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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. 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 is 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 behavior, as in Calvo (1983) and Taylor (1980), which both in some way assume price rigidity[2]. 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.

[2] 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 complimentary names that have been applied, namely, nominal rigidities, price inertia, price stickiness, and price inflexibility.

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 behaviors 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.

2. 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. 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 prices 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 producers 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 percent and in unprocessed food 54 percent of monthly price changes were zeros, while in the other three subgroups the frequency was over 80 percent. 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 alter. 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.

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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