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WORKING PAPER SERIES

NO. 563 / DECEMBER 2005

**EUROSYSTEM INFLATION
PERSISTENCE NETWORK**

**STICKY PRICES IN
THE EURO AREA**

**A SUMMARY OF NEW
MICRO EVIDENCE**

by Luis J. Álvarez, Emmanuel Dhyne,
Marco M. Hoeberichts, Claudia Kwapil,
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The Eurosystem Inflation Persistence Network

This paper reflects research conducted within the Inflation Persistence Network (IPN), a team of Eurosystem economists undertaking joint research on inflation persistence in the euro area and in its member countries. The research of the IPN combines theoretical and empirical analyses using three data sources: individual consumer and producer prices; surveys on firms' price-setting practices; aggregated sectoral, national and area-wide price indices. Patterns, causes and policy implications of inflation persistence are addressed.

Since June 2005 the IPN is chaired by Frank Smets; Stephen Cecchetti (Brandeis University), Jordi Galí (CREI, Universitat Pompeu Fabra) and Andrew Levin (Board of Governors of the Federal Reserve System) act as external consultants and Gonzalo Camba-Méndez as Secretary.

The refereeing process is co-ordinated by a team composed of Günter Coenen (Chairman), Stephen Cecchetti, Silvia Fabiani, Jordi Galí, Andrew Levin, and Gonzalo Camba-Méndez. The paper is released in order to make the results of IPN research generally available, in preliminary form, to encourage comments and suggestions prior to final publication. The views expressed in the paper are the author's own and do not necessarily reflect those of the Eurosystem.

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Abstract: This paper presents original evidence on price setting in the euro area at the individual level. We use micro data on consumer (CPI) and producer (PPI) prices, as well as survey information. Our main findings are: (i) prices in the euro area are sticky and more so than in the US; (ii) there is evidence of heterogeneity and of asymmetries in price setting behaviour; (iii) downward price rigidity is only slightly more marked than upward price rigidity and (iv) implicit or explicit contracts and coordination failure theories are important, whereas menu or information costs are judged much less relevant by firms.

JEL codes: C25, D40, E31

Keywords: Price setting, Price stickiness, Consumer prices, Producer prices, survey data

Non technical summary

This paper brings together original evidence on price setting in the euro area based on recently available quantitative individual price data underlying official consumer (CPI) and producer (PPI) price indices, as well as qualitative information from surveys of firms. The quantitative datasets are particularly well suited for the analysis of the key features of price setting behaviour, since they have a comprehensive coverage of retail and manufacturing prices and are made up of a huge number of price quotes that extend over several years. This contrasts with the bulk of previous micro-studies, which mostly focused on very specific products or markets, referred to the United States and analysed consumer prices only. In addition, we use survey based data that complement the previous ones, given that certain aspects of firms' pricing policies can only be investigated on the basis of this information. Specifically, firms' responses can provide insights into the relative importance of nominal versus real rigidities or the type of information set used in the revision of prices.

Our main findings on price setting practices at the micro level can be summarised in 9 main stylised facts.

1. Firms in the euro area change their prices infrequently, on average around once a year. Price durations are significantly longer than in the US.
2. Price adjustment is heterogeneous across sectors. For consumer prices, flexibility is highest for energy and unprocessed food and lowest for services. For producer prices, flexibility is highest for energy and food and lowest for capital goods.
3. Price decreases are common, so there is no evidence of strong downward price rigidity. The service sector is the main exception.
4. When price adjustments occur, they tend to be quite large: the absolute magnitude is around 8-10 percent in the retail sector and about 5 percent in the producer sector.

5. The frequency of price changes is affected by macroeconomic conditions (such as the inflation rate), sectoral conditions (such as the cost structure or the degree of competition), time factors (like seasonality) and specific shocks (such as VAT changes, the euro cash changeover, etc.). Survey evidence also supports the coexistence of firms with time and state dependent pricing strategies
6. According to surveys, mark-up pricing is the dominant strategy; price setting according to main competitors' prices is also relevant.
7. Survey evidence suggests asymmetries in the adjustment of prices in response to cost versus demand factors. In particular, prices respond more strongly to cost increases rather than decreases, while they react more to a fall in demand than to a rise.
8. Surveys show a coexistence of forward and backward looking price setters.
9. Surveys indicate that implicit or explicit contracts and strategic interactions among competing firms are the main sources of price stickiness. Menu and information costs theories are judged much less relevant by firms

1 Introduction

A better empirical understanding of individual price setting is crucial for building macro models of inflation with adequate micro foundations that may help in the design and conduct of monetary policy³. Micro founded macro models of inflation are typically based on highly stylised assumptions on firms pricing behaviour, as in Calvo (1983) and Taylor (1980). However, implications for inflation dynamics are not invariant to the type of micro price setting. In addition, the speed of adjustment of inflation to shocks to the economy is directly linked to the speed of price adjustment of individual agents.

This paper summarises original evidence on price setting in the euro area based on recently available quantitative individual price data underlying official consumer⁴ (CPI) and producer⁵ (PPI) price indices, as well as qualitative information from surveys of firms⁶. These empirical analyses have been produced in the context of the Inflation Persistence Network (IPN), a large research effort conducted by economists of the Eurosystem. This approach has allowed to obtain unprecedented evidence for the euro area, based on three types of data sources⁷.

The first corresponds to micro consumer prices collected by National Statistical Institutes (NSIs) to construct national CPIs. Available databases contain several millions monthly price quotes for 10 euro area countries (Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain). The second source corresponds to individual producer prices also collected by NSIs to compute PPIs. Databases are available for 5 euro area countries (Belgium, Germany, Italy, Portugal and Spain). The typical CPI and PPI quantitative information used is the price trajectory associated to one particular product

³ See Angeloni *et al* (2005)

⁴ See Álvarez *et al.* (2005a), Álvarez and Hernando (2004), Aucremanne and Dhyne (2004, 2005), Baudry *et al.* (2004), Baumgartner, *et al.* (2005), Dias *et al.* (2004, 2005), Fougère *et al.* (2005), Hoffmann and Kurz-Kim (2005), Jonker *et al.* (2004), Lünnemann and Mathä (2005a), Veronese *et al.* (2005), Vilmunen and Laakkonen (2005) and the summary by Dhyne *et al.* (2005).

⁵ See Álvarez *et al.* (2005b), Dias *et al.* (2004), Dossche (2005), Sabbatini *et al.* (2004), Stahl (2005a) and the summary by Vermeulen *et al.* (2005).

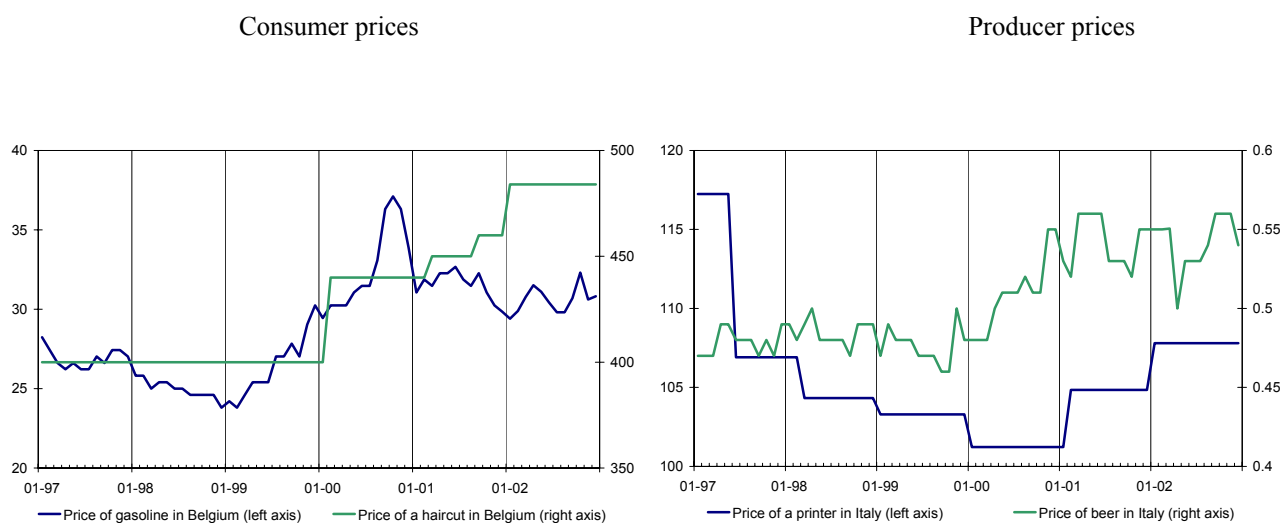
⁶ See Álvarez and Hernando (2005), Aucremanne and Druant (2004), Fabiani *et al.* (2004), Hoerberichts and Stokman (2004), Kwapil *et al.* (2005), Loupias and Ricart (2004), Lünnemann and Mathä (2005b), Martins (2005), Stahl (2005b) and the summary by Fabiani *et al.* (2005).

⁷ CPI evidence for the euro area is based on the analysis of a common basket of 50 product categories observed during the January 1996- January 2001 period. Corresponding figures for the US are based on a similar basket of 50 products when statistical information at the product category level was available (Bils and Klenow (2004)). PPI and survey evidence are based on more heterogeneous national samples, although results emerge consistently in all the euro area countries analysed.

sold in one particular outlet (in the case of CPI) or by one specific manufacturing firm (in the case of PPI). Examples of price trajectories taken from the Belgian CPI and Italian PPI datasets are given in Figure 1.

Such large datasets are particularly well suited for the analysis of the key features of price setting behaviour, since they have a comprehensive coverage of retail and manufacturing prices and are made up of a huge number of price quotes that extend over several years. This contrasts with the previous micro-studies⁸, which mostly focused on very specific products or markets, referred to the United States and analysed consumer prices only.

Figure 1 - Examples of individual price trajectories



Note : Actual examples of price trajectories, from the Belgian CPI and Italian PPI databases (See Aucremanne and Dhyne (2004) and Sabbatini (2005)). Prices are in Belgian Francs and Euro, respectively.

The third source of information stems from surveys of firms, following the seminal work by Blinder *et al.* (1998). In the surveys, performed by euro area national central banks (NCBs), more than 11,000 firms from 9 countries (Austria, Belgium, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain) were questioned about their price-setting practices. These qualitative data are complementary to the previous ones, since there are certain aspects of firms' pricing policies that can only be investigated on the basis of this information. In particular, firms' responses can provide insights into the relative importance of nominal versus real rigidities or the type of information set used in the revision of prices. Furthermore, survey analysis allows to empirically assess alternative theories on price

⁸ Cecchetti (1986) for consumer prices and Stigler and Kindhal (1970) and Carlton (1986) for producer prices are seminal papers in this area. Recently, Bils and Klenow (2004) for the US and Baharad and Eden (2004) for Israel have exploited similar consumer price data to the ones we use.

stickiness. Finally, survey results are also useful in cross checking the evidence obtained from quantitative databases⁹.

The remaining of the paper is organized as follows. Section 2 presents a set of stylised facts describing firms' price setting practices as they can be captured by the available quantitative data. Section 3 investigates different aspects of price-setting behaviour, dealing with issues such as time- and state dependency, asymmetries and factors underlying price stickiness. Finally, section 4 concludes and highlights implications for monetary policy.

2 Firms price setting practices: stylised facts

The following stylised facts emerge consistently in the different euro area countries investigated:

Fact 1 – Firms change their prices rather infrequently: on average around once a year.

Table 1 – Measures of price stickiness in the euro area and the US
(p.c. per month unless otherwise stated)

	Statistics	Euro area	US
CPI ¹	Frequency	15.1	24.8
	Average duration (<i>months</i>)	13.0	6.7
	Median duration (<i>months</i>)	10.6	4.6
PPI ²	Frequency	20.0	n.a
	Surveys ³	Frequency	15.9
NKPC ⁴	Average duration (<i>months</i>)	10.8	8.3
	Average durations (<i>months</i>)	13.5-19.2	7.2-8.4
Internet prices ⁵	Frequency	95.5	94.7

¹ Dhyne *et al.* (2005) for the euro area, Bils and Klenow (2004) for the US. Euro area refers to the aggregate of Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain. ² Vermeulen *et al.* (2005). Euro area corresponds to the aggregate of Belgium, Germany, Italy, Portugal and Spain. ³ Fabiani *et al.* (2005) for the euro area and Blinder *et al.* (1998) for the US. Euro area refers to the aggregate of Austria, Belgium, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain. Converted from original interval grouped figures ⁴ Gali *et al.* (2001, 2003). Estimates correspond to the GDP deflator and are converted from original quarterly figures. ⁵ Lünemann and Wintz (2005). Euro area corresponds to the aggregate of Germany, France and Italy and are converted from original daily figures.

On average, 15 p.c. of consumer prices (see Table 1) are changed in a given month in the euro area compared to 25 p.c. in the US (Bils and Klenow, 2004). Producer prices set in the euro

⁹ In this respect, it is worth mentioning that most surveyed firms sell their main product predominantly to other firms. This means that survey prices are closer to producer prices than to consumer prices.

area seem to be adjusted slightly more frequently than retail prices: around 20 p.c. of them are changed in a given month. These frequencies imply average price durations close to one year in the euro area, while the corresponding duration in the US is slightly above half a year. In addition, survey results show that in the euro area about two-thirds of firms do not change their prices more than once a year (Fabiani et al., 2005). These results are also consistent with the estimates of New-Keynesian Phillips curves for the euro area and the US by Gali et al. (2001, 2003). In contrast, Lünnemann and Wintr (2005) find that the frequency of price adjustment does not differ substantially between the US and the three largest euro area countries using Internet prices for a selection of product categories.

Several factors can be put forward to explain the discrepancy in the frequency of consumer price changes observed between the euro area and the US: (i) differences in the level and variability of inflation, (ii) in the structure and degree of competition of the distribution sector, (iii) in the methods followed by National Statistical Institutes to collect elementary prices, (iv) in the frequency and magnitude of cost and demand shocks, and (v) in the composition of the consumption basket. Next we briefly report a few facts underlying each of the above arguments.

First, both the level and the volatility of inflation was somewhat higher in the United States than in the euro area in the considered sample period (average monthly inflation was, respectively, 0.21 p.c. and 0.12 p.c. and its standard deviation 0.20 p.c. and 0.16 p.c.) and the frequency of price adjustment is found to be positively related to inflation and its variability. Second, small corner shops have a higher market share in euro area countries, while super and hypermarkets play a more substantial role in the US (Pilat, 1997) and available evidence suggests that large retailers change their prices more frequently¹⁰. The third factor is also relevant, particularly as regards the statistical treatment of sales and promotions: in the samples used, price changes due to sales were not considered in most euro area countries in contrast with the US. The fourth factor might also play a role, since the analysis of the frequency of price changes does not control for differences in cost shocks. To the extent that wage and other input prices are more flexible in the US, this could help explain the lower frequency of price changes in the euro area. Finally, the difference in the degree of price stickiness is unlikely to be due to differences in consumption patterns, as the expenditure share of the more flexible components of the HICP (see Table 2) is larger in the euro area compared to the US.

Fact 2 – Price adjustment is heterogeneous across sectors.

Large differences are observed across sectors in the frequency of price adjustment. As shown in Figure 1, firms that change their prices very frequently (e.g. almost on a continuous basis for gasoline products) coexist with those keeping their prices constant for relatively long periods.

Consumer price changes are relatively frequent for energy products (only refined petroleum products are considered) and unprocessed food (see Table 2). On the opposite, prices change very infrequently in the service sector and, to a lesser extent, for non-energy industrial goods. Processed food occupies an intermediate situation. The same ranking is also observed in the US.

As regards producer prices, energy and food products are also characterized by more frequent price changes, whereas capital goods and durables are the stickier components. It seems that the frequency of price changes decreases with the degree of sophistication of the product. Capital goods and products at the end of the production line (durables and non durables other than food) are characterised by less frequent price changes than food products and intermediate goods.

Table 2 – Frequency of price changes by type of goods (*in p.c per month.*)

CPI ¹	Unprocessed food	Processed food	Non-energy industrial goods	Energy	Services	
Euro area	28	14	9	78	6	
US	48	27	22	74	15	
PPI ²	Food	Durable goods	Consumer non durable non food	Energy	Intermediate goods	Capital goods
Euro area	26	10	12	70	22	9
Surveys ³	Goods	Trade	Other services			
Euro area	16	18	11			

¹ Dhyne *et al.* (2005) for the euro area, Bils and Klenow (2004) for the US

² Vermeulen *et al.* (2005)

³ Authors' calculations based on Fabiani *et al.* (2005)

¹⁰ See Baudry *et al.* (2004), Dias *et al.* (2004), Jonker *et al.* (2004) and Veronese *et al.* (2005)



Finally, survey evidence points out that prices of services other than trade are stickier than those for manufacturing goods and trade. Within trade, prices of food and energy change more frequently than for other goods or services, in line with CPI evidence¹¹.

Heterogeneity in the degree of consumer price flexibility is found by Hoffmann and Kurz-Kim (2005) to be related to the volatility of the respective input prices (wages, producer and import prices). In line with this result, Álvarez *et al.* (2005b), Álvarez and Hernando (2005) and Sabbatini *et al.* (2005) document that differences in the cost structure across sectors help explain differences in the degree of price flexibility. Specifically, it is found that labour intensity negatively affects the frequency of price adjustments, given that wages are typically changed once a year, whereas the share of intermediate goods (e.g. energy) in overall inputs affects it positively. Survey evidence in Álvarez and Hernando (2005) also shows that sectors in which the perceived degree of competition is high feature less sticky prices (See Section 3 below). Similarly, Lünemann and Mathä (2005a) report that the larger the number of competitors a supermarket has the higher the frequency of price adjustment, whereas a larger market share reduces the frequency of price reductions.

Fact 3 – Price decreases are common.

Price changes occur infrequently in the euro area but this is not due to generalised downward nominal rigidities (see Table 3). As regards micro CPI data, around 40 p.c. of the price changes observed in a given month are price decreases and a share of 45 p.c. of price decreases is found with micro PPI data. This somewhat surprising fact is in line with the evidence obtained by Klenow and Kryvstov (2005) for the US and characterises all euro area countries. The higher price stickiness observed in the euro area compared to the US is, therefore, not the result of an excess of downward nominal price rigidity.

Nevertheless, it has to be pointed that although there is not general evidence in favour of downward price rigidity, large sectoral discrepancies are again observed. Particularly, price decreases are relatively uncommon in the service sector, where only 1 price change out of 5 is a price reduction (Dhyne *et al.*, 2005). This may reflect that variable costs for services are rarely reduced, reflecting the intensive use of labour in services and the fact that wages do not go down frequently.

¹¹ See Álvarez and Hernando (2005).

Table 3 – Occurrence and size of price increases and price decreases

	CPI ¹	Euro area	US
Price increases	Frequency (<i>in p.c per month.</i>)	8.3	16.1
	Average size (<i>in p.c per month.</i>)	8.2	12.7
Price decreases	Frequency (<i>in p.c per month.</i>)	5.9	13.2
	Average size (<i>in p.c. per month</i>)	10.0	14.1
PPI ²			
Price increases	Frequency (<i>in p.c per month.</i>)	11.0	
Price decreases	Frequency (<i>in p.c per month.</i>)	9.0	

¹ Dhyne *et al.* (2005) for the euro area, Klenow and Kryvstov (2005) for the US

² Vermeulen *et al.* (2005)

Facts 4 – Price changes, when they occur, are sizeable.

When prices change, they are changed by a large amount. Thus, on average, consumer price increases have a size of 8.2 p.c., with 10 p.c. being the size of the average price cut. In the US the size of consumer price decreases is also slightly larger than that of price increases. Based on evidence presented in Vermeulen *et al.* (2005), it seems that the typical size of producer price increases and decreases are smaller than the figures for comparable consumer prices.

With regard to the sectoral dimension, we observe in the unprocessed food sector not only frequent but also very large price changes (see Dhyne *et al.* (2005)). Furthermore, price increases and decreases tend to offset each other, since the frequency and the size of price increases and decreases are almost identical. This suggests that prices in this sector are driven largely by supply-side factors related to the seasonal nature of many unprocessed food items.

Energy prices change very often but by a limited amount in most countries. This is consistent with the pronounced variability of marginal costs (oil prices) and the large incidence of indirect taxation on these products.

3 The mechanics of price-setting

In this section, we analyse price-setting practices of firms in the euro area, drawing on the evidence from surveys (Fabiani *et al.*, 2005) and from various econometric analyses conducted using quantitative price data.

3.1 Competition and price-setting rules

The degree of market competition is a key factor in firms' pricing strategies. In a market with perfect competition, prices are set at a unique market clearing level, which equals marginal costs and there are no mark-ups. Thus, price rigidities after shocks do not arise. Price stickiness is thus only possible in the presence of some departure from perfect competition. Under the New-Keynesian sticky price models framework, firms are assumed to operate in monopolistic markets. Survey results show that, even though the majority of firms seem to operate in a highly competitive environment, most of them still possess some degree of price-setting autonomy. Indeed, as shown in Table 4, mark-up pricing is the dominant pricing rule identified in the euro area: Fabiani *et al.* (2005) find that, using GDP weights, 54 p.c. of euro area firms report to follow such a rule. Furthermore, as expected, the use of mark-up pricing increases as the perceived level of competition goes down.

In addition, survey results show that firms facing strong competitive pressures – proxied by the importance they attached to competitors' price changes – tend to adjust their prices more frequently¹².

Table 4 - Survey evidence on price setting

(mean scores, unless otherwise stated)

Use of price setting rules (percentages)	
Markup	54
Competitors' price	27
Other	18
Importance of factors driving price increases	
Costs of raw materials	3.0
Labour costs	3.0
Competitors' price	2.4
Demand	2.2
Financial costs	2.2
Importance of factors driving price decreases	
Costs of raw materials	2.5
Labour costs	2.1
Competitors' price	2.8
Demand	2.5
Financial costs	1.9

Source: Fabiani *et al.* (2005)

Note: Mean scores correspond to a scale from 1 (not important) to 4 (very important)

3.2 Asymmetries in price reaction to shocks

There is some empirical evidence that price responses are sensitive to the nature and direction of shocks hitting the economy¹³. Survey analysis provides evidence not only on the relative

¹² Other measures, such as the number of competitors in the main market or the market share, were also analysed but they were considered as poor indicators of how firms' behaviour is affected by the degree of competition.

importance of various factors driving price changes and whether there are asymmetries in price reactions to the direction of shocks but also on the speed of price responses to different types of shocks. Regarding the former, cost shocks are more relevant in driving prices upwards than downwards, while changes in market conditions (in demand and competitors' prices) matter more for price decreases. Fabiani *et al.* (2005) provide evidence that labour and raw materials costs are the most important factors driving prices upward (see Table 4), while these factors rank fourth and second in explaining price decreases. With regard to market conditions, the surveys show that the competitor's price is the most important factor explaining price decreases, while it ranks third among the explanations for price increases. In addition, firms in highly competitive markets are more likely to respond to shocks, in particular to those affecting demand.

As to the time dimension of price responses, Fabiani *et al.* (2005) conclude that the time lag of the median firm for a price reaction after a shock lies between 1 and 3 months. This is broadly in line with a mean lag of around 3 months reported by Blinder *et al.* (1998) for the US. Furthermore, on the basis of information coming from the mean lag of a price reaction to four different types of shocks (cost and demand shocks, both positive and negative), Blinder *et al.* (1998) conclude that there is no evidence that prices (i) adjust faster upward than downward, and (ii) respond more rapidly to cost shocks than to demand shocks. The findings in the euro area are in line with those obtained for the US.

3.3 Time-dependent versus state-dependent price reviewing

In the theoretical literature time-dependent and state-dependent rules are considered for modelling price-setting behaviour.¹⁴ In the presence of shocks, time-dependent rules might lead to stickier prices than state-dependent ones.

When looking at the micro price datasets there are several indications for the presence of both rules, although it is difficult to clearly distinguish between the two. In all countries, there is clear evidence that prices exhibit a seasonal pattern: prices are more likely to be changed in the first quarter, especially in January, or after the summer, especially in September.

¹³ For instance, Peltzman (2000) shows that prices respond asymmetrically to positive and negative cost changes.

¹⁴ Under time-dependent rules, prices are reviewed at discrete time intervals, which are independent of the state of the economy and can be either fixed as in Taylor (1980) or stochastic as in Calvo (1983). As opposed to time-dependent rules, in state-dependent rules the timing of price reviews is endogenous and firms decide to review their prices only when there is a sufficiently large shift in market conditions, as in Sheshinski and Weiss (1977) or Dotsey, King and Wolman (1999).

However, this pattern itself does not discriminate between rules, as the observed behaviour could reflect changes in costs or in demand, which are subject to seasonal patterns as well, or be related to time-dependent behaviour of price setters. This is also corroborated by the evidence coming from survey analysis, where firms were directly asked whether their prices are predominantly reviewed at a well-defined frequency or in response to market conditions. The results show that firms in the euro area apply both time and state dependent rules (see Table 5): around one-third of them follow pure time-dependent rules whereas the remaining two-thirds use pricing rules with some elements of state-dependency. Among this last group of firms those applying a mixed strategy, i.e. that follow time-dependent rules but switch to state-dependent ones in the event of specific circumstances, are predominant (46 p.c. of total firms). These findings are in line with those obtained by Blinder *et al.* (1998) that report that in the United States the share of firms following time-dependent rules is 40 p.c.

Additional evidence supporting the use of state-dependent pricing strategies comes from quantitative data on consumer and producer prices. For instance, Dhyne *et al.* (2005) report that the frequency of price adjustment or the probability of price change is generally found to be influenced by sectoral or aggregate price or wage developments. It is also systematically found to be affected by changes in indirect taxation and the euro-cash changeover.

Table 5 - Survey evidence on price reviewing

(percentages)			
Price reviewing rules		Information set used in price reviews	
Time-dependent	34	Rule of thumb	n.a.
State-dependent	20	Past and present	34
Both	46	Present and future	48
		Past, present and future	n.a.

Source: Fabiani *et al.* (2005)

3.4 The role of information in pricing behaviour

One unresolved issue in macroeconomic theory is whether inflation should be modelled primarily as a backward-looking variable, as in the so-called traditional expectations-augmented Philips Curve, or as a forward-looking variable, as in New Keynesian Philips Curve (NKPC). In this debate, the main point lies in the short run behaviour of inflation and its implications for monetary policy (see, for instance, Galí *et al.*, 2001). The unsettled nature of this issue has led some authors to prefer hybrid versions of the Phillips Curve that also include backward-looking terms (see, for instance, Fuhrer, 1997).

Survey analysis, by asking firms directly about the information set they take into account when reviewing their prices, can help assess the relative relevance of the two paradigms. According to the evidence collected, around half of the interviewed firms (48 p.c.) review their prices taking into account a wide range of information, which includes expectations about future economic developments¹⁵. However, one-third of firms build their price decisions without looking to economic forecasts. This is important evidence since departures from fully optimising behaviour could be an additional source of stickiness in the response of inflation to shocks. Further evidence that firms do not follow a fully optimising behaviour when reviewing their prices is available for Belgium, Luxembourg, Portugal and Spain: around 30% of firms indicate that a “rule of thumb” (e.g. indexation based on the consumer price index or on wage growth) is used.

3.5 The main theories of price stickiness

In the various national surveys, firms were also asked directly about the reasons which prevent prompt adjustment of their prices. Each option, explained in a language that could be easily understood, aimed at capturing one of the most common theories of sticky prices¹⁶. The theory of “implicit contracts” ranks first among the explanations (see Table 6) underlying price stickiness. It is based on the idea that firms want to establish a long-run relationship with their customers in order to make their future sales more predictable. To do so, they try to win customers’ loyalty by changing their prices as rarely as possible. Customers are attracted by stable prices because it helps them to minimise search costs (e.g. shopping time). This empirical result is consistent with others found in the surveys, in particular with the fact that most of the firms (70 p.c.) reported that they have a long-term relationship with their customers and may also explain why firms are more likely to increase their prices in response to cost shocks than to demand shocks, as they try not to jeopardise customer relationships.

¹⁵ The question asked by Blinder et al. (1998) for the US relates only to the role of inflation forecasts in firms’ price setting. They found that half of respondents never take into account economy-wide inflation forecasts when setting their prices.

¹⁶ A detailed description of each theory as well as their rankings can be found in Fabiani *et al.* (2005).

Table 6 – Theories of price stickiness

	Euro area (mean score)	US (ranking)
Implicit contracts	2.7	4
Explicit contracts	2.6	5
Cost-based pricing	2.6	2
Co-ordination failure	2.4	1
Judging quality by price	2.1	12
Temporary shocks	2.0	
Change non-price factors	1.7	3
Menu costs	1.6	6
Costly information	1.6	
Pricing thresholds	1.6	8

Sources: Euro area: Fabiani *et al.* (2005). US: Blinder *et al.* (1998)

Other explanations underlying price stickiness considered as important by the interviewed firms were explicit contracts which are costly to renegotiate, marginal costs that vary too little when costs are an important determinant in firms' pricing decisions (cost-based pricing) and coordination failure problems arising from the preference of firms not to change prices unless their competitors do so. In contrast, alternative explanations of price stickiness such as menu costs, pricing thresholds and costly information were not considered very relevant by respondents. These results are in line with previous studies (Apel *et al.*, 2005, Amirault *et al.*, 2005, Blinder *et al.*, 1998, Hall *et al.*, 1997). However, it is interesting to note that the existence of implicit or explicit contracts as a source of price stickiness is considered somewhat less important in the US (Blinder *et al.*, 1998) than in the euro area. This could also partly explain the higher frequency of price changes observed in the US.

Finally, it is worth noting that price adjustment takes place in two steps, namely a price *review* and a price *change*. The four theories indicated by firms as the main explanations underlying price stickiness concern the second stage of price setting, suggesting that the main impediments for more frequent price adjustments lie at the stage in which firms consider the possibility of changing the price, without necessarily taking any action. Indeed, the theory of "costly information", namely the costs associated with the gathering and processing information for pricing decisions at the first stage of price adjustment, received the lowest score in the euro area surveys.

4 Conclusions

The research summarized in this paper has produced numerous new empirical results on the characteristics and determinants of price-setting in the euro area. Three of the most noticeable are the following. First, prices in the euro area are sticky and considerably than in the US.

Second, there is no apparent general downward price rigidity: around 40 p.c. of price changes are decreases, although there exist important sectoral differences (in particular in services this share is around 20 p.c.). Third, price-setting in practice cannot be easily reconciled with one simple model given the evidence of heterogeneity and of asymmetries. As regards the factors driving price stickiness, the relevance of some theoretical explanations is confirmed by survey analyses (explicit contracts, marginal costs and coordination failure); others, instead, are judged much less relevant by firms (menu costs, pricing thresholds and costly information).

Regarding monetary policy, the first finding has two implications. On the one hand, a longer duration of price spells is expected to reduce the impact of adverse shocks on inflation. On the other hand, assuming a positive relationship between price rigidity and inflation persistence, a given deviation of inflation from target requires a stronger reaction of monetary policy to stabilize inflation under sticky prices than under flexible prices. The second finding suggests that the Eurosystem can in the long run pursue a low inflation target without impeding real price adjustments. The implications of the third finding are likely to be more involved, which suggests that studying optimal monetary policy under asymmetry and heterogeneity is an important research avenue.

References

- Álvarez, L. J. and I. Hernando, (2004), "Price Setting Behaviour in Spain. Stylised Facts Using Consumer Price Micro Data", *ECB Working Paper Series* No 416.
- Álvarez, L. J. and I. Hernando, (2005), "The price setting behaviour of Spanish firms: evidence from survey data", *ECB Working Paper Series* No ///
- Álvarez, L. J., Burriel, P. and I. Hernando, (2005a), "Do Decreasing Hazard Functions Make Sense?", *ECB Working Paper Series* No 461.
- Álvarez, L. J., Burriel, P. and I. Hernando, (2005b), "Price-setting behaviour in Spain: evidence from micro PPI data", *ECB Working Paper Series* No 522
- Amirault, D., Kwan, C. and G. Wilkinson (2004), "A survey of the price-setting behaviour of Canadian companies", *Bank of Canada Review*, Winter 2004-2005, pp. 29-39.
- Angeloni, I.; Aucremanne, L.; Ehrmann, M.; Galí, J.; Levin, A. Y Smets, F. (2005): "New evidence on inflation persistence and price stickiness in the euro area: implications for macro models and policy". Paper presented at the 20th Congress of the European Economic Association.
- Apel, M., R. Friberg and K. Hallsten (2005), "Micro foundations of macroeconomic price adjustment: survey evidence from Swedish firms", *Journal of Money, Credit, and Banking*, 37(2), pp. 313-338.
- Aucremanne, L. and E. Dhyne (2004), "How Frequently Do Prices Change? Evidence Based on the Micro Data Underlying the Belgian CPI", *ECB Working Paper Series* No 331.
- Aucremanne, L. and E. Dhyne (2005), "Time-dependent versus State-dependent Pricing: A Panel Data Approach to the Determinants of Belgian Consumer Price Changes.", *ECB Working Paper Series* No 462.
- Baharad, E. and B. Eden. (2004) "Price Rigidity and Price Dispersion: Evidence from Micro Data", *Review of Economic Dynamics*, 7 pp. 613-641.
- Baudry, L., Le Bihan H., Sevestre, P. and S. Tarrieu (2004), "Price Rigidity- Evidence from French CPI micro-data", *ECB Working Papers Series* No 384.
- Baumgartner, J., E. Glatzer, F. Rumler and A. Stiglbauer (2005), "How Frequently Do Consumer Prices Change in Austria? Evidence from Micro CPI Data", *Oesterreichische Nationalbank*, mimeo.
- Bils, M, and P. Klenow (2004), "Some evidence on the importance of sticky prices", *Journal of Political Economy* 112, pp. 947-985.
- Blinder, A.S., E. Canetti, D.E. Lebow and J.B. Rudd (1998), *Asking about prices: a new approach to understanding price stickiness*, Russell Sage Foundation, New York.
- Calvo, G. (1983), "Staggered Prices in a Utility Maximizing Framework", *Journal of Monetary Economics*. Vol. 12, pp. 383-98.
- Carlton, D. (1986), "The rigidity of prices", *American Economic Review*, 76, pp. 637-658.
- Cecchetti, S. (1986), "The frequency of price adjustment: a study of the newsstand prices of magazines", *Journal of Econometrics*, 31, 255-274.
- Dhyne, E., L. Álvarez, H. Le Bihan, G. Veronese, D. Dias, J. Hoffman, N. Jonker, P. Lünemann, F. Rumler and J. Vilmunen (2005), "Price setting in the euro area: some stylised facts from individual consumer price data", *ECB Working paper* n° ///

- Dias, D., C. Robalo Marques, and J. M. C. Santos Silva (2005), "Time or State Dependent Price Setting Rules? Evidence from Portuguese micro data", *Banco de Portugal*, mimeo.
- Dias, M., Dias, D., and P. Neves (2004), "Stylised Features of Price Setting Behaviour in Portugal: 1992-2001", *ECB Working Paper Series No 332*.
- Dossche, M. (2005), "The Patterns of Price Setting in the Belgian Manufacturing Industry", *National Bank of Belgium*, mimeo
- Dotsey, M., R. King and A. Wolman (1999), "State-dependent pricing and the general equilibrium dynamics of money and output", *Quarterly Journal of Economics*, Vol. 114, pp. 655-690.
- Fabiani S., M. Druant, I. Hernando, C. Kwapil, B. Landau, C. Loupias, F. Martins, T. Mathä, R. Sabbatini, and A. Stokman (2005), "The pricing behaviour of firms in the Euro Area: new survey evidence", forthcoming *ECB Working Paper*.
- Fabiani, S., A. Gattulli and R. Sabbatini (2004), "The pricing behaviour of Italian firms: new survey evidence on price stickiness", *ECB Working Paper No 333*.
- Fougère, D., Le Bihan H. and P. Sevestre (2005), "Heterogeneity in Price Stickiness: a Microeconomic Investigation", forthcoming *ECB Working Paper*.
- Fuhrer, J. C. (1997), The (Un)importance of Forward Looking Behavior in Price Specifications, *Journal of Money, Credit, and Banking*, 29(3), pp 338-350.
- Galí, J., M. Gertler and D. López-Salido (2001), "European inflation dynamics", *European Economic Review*, Vol. 45, pp. 1237-1270.
- Galí, J., M. Gertler, and D. López-Salido (2003), "Erratum to European Inflation Dynamics [European Economic Review 45 (2001), 1237-1270]", *European Economic Review*, 47(4), 759-760.
- Hall, S., M. Walsh and A. Yates (2000), "Are UK companies' prices sticky?", *Oxford Economic Papers*. Vol. 52, pp. 425-46.
- Hoeberichts, M. and A. Stokman (2005), "Pricing behaviour of Dutch companies: main results from a survey", *De Nederlandsche Bank*, mimeo.
- Hoffmann, J. and J.-R. Kurz-Kim (2005), "Consumer price adjustment under the microscope: Germany in a period of low inflation", *Deutsche Bundesbank*, mimeo.
- Jonker, N., Blijenberg H. and C. Folkertsma (2004), "Empirical analysis of price setting behaviour in the Netherlands in the period 1998-2003 using micro data ", *ECB Working Paper No 413*.
- Klenow, P. and O. Kryvtsov (2005), "State-Dependent or Time-Dependent Pricing: Does it Matter for Recent U.S. Inflation?", mimeo
- Kwapil, C., J. Baumgartner and J. Scharler (2005), "The price-setting behavior of Austrian firms: some survey evidence", *ECB Working Paper No 464*.
- Loupias, C. and R. Ricart (2004), "Price setting in France: new evidence from survey data", *ECB Working Paper No 423*.
- Lünnemann, P. and T. Mathä (2005a), "Consumer Price Behaviour in Luxembourg: Evidence From Micro CPI data", forthcoming *ECB Working Paper*.
- Lünnemann, P. and T. Mathä (2005b), "New survey evidence on the pricing behaviour of Luxembourg firms", *Banque Centrale du Luxembourg*, mimeo.
- Lünnemann, P. and L. Wintr (2005): "Are Internet Prices Sticky?", mimeo

- Martins, F. (2004), "The price setting behaviour of Portuguese firms: evidence from survey data", *Banco de Portugal*, mimeo.
- Peltzman, S. (2000), "Prices rise faster than they fall", *Journal of Political Economy*, Vol. 108, no. 3, pp. 466-502.
- Pilat, Dirk (1997), "Regulation and Performance in the Distribution Sector", *OECD Economics Department Working Paper No 180*
- Sabbatini, R, Fabiani S., Gattulli A. and G. Veronese, (2005), "Producer price behaviour in Italy : Evidence from micro PPI data", *Banca d'Italia*, mimeo
- Sheshinski, E. S., and Y. Weiss (1977), "Inflation and Costs of Price Adjustment", *Review of Economic Studies*. Vol. 44, pp. 287-303.
- Stahl, H. (2005a), "Producer Price Adjustment at the Micro Level: Evidence from Individual Price Records Underlying the German PPI", *Deutsche Bundesbank*, mimeo.
- Stahl, H. (2005b), "Price setting in German Manufacturing: New Evidence from New Survey Data", *Deutsche Bundesbank*, mimeo.
- Stigler, G. and J. Kindhal (1970), *The Behavior of Industrial Prices*, NBER General Series, No. 90, New York: Columbia University Press.
- Taylor, J. B., (1980), "Aggregate Dynamics and Staggered Contracts", *Journal of Political Economy*. Vol. 88 (1), pp. 1-23.
- Taylor J. (1999), "Staggered price and wage setting in macroeconomics", *Handbook of Macroeconomics*, vol. I, J. Taylor and M. Woodford, ed. chapter 15.
- Vermeulen P. *et al* (2005), "Price setting in the euro area: some stylised facts from individual producer price and survey data", ECB, mimeo.
- Veronese G, S. Fabiani, A. Gattulli. and R. Sabbatini (2005), "Consumer Price Behaviour In Italy: Evidence From Micro CPI Data", *ECB Working Paper No 449*.
- Vilmunen, J. and H. Laakkonen (2005), "How Often Do Prices Change in Finland ? Evidence from Micro CPI Data", *Suomen Pankki*, mimeo.

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