

# Inflation persistence and price-setting in the euro area: results of the Eurosystem Inflation Persistence Network

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## Introduction

With the conduct of a single monetary policy for all the participants of the Eurosystem and the operation of the monetary union among the twelve Member States, both the ECB and the National Central Banks (NCBs) need to increase their understanding of the economic mechanisms at work within the euro area. One of the ways in which that need is being met consists in the establishment of temporary research networks, conducting a coordinated analysis of monetary policy issues. Thus, in 2003 the Eurosystem Inflation Persistence Network (IPN) – a temporary network of researchers from the ECB and the NCBs – was established for the purpose of joint research on inflation persistence and price-setting mechanisms.

Intuitively, inflation persistence is defined as the speed at which inflation returns to its long-run equilibrium value, following a shock; that long run value is determined by the inflation target – explicit or not – set by the monetary authorities. For a central bank whose main objective is to aim at a particular inflation rate, the knowledge of the degree of inflation persistence is a key factor determining the scale of its response to economic shocks. Apart from examining inflation persistence, the IPN also analysed the behaviour of firms in terms of their pricing policy, as the way firms set their prices has some impact on the aggregate pattern of prices and on the conduct of monetary policy. For example, the degree of price rigidity, which is an inverse function of the frequency at which firms adjust their prices, is one of the factors determining how quickly the economy reacts to a shock. Similarly, the

degree of downward price rigidity is one of the parameters influencing the optimal inflation rate.

The aim of this article is to present a summary of the main results produced by the IPN and their main implications for monetary policy. It is structured as follows. The first two sections describe the scale, determinants and consequences of inflation persistence. After defining the concept of inflation persistence, the first section presents an analytical breakdown of inflation, pinpointing the various potential sources of persistence and their potential implications for monetary policy. The second section presents a summary of the results obtained by means of econometric analyses conducted at macroeconomic level (at the euro area level or at the level of each individual Member State) and at sectoral level.

The third section discusses the results concerning price-setting behaviour. This section is based on analysis of various types of microeconomic data not previously used for research purposes. In particular, it summarises the results obtained by analysing the individual price surveys, which are conducted by the various national statistical institutes for the purpose of compiling consumer and producer price indices, or specific surveys on the pricing behaviour of firms.

Finally, section 4 presents the various general conclusions and implications for monetary policy drawn by the IPN.

## Box 1 – The Eurosystem Inflation Persistence Network (IPN)

The IPN is a network of researchers from each of the twelve NCBs in the euro area, the ECB and the academic world. Set up in 2003, this network has examined inflation persistence and the pricing behaviour of firms within the euro area using a wide range of information, some of which was not accessible for research purposes before the establishment of this network.

### THE VARIOUS TYPES OF DATA AVAILABLE IN THE IPN

	Macroeconomic and sectoral data	Microeconomic data		Specific surveys
		Consumer prices	Producer prices Quantitative / Qualitative	
Germany .....	Yes	Yes	Yes / Yes	Yes
Austria .....	Yes	Yes	/	Yes
Belgium .....	Yes	Yes	Yes /	Yes
Spain .....	Yes	Yes	Yes /	Yes
Finland .....	Yes	Yes	/	
France .....	Yes	Yes	/ Yes	Yes
Greece .....	Yes		/	
Ireland .....	Yes		/	Yes
Italy .....	Yes		Yes /	Yes
Luxembourg .....	Yes	Yes	/	Yes
Netherlands .....	Yes	Yes	/	Yes
Portugal .....	Yes	Yes	Yes /	Yes
Euro area <sup>(1)</sup> .....	100 p.c.	97 p.c.	85 p.c.	94 p.c.

(1) Percentage of the euro area covered.

This network was created in response to the results of a previous research network which analysed the monetary policy transmission mechanisms within the euro area. The results produced by that network, the Monetary Transmission Network (MTN), had included the following finding: the effects of a monetary policy decision on the output of the euro area reach their peak – as in the United States – after 4 to 6 quarters, before fading relatively quickly, whereas the effect on prices is more gradual but permanent. However, the response of prices in the euro area is both slower and less marked than in the United States. This slower response by prices to a change in monetary policy was interpreted as being due to greater price rigidity and/or stronger inflation persistence in the euro area compared to the United States.

The IPN was therefore given the task of assessing the importance of the degree of inflation persistence in the euro area and analysing its causes and implications for the conduct of monetary policy. The members of the IPN were also asked to analyse the pricing behaviour of firms. For that purpose, the IPN used a range of empirical approaches and summarised the various results obtained by means of a meta-analysis. This diversity of method is reflected in particular in the range of data analysed.



First, the IPN conducted a series of macroeconomic analyses, some covering the euro area and others covering the individual Member States. These analyses adopted either a univariate approach aimed at identifying the dynamic properties of the aggregate and/or sectoral time series relating to inflation,<sup>(1)</sup> or a multivariate approach based on analysis of the results obtained by econometric models and allowing detailed analysis of the inflation response following various types of shock.

Next, the IPN also conducted a series of statistical and econometric analyses based on quantitative microeconomic data permitting a description of the pricing behaviour of firms. These quantitative data come either from price surveys conducted by the national statistical institutes for the purpose of computing the consumer price index, or from the price surveys used to compute the producer price index. In all, several tens of millions of prices were analysed.

The consumer prices used were prices recorded at the outlet level, and refer to finished products sold to the final consumer. They were analysed in 10 countries (Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain) representing almost 97 p.c. of the GDP of the euro area.<sup>(2)</sup> The period covered by these data varies from one country to another, but generally covers the period from January 1996 to December 2001.

In the case of the producer prices, the data were collected directly from the producers and refer to finished or intermediate products sold to other firms. However, they were only analysed in 5 countries (Belgium, Germany, Italy, Portugal and Spain). The period examined also varies from one country to another. Most countries have data covering a period of at least 4 years during 1991-2004. However, in the case of Germany and France this quantitative analysis of producer prices was supplemented by an analysis of qualitative data obtained from the business surveys, as those surveys provide information on price movements observed at the level of firms. Despite the small number of countries for which quantitative or qualitative information was available on the movement in producer prices, they nevertheless represent almost 85 p.c. of the euro area's GDP, so that those data sets provide a relatively accurate picture of the behaviour observed in the euro area as a whole.<sup>(3)</sup>

Finally, the IPN also decided to conduct a specific survey of firms to obtain additional information on the way they set their prices. That survey, based on the American study by Blinder et al. (1998) and conducted on a decentralised basis by the NCBs, was carried out between January 2003 and December 2004 in 9 countries (Austria, Belgium, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain). The total number of firms questioned came to over 11,000.<sup>(4)</sup>

(1) For a detailed analysis of the Belgian data, see Aucremanne and Collin (2005).

(2) The analysis of the Belgian consumer price data has formed the subject of two articles by Aucremanne and Dhyne (2004, 2005). A fuller presentation of the findings obtained in the various participating countries is supplied in Dhyne et al. (2005).

(3) The detailed analysis of the Belgian producer prices is presented in Dossche and Cornille (2005). An as yet provisional summary of the findings for the euro area as a whole may be found in Vermeulen et al. (2005).

(4) The results relating to the Belgian section of the survey were presented in Aucremanne and Druant (2004, 2005). A detailed summary of the results of these surveys in the various participating countries was also presented in Druant (2005) and in Fabiani et al. (2005).

## 1. Inflation persistence: definition and sources

### 1.1 Definition of inflation persistence

As explained in the introduction, one of the IPN's main aims was to measure the speed at which inflation responds to a shock. The definition of persistence adopted by the network referred to the *tendency of inflation to converge slowly towards its long-run value following a shock*.

For a central bank which aims to keep inflation close to its long-run target level (explicit or not), the fact that inflation is slow to change is not a good thing if the observed inflation rate deviates from that target. If the economy has a high degree of inflation persistence, the observed inflation rate will deviate from that target over a long period. Moreover, if the monetary authorities wish to bring inflation down more quickly to its target level, they will have to take more vigorous action than in a low persistence situation.

It is important to note that the concept of inflation persistence adopted by the IPN explicitly refers to the response of inflation following a single shock and to the long-run value of inflation. This long-run value is assumed to be the inflation target explicitly or implicitly pursued by the monetary authorities. In regard to empirical application, that definition raises the issue that, in the past, that long-run value was not explicitly announced; moreover, it has probably varied over time.

Since this definition also refers to the response of inflation following a single shock, an economy with low inflation persistence affected by a series of shocks influencing inflation in the same direction could see its inflation rate deviate from the long-term value over a relatively long period, despite low inflation persistence. In that case, the period of deviation would not be due to the slow rate at which the shocks spread through the economy but to the unfortunate accumulation of shocks.

### Box 2 – Degree of persistence and inflation dynamics

The degree of inflation persistence is a measure of the speed at which inflation converges towards its long-run value. Traditionally, this measurement is taken by estimating the coefficient of correlation between the inflation observed in period  $t$  and the inflation observed in period  $t-1$ , i.e. the coefficient of autocorrelation of order 1 of the inflation series.

In order to illustrate the importance of this parameter for inflation dynamics, we shall assume that inflation can be described by the following equation:

$$\pi_t = (1 - \rho)\bar{\pi} + \rho\pi_{t-1} + u_t$$

This equation assumes that the inflation observed in time  $t$ ,  $\pi_t$ , is a linear combination of the inflation target pursued by the monetary authorities,  $\bar{\pi}$ , and the inflation rate observed during the previous period,  $\pi_{t-1}$ . It also suffers shocks  $u_t$  which are taken as zero on average, with constant variance, and are independent of the past values of the shocks. The coefficient  $\rho$ , which normally takes its value between 0 and 1, determines the degree of inflation persistence.

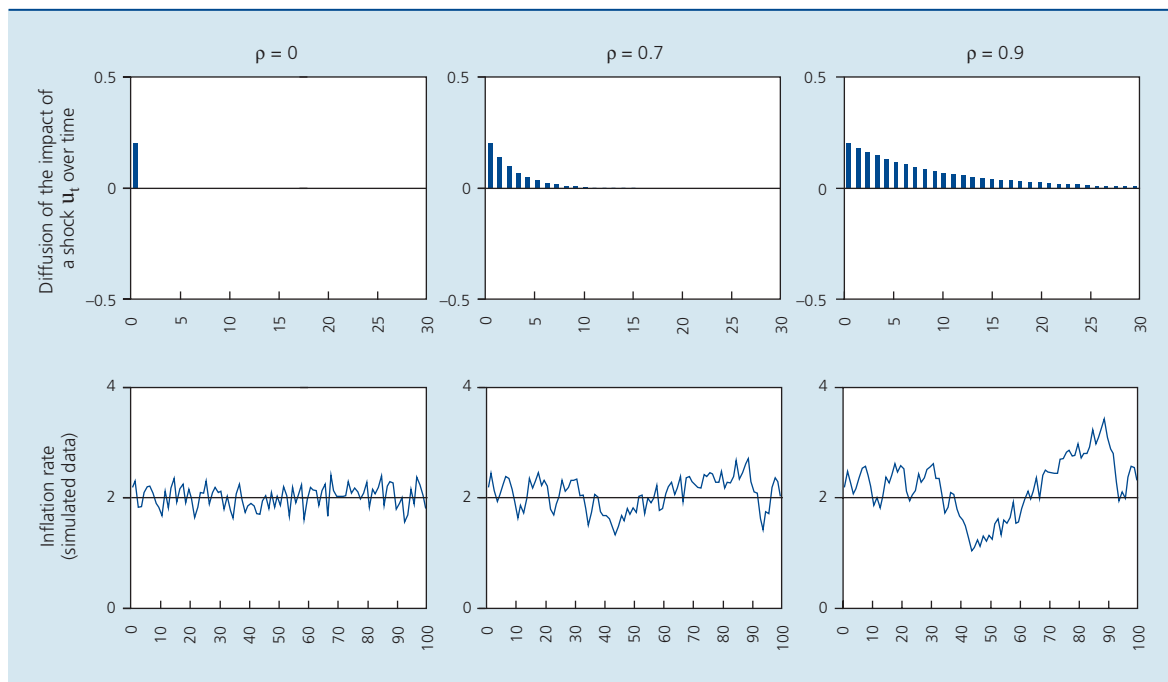
If the coefficient  $\rho$  is equal to 0, inflation at time  $t$  does not depend on its value in  $t-1$  and will randomly fluctuate around the inflation target. Conversely, the closer the coefficient  $\rho$  gets to 1, the more the inflation observed in  $t$  will be influenced by inflation in  $t-1$ . Therefore, the effects of a shock  $u_t$  will be felt over long periods, and inflation will be very slow to revert to its long-run equilibrium level. Moreover, the variability of inflation will increase with  $\rho$ . Inflation will therefore deviate not only persistently but also more significantly from the inflation target. In the extreme case, if the value of  $\rho$  is equal to 1, inflation will never revert to its long-run value following a shock. In that case, the pattern of inflation presents what the literature calls a unit root. When estimating the



equation presented above, it is important to check whether or not the unit root hypothesis is validated by the observations.

A more complex dynamic structure may be imposed by assuming that inflation is affected by its past values (t-1, t-2, t-3,...). In that case, the degree of persistence,  $\rho$ , is measured by the sum of all the coefficients associated with past inflation values.

#### INFLATION PERSISTENCE: AN ILLUSTRATION



The equation presented above is a reduced form of the structural representation of inflation used by the IPN. It can be used to measure the degree of persistence, but it cannot identify its sources.

### 1.2 Sources of inflation persistence

In order to identify the causes of inflation persistence, the IPN used a model of inflation known as the hybrid neo-Keynesian Philips curve (HNKPC). That representation combines the traditional representation of the Philips curve and what the literature calls the neo-Keynesian Philips curve. It can be used to identify the various sources of inflation persistence. In that framework, inflation is described by the following equation:

$$\pi_t = \delta_b \pi_{t-1} + \delta_f E_t[\pi_{t+1}] + \gamma X_t + \varepsilon_t$$

Firstly, inflation has a retrospective component, i.e. it is determined partly by earlier inflation levels ( $\pi_{t-1}$ ), as in the traditional Philips curve. This retrospective component of the HNKPC can be justified by the fact that some firms use indexation mechanisms to adjust their prices. This retrospective component of inflation is the source of what is referred to in the literature as *intrinsic inflation persistence*. Since the past inflation level partly determines the present inflation level, this component helps to slow down the rate at which inflation reverts to its long-run equilibrium value following a shock.

Secondly, inflation also has a prospective component, i.e. it is also partly determined by the inflation expectations of the economic agents ( $E_t[\pi_{t+1}]$ ), as in the neo-Keynesian Philips curve. That contribution of future inflation expectations towards determining the current level of inflation is not in itself a source of inflation persistence if those expectations are rational and are constantly adjusted by the economic agents. However, if the agents depart from the rational expectations hypothesis and fail to adjust their expectations continuously, that component may also become a source of persistence known as *expectations-based persistence*. If inflation expectations are very persistent, that persistence will also be reflected in a high degree of persistence in the observed inflation.

The credibility of monetary policy has a very specific influence on this form of persistence. If the economic agents are confident in the monetary authorities' ability to keep inflation close to the long-run target level, they will anchor their inflation expectations at a level close to that target. Conversely, if the inflation target is not credible, the economic agents are liable to anchor their expectations consistently at a level very different from that target. The impact of the prospective component of the HNKPC will therefore be to maintain inflation at a level close to its long-run equilibrium level if that is credible, or to deviate from that target if the economic agents are not confident in the Central Bank's ability to achieve its target inflation rate.

Thirdly, inflation is a function of the economic situation, and particularly the size of the *output gap* ( $X_t$ ), i.e. the difference between actual GDP and its potential value. The microeconomic basis of the HNKPC links current inflation to the deviations between actual marginal costs and their equilibrium value, deviations which are themselves a function of the output gap. This last component introduces a third source of persistence known as *extrinsic persistence*. This is the inflation persistence derived from the persistence observed in the deviations between real marginal costs and their long-run value, or the persistence of the output gap. If the deviations between output and its potential level are persistent, they will be reflected in persistent deviations between inflation and the long-run target set by the monetary authorities.

The contribution of this third component of inflation movements is determined by the value of the coefficient  $\gamma$ , which represents the slope of the neo-Keynesian Philips curve. This coefficient determines the sacrifice ratio confronting the monetary authorities in their battle against inflation: the lower this coefficient, the more restrictive monetary policy will need to be, and hence the greater its costs in terms of growth if inflation deviates from the

target. The degree of price stickiness on the goods and services market influences the value of this coefficient  $\gamma$ . Stickier prices mean that inflation is less sensitive to changes in the output gap, thus increasing the sacrifice ratio.

Finally, inflation is due to the occurrence of random shocks ( $\varepsilon_t$ ). These are assumed to be independent over time, so that they do not generate any persistence in inflation dynamics. However, as mentioned earlier, we may occasionally observe a succession of exceptional shocks affecting inflation in the same direction over a period of time, giving the false impression that inflation is deviating persistently from its long-run target.

It is important to mention that the value of the coefficient  $\delta_b$  of the HNKPC is less than or equal to the degree of inflation persistence based on the estimation of the reduced form presented in box 2. The coefficient  $\rho$  in fact reflects the overall degree of inflation persistence, whereas the coefficient  $\delta_b$  represents only the level of the intrinsic inflation persistence.

## 2. Inflation persistence: what can we learn from the macroeconomic and sectoral analyses?

This section presents a summary of all the IPN's findings concerning the degree of inflation persistence in the euro area. This section is therefore based on the econometric analysis of the inflation time series. As explained in box 2, the main measure of persistence used by the network is obtained from the sum of the coefficients associated with an autoregressive representation of inflation, i.e. an econometric representation which links current inflation to its past values. Other measures were also used, but that does not cause any fundamental change in the conclusions presented below. This section is based on the results presented by Altissimo et al. (2005), which were found consistently in the various countries analysed, regardless of the analysis method used.

### 2.1 Moderately persistent inflation

The observation of the pattern of inflation over the past 35 years appears to indicate that inflation is in fact a persistent phenomenon. Both in the euro area member countries and in the United States, inflation persisted at a relatively high level in the 1970s, before decreasing slowly and remaining steady at a relatively low level over the past ten years. If this pattern was due to a natural trend in inflation, i.e. assuming that there was no change in the

conduct of monetary policy over the past 30 years, that would in fact reflect a high degree of persistence.

That observation is confirmed by “naïve” estimates of the degree of persistence, i.e. estimates of the degree of persistence made under the assumption that the inflation target set by the monetary authorities remained constant over the past 30 years. In that context, the degree of inflation persistence varies from 0.74 to 1.04 in the euro area, depending on the study. A similar measure for the United States fluctuates between 0.65 and 1.03 (Altissimo et al., 2005). The majority of the studies present findings in the upper range of these intervals and do not reject the unit root hypothesis (i.e. that the degree of persistence is not significantly different from 1), which would imply that inflation never returns to its long-run level. A naïve estimate of the degree of inflation persistence in Belgium over the period from the 2nd quarter of 1978 to the 4th quarter of 2004 comes to 0.95, and also does not reject the unit root hypothesis (Aucremanne and Collin, 2005).

However, the pattern of inflation observed over the past 30 years did not occur without any change in monetary policy. To suppose that, in the 1970s, the central banks of the Eurosystem member countries had already set themselves the goal of maintaining the inflation rate in their respective countries at a level comparable to the ECB's current target is out of line with historical reality. In fact,

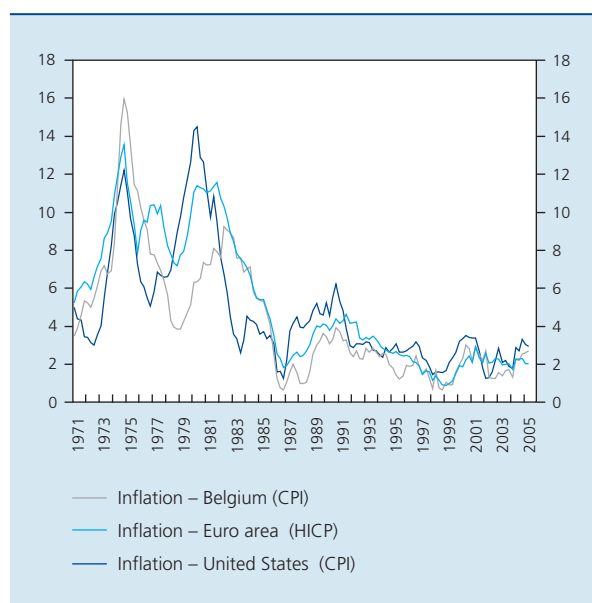
**TABLE 1** ESTIMATE OF THE DEGREE OF INFLATION PERSISTENCE

(Assuming a single monetary policy<sup>(1)</sup>)

	Belgium	Euro area	United States
Altissimo, Mojon and Zaffaroni (2004) <sup>(2)</sup> . . . . .		0.93	
Batini (2002) <sup>(3)</sup> . . . . .		<b>0.74</b>	
Gadzinski and Orlandi (2004) <sup>(4)</sup> . . . . .		[1.02; 1.04]	[0.92; 1.03]
O'Reilly and Whelan (2004) <sup>(5)</sup> . . . . .		0.96	
Robalo Marques (2004) <sup>(6)</sup> . . . . .		0.85	<b>0.66</b>
Levin and Piger (2004) <sup>(7)</sup> . . . . .			[0.65; 1.02]
Aucremanne and Collin (2005) <sup>(8)</sup> . . . . .	[0.95; 0.95]		

- (1) The persistence is measured by the sum of the coefficients of an autoregressive model of order p. The estimates in bold type indicate that the assumption that the sum of the coefficients is equal to 1 (unit root hypothesis) can be rejected.
- (2) Estimates based on the movement in the CPI from the 1st quarter of 1985 to the 1st quarter of 2004.
- (3) Estimates based on the movement in the HICP from the 3rd quarter of 1984 to the 2nd quarter of 2002.
- (4) Estimates for the euro area based on the movement in the GDP deflator, the CPI and the HICP and the underlying trend in inflation from the 2nd quarter of 1970 to the 3rd quarter of 2003. Estimates for the United States based on the movement in the GDP deflator, the CPI, the PCE and the underlying trend in inflation from the 2nd quarter of 1970 to the third quarter of 2003.
- (5) Estimates based on the movement in the GDP deflator and the HICP from the 1st quarter of 1970 to the 4th quarter of 2002.
- (6) Estimates for the euro area based on the movement in the CPI from the 1st quarter of 1984 to the 4th quarter of 2002. Idem for the United States.
- (7) Estimates based on the movement in the GDP deflator, the CPI, the PCE and the underlying trend in inflation from the 1st quarter of 1984 to the 4th quarter of 2003.
- (8) Estimates based on the movement in the CPI and the underlying trend in inflation from the 2nd quarter of 1978 to the 4th quarter of 2004.

**CHART 1** PATTERN OF INFLATION SINCE 1971  
(percentage change compared to the corresponding month in the previous year)



Sources: NSI, ECB, BLS.

during the period analysed, central banks both in the euro area member countries and in the United States progressively attached greater importance to price stability, and that led to changes in the monetary policy regime. For the euro area members, this was reflected sooner or later in a reduction in the implicit inflation target (for some of them this occurred by 1984, for others it took place during the 1990s), so that by the end of the 1990s there was convergence towards a target close to the one currently set by the ECB. These changes in the target were reflected in breaks in the average level of inflation.

If we take account of these breaks in the average level of inflation, the measures of the degree of inflation persistence are much lower. For the euro area, they range between 0.34 and 0.90, and for the United States between 0.27 and 0.89. Most of the estimates fall in the lower part of these ranges and reject the unit root hypothesis.

**TABLE 2** ESTIMATE OF THE DEGREE OF INFLATION PERSISTENCE(Assuming one or more changes in the monetary policy regime<sup>(1)</sup>)

	Belgium	Euro area	United States
Dossche and Everaert (2005) <sup>(2)</sup> . . . . .		<b>0.40</b>	<b>0.58</b>
Lünnemann and Mathä (2005) <sup>(3)</sup> . . . . .		<b>0.40</b>	
Gadzinski and Orlandi (2004) <sup>(4)</sup> . . . . .		[0.60 ; 0.90]	[0.52 ; 0.80]
Robalo Marques (2004) <sup>(5)</sup> . . . . .		<b>0.34</b>	<b>0.27</b>
Levin and Piger (2004) <sup>(6)</sup> . . . . .			[0.37 ; 0.89]
Aucremanne and Collin (2005) <sup>(7)</sup> . . . . .	[0.51 ; 0.79]		

(1) The persistence is measured by the sum of the coefficients of an autoregressive model of order  $p$ . The estimates in bold type indicate that the assumption that the sum of the coefficients is equal to 1 (unit root hypothesis) can be rejected.

(2) Estimates for the euro area based on the movement in the GDP deflator from the 2nd quarter of 1971 to the 4th quarter of 2003, assuming an inflation target variable over time. Idem for the United States.

(3) Estimates based on the movement in the HICP from the 2nd quarter of 1995 to the 4th quarter of 2000.

(4) Estimates for the euro area based on the movement in the GDP deflator, the CPI, the HICP and the underlying trend in inflation from the 2nd quarter of 1970 to the 3rd quarter of 2003, assuming a break in average inflation in 1993. Estimates for the United States based on the movement in the GDP deflator, the CPI, the PCE and the underlying trend in inflation from the 2nd quarter of 1970 to the third quarter of 2003, assuming a break in the mean in 1991.

(5) Estimates for the euro area based on the movement in the CPI from the 1st quarter of 1984 to the 4th quarter of 2002. Idem for the United States.

(6) Estimates based on the movement in the GDP deflator, the CPI, the HICP and the underlying trend in inflation from the 1st quarter of 1984 to the 4th quarter of 2003, assuming a break in the mean in 1991.

(7) Estimates based on the movement in the CPI and the underlying trend in inflation from the 1st quarter of 1993 to the 4th quarter of 2004.

These measures therefore seem to indicate that inflation is not an extremely persistent phenomenon. Moreover, the persistence does not seem to be much greater in the euro area than in the United States. However, it should be noted that while the estimates of the degree of inflation persistence – assuming changes in the conduct of monetary policy – are relatively low, they are relatively inaccurate.

Mention must be made of the fact that, for this last series of estimates, the dates of breaks in the average level of the inflation series analysed were not imposed in advance in order to coincide with changes in monetary policy, but were determined endogenously by econometric analysis of the data. However, ex post analysis made it possible to link the dates of these breaks with changes in monetary policy. In the case of the euro area Member States, breaks in the average level of inflation were detected either in the early 1980s (when the EMS started) or in the early 1990s (start of EMU, Maastricht Treaty convergence criteria). Furthermore, sectoral analyses conducted on French data (Bilke, 2005) and Belgian data (Aucremanne and Collin, 2005) showed that most sub-indices of sectoral inflation contained breaks in their average levels around certain dates. For France, the breaks coincided with the implementation of the “strong franc” policy in 1983, whereas in Belgium they coincided with the wage moderation policy which accompanied the devaluation of the Belgian franc in 1982. Finally, the analysis over a very long period of a set of nominal and real economic variables for some OECD countries (Corvoisier and Mojon, 2005) revealed that 3 waves of breaks in the mean – the first in the late

1960s/early 1970s, the second in the mid 1980s and the third at the beginning of the 1990s – had a synchronised effect on the nominal variables and not on the real variables, reinforcing the hypothesis that these breaks were linked to changes in monetary policy.

As regards the sources of inflation persistence, it should be noted that recent studies based on the estimation of hybrid neo-Keynesian Philips curves have shown that the influence of the retrospective component of the HNKPC has declined over time. For example, in the United States, Galí and Gertler (1999) showed that the contribution of the retrospective component became insignificant in favour of the prospective component when the recent period was analysed. Similarly, it has been shown that during the recent period, inflation in the euro area has become more prospective in character (Galí et al., 2001; Rumler, 2005). According to Paloviita (2004), the prospective character of inflation is actually reinforced if the process whereby the inflation expectations of the economic agents are formed may deviate from the rational expectations hypothesis. Such results indicate the extent to which preserving the credibility of the ECB’s inflation target is essential to maintain a relatively low inflation rate in the euro area. Any relaxation in the conduct of monetary policy leading to deterioration in inflation expectations could cause inflation to deviate persistently from its target.



## 2.2 Substantial international and sectoral variations

While the studies mentioned revealed a relatively moderate degree of persistence in the euro area, they also showed very substantial variations both between the various Member States and between the various components of the CPI.

As regards the variations between countries, the study by Gadzinski and Orlandi (2004) shows that the degree of persistence in the various Member States of the euro area ranges from 0.32 for Belgium to 1.03 for Austria. However, other studies (Cecchetti and Debelle, 2004; Lünemann and Mathä, 2004) obtain very different estimates. In fact, the ranking of the countries by degree of persistence varies from one study to another, making it very difficult to interpret the results.

In relation to the euro area, the results obtained for Belgium by Aucremanne and Collin (2005) differ little from those obtained by Gadzinski and Orlandi (2004). Aucremanne and Collin (2005) obtain an estimate of 0.51 for the degree of inflation persistence, when focusing their analysis on the past 12 years – a period for which the monetary policy regime can be taken as relatively stable. Conversely, the degree of persistence in the underlying trend in inflation in Belgium is still 0.79, but even in this case the unit root hypothesis is rejected.

This confirms the hypothesis that inflation persistence has been lower in the recent period, but also that these estimates are not very accurate. The negative degrees of persistence obtained for Belgium by Cecchetti and Debelle (2004) and by Lünemann and Mathä (2004) are difficult to interpret. Their results seem to be greatly influenced by the fact that the seasonal sales are taken into account, as these studies are based on the analysis of the HICP which incorporates from the 1st quarter of 2000 price movements due to the sales, whereas Aucremanne and Collin (2005) and Gadzinski and Orlandi (2004) use a measure of inflation based on the CPI which disregards the sales. For other countries, negative values for the degree of persistence were also obtained, probably for the same reason.

At the sectoral level, the findings are far more comparable. It seems that, for services and for non-energy industrial goods, inflation is more persistent than in the rest of the economy. However, that should not be interpreted as indicating that the central bank does not need to monitor inflation in the other components of the CPI (energy, unprocessed food). If second-round effects (such as the transmission of changes in energy prices to the prices of other products) were to cause the inflation associated with those components to be passed on to the more persistent components of inflation, that could cause inflation to deviate persistently from its medium/long-term target.

**TABLE 3** MEASURES OF INFLATION PERSISTENCE IN THE VARIOUS MEMBER STATES OF THE EURO AREA <sup>(1)</sup>

	Aucremanne and Collin <sup>(2)</sup>	Gadzinski and Orlandi <sup>(3)</sup>	Cecchetti and Debelle <sup>(4)</sup>	Lünemann and Mathä <sup>(5)</sup>
Belgium .....	<b>[0.51; 0.79]</b>	<b>0.32</b>	<b>-0.11</b>	<b>-0.33</b>
Germany .....		0.82	-0.34	-0.16
Greece .....		0.82		0.51
Spain .....		0.93	0.23	-0.50
France .....		0.54	0.25	0.49
Ireland .....		0.79		0.38
Italy .....		0.58	0.45	0.23
Luxembourg .....		0.47	-0.62	-0.17
Netherlands .....		0.44	-0.02	0.28
Austria .....		1.03	0.33	0.43
Portugal .....		0.49	0.45	0.31
Finland .....		0.47	0.30	0.07
Euro area .....		<b>[0.60; 0.90]</b>		

(1) The persistence is measured by the sum of the coefficients of an autoregressive model of order p. The estimates in bold type indicate that the assumption that the sum of the coefficients is equal to 1 (unit root hypothesis) can be rejected.

(2) Estimates based on the movement in the CPI and the underlying trend in inflation from the 1st quarter of 1993 to the 4th quarter of 2004.

(3) Estimates based on the movement in the HICP from the 1st quarter of 1984 to the 2nd quarter of 2003.

(4) Estimates based on the movement in the HICP from 1990 to 2003.

(5) Estimates based on the monthly movement in the HICP from January 1995 to December 2003.

**TABLE 4** MEASURES OF INFLATION PERSISTENCE BY COMPONENTS OF THE CPI<sup>(1)</sup>

	Belgium	Euro area
Unprocessed food .....	0.27	0.55
Processed food .....	0.22	0.61
Energy .....	0.43	0.44
Non-energy industrial goods ...	0.75	0.68
Services .....	0.69	0.53
CPI .....	0.51	0.87

Sources: Aucremanne and Collin (2005) for Belgium, Altissimo et al. (2004) for the euro area.

(1) The persistence is measured by the sum of the coefficients of an autoregressive model of order p.

These sectoral and international variations prompted the IPN to question the impact of aggregation on the measures of persistence. It appears that the aggregate inflation persistence in an individual country tends to exceed the average inflation persistence measured at the level of the various components of the CPI. Similarly, the degree of inflation persistence in the euro area is higher than the average of the degrees of inflation persistence in the various Member States. In fact, it emerged that in the aggregation of the inflation series, the aggregate inflation persistence stems primarily from the most persistent components.

### 3. Price-setting behaviour of firms: what can we learn from microeconomic analysis?

The object of this section is to summarise all the findings relating to the description of the price-setting behaviour of firms. This section is based on the articles by Álvarez et al. (2005), Dhyne et al. (2005), Fabiani et al. (2005) and Vermeulen et al. (2005).

As stated in section 1.2, the price adjustment frequency determines the slope of the HNKPC, which explains why the IPN is interested in this issue. However, the aim of the analyses conducted by the IPN was not only to depict the price adjustment frequency but actually to describe as accurately as possible the price dynamics observed at the level of the firms, and to understand its underlying reasons. Having gained access for the first time to both quantitative and qualitative microeconomic data, the IPN was able to address other questions which are equally important for the conduct of monetary policy. For example, the analysis of consumer or producer prices and the specific surveys on firms' pricing behaviour made

it possible to test certain microeconomic assumptions underlying the HNKPC. Among other things, these data permitted verification of whether the price changes were time-dependent as assumed by the majority of theoretical models, rather than being made in response to economic shocks. Similarly, the surveys made it possible to analyse the relative importance of the prospective and retrospective components of the HNKPC. The microeconomic data used by the IPN also allowed measurement of the scale of the nominal downward rigidity of prices, that form of rigidity having implications for the definition of the optimal inflation rate. Finally, the specific surveys allowed the main sources of price rigidity to be determined.

Analysis of these various questions is essential for designing macroeconomic models based on realistic assumptions regarding firms' behaviour. However, there is no point in analysing these questions except in a world where firms have enough market power to set the prices of their products more or less independently. In perfectly competitive markets, prices reflect all changes in marginal costs, and there are therefore no nominal price rigidities to be seen. Conversely, if monopolistic competition is the dominant feature of the economy, firms can adjust their prices with some delay and only partially following changes in their marginal costs. The monopolistic competition hypothesis is supported by the findings of the specific survey on firms' behaviour, as that survey showed that 54 p.c. of firms in the euro area considered that they had sufficient market power to apply a variable or fixed margin (Fabiani et al., 2005).

In all, the IPN conducted over thirty studies based on microeconomic data. The results below emerged consistently in the various Member States, regardless of the type of data, the period analysed and the methods of analysis used.

#### 3.1 Rather infrequent price changes

As regards the frequency of price changes, the microeconomic studies conducted on the basis of consumer prices indicated that firms operating in the euro area changed their prices less frequently than American firms. In any given month, only 15.1 p.c. of the prices of a sample of products representing the basket of goods and services making up the HICP were changed (Dhyne et al., 2005), compared to 24.8 p.c. in the United States (Bils and Klenow, 2004). This rate of price changes of 15.1 p.c. is reflected in the fact that, on average, the price of a product in the euro area is held constant for a period of 13 months, whereas that period is just under 7 months in the United States. The Belgian economy is in a situation very close to that of the euro area, since the frequency of

TABLE 5 MEASURES OF THE DEGREE OF PRICE RIGIDITY

	Price rigidity indicator	Belgium	Euro area	United States
CPI micro data <sup>(1)</sup> . . . . .	Frequency (in p.c. per month)	17.6	15.1	24.8
	Duration (in months) <sup>(5)</sup>	13.2	13.0	6.7
PPI micro data <sup>(2)</sup> . . . . .	Frequency (in p.c. per month)	20.0	20.0	n.
Specific survey <sup>(3)</sup> . . . . .	Duration (in months)	12.0	12.0	8.6
Macro – NKPC (GDP deflator) <sup>(4)</sup> . .	Duration (in months)		13.5 – 19.2	7.2 – 8.4

(1) Aucremanne and Dhyne (2004) for Belgium, Dhyne et al. (2005) for the euro area, Bils and Klenow (2004) for the United States.

(2) Dossche and Cornille (2005) for Belgium, Vermeulen et al. (2005) for the euro area.

(3) Aucremanne and Druant (2004, 2005) for Belgium, Álvarez et al. (2005) and Fabiani et al. (2005) for the euro area, Blinder et al. (1998) for the United States.

(4) Galí et al. (2001, 2003).

(5) For Belgium, this is a measure of the median duration based on a large sample of goods and services composing the CPI, whereas it is a measure of the average duration calculated on a sample of 50 products and services for the euro area and the United States.

price changes there is 17.6 p.c. and the median duration between two price changes is very close to the European average.

This relatively high level of consumer price rigidity is confirmed by the results of the specific surveys. Analysis of the answers to the specific surveys conducted in the various euro area Member States also shows that the median life span of a price in the euro area and in Belgium is close to 12 months (Fabiani et al., 2005), whereas it is less than 9 months in the United States (Blinder et al., 1998).

As regards adjustments to producer prices, the latter appear to be slightly more flexible than consumer prices. In fact, the average frequency of producer price changes in the euro area is 20 p.c., Belgium being in line with the euro area (Dossche and Cornille, 2005; Vermeulen et al., 2005). However, as similar information is unfortunately not available for the United States, it is not possible to conclude that the rigidity differential observed between the euro area and the United States, on the basis of the other data sources, partly disappears when focusing on the prices of products traded between firms.

These microeconomic assessments of the degree of price rigidity are in line with the estimates obtained on the basis of macroeconomic analyses by Galí et al. (2001; 2003), who assessed the average life span of prices in the euro area at between 13.5 and just over 19 months, whereas in the United States the figure was only between 7 and 8.5 months.

Various factors explain the difference in the frequency of price changes observed between the euro area and the United States. First, both the level and the variability of inflation were slightly higher in the United States during

the period analysed (January 1996 – December 2001). Second, small retailers still seem to hold a very important position compared to the super and hyper markets in the euro area, in comparison with the United States (Pilat, 1997). The results obtained in some euro area Member States show that the super and hyper markets change their prices significantly more often than the small retailers. Differences in statistical methodology are a third factor. In the majority of the euro area Member States, the data sets used take no account of price changes associated with sale periods, whereas those price changes are included in the American measures. A fourth explanation might lie in the greater variability of wages and input prices in the United States. Conversely, the analysis showed that this difference was not due to divergences in the structure of consumption between the euro area and the United States, as services – which are the most rigid component of the HICP – represent a larger share of consumption in the United States than in Europe. If the consumption structure had been the same, the price change frequency differential between the two areas would have been even greater.

### 3.2 Wide variations between sectors

The relatively low frequency of price changes observed at aggregate level in the euro area conceals considerable sectoral diversity. In some sectors, the degree of price flexibility is high or even very high. These sectors have a price change frequency of over 20 p.c., and even as high as 80 p.c. This applies to petroleum products and unprocessed foods in the case of consumer prices, and to energy, food products and intermediate goods in the case of producer prices. Conversely, certain product categories display very

**TABLE 6** FREQUENCY OF PRICE CHANGES BY PRODUCT TYPE  
(In p.c. per month)

	Consumer prices <sup>(1)</sup>					
	Unprocessed food	Processed food	Non-energy industrial goods	Energy (petroleum products)	Services	
Belgium .....	31	19	6	82	3	
Euro area .....	28	14	9	78	6	
United States .....	48	27	22	74	15	
	Producer prices <sup>(2)</sup>					
	Food	Consumer durables	Non-durable consumer goods	Energy	Intermediate goods	Investment goods
Belgium .....	18	13	18	n.	22	15
Euro area .....	26	10	12	70	22	9
United States .....	n.	n.	n.	n.	n.	n.

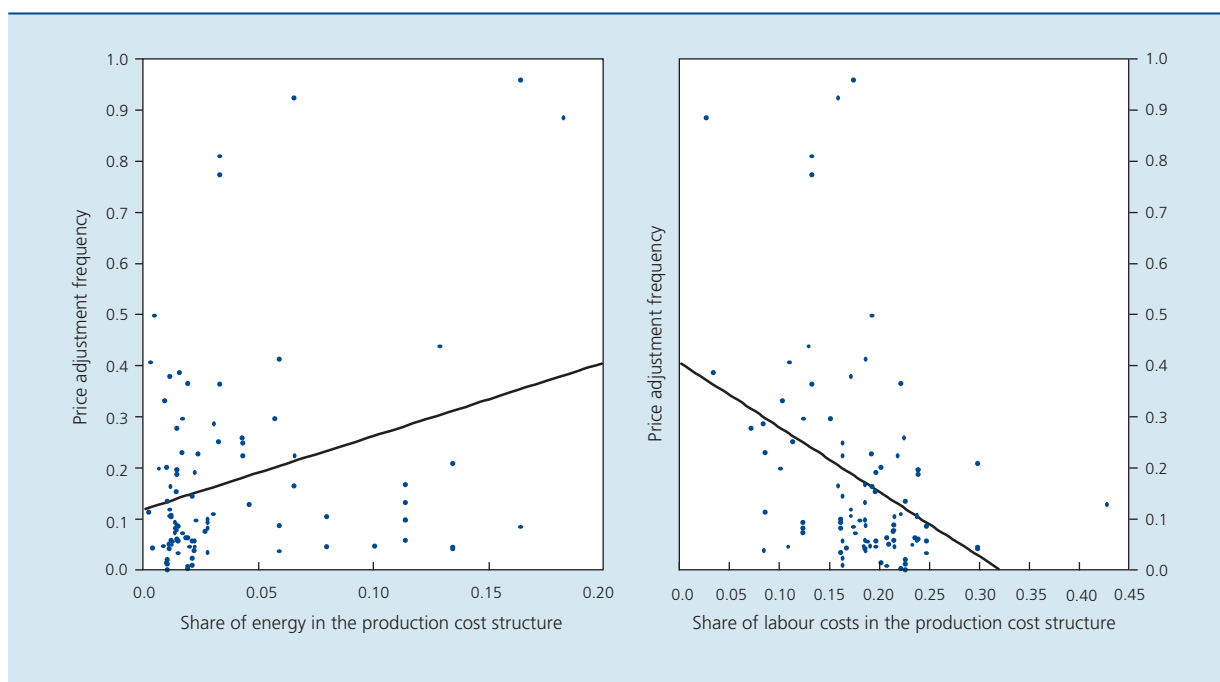
(1) Aucremanne and Dhyne (2004) for Belgium, Dhyne et al. (2005) for the euro area, Bils and Klenow (2004) for the United States.

(2) Dossche and Cornille (2005) for Belgium, Vermeulen et al. (2005) for the euro area.

high price rigidity, as these products have a price change frequency of less than 10 p.c. This concerns non-energy industrial goods and services in the case of consumer prices, durable goods and investment goods in the case of producer prices.

In fact, it seems that the degree of product sophistication reduces the price adjustment frequency. If the degree of product sophistication is regarded as an indicator of the firm's market power, that finding is supported by the fact that the specific surveys on firms' behaviour appear to

**CHART 2** LINK BETWEEN PRICE ADJUSTMENT FREQUENCY AND PRODUCTION COST STRUCTURE



Source : Dossche and Cornille (2005).

indicate that the degree of competition increases that frequency (Fabiani et al., 2005). The production cost structure also influences the price adjustment frequency. Thus, the importance of labour costs in the production cost structure of a product reduces the price adjustment frequency, whereas its energy content (mainly petroleum products) accelerates the price changes (see Dossche and Cornille, 2005, for the detailed results for Belgium).

It is important to note that the sectoral differences observed in the euro area are also found in the United States. Also, the price change frequencies per sector observed in Belgium are not significantly different from the European average.

### 3.3 No greater downward price rigidities

Although prices are adjusted relatively infrequently in the euro area, that is not due to excess nominal downward price rigidity, preventing firms from lowering their prices when they wish. In fact, consumer price surveys indicate that on average almost 40 p.c. of the price adjustments recorded in the euro area are price reductions. A similar proportion is also observed in Belgium (Aucremanne and Dhyne, 2004) and in the United States (Klenow and Kryvtov, 2005). If producer prices are analysed, the proportion is actually 45 p.c.

However, the situation varies greatly from one sector to another. In services, where the price adjustment frequency is particularly low, price reductions are less common. In this sector, only one out of five price changes is a reduction. This greater rarity of price reductions in the service sector is due partly to the higher inflation rates seen in this sector, compared to the other components of the HICP. Since inflation is higher in services, firms have less reason to lower their prices. However, the importance of wages in the service production cost structure could also indicate that the rarity of price reductions in services in fact reflects greater nominal downward rigidity in wages. Conversely, for certain products featuring rapid technological depreciation, such as electronic goods, up to 95 p.c. of the price adjustments observed are reductions (Aucremanne and Dhyne, 2004).

### 3.4 Substantial price changes

Analysis of the consumer price surveys also showed that when a firm adjusts the price of a product, the adjustment is relatively large compared to the inflation rate. The average size of price increases in the euro area is in fact close to 8 p.c. The average size of price reductions is even slightly greater, since a firm which lowers its price does so by 10 p.c. on average. These values are comparable to those obtained for Belgium (Aucremanne

**TABLE 7** FREQUENCY AND AVERAGE SIZE OF PRICE INCREASES AND REDUCTIONS

	Consumer prices <sup>(1)</sup>		
	Belgium	Euro area	United States
Price increases			
Frequency (in p.c. per month) .....	9.8	8.3	16.1
Average size (in p.c.) .....	6.8 <sup>(3)</sup>	8.2	12.7
Price reductions			
Frequency (in p.c. per month) .....	5.2	5.9	13.2
Average size (in p.c.) .....	8.7 <sup>(3)</sup>	10.0	14.1
	Producer prices <sup>(2)</sup>		
	Belgium	Euro area	United States
Price increases			
Frequency (in p.c. per month) .....	11.0	11.0	n.
Price reductions			
Frequency (in p.c. per month) .....	9.0	9.0	n.

(1) Aucremanne and Dhyne (2004) for Belgium, Dhyne et al. (2005) for the euro area, Klenow and Kryvtov (2005) for the United States.

(2) Dossche and Cornille (2005) for Belgium, Vermeulen et al. (2005) for the euro area.

(3) For Belgium, the figure shows the median size and not the average size.

and Dhyne, 2004) and the United States (Klenow and Kryvtsov, 2005).

In terms of sectoral variation, unprocessed foods are the products which feature the largest price changes. This suggests that prices in this sector are largely determined by supply factors relating to weather conditions. Conversely, the prices of petroleum products, which have the highest degree of flexibility, display small changes in relation to the more rigid components of the HICP.

### 3.5 Asymmetric reactions to shocks

While price reductions do not appear to be much less common, on average, than price increases, the surveys specifically analysing the behaviour of firms seem to indicate that the way in which firms adjust their prices varies according to whether the firms face changes in costs or changes in demand. Moreover, their reactions may differ according to whether the changes are increases or reductions. Thus, cost increases seem to be the main reason for price increases, whereas price reductions are motivated primarily by a fall in demand. The results obtained also indicate that the response to cost increases is faster than the response to a fall in demand (Fabiani et al., 2005). Similar results were obtained for Belgium (Aucremanne and Druant, 2004; 2005) and the United States (Blinder et al., 1998).

**TABLE 8** ASYMMETRY IN FIRMS' REACTION: RESULTS OF SPECIFIC SURVEYS  
(Average scores<sup>(1)</sup>)

	Belgium	Euro area
Factors explaining price increases		
Raw material costs .....	2.9	3.0
Labour costs .....	2.9	3.0
Competitors' prices .....	2.5	2.4
Demand .....	2.2	2.2
Interest charges .....	2.2	2.2
Factors explaining price reductions		
Raw material costs .....	2.3	2.5
Labour costs .....	2.1	2.1
Competitors' prices .....	2.9	2.8
Demand .....	2.5	2.5
Interest charges .....	1.8	1.9

Sources: Aucremanne and Druant (2004; 2005) for Belgium, Fabiani et al. (2005) for the euro area.

(1) The average score has a value between 1 (not important) and 4 (very important).

### 3.6 Price changes made on particular dates or in response to the economic situation

On the basis of the analysis of the quantitative data from surveys of both consumer and producer prices, it emerged that a substantial proportion of price changes occur in specific months, mainly in January and to a lesser extent in September, whereas they were relatively uncommon in July and August. However, it is not possible to determine from these observations whether these price changes reflect a seasonality inherent in price dynamics or a response to seasonal variations in production costs. In the first case, it can be said that most of the price changes are time-dependent, whereas in the latter case prices are adjusted in response to a change in the economic context in which the firms operate. Since these two interpretations have different implications as regards inflation dynamics, it is important to be able to distinguish between the two phenomena.

The specific surveys of firms' behaviour provided an answer to this question. The results obtained show that around one-third of the firms questioned change their prices using only time-dependent rules (e.g. prices are changed once a year, in January) whereas the other two-thirds decide to change their prices either solely in response to shocks (20 p.c. of the firms questioned) or – in the case of 46 p.c. of firms – according to a combination of the two strategies. According to this hybrid strategy, a firm reviews its prices at regular intervals in a normal economic context, but may respond quickly to a significant change in its situation. Similar results were obtained for the United States (Blinder et al., 1998). In Belgium, the proportion of firms using only time-dependent pricing rules is 26 p.c., whereas 34 p.c. of firms change their prices only in response to shocks (Aucremanne and Druant, 2004; 2005).

The importance of price changes motivated by shocks is also confirmed by certain results obtained on the basis of the quantitative data. Dhyne et al. (2005) demonstrate that the frequency of price changes has a significant correlation with changes in indirect taxation or changes in the general and/or sectoral price trend, and to changes in the price of inputs or wages. Similarly, an event such as the introduction of the euro notes and coins in January 2002 caused a temporary increase in the frequency of price changes around that date.

**TABLE 9** PRICE ADJUSTMENT PRACTICES:  
RESULTS OF THE SPECIFIC SURVEYS  
(in p.c.)

	Belgium	Euro area
Prices adjusted according to		
the date . . . . .	26	34
the situation . . . . .	34	20
both the date and the situation	40	46
Information used to set the price		
Predefined rule . . . . .	37	n.
Information on the past and the present . . . . .	29	34
Information on the present and the future . . . . .	34	48

Sources: Aucremanne and Druant (2004; 2005) for Belgium, Fabiani et al. (2005) for the euro area.

### 3.7 Price indexation or pricing on the basis of expectations

Having considered the question of the criterion underlying a firm's decision on when to change its prices, this section looks at the information used to determine the size of the change. That question is particularly important for assessing the relative significance of the retrospective and prospective components of the HNKPC.

As mentioned in section 1.2, when a firm chooses to adjust its price, it may determine the scale of that adjustment on the basis of simple rules, such as the indexation of its price to an aggregate price indicator, or historical data. Both types of behaviour contribute to the significance of the retrospective component of the HNKPC. The firm may also engage in prospective behaviour and take account of its inflation expectations in deciding on the price; that contributes to the significance of the prospective component of the HNKPC. According to the results obtained by the specific surveys, it seems that almost 50 p.c. of firms use this latter option when deciding to change their prices. In the countries where the information is available – namely Belgium, Luxembourg, Portugal and Spain – the first solution is evidently used by only one-third of respondents. These results are therefore in line with those obtained on the basis of the macroeconomic analyses.

As regards the behaviour of Belgian firms, the proportion of firms adopting prospective behaviour is smaller (34 p.c.) than the percentage observed in the euro area. This is due mainly to the composition of the samples of firms

questioned in the various countries. The Belgian sample contains both manufacturing firms and firms operating in the retail sector, the service sector and the building industry. In contrast, the majority of the other surveys covered the manufacturing sector only. If we restrict ourselves to that sector, the findings for Belgium are quite close to the average for the euro area.

### 3.8 The main causes of price rigidity

Finally, the IPN wanted to identify the main causes of price rigidity by questioning firms on the reasons preventing them from adjusting their prices. Economic theory presents an abundance of different hypotheses explaining nominal price rigidity. One of the best known is the menu cost theory, i.e. the costs associated with printing new prices. Since there is a cost entailed in making a price change (the cost of new labels), a firm may decide to postpone the change because the associated gain is not sufficient to offset the cost. Examples of the various theories include the implicit or explicit contract theory, which attributes the source of price rigidity to the contractual nature (explicit or otherwise) of the business relationship, or the theory concerning the existence of information costs (in this case, it is not changing the price that is costly but the need to collect information in order to establish the new optimal price level). A more comprehensive list of the various sources of rigidity is given in Aucremanne and Druant (2004; 2005).

The pricing survey was an opportunity for asking directly to firms which theories were the most relevant. It emerged that European firms consider that the main obstacle to price changes is the existence of implicit or explicit contracts with their customers. This finding is in line with the fact that the firms questioned state that 70 p.c. of their business is done with customers with whom they have a long-standing relationship. The next reason for price rigidity is that some firms have little incentive to adjust their prices since their marginal cost curve is relatively flat, i.e. their marginal costs and hence their prices vary little if at all according to the quantities produced. Finally, it seems that firms do not like to be the first to change their prices and prefer to wait for their competitors to make a decision. This behaviour is associated with the "truncated demand curve" theory.

Conversely, firms consider that the information cost and menu cost theories, though popular in the literature, are of little importance; the same applies to the psychological price threshold theory, which refers to the fact that firms set many prices at specific levels (multiples of 5 or ending in 9), which may cause some rigidity. The low

**TABLE 10** FACTORS EXPLAINING PRICE RIGIDITY

	Belgium (average scores) <sup>(1)</sup>	Euro area (average scores) <sup>(1)</sup>	United States (ranking)
Implicit contracts .....	2.5	2.7	4
Explicit contracts .....	2.4	2.6	5
Flat marginal costs curve .....	2.4	2.6	2
Truncated demand curve .....	2.2	2.4	1
Product judged according to price .....	1.9	2.1	12
Risk of having to adjust the price in the opposite direction .....	1.8	2.0	
Changes in factors other than price .....	1.7	1.7	3
Menu costs .....	1.5	1.6	6
Cost of collecting information .....	1.6	1.6	
Psychological price thresholds .....	1.7	1.6	8

Sources: Aucremanne and Druant (2004; 2005) for Belgium, Fabiani et al. (2005) for the euro area and Blinder et al. (1998) for the United States.  
 (1) The average score has a value between 1 (not important) and 4 (very important).

importance of the information cost theory is also evident from the firms' statement that they review their prices more frequently (1 to 3 times a year) than they change them (once a year).

If there are rigidities in the adjustment of prices, they therefore lie mainly in the decision to change the price and are motivated by the customers' desire for fixed nominal prices.

Finally, it is worth mentioning that the ranking of the various theories within the euro area is not noticeably different from the ranking indicated by Belgian or American firms.

#### 4. Conclusions and general implications for monetary policy

The IPN has produced a description of both the degree of inflation persistence in the euro area Member States and the practices followed by firms in terms of their price adjustment policy. The main conclusions for the euro area are as follows.

As regards inflation persistence:

1. The degree of inflation persistence in the euro area is relatively moderate, but estimates of the degree of persistence are not very accurate.
2. The degree of intrinsic persistence is fairly low under the current monetary policy regime.
3. Inflation expectations play an increasingly important role in inflation dynamics.

4. Aggregate inflation persistence is mainly the outcome of a higher degree of persistence in the components of the underlying inflation trend represented by services and non-energy industrial goods.

As regards firms' pricing policies:

1. Firms in the euro area change their prices less frequently than American firms.
2. The frequency of price changes varies greatly from one sector to another (high frequency for petroleum products and unprocessed food, low frequency for non-energy industrial goods, and especially for services).
3. Price reductions are not rare events in comparison with price increases, but firms appear to be slower to pass on negative shocks in their prices.
4. Firms adjust their prices by significant amounts, and do so mainly in response to shocks.
5. Only one-third of firms use simple rules such as indexation for adjusting their prices.
6. The main causes of price rigidity lie in the contractual character (explicit or otherwise) of business relationships, and not in other factors such as the cost entailed in changing prices.

These results have numerous implications for the macroeconomic modelling of inflation (Angeloni et al., 2005). They should in fact enable the development of theoretical models based on microeconomic fundamentals compatible with the observed behaviour. Such models would provide a better understanding of inflation and the impact of monetary policy.



More generally, these results also have implications for the conduct of monetary policy.

Firstly, the fact that the degree of inflation persistence is low under the current monetary policy regime can be regarded as a good thing. Bringing inflation down to the target set by the ECB is actually easier than the naïve estimates of inflation persistence would suggest. However, if this low persistence is attributable primarily to the beneficial effects of the efforts made during the convergence period to anchor the inflation expectations of the economic agents at a level close to 2 p.c., it must be stressed that this low persistence should not be interpreted as a signal to ease monetary policy. Something which has taken a long time to achieve can be rapidly destroyed if the economic agents begin to doubt the ability of the monetary authorities to attain their objectives. Any relaxation of monetary discipline could soon cause inflation expectations to drift, leading to a return to pricing practices which are more retrospective than prospective. The relative uncertainty surrounding the estimates of the degree of persistence further reinforces the need not to underestimate the importance of maintaining credibility in monetary policy.

Secondly, while the fact that price changes appear to be less frequent in the euro area than in the United States may indicate an attenuation of the effects of extrinsic persistence on inflation dynamics, as inflation is less sensitive to changes in real marginal costs and the output gap, these results confirm that inflation control seems to entail higher costs in the euro area than in the United States. Maintenance of price stability is therefore essential to the preservation of growth in the euro area, since correcting any excess inflation would be costly in terms of growth and employment.

Thirdly, the results obtained showed the existence of wide sectoral variations, both in terms of persistence and in the frequency of price adjustments. As regards the conduct of monetary policy, the economic literature suggests that the monetary authorities should focus particularly on the inflation picture in the economic sectors where inflation is most persistent, namely services and non-energy industrial goods. This finding therefore implies a need for close monitoring of the underlying trend in inflation. However, the pattern of inflation in the other components of the HICP (energy and food) should not be ignored altogether, since inflation in those sectors could be passed on to the more persistent sectors, particularly via the movement in labour costs.

Fourthly, one surprising result merits attention. In contrast to common beliefs, the analyses conducted by the IPN showed that a large percentage of the price changes observed in the euro area consisted of price reductions, which suggests that nominal downward price rigidities are not very significant. Such a result reduces the need to maintain a positive inflation rate in the long term, as the benefits of doing so lie in the fact that inflation facilitates relative price adjustments where nominal downward rigidity exists. Since the downward price rigidities appear to be low, there is less benefit in maintaining a positive inflation rate. However, it is important to note that in the service sector, which has a very significant weight in the HICP, price reductions are rare, and this could be partly due to the fact that wages represent a large share of the production costs. Since the IPN did not investigate the dynamics of labour costs, the question of the importance of rigidities in the adjustment of wages in the euro area has been left unanswered for now. But even though there is no overall downward rigidity in the case of prices, there could be for wages. That could justify maintaining a low but positive inflation target for the long term.

Where Belgium is concerned, it is important to point out that the conclusions based on the analysis of the Belgian data are similar to those arrived at for the euro area. In terms of both price rigidity and inflation persistence, the findings for Belgium are very close to the average for the euro area. Similarly, the scale of the nominal downward price rigidities in Belgium differs little from that observed for the euro area. That shows that the conduct of a single monetary policy for the euro area is not a handicap for our economy, and does not lead to substantial asymmetries in its transmission.

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