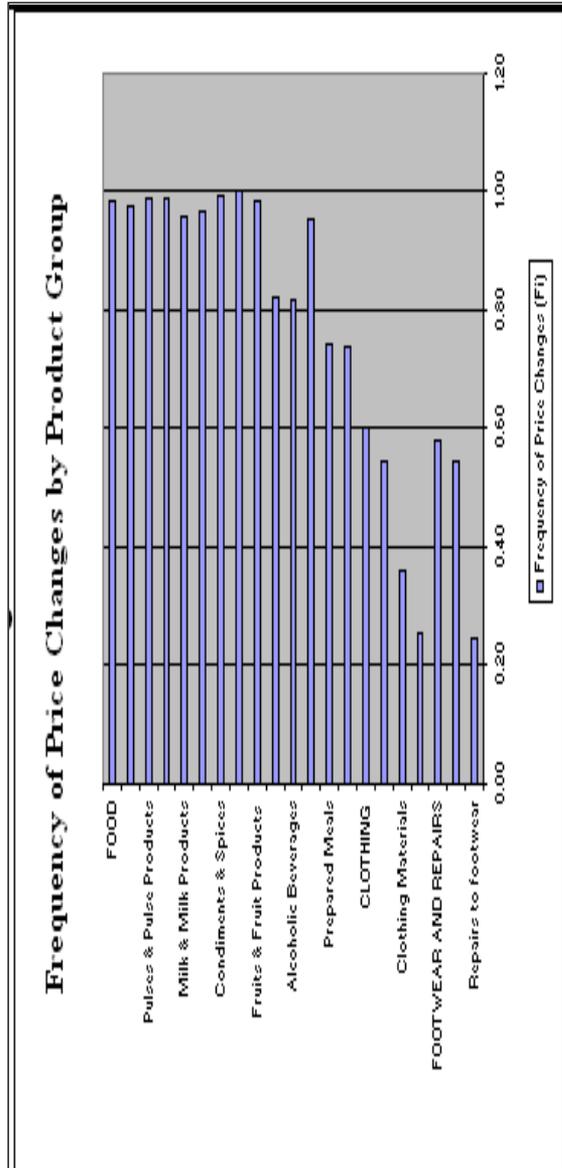


Figure 1 (Continued)
 Frequency of Price Changes by Product Group

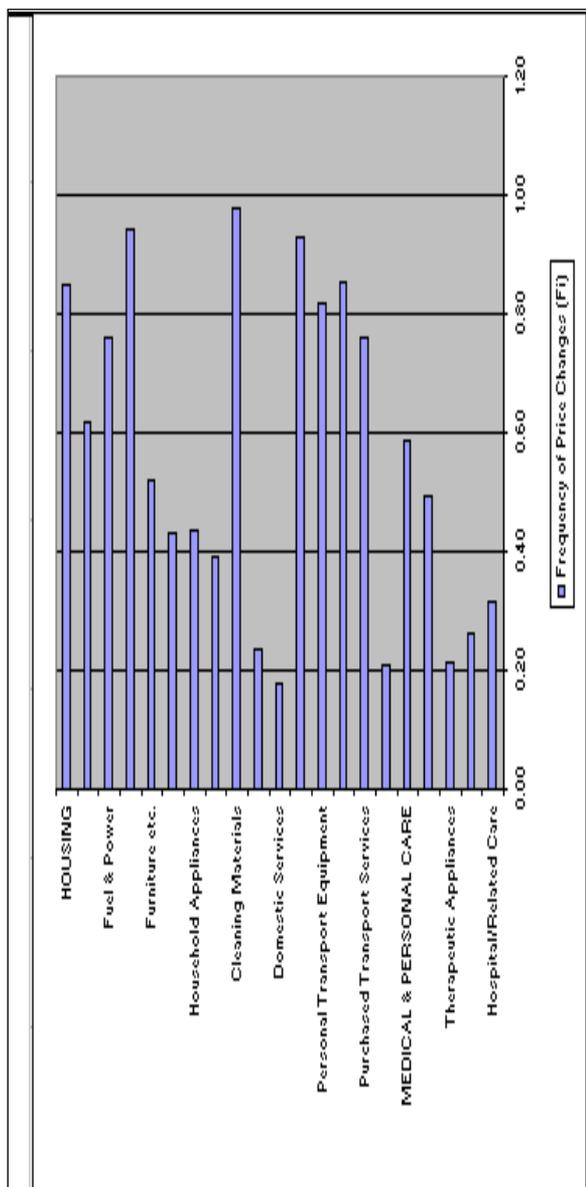


Figure 1 (Continued)
 Frequency of Price Changes by Product Group

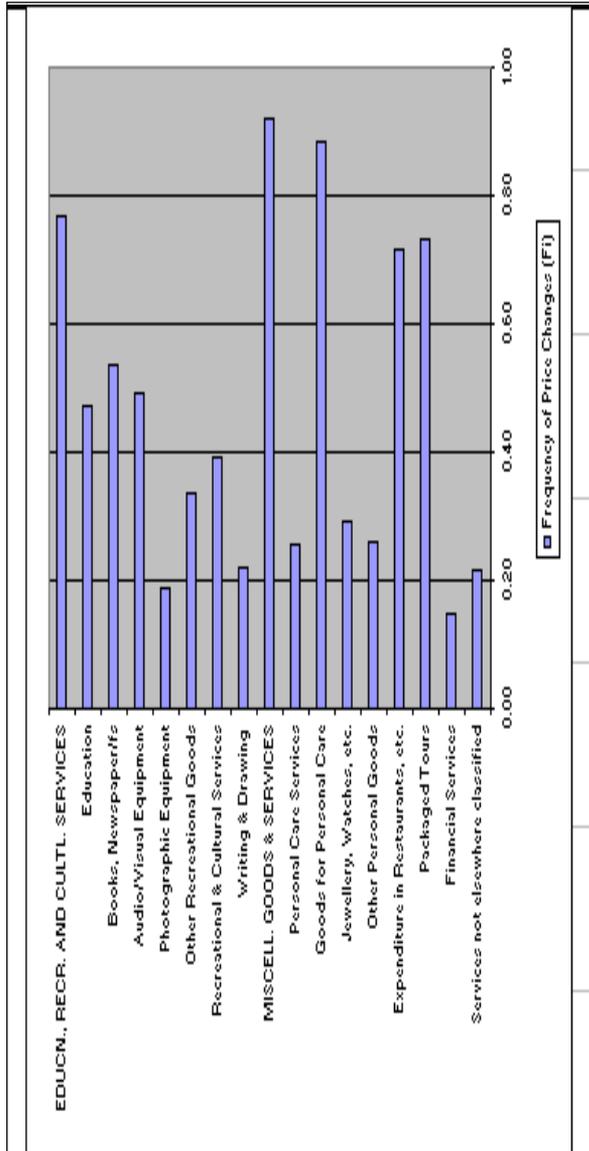


Figure 2

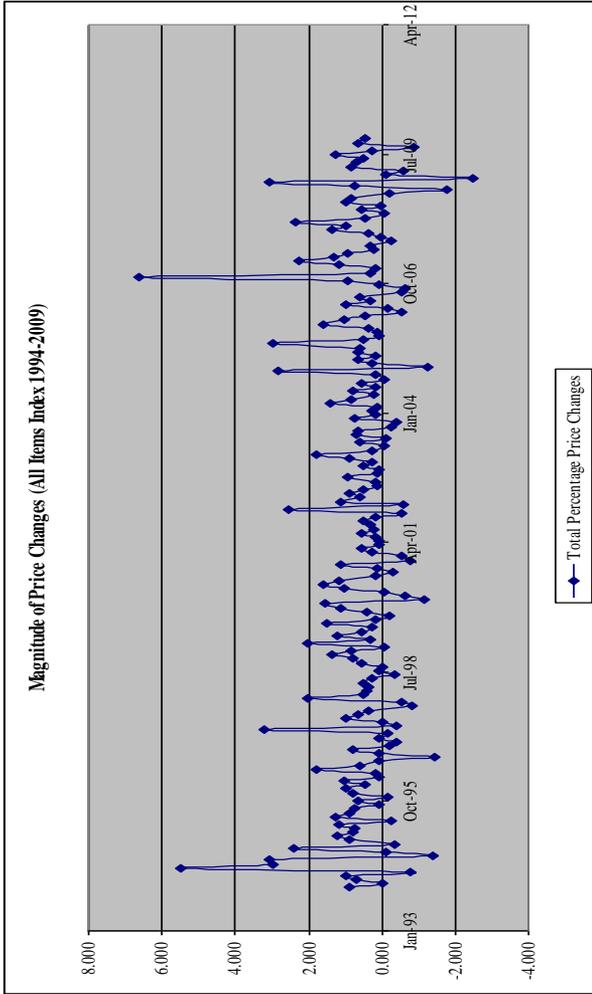


Figure 3

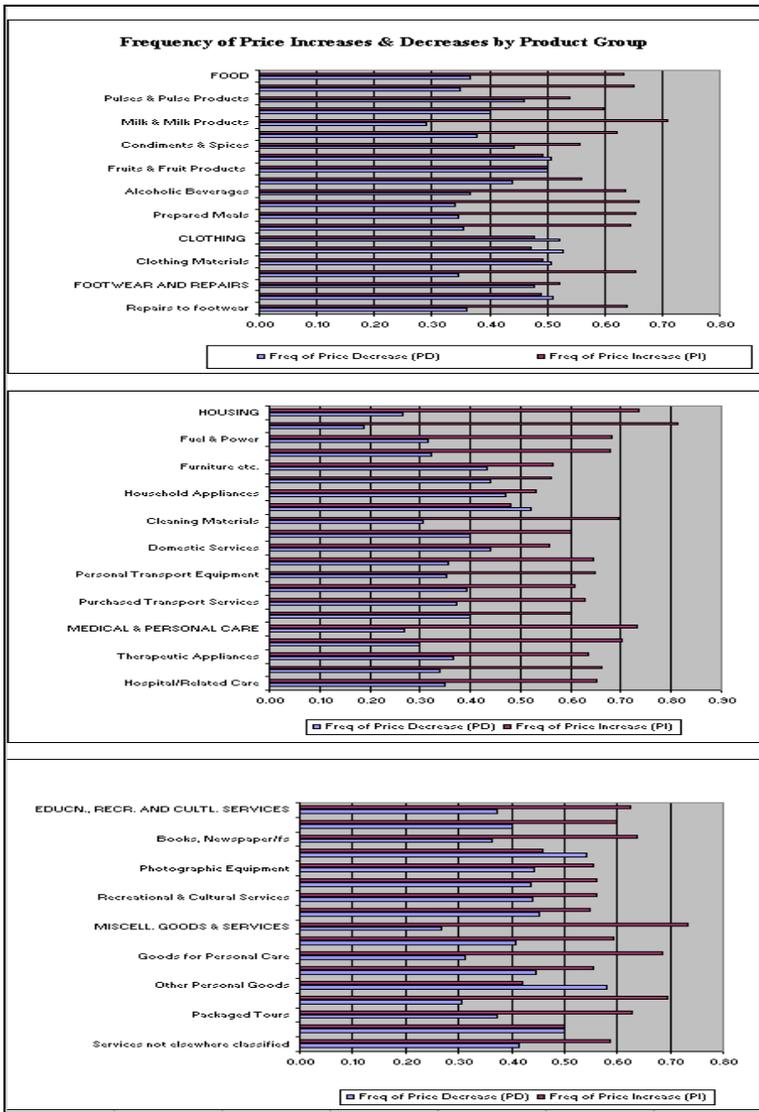


Figure 4

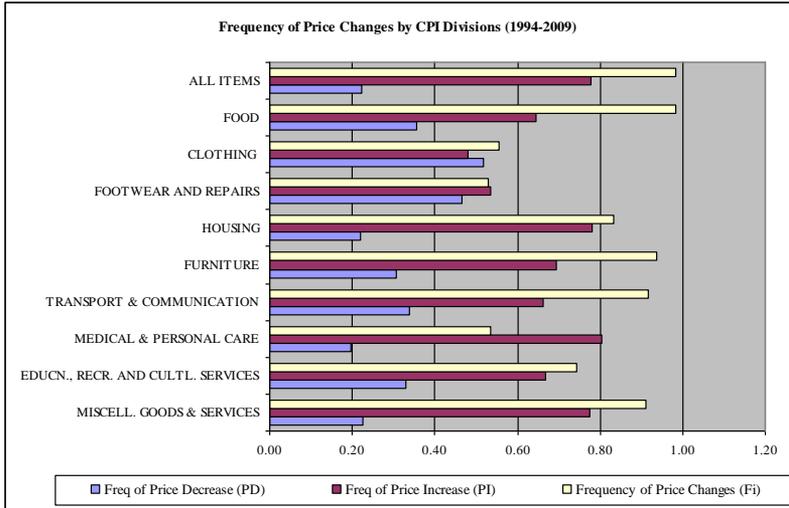


Figure 5

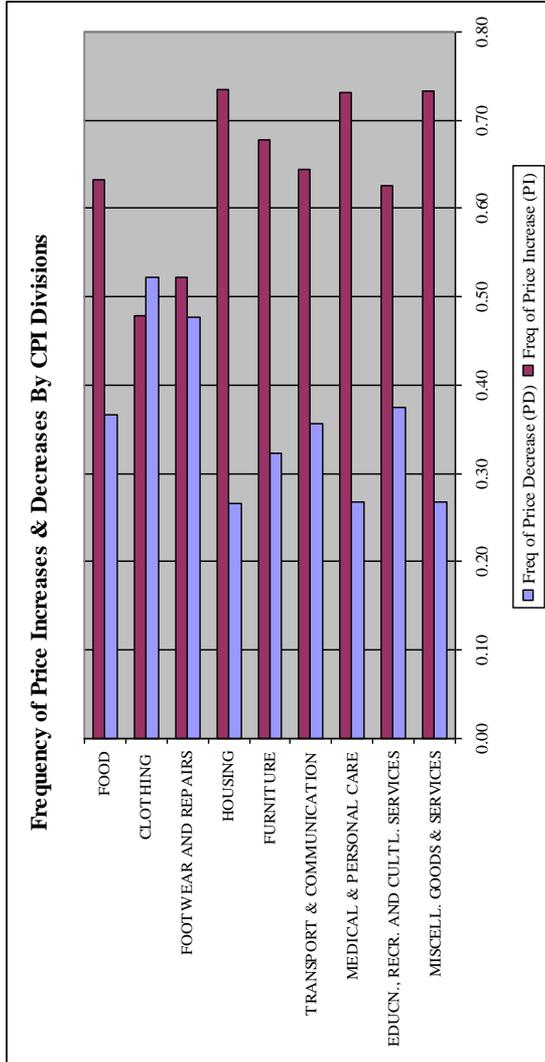


Figure 6

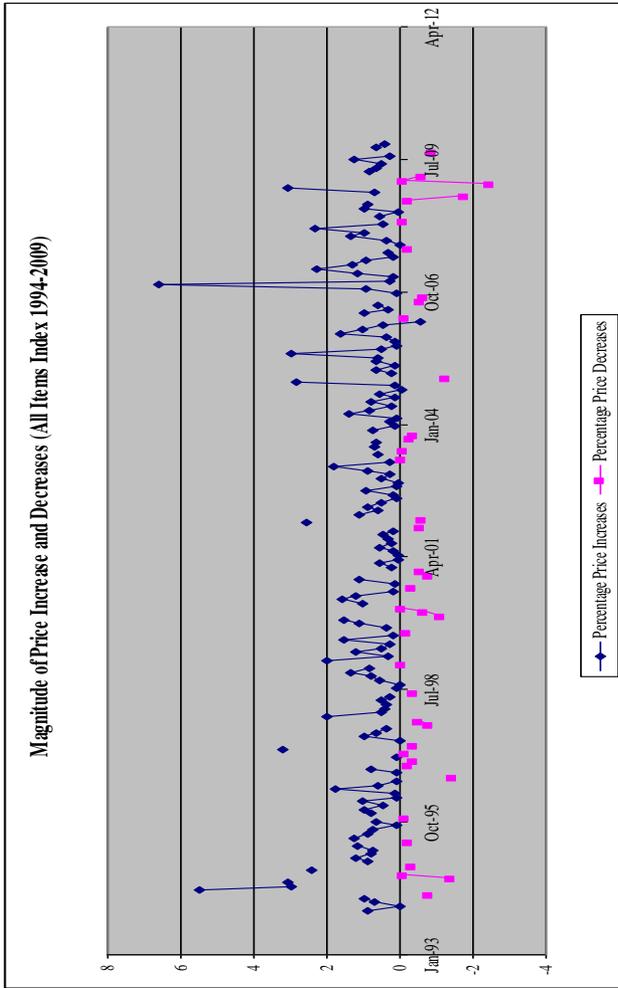


Figure 7

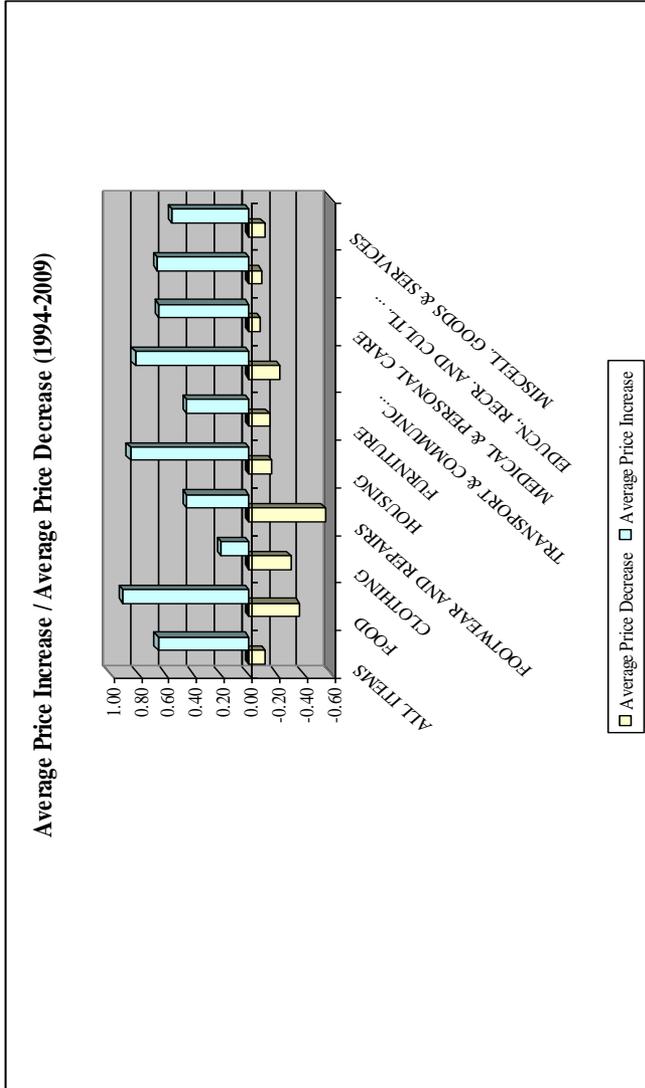
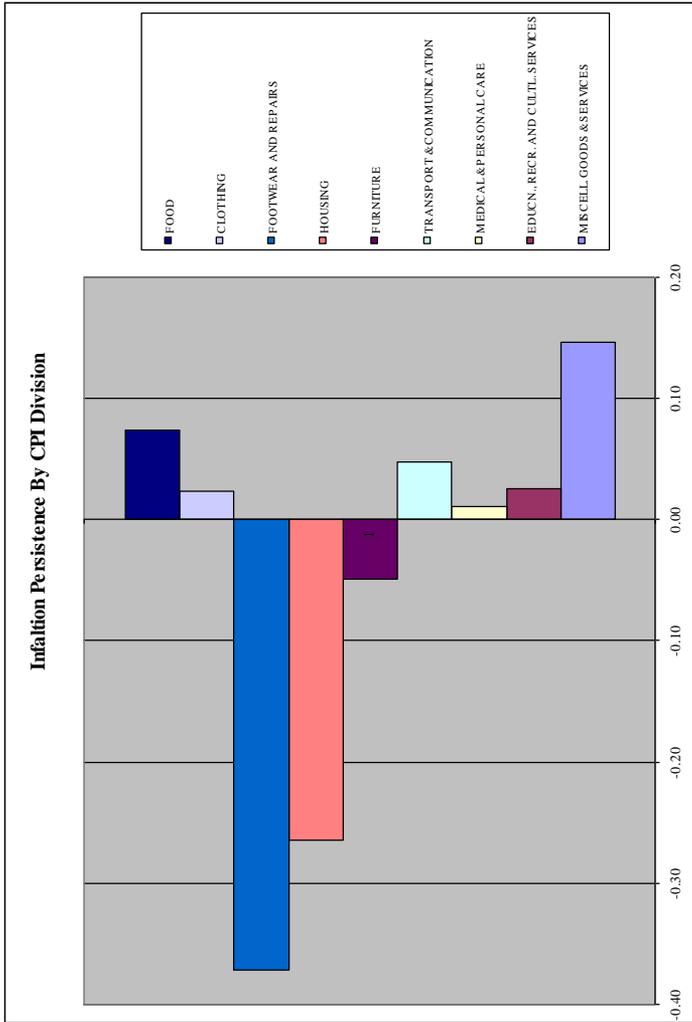


Figure 8



PRICE RIGIDITY IN CURAÇAO

MIRIELA G. L. CAROLINA¹

ABSTRACT

This study provides information on the frequency of price changes of consumer goods and services in Curaçao.

The data covered the majority of consumer spending (94.5 per cent) in the period 2006 to 2010. The results emphasize the price setting policy of the government, characterized by regulated pricing. The frequencies vary considerably across categories. Fifty per cent of the price quotes remain unchanged for approximately 8.6 months.

JEL Classification: E31.

Keywords: Price rigidity, duration analysis, frequency of price changes.

¹ This study was initiated by the Caribbean Centre for Money and Finance and coordinated by Prof. R. Craigwell of The University of the West Indies. The author wants to thank Mr. Angelino de Pool, an intern at the Centrale Bank van Curaçao en Sint Maarten, for research assistance and composing the tables and figures. The views expressed in this paper are those of the author and do not necessarily represent those of the Bank van de Nederlandse Antillen.

1.0 Introduction

Price setting of goods and services in Curaçao is largely influenced by the government, which has controls on selected food products, energy goods and services, medical care and selected drugs, transportation services, car insurance and household services. One important component of the government price setting behaviour is in the oil and oil derivatives market. Curaçao, as a non-oil producing economy, is vulnerable to oil price shocks. Policy makers are aware that these shocks can trigger an inflationary wage-price spiral in Curaçao. To mitigate the oil price shocks, the pricing policy on energy was amended frequently in the last decade; an energy fund financed the oil price increases in the period 2005 -2007 allowing retail prices for oil derivatives and of energy to remain unchanged. After depletion of the energy fund, the proposed energy pricing policy was set on a monthly basis. Evidently, the government price setting policy affected the price frequency and duration price spell of the energy sector and energy related goods and services.

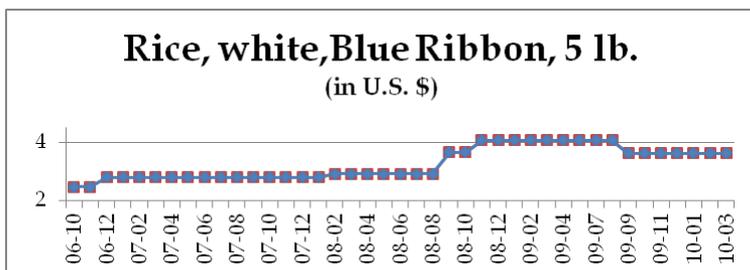
The objective of this study is to provide information on the frequency of price changes and durations across consumer goods and services in Curaçao over the period October, 2006 to March, 2010. The paper is organized as follows. The next section deals with information on the micro data-set. Section 3 looks at the literature on price frequencies and in section 4 the methodology is presented. Section 5 analyzes the empirical results and section 6 concludes.

2.0 Data

The dataset consists of the unpublished monthly retail price quotes, collected for producing the consumer price index (CPI) during the period October, 2006 to March, 2010. The prices are gathered by field agents of the Central Bureau of Statistics in selected outlets in Curaçao. Prices are collected on a monthly, bi-monthly, quarterly, bi-annual or annual basis. The category 'Rent' is estimated by the Central Bureau of Statistics, by assuming a monthly increase of 0.2 per cent. The data on prices of energy are sourced from the general information system (websites) of the companies providing utilities in Curaçao. Data on tariffs of health insurance and postal services are adjusted once a year.

A price trajectory refers to a series of price quotes for a specific article of a specific brand observed in a specific outlet. It consists of price spells, which are periods where the price remained unchanged. The price trajectories observed covered 4,800 goods and services. In Figure 1, the price trajectory of a food product, white rice, of the brand name 'Blue Ribbon' in five-lb bags in an unnamed outlet is shown in United States dollars (US\$). Figure 1 reveals that this product has six price spells in three years. In the database the product 'Rice' has 70 price trajectories.

Figure 1



In constructing the data several problems were encountered. One, missing data were generated as one converted the information on prices into binary codes using the Microsoft Excel software (Section 4, Methodology). As a change in price is programmed to be the change in two consecutive months, computational errors occur in the month following the missing data (seen as a 0). Second, on some occasions, within a price spell, the same price is recorded in the months $t - 1$ and $t + 1$. Instead of creating two time spells, it is reasonable to impute the price of the month $t - 1$ in month t .

3.0 Some Empirical Studies on Price Frequency

In 2008, the Caribbean Centre for Money and Finance initiated the research on inflation persistence for the Caribbean region. It is based on the Euro's system Inflation Persistence Network (IPN) project, which was concluded in 2005.

Jonker et al. (2004) uses Dutch CPI micro data to present the results on price frequency. The frequencies and the size of the price changes vary widely across the products. High price frequency for fuel and unprocessed food items (e.g., lettuce, bananas) and low price frequency in domestic services (e.g., car wash, hiring video tapes) were reported. The average duration price spell is about 9.7 months (double weighted).

Dhyne et al. (2005) summarized the euro area. In this area prices move rarely; the average duration price spell is 4 to 5 quarters. The frequency of price adjustments across products and countries varies considerably. Price changes are very frequent for energy (oil products) and unprocessed food and less frequent for non-energy industrial goods and services.

The latest U.S. price frequency data were examined by Bils and Klenow (2004). The results cover approximately 70 per cent of consumer spending for the 1995 to 1997 period. Frequency of price adjustments differs across goods with half of the prices lasting less than 4.3 months (weighted). Prices of newspapers, men's haircut, and taxi fares change less than five per cent of the months whilst prices of gasoline, airfare, and fresh foods move more frequently (70 per cent of the months).

In the Caribbean region, studies on Barbados, Saint Lucia and Belize analyzed the frequencies in their respective countries. In the paper on Barbados by Craigwell et al. (Chapter 2), the period of study is 1994 to 2008. The study

indicates that prices in Barbados tend to change relatively frequently, with 50 to 80 per cent of the items in every category being altered every month.

Frequency of price movements in Saint Lucia was conducted by Polius and St. Catherine (2010, Chapter 4) in the period 1984 to 2008. Price change frequencies differ significantly across categories. Prices are relatively flexible with a weighted average duration of seven days (0.26 month). In the services categories (except transportation) prices exhibited greater stickiness than those for (raw) food, transport, fuel, and electricity.

In Belize, quarterly data for the period 1991 to 2008 was analyzed (see Ford, 2010). Prices are altered frequently - on average every 4.5 months with those for services (e.g., communication, gross rent, water charges, and transportation) showing more rigidity than prices of goods (e.g., beverages and footwear).

4.0 Methodology

In this section, frequency of price changes and duration of price spells are defined. Each product in category j in store i at time t is defined to have a price P_{ijt} . The following variables characterize the price setting behaviour of the product in category j :

- a binary variable for observation of the price at time $t - 1$ and t in store i .
 $x_{ijt} = 1$ if P_{ijt} and $P_{ij, t-1}$ are observed

$x_{ijt} = 0$ if P_{ijt} exists but not $P_{ij, t-1}$

- a binary variable indicating a price change in t .

$y_{ijt} = 1$ if $P_{ijt} \neq P_{ij, t-1}$

$y_{ijt} = 0$ otherwise

- a binary variable where a price increase in t is given as:

$y_{1ijt} = 1$ if $P_{ijt} > P_{ij, t-1}$

$y_{1ijt} = 0$ otherwise

- a binary variable where a price decrease in t is expressed as:

$y_{2ijt} = 1$ if $P_{ijt} < P_{ij, t-1}$

$y_{2ijt} = 0$ otherwise

Using these 4 variables, the following 4 indicators can be computed:

- the frequency of price changes:

$$F_j = \sum_i \sum_t y_{ijt} / \sum_i \sum_t x_{ijt}$$

$$i=1,2,\dots,n_j; t=2, 3, \dots,\tau$$

- the frequency of price increases:

$$F_j^+ = \sum_i \sum_t y_{1ijt} / \sum_i \sum_t x_{ijt}$$

$$i=1,2,\dots,n_j; t=2, 3, \dots,\tau$$

- the frequency of price decreases:

$$F_j^- = \sum_i \sum_t y_{2ijt} / \sum_i \sum_t x_{ijt}$$

$$i=1,2,\dots,n_j; t=2, 3, \dots,\tau$$

- the frequency of price changes at time t for product category j :

$$F_{jt} = \sum_i y_{ijt} / \sum_i x_{ijt}$$

$$i=1,2,\dots,n_j$$

A price spell is defined as the period between two price changes. Price duration is the interval length for which the price of a good or service remains constant. For large samples, the average duration of a price spell is the inverse of the frequency of the price change (assuming that prices are set in time discrete manner):

$$T_j = 1/F_j$$

When it is assumed that prices are set in a continuous manner, which means that prices can move at any point in time, the average price duration of the product category j :

$$T_j = -1 / \ln(1 - F_j)$$

The median price duration is calculated as follows:

$$T_j = \ln(0.5) / \ln(1 - F_j)$$

5.0 Empirical Results

Figure 2 (Appendix) shows the frequencies by categories which are similar to those of the CPI data. The red (darker color in black and white print)/blue (lighter color in black and white print) bars are, respectively, the main categories and the subcategories.

Prices in Curaçao have a low frequency, emphasizing the government policy of price regulation. The results indicate that prices are changed in 17 per cent of the months (double weighted). In Curaçao, the frequency differs considerably across the categories (Table 1, Appendix). 'Alcohol and Tobacco' has the highest frequency, followed by the subcategory 'Energy and Rent.' Price adjustments in the 'Alcohol and Tobacco' subcategory are due to market forces as prices are not regulated in this sector. In the subcategory 'Energy and Rent,' the price changes are the result of alterations in the domestic energy price setting which are related to the adjustment in crude oil prices. However, due to government price setting procedures, the pass-through of the change in the crude oil price in the domestic energy prices occur with a lag or is postponed.

The categories with the lowest frequencies are 'Upholstery and Soft Furnishing' and 'Transport.' The duration price spell of both 'Upholstery and Soft Furnishing' and 'Transport' is two years and four months. The low frequency

in transport is on account of the price setting of public transportation by the government.

Price changes behave asymmetrically, as price increases occur more frequently than price decreases in all categories. For insurances and household services (the minimum wages), only price expansions are listed.

6.0 Conclusion

In Curaçao, the prices are less flexible compared to other Caribbean countries. The price regulation policy on selected goods and services expands the duration of the price spells. In Curaçao, 50 per cent of the duration of price spells is 8.6 months. The duration of price spells varies across categories, with the greatest duration of two years and months for the categories 'Upholstery and Soft Furnishing' and 'Transport' and the shortest duration of 1.2 months for the category 'Alcohol and Tobacco.' This study also shows that, in all categories, price increases occur more frequently than price decreases.

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APPENDIX 1

Table 1
Frequency of price changes by category

Code	Expenditure Category	Frequency of Price Changes	Frequency of Price Increases	Frequency of Price Decreases	Median Duration of Price Spells	Average Duration of Price Spells
10000	FOOD	0.16	0.12	0.04	4.03	5.82
11000	Cereals, Flour, and Bakery Product	0.16	0.11	0.05	3.98	5.74
12000	Meats and Fish	0.17	0.12	0.05	3.62	5.22
13000	Edible Fats and Oils	0.18	0.14	0.04	3.48	5.01
14000	Dairy Products	0.18	0.14	0.04	3.50	5.05
15000	Fruits and Vegetables	0.22	0.15	0.06	2.84	4.10
16000	Sugar	0.13	0.11	0.03	4.81	6.94
17000	Ready Meals	0.14	0.10	0.04	4.60	6.63
18000	Outdoor Consumption	0.05	0.05	0.00	12.86	18.56
19000	Other Food Products	0.15	0.11	0.03	4.42	6.37
20000	ALCOHOL & TOBACCO	0.57	0.44	0.14	0.81	1.17
30000	CLOTHING & FOOTWEAR	0.06	0.05	0.01	10.81	15.59
40000	HOUSING	0.05	0.04	0.01	13.26	19.13
43000	Home Maintenance	0.05	0.04	0.01	13.79	19.90
44000	Gardening	0.04	0.03	0.01	17.17	24.77
41/42/ 45000	Energy & Rent	0.37	0.33	0.11	1.49	2.16
50000	HOUSEHOLD FURNISHING & APPLIANCES	0.09	0.07	0.02	7.65	11.03
51000	Furniture and Lighting	0.07	0.06	0.01	9.94	14.35
52000	Upholstery and Soft Furnishing	0.03	0.03	0.00	19.99	28.84

Table 1 (Continued)
Frequency of price changes by category

Code	Expenditure Category	Frequency of Price Changes	Frequency of Price Increases	Frequency of Price Decreases	Median Duration of Price Spells	Average Duration of Price Spells
53000	Home Tools and Equipments	0.07	0.06	0.01	9.80	14.14
54000	Household Items	0.12	0.09	0.03	5.63	8.13
55000	Household Expenditure	0.11	0.08	0.02	6.18	8.91
56000	Household Services	0.08	0.08	0.00	8.89	12.83
59000	Household Furnishing	0.04	0.03	0.00	17.76	25.63
61000	MEDICAL CARE	0.14	0.10	0.03	4.72	6.81
70000	TRANSPORTATION AND COMMUNICATION	0.10	0.08	0.02	6.40	9.23
72000	Expenses for own transport vehicles	0.11	0.09	0.02	5.99	8.64
73000	Transport	0.03	0.03	0.01	19.75	28.50
74000	Communication	0.06	0.06	0.00	10.64	15.36
80000	RECREATION AND EDUCATION	0.07	0.05	0.01	9.74	14.06
81000	Recreation	0.06	0.05	0.01	11.31	16.32
82000	Entertainment and Culture	0.30	0.26	0.04	1.97	2.85
83000	Books etc...	0.09	0.07	0.02	7.78	11.22
85000	Education	0.07	0.05	0.02	9.71	14.01
86000	Hobby Articles	0.04	0.03	0.00	17.62	25.42
90000	MISCELLANEOUS	0.10	0.08	0.02	6.40	9.23
91000	Personal Body Care	0.10	0.08	0.02	6.57	9.48
92000	Insurance	0.08	0.08	0.00	8.89	12.83
93000	Commodities and Services	0.11	0.09	0.02	5.99	8.64

Figure 2
Frequency of price changes by categories

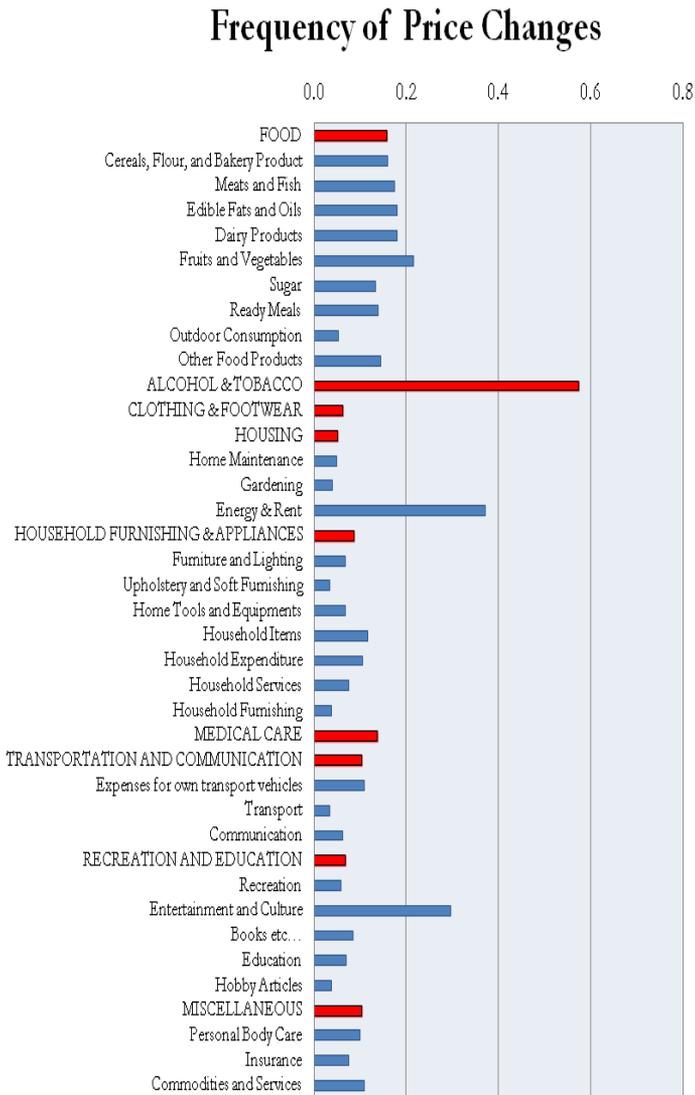


Table 2
Frequencies and weights of the major categories

Code	Category	Frequency	Weights (%)
10000	Food	0.16	12.33
20000	Alcohol & Tobacco	0.57	1.57
30000	Clothing & Footwear	0.06	4.76
40000	Housing	0.05	30.84
50000	Household Furnishing & Appliances	0.09	7.02
60000	Medical Care	0.14	1.27
70000	Transportation & Communication	0.10	22.63
80000	Recreation & Education	0.07	7.65
90000	Miscellaneous	0.10	11.93

Table 3
Weighted statistics*

Mean frequency for all goods and services	0.17
Mean duration for all goods and services	5.27
Median frequency for all goods and services	0.11
Median duration for all goods and services	8.64

Note: * means that the formula used to construct the CPI statistics S from the category statistic S_k is: $S = \frac{\sum W_k S_k}{\sum W_k}$, with W_k the weight of the category k . A similar formula is used to estimate S_k using the product level statistics S_j : $S_k = \frac{\sum_{j=1}^{n_k} I_{jk} w_j S_j}{\sum_{j=1}^{n_k} I_{jk} w_k}$, with S_j the estimated statistic for product j from the micro data and W_j the weight of product j in the CPI. The aggregate statistics on product level is weighted once (CPI weight of product) and the statistics representing all goods and service are weighted twice; on product level and on category level.

THE RIGIDITY OF ENERGY RETAIL PRICES IN CURAÇAO

MIRIELA G. L. CAROLINA¹

ABSTRACT

This paper analyzes the frequency of retail price changes and the duration of spells of unchanged prices, in the energy components of the consumer price index in Curaçao, during the period 1999-2009. The government regulates the tariffs of energy components, and the evidence provided in this study underlines that the system of regulation of energy prices in Curaçao results in low frequencies of price movements. The price setting of the regulator is based on attractive pricing, as most prices of components of energy are rounded to 0 or 5.

JEL Classification: E31, D49, C41.

Keywords: Price rigidity, duration analysis, frequency of price changes.

¹ The views expressed in this paper are those of the author and do not necessarily represent those of the Bank van de Nederlandse Antillen.

1.0 Introduction

This study focuses on the pass-through mechanisms of energy retail prices in Curaçao, on the demand for energy and on the general price level, during the period 1999 to 2009. It analyzes the frequency, the magnitude and the duration of the price changes in the energy component of the consumer price index (CPI). What are the factors that determine the domestic energy prices? Does the price setting exhibit time- or state-dependent behaviour? Are the domestic energy prices stickier than for other countries?

Despite the oil price shocks of the last decades, Curaçao, a non-oil producing country, had low inflation of approximately two per cent. On a macro level, the low inflation environment is the result of the peg to the United States (US) dollar. According to the Purchasing Power Parity (PPP) theory, inflation in Curaçao is equal to US inflation in the long run. In the work done by Carolina (2006), the PPP theory was not rejected.

This study is based on the framework of the Euro-system Inflation Persistence Network (IPN). The description of the framework is presented in working papers, coordinated by the European Central Bank (2004, 2005). The research on inflation persistence for the Caribbean region was initiated by the Caribbean Centre for Money and Finance in 2008. This is the first empirical paper on this topic on Curaçao using micro data. It uses monthly data starting from 1999 until September 2009 and is organized as follows. Section 2 presents a general overview on the energy components and its share in the CPI. Section 3 gives

the theoretical background. The empirical results are discussed in section 4. Section 5 concludes.

2.0 The Energy Retail Prices

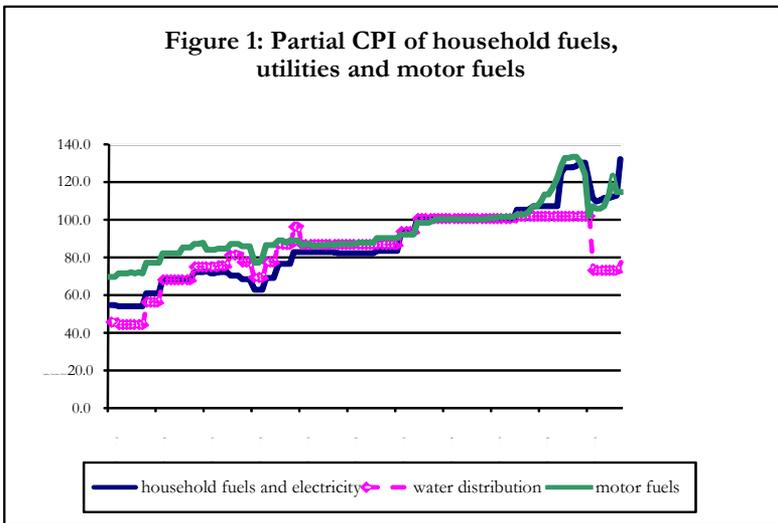
2.1 *Price Setting Policy*

In Curaçao, the government regulates the setting of energy prices (prices of energy-related products and services), selected food products, healthcare services, public transportation services, drugs, and some other selected items. Energy prices consist of prices of oil derivatives and products, water and electricity. The price setting behaviour of the regulator is time-dependent. Prices of oil derivatives on the international oil markets determine (with a lag), the price setting of the domestic energy prices.

In the period of 1990 up till mid 2005, the prices of motor fuels (gasoline and gas oil) were set quarterly. In the period from mid 2005 to May 2008, these prices were held constant. From May 2008 to date, motor fuel prices are set on a monthly basis. One company, the government-owned company Curoil, carries out the distribution of motor fuels.

In the period under review, price setting for water, household fuels, and electricity occurred less frequently than the quarterly price setting of motor fuels. One government-owned company coordinates the production and distribution of water and electricity: Aqualetra. Figure 1 shows the price trajectories of the energy components in the period under consideration.

Another noticeable feature of domestic price setting in the energy components is attractive pricing. Attractive pricing is the term used to describe a situation where prices are rounded down or up with the last digit of 0, 5, or 9. An analysis in the United States (US) and the Euro area shows that the use of attractive pricing affects the frequency of price adjustments. Attractive pricing can result in sticky prices, as any change in price can result in a 'non-attractive' price, meaning a price that is not so appealing to the consumer.



Source: Central Bureau of Statistics

In Curaçao, motor fuels price setting meets the criteria of attractive pricing. In the period under review, motor fuels prices were varied down or up to 0 or 5.

2.1.1. The Impact of Indirect Taxes

The government levies excises and sales or turnover tax on the energy components. The indirect taxes were adapted as follows: The sales tax was replaced by a two per cent turnover tax (NAOB) in March-May 1999. This tax was raised to five per cent in October 1999. Between 2001 and 2005, the economic levies on imported goods were phased out. Only the amendments in the sales or turnover tax affected the prices of the energy components.

2.1.2. The Impact of Wages

In Curaçao, an absence of data on wages precludes any analysis of how inflation persistence may be related to a price - wage adjustment process. However, the price setting for energy components is based on the price of international oil products, a margin for profit, and indirect taxes. Of these domestic components, the margin for profit is the only component that could have been raised as a result of a price - wage spiral. However, in the period under review this component has remained constant.

2.1.3. Weights of the Energy Components in the CPI

The classification system (Table 1, Appendix) used by the Central Bureau of Statistics of the Netherlands Antilles (CBS), resembles the international classification systems. The base year of the CPI is 2004 to 2005. The energy components represent

approximately 13 per cent of the CPI with electricity accounting for almost half (Table 2, Appendix).

3.0 Data on Energy Prices

The data of the motor fuels prices are available on the website (www.curoil.com) of Curoil. Curoil distributes oil products and oil derivatives. The data on utility prices are available on the CBS website (www.cbs.an). The price of water is based on the utilization of 9.3 m³ and the price of electricity on the use of 357 KWH. The dataset consists of retail energy prices. A price change is defined as an observed price move or a forced product replacement.

3.1 Theory

The main indicators of price adjustment are the frequency of price changes, the average duration of price spells, the frequencies of price increases and price decreases, the average sizes of price expansions and declines, and the degree of synchronization of price changes. The computation of these indicators is presented in the Appendix (Empirical Methods: Definitions and Modeling).

Price synchronization as proposed by Fisher and Konieczny (2000) is a measure to assess the movement of prices of different items with each other. The index takes the value 1 in the case of perfect synchronization of price changes, while a value 0 is applied when there is perfectly staggered price adjustments across price setters (Appendix: Empirical Methods: Definitions and Modeling).

When oil price shocks affect a non-oil producing economy, as in the case of Curaçao, measuring the inflation persistence is useful. Moreover, not only external shocks but also domestic wage-price adjustments can lead to inflation persistence. Inflation persistence is measured by the following equation:

$$\Psi_{jt} = \rho * \Psi_{jt-1} + \varepsilon_{jt} \quad (1)$$

where Ψ_{jt} is the month-on-month change in price of category j at time t and ε is a white noise error term. A small ρ means low degree of inflation persistence. Another test of inflation persistence is the unit root test. Rejection of a unit root of inflation is equivalent to a low degree of inflation persistence. Empirical work uses OLS estimates or unit root tests.

The pass-through will have a lag of more than one month (Equation 1) due to the quarterly price regulation on energy prices. In Curaçao, the lag of one month has to be adjusted according to the period of the duration spells, as prices have not changed during the duration spells. The persistence can also be obtained by unit root testing. In general, Curaçao has low inflation levels. Hence, inflation persistence will be highly unlikely.

The regressions for the energy retail prices and the energy components' demand equations have the ARDL (autoregressive

distributed lag) / ARMAX (autoregressive moving average) form:

$$y_t = \mu + \gamma_1 * y_{t-1} + \gamma_2 * y_{t-2} + \dots + \gamma_p * y_{t-p} + \dots + \beta_1 * x_{t-1} + \beta_2 * x_{t-2} + \dots + \beta_r * x_{t-r} + \theta_1 * \varepsilon_{t-1} + \theta_2 * \varepsilon_{t-2} + \dots + \theta_q * \varepsilon_{t-q} \quad (2)$$

where y_t is the dependent variable at time t and x_t is a vector of explanatory variables at time t .

Equation (2) is an ARMAX (p, r), autoregressive moving average model, with p indicating the lags of the polynomials in the lag operators of the dependent variable and r the lag of the polynomials of the explanatory variables² (Greene, 2000). The ARMAX model is a non-linear model and is estimated by non-linear least squares estimation. The model with $q=0$, is an ARDL(p, r) model with OLS as an efficient estimator. The empirical results are presented in Sections 4.4, 4.5, and 4.6.

Frequencies are fractions. The fraction F_{it} is restricted to the interval [0, 1]. For a fraction dependent variable, fractional logit models are applicable, as linear models are not appropriate. Given the vector of explanatory variables x , the most appropriate model for a fraction y is the logistic function (Equation 3).

$$E(y|x) = \exp(x\beta) / [1 + \exp(x\beta)] \quad (3)$$

² In the ARDL model, $q=0$.

β is estimated by using the quasi-log likelihood estimator (QMLE), where the quasi-likelihood function is the binary choice log likelihood (Woolridge, 2002). The partial effects are $\frac{\partial E(y|x)}{\partial x_j} = \beta_j g(x\beta)$ where $g(z) = \exp(z) / (1 + \exp(z))^2$. For γ_j being the OLS estimates of the linear regression of y on x , $E(y|x)$, $\gamma_j \approx \hat{\beta}_j g(\bar{x}\beta)$.

4.0 Results

4.1 Frequency and Duration Analysis

In Table 3 (Appendix), frequencies of price changes of the energy components in the consumer price index and their duration are presented. Price increases occurred more frequently than price reductions with the exception of the gasoline of type Mogas 92 and gas cylinders of 100 lbs. The frequencies of price expansions and declines are similar for gas cylinders. However, for Mogas 92 the frequency of price increases is 12 per cent compared to 18 per cent for price contractions.

The category of “motor fuels” (used for transportation, category 72) showed price alterations in 30.5 per cent of the observations. This is similar to the lapse of period of 2.7 months between changes in the price of fuels. The result coincides with the government pricing policy in the period 1990 to 2005, which was based on quarterly price adjustments. Although the frequencies of price increases for both types of gasoline (Mogas 92 and Mogas 95) differ from those of price decreases, the magnitudes of the former were similar to that of the latter. In this group of products, the gas oil displayed a higher magnitude of price

changes, namely 23 per cent price expansions and 16 per cent price declines.

The prices of the group of “fuels and utility” (category 42) were thought to have changed every quarter; however, the frequency of price adjustments was 19.9 per cent, equivalent to a price alteration in 4.5 months. The sub-item “electricity” had the longest duration, with a move in prices every 6.2 months. In this group, the magnitude of price increases was higher than that of the decreases.

According to the price setting policy of the government, the price of “water” (category 45) was to be adjusted on a quarterly basis; however, the duration spell was 6.6 months, coinciding with a low frequency of price changes (14.1 per cent). The magnitude of the average price cut (12.0 per cent) of “water” was higher than that of the average price increase (9.0 per cent).

Tables 4 and 5 show a comparison of the frequencies and duration spells of motor fuels of Curaçao and their two main trading partners, i.e., the US and the Netherlands.

Table 4
Comparison of Frequency of Price Changes (in per cent)

	U.S.	Netherlands	Curaçao
Motor fuels	74.1 (**)	94.1 (*)	30.5

Source: Working paper series No. 413, ECB and Bils, A. and P. Klenow (2004).

Notes: (*) means Fuel type 1 (gasoline) and Fuel type 2 (gas oil) have approximately similar results; (**) means Premium unleaded gasoline, mid-grade unleaded gasoline, regular unleaded gasoline have frequencies of respectively 72.2%, 77.5%, and 78.9%.

The comparison shows that Curaçao has a lower frequency of price changes, as a result of the regulation of energy prices. In line with the high frequencies of the US and the Netherlands, duration spells of motor fuels in these countries have a short life span: the US motor fuels have bi-monthly price movements and the Netherlands adjusts these products every week (Table 5). The energy component “water” has a longer duration spell (12.1 months) in the US compared to Curaçao (6.6 months). In the US, the duration spell on “electricity” is shorter (1.8 months) than for Curaçao (6.2 months).

Table 5
Average and Median Duration (In Months)

	U.S.		Netherlands		Curaçao	
	average	median	average	median	average	median
Motor fuels	0.7	0.48	0.353	0.245	2.7	1.9
Water	12.1 (*)	8.4	-	-	6.6	4.5
Electricity	1.8	1.2	-	-	6.2	4.3
Housing, water, electricity and other fuels	-	-	4.96	3.3	-	-

Source: Working paper series no 413, ECB, Bils, M and P. Klenow (2004)

Notes: (*) means Residential water and sewer service. The median duration of the is calculated by using the formula: $\ln(0.5)/\ln(1-F_j)$

4.2 Price Rigidity in the Energy Components in Curaçao

In Curaçao, the energy prices are sticky and prices are changed infrequently. The low frequency is mainly the result of the price setting policy of the government. In addition, the energy components “water” and “electricity” have not been altered as often as proposed by government policies, resulting in lower than expected frequencies. Deviation from the proposed regulation is based on political arguments and can be classified as either sticky downwards (resistance to lower prices) or sticky upwards (resistance to increase the prices).

To gain insights on price rigidity in motor fuels, the average price of motor fuels and the data on the West Intermediate crude oil prices are useful. As already noted, the domestic energy prices are adjusted periodically based on international price setting. A comparison between the actual government

intervention (Table 6, Column 4, Appendix) and the expected government interventions (Table 6, Column 5, Appendix) reveals that the government price policy on gasoline was rigid upwards. A government that is likely to raise prices but abstains from taking action can be classified as having a sticky upwards approach. In general, as shown in Table 6, column 6, the sticky upward method was used more frequently than the sticky downward procedure.

4.3 Price Synchronization and Inflation Persistence

Price synchronization measures the extent to which prices in different categories change simultaneously. When prices of goods of the same category move at the same time the ratio is 100 per cent. The quarterly regulated prices of the energy components are expected to have synchronization ratio per group close to 100 per cent. The results (Table 3, Appendix) show synchronization ratios of 89.2 per cent for the category “fuels and utilities” and 93.6 per cent for the group “motor fuels.”

Inflation persistence (see Equation 1) is the process of a price change of the previous month affecting the price adjustment in the current month. As the duration spells indicate the number of months over which the prices remain constant, the lag in each category is adjusted to the average or median duration. The regressions in Table 7 show small ρ -coefficients. This indicates an absence of inflation persistence in the energy components of the CPI.

Table 7
Inflation Persistence by Energy Category'

Variables in logs	lags	ρ	t-statistics
Ψ of category 42: fuels and utility (electricity)	4	0.25	2.69 (**)
Ψ of category 45: water	4	0.21	2.39 (**)
Ψ of category 72: Motor fuels	3	-0.15	-1.3

Note: (**) significant at 5%

The lack of persistence is confirmed by testing for unit roots on inflation of the energy components (Table 9, Column 2). The hypothesis of the presence of a unit root is rejected.

4.4 Price Equations of the Energy Components

The impact of the energy components on the CPI can be measured directly (using weights) and indirectly, using regression techniques. The weights of motor fuels (Table 8) in the CPI in the Netherlands and the US are comparable to Curaçao's. However, those for "water distribution" and "electricity" are higher in Curaçao than in the US and the Netherlands, because the latter countries use alternative sources of energy as well as oil. A higher weight in the CPI indicates that energy components have a larger influence on Curacao's inflation relative to those of the US and the Netherlands.

Table 8
Comparison of Weights in the Consumer Price Index (in per cent)

Motor fuels	US	Netherlands	Curaçao
Gasoline	3.2	3.1	3.4
Gas oil (*)	0.2	0.4	0.2
Housing (**)	37.3	24.4	30.8
Water distribution (***)	0.7	1.3	3.4
Fuels and utilities (****)	5	5.3	5.9
Electricity	2.7		5.3
Other household fuels	0.09		0.2

Source: CBS Nederland (statline, persbericht pb09-2009), CBS Nederlandse Antillen, Bureau of Labor Statistics

Notes: (*) means U.S.: other motor fuels (excluding gasoline), (**) means Excluding furnishing, appliances; (***) means U.S.: Water and sewerage Maintenance; (****) means Netherlands, Curacao: household fuels

Data in Table 9 shows that energy prices are I (1), that is, the null-hypotheses of a unit root for all the variables were not rejected in levels but rejected in first differences.

Table 9
Unit Roots Tests

	ADF-test level	ADF-test difference
CPI Curacao	4	-9.1
Price index category 42	2.1	-7.8
Price index category 45	0.3	-11.2
Price index category 72	1.52	-7.1
Price index WTI	-0.55	-6.7

Notes: 1 per cent: ADF-test is -2.58; 5 per cent: ADF-test is -1.94

The energy prices are estimated using the ARMAX/ARDL specification while the ARDL (1, 1) model is applied to the price index of electricity (CPI42) (Table 10). The WTI crude price index (WTI-index) and the money supply (M2) have a lagged impact of three months and one month on the CPI42, respectively. In the long run, a one per cent increase in the WTI price leads to a 0.59 per cent rise in the CPI42.

Table 10
Regressions for Domestic Prices

	Log(CPI42)	Log(CPI45)	Log(CPI72)
No. of observations	124	126	126
Log(WTI-index (-3))		0.20 (***)	0.12 (***)
Log(WTI-index (-4))	0.13 (***)		
Log(M2)(-1))	0.51 (***)		
Log(CPI45 (-1))		0.98 (***)	
Log(CPI42 (-1))	0.78 (***)		
Log(CPI72 (-1))			0.96 (***)
MA(1)		-0.22	-0.12
Constant	-0.33	3.4 (***)	4.03 (***)
log likelihood	252.37	211.2	271.2
AIC	-4.01	-3.27	-4.23
SC	-3.9	-3.16	-4.11
LR price	0.59	3	10

Notes: (***) , (**), (*) indicate significance at 1 per cent, 5 per cent, and 10 per cent respectively. On equation on CP145, p-value = 0 for the coefficients on WTI-index and CPI, and the constant. P-value=0.12 for the MA; On equation on CP172, p-value of 0 coefficient on WTI-index and CPI, and the constant. P-value=0.86 for the MA.

The price index of water (CPI45) and the price index of motor fuels (CPI72) are modeled as an ARMAX (1, 1) where the WTI - index has a lagged effect of three months on both indices. However, in the long run, a one per cent increase in the WTI price leads to a three per cent and a ten per cent expansion in the price of water and the price of motor fuels, respectively.

4.5 *The Demand Equations of the Energy Components*

The demand for each energy component per person is determined by the price index of the particular energy component, the number of households measured by population (pop), and total production proxied by total sales in constant prices (sales06). These demand equations (ARDL) are estimated by Ordinary Least Squares (OLS) using monthly data for the period between 2005 and 2009. Detailed information on the variables is in the Appendix, Table 13.

The results from the demand equations show that the long term price elasticities of electricity, water, and the motor fuel Mogas 95 are respectively -0.78, -0.88 and -0.35, implying inelastic price reactions. In addition, the findings also suggest that it will take consumers seven months, four months and three months respectively to alter their demand for electricity, water and motor fuel Mogas 95. Moreover, the evidence reveals that the demand for electricity per person and the demand for water per person are determined by production with a lag of eight months and seven months respectively. Additionally, it shows that construction activities (proxied by lbouwtotaal and lbricks) and temperature influence the respective demands positively; a rise of temperature by one per cent results in an expansion in the

demand for electricity and water by 1.12 per cent and 0.55 per cent, respectively. The demand for water consumption and gasoline is also significantly directly affected by the density of cars, the latter effect with a lag of eight months. The policy change that eliminated the motor fuel, Mogas 92, in the second half of 2009, led to an increase in the demand for the only available motor fuel: Mogas 95. A dummy (dummo95) is included for this product replacement.

4.6 *The Frequency Equations*

The frequencies of changes in energy prices (see equation 3) are determined by the world oil crude price changes, government regulation, the demand for the particular energy component and overall inflation. World crude oil inflation will lead to a change in the domestic energy prices. The results of the frequency equation are presented in Table 12.

Table 11
Demand Equations

	Log (electricity/pop)	Log (water/pop)	Log (Mogas95/pop)
No. of observations	40	40	52
Log(CPI42 (-7))	-0.78 (***)		
Log(CPI45(-4))		-1.19 (***)	
Log(CPI72(-3))			-0.35 (***)
Log(CPI)		-8.44 (***)	
Log(sales06 (-4))			0.17(*)
Log(sales06 (-7))		0.18(*)	
Log(sales06 (-8))	0.18 (**)		
Stay-over/10000	0.004		0.04(**)
Log(bricks)		0.07(**)	
log(bouwtotaal)	0.03 (***)		
Log(cars per 1000)		9.88 (***)	
Log (cars per 1000 (-8))			0.69(**)
Log(temp)	1.12 (***)	0.55(***)	
Dummo09			0.3(***)
Log(water/pop(-1))		-0.37(**)	
Constant	-8.33 (***)	-27.02 (***)	0.099
R-squared	0.65	0.54	0.69
D-W	2.32	2.04	2.23
LR price	-0.78	-0.88	-0.35

Notes: (***), (**), (*) indicate significance at 1%, 5%, and 10% respectively.

Table 12
Frequency Equations

	F_electricity	F_water	F_motor fuels
No. of observations	104	104	110
F_electricity (-3)	3.7 (***)		
F_electricity (-6)	3.59 (***)		
F_water (-3)		3.78 (***)	
F_water (-6)		3.75 (***)	
F_motor fuels(-3)			1.8 (***)
F_motor fuels(-6)			2.7 (***)
Dlog(CPI(-4))	147.7 (**)	158.26 (**)	
Dlog(WTI_index(-2))	-7.86 (*)	-14.62 (**)	
Dlog(WTI_index(-3))			-5.9 (***)
Log(demand electricity(-4))	16.86 (*)		
Log(demand water (-4))		31.59 (**)	
Log(demand Mogas95 and gasoil (-6))			4.6 (*)
Constant	-89.83 (*)	-157.6 (**)	-75.2 (**)
Mc Fadden r squared	0.54	0.6	0.4
log likelihood	-18.82	-16.48	-41.2

Notes: (***), (**), (*) indicate significance at 1%, 5%, and 10% respectively.

The frequency changes in electricity prices are determined by the frequency of past quarterly movements regulated by the government. General inflation affects the costs of electricity production (with a lag of four months) and increases the likelihood of frequency change. The inflation of crude oil lowers the likelihood of price adjustments in electricity (with a lag of two months), indicating that prices are sticky upwards. The lagged demand (four months) for more electricity increases the likelihood for a frequency change.

The frequency movements of water are determined similarly. The frequency changes on motor fuels are determined by the frequency of past quarterly adjustments regulated by the government. The inflation of crude oil lowers the likelihood of price changes with a lag of three months, indicating upward price stickiness. Higher demand for motor fuels increases the likelihood of a frequency alteration.

5.0 Conclusion

The frequency of price changes in the energy components are determined by government regulation, international crude oil inflation, the demand for energy components and domestic inflation. The energy components in the CPI of Curaçao have a low frequency of price change with duration spells that vary from three to six months. The low frequency is mainly attributed to regulated prices in the energy sector. In general, price rigidity exists in the energy sector with a government policy biased towards upward price rigidity. There is also evidence of attractive price policy on gasoline prices, as the last digit of these prices is 0 or 5. The price elasticities of water and electricity and Mogas 95 (motor fuel) are inelastic.

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Table 1
The Classification System

I	FOOD
11	Cereals and bakery products
12	Meats, poultry and fish
13	Fats and oils
14	Diary and related products
15	Fruit and vegetables
16	Sugar and sweets
17	Full service meals and snacks
18	Food away from home
19	Other miscellaneous foods
II	BEVERAGE AND SMOKING PRODUCTS
21	Beverages
22	Smoking products
III	APPAREL
31	Apparel
32	Footwear
IV	HOUSING
41	Shelter
42	Fuels and utilities
43	House maintenance
44	Gardening and lawn care services
45	Water distribution
VI	HOUSEHOLD FURNISHINGS AND OPERATIONS
51	Furniture and lightning's
52	Coverings and other linens
53	Appliances
54	Household equipment
55	Other housekeeping expenses
56	Domestic services
59	Miscellaneous
VI	MEDICAL CARE
61	Medical care
VII	TRANSPORTATION AND COMMUNICATION
71	Private transportation
72	Motor vehicle parts, equipment and fees
73	Public transportation
74	Communication

Table 1 (Continued)

VIII	RECREATION
81	Recreation
82	Recreation services
83	Recreational reading materials
85	Education
86	Hobbies and related goods and services
IX	MISCELLANEOUS ITEMS
91	Personal care services
92	Insurances
93	Goods and services not else mentioned

Table 2
Structure and Composition of the Sample

Code/Category	Code/ Group of product	Type of product	Selected product Categories	Regulated/ Non- regulated	CPI weight (in %, 2004)
42 Fuels and utility:					
	42110 Gas	Energy	2 Gasses: lgp200, lgp 20	Regulated	0.4
	42120 Electricity	Energy	357 KWH	Regulated	5.3
	42140 Other household fuels	Energy		Regulated	0.2
45 Water distribution:					
	45000 Water	Energy	9.3 m ³	Regulated	3.4
72 Motor vehicle parts, equipment and fees:					
	72120 Gasoline	Energy	2 fuels: Mogas 95, Mogas 92	Regulated	3.4
	72121 Gas oil	Energy		Regulated	0.2

Table 3: Frequency and duration of price changes

Code/Category	Code/Product	Frequency of Price Changes (in %)	Frequency of Price Increases (in %)	Frequency of Price Decreases (in %)	Average Price Increases (in %)	Average Price Decreases (in %)	Average Duration of Price Spells	Synchronization ratio by group (in %)
42 Fuels and utility		19.9	11.3	8.6	15.3	13.8	4.5 mths.	89.2
	42110 Gas:							
	lgp 200=100lbs	20.3	10.2	10.2	16.1	9.2	4.4 mths.	
	Lgp 20=20lbs	19.5	10.9	8.6	12.0	11.0	4.6 mths.	
	42120 Electricity	14.8	9.4	5.5	9.4	3.7	6.2 mths.	
	42140Other use of energy (357 KWH)	24.8	14.7	10.0	20.0	26.0	3.5 mths.	
45 Water distribution								
	45000 Water (9.3 m3)	14.1	10.2	3.9	9.0	12.0	6.6 mths.	
72 Motor vehicle parts, etc: Energy components	Motor fuels:	30.5	18.6	11.9	10.0	11.0	2.7 mths.	93.6
	72120 Mogas 95	33	20	13	7.0	7.7	2.5 mths.	
	72120 Mogas 92	28	12	18	7.5	8.7	3 mths.	
	72121 Gas oil	29.6	17	12.6	23.0	16.0	2.8 mths.	

Table 6
The Rigidity in Energy Components of the CPI

Quarter	Monthly change internat'l oil prices	Monthly change Curoil prices	Change internat'l	Expected gov't	Gov't intervention	Rigidity upward	Rigidity downward
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Q1 1999	-0.2	-4.2	-	-	-		
Q2 1999	5.0	0.0	+	-	=		*
Q3 1999	5.1	0.0	+	+	=	*	
Q4 1999	3.8	16.4	+	+	+		
Total	13.7	12.2					
Average 1999	3.4	3.1					
SD 1999	2.5	9.1					
Q1 2000	3.2	8.2	+	+	+		
Q2 2000	0.2	0.0	+	+	=	*	
Q3 2000	3.6	0.0	+	+	=	*	
Q4 2000	-0.2	14.6	-	+	+		
Total	6.7	22.8					
Average 2000	1.7	5.7					
SD 2000	2.0	7.1					
Q1 2001	-4.1	-5.1	-	-	-		
Q2 2001	0.8	-4.4	+	-	-		
Q3 2001	-1.7	8.6	-	+	+		
Q4 2001	-6.8	-3.6	-	-	-		
Total	-11.9	-4.4					
Average 2001	-3.0	-1.1					
SD 2001	3.2	6.5					
Q1 2002	1.8	-15.3	+	-	-		
Q2 2002	4.9	5.8	+	+	+		
Q3 2002	2.0	7.0	+	+	+		
Q4 2002	-0.2	-1.6	-	+	-	*	
Total	8.5	-4.1					
Average 2002	2.1	-1.0					
SD 2002	2.1	10.2					

Table 6 (Continued)

Quarter	Monthly change internat'l oil prices	Monthly change Curoil prices	Change internat'l	Expected gov't	Gov't intervention	Rigidity upward	Rigidity downward
Q1 2003	5.3	3.1	+	-	+		*
Q2 2003	-5.6	-6.3	-	+	-	*	
Q3 2003	2.2	0.0	+	-	=		*
Q4 2003	1.1	2.0	+	+	+		
Total	3.0	-1.2					
Average 2003	0.8	-0.3					
SD 2003	4.6	4.2					
Q1 2004	3.2	0.0	+	+	=	*	
Q2 2004	4.0	0.0	+	+	=	*	
Q3 2004	5.6	8.3	+	+	+		
Q4 2004	2.5	0.0	+	+	=	*	
Total	15.3	8.3					
Average 2004	3.8	2.1					
SD 2004	1.4	4.2					
Q1 2005	3.9	5.1	+	+	+		
Q2 2005	5.3	20.0	+	+	+		
Q3 2005	10.5	0	+	+	=		*
Q4 2005	-3.9	0	-	+	=		*
Total	15.8	25.1					
Average 2005	4.0	6.3					
SD 2005	6.0	9.5					
Q1 2006	5.1	0	+	-	=	*	
Q2 2006	8.4	0	+	+	=	*	
Q3 2006	0.5	0	+	+	=	*	
Q4 2006	-11.1	0	-	+	=	*	
Total	2.8	0.0					
Average 2006	0.7	0.0					
SD 2006	8.5	0					

Table 6 (Continued)

Quarter	Monthly change internat'l oil prices	Monthly change Curoil prices	Change internat'l	Expected gov't	Gov't intervention	Rigidity upward	Rigidity downward
Q1 2007	-2.1	0.0	-	-	=		*
Q2 2007	10.2	0.0	+	-	=		*
Q3 2007	8.6	3.0	+	+	+		
Q4 2007	16.0	11.5	+	+	+		
Total	32.7	14.5					
Average 2007	8.2	3.6					
SD 2007	7.6	5.4					
Q1 2008	9.0	10.0	+	+	+		
Q2 2008	29.4	18.3	+	+	+		
Q3 2008	-6.5	34.7	-	+	+		
Q4 2008	-68.0	-20.5	-	-	-		
Total	-36.1	42.4					
Average 2008	-9.0	10.6					
SD 2008	41.9	23.1					
J- 2009	0.3	-75	+	-	-		
F- 2009	-3.0	18.7	-	+	+		
M- 2009	10.1	-3.1	+	-	-		
A-2009	2.1	-0.4	+	+	-	*	
M-2009	10.7	3.8	+	+	+		
J- 2009	12.0	23.3	+	+	+		
J- 2009	-6.2	30.2	-	+	+		
J- 2009	-6.2	30.2	-	+	+		
A-2009	7.9	-15.45	+	-	-		
S-2009	-1.9	-0.2	-	+	-	*	

Notes: Curoil prices: Mogas 92 and Mogas 95; International oil prices: WTI oil prices. In Table 6 the actual government intervention and the expected government intervention is shown. The government intervention is “+” when the government increased the domestic gasoline price and “-” at a decrease in price.

Table 13
Definition of Variables

CPI	Consumer price index
CPI42	Consumer price index of category 42 (including electricity)
CPI45	Consumer price index of category 45 (water)
CPI72	Consumer price index of category 72 (including motor fuels)
Bricks	Amount of bricks
Bouwtotaal	Value of finished construction projects ??
Carsper1000	Number of cars per 1000 inhabitants
Sales06	Sales in constant prices=(salestax*100/5) /CPI
Temp	Temperature
Stay-over/10000	Number of stay-over tourists:10000
Dummo95	Dummy in year 2009 for policy change for elimination of Mogas 92

EMPIRICAL METHODS: DEFINITIONS AND MODELING

Each product in category j in store i at time t is defined to have a price P_{ijt} .

The following variables characterize the price setting behavior of the product in category j :

a binary variable for observation of the price at time $t-1$ and t in store i .

$x_{ijt} = 1$ if P_{ijt} and $P_{ij, t-1}$ are observed

$x_{ijt} = 0$ if P_{ijt} exists but not $P_{ij, t-1}$

a binary variable indicating a price change in t .

$y_{ijt} = 1$ if $P_{ijt} \neq P_{ij, t-1}$

$y_{ijt} = 0$ otherwise

a binary variable indicating a price increase in t .

$y_{1ijt} = 1$ if $P_{ijt} > P_{ij, t-1}$

$y_{ijt} = 0$ otherwise

a binary variable indicating a price increase in t .

$y_{2ijt} = 1$ if $P_{ijt} < P_{ij, t-1}$

$y_{ijt} = 0$ otherwise

Using these 4 variables, the following 8 indicators are defined:

the frequency of price changes:

$$F_j = \sum_i \sum_t y_{ijt} / \sum_i \sum_t x_{ijt} \quad i=1,2,\dots,n_j; t=2, 3, \dots, \tau$$

the frequency of price increases:

$$F_{j+} = \sum_i \sum_t y_{1ijt} / \sum_i \sum_t x_{ijt} \quad i=1,2,\dots,n_j; t=2, 3, \dots, \tau$$

the frequency of price decreases:

$$F_{j-} = \sum_i \sum_t y_{2ijt} / \sum_i \sum_t x_{ijt} \quad i=1,2,\dots,n_j; t=2, 3, \dots, \tau$$

the frequency of price changes at time t for product category j :

$$F_{jt} = \sum_i y_{ijt} / \sum_i x_{ijt} \quad i=1,2,\dots,n_j$$

average price duration of the product category j :

$$T_j = -1 / \ln(1 - F_j)$$

average size of price increases:

$$\Delta j^+ = \frac{\sum_{i=1,2,\dots,n_j} \sum_{t=2,3,\dots,\tau} y_{1ij} (\ln P_{ijt} - \ln P_{ij,t-1})}{\sum_{i=1,2,\dots,n_j} \sum_{t=2,3,\dots,\tau} y_{1ij}}$$

average size of price decreases:

$$\Delta j^- = \frac{\sum_{i=1,2,\dots,n_j} \sum_{t=2,3,\dots,\tau} y_{2ij} (\ln P_{ij,t-1} - \ln P_{ijt})}{\sum_{i=1,2,\dots,n_j} \sum_{t=2,3,\dots,\tau} y_{2ij}}$$

the synchronization ratio, FK_j (Fisher and Konieczny (2000)):

$$FK_j = \sqrt{\frac{1}{(\tau - 1)} \sum_{t=2,3,\dots,\tau} (F_{jt} - F_j)^2 / F_j (1 - F_j)}$$

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Dr. Gobind Ganga completed his BA degree in Economics and Administrative Studies at the University of Winnipeg and his MA and PhD degrees in Economics at the University of Manitoba during the 1980s. He was a lecturer and Senior Research Fellow at his alma mater. In 1992, he returned to the Caribbean and took up an appointment as lecturer in economics at The University of the West Indies, Mona Campus, in Jamaica. He was also an adjunct professor at the Consortium Graduate School at Mona, Jamaica. In 1993, Dr. Ganga returned to Guyana and assumed the position of senior researcher/senior lecturer at the University of Guyana, Turkeyen Campus.

In 1995, Dr. Ganga was appointed Director of the Research Department at the Bank of Guyana. He held that position until November 2003, when was appointed Alternate Executive Director at the World Bank in Washington, D.C., representing 10 Caribbean territories along with Canada and Ireland. In June 2005, Dr. Ganga was appointed Deputy Governor at the Bank of Guyana. However, he was only able to take up his appointment after completing his term at the World Bank. Dr. Ganga comes to

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