

# DISCUSSION PAPER SERIES

No. 6227

**EVIDENCE FROM SURVEYS OF  
PRICE-SETTING MANAGERS: POLICY  
LESSONS AND DIRECTIONS FOR  
ONGOING RESEARCH**

Vítor Gaspar, Andrew Levin,  
Fernando Martins and Frank Smets

***INTERNATIONAL MACROECONOMICS***



**Centre for Economic Policy Research**

**[www.cepr.org](http://www.cepr.org)**

Available online at:

**[www.cepr.org/pubs/dps/DP6227.asp](http://www.cepr.org/pubs/dps/DP6227.asp)**

# EVIDENCE FROM SURVEYS OF PRICE-SETTING MANAGERS: POLICY LESSONS AND DIRECTIONS FOR ONGOING RESEARCH

**Vítor Gaspar**, European Commission  
**Andrew Levin**, Federal Reserve Board and CEPR  
**Fernando Martins**, Banco de Portugal  
**Frank Smets**, European Central Bank and CEPR

Discussion Paper No. 6227  
April 2007

Centre for Economic Policy Research  
90–98 Goswell Rd, London EC1V 7RR, UK  
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999  
Email: [cepr@cepr.org](mailto:cepr@cepr.org), Website: [www.cepr.org](http://www.cepr.org)

This Discussion Paper is issued under the auspices of the Centre's research programme in **INTERNATIONAL MACROECONOMICS**. Any opinions expressed here are those of the author(s) and not those of the Centre for Economic Policy Research. Research disseminated by CEPR may include views on policy, but the Centre itself takes no institutional policy positions.

The Centre for Economic Policy Research was established in 1983 as a private educational charity, to promote independent analysis and public discussion of open economies and the relations among them. It is pluralist and non-partisan, bringing economic research to bear on the analysis of medium- and long-run policy questions. Institutional (core) finance for the Centre has been provided through major grants from the Economic and Social Research Council, under which an ESRC Resource Centre operates within CEPR; the Esmée Fairbairn Charitable Trust; and the Bank of England. These organizations do not give prior review to the Centre's publications, nor do they necessarily endorse the views expressed therein.

These Discussion Papers often represent preliminary or incomplete work, circulated to encourage discussion and comment. Citation and use of such a paper should take account of its provisional character.

Copyright: Vítor Gaspar, Andrew Levin, Fernando Martins and Frank Smets

## ABSTRACT

### Evidence from Surveys of Price-Setting Managers: Policy Lessons and Directions for Ongoing Research\*

Understanding the features and the determinants of individual price setting behaviour is important for the formulation of monetary policy. These behavioural mechanisms play a fundamental role in influencing the characteristics of aggregate inflation and in determining how monetary policy affects inflation and real economic activity. The Inflation Persistence Network, a collaborative research effort of the Eurosystem, analysed a large number of panel data sets of individual price records and conducted surveys of price-setting managers in many euro area countries. This paper discusses to what extent the extensive evidence coming from those two data sources provides support for some basic elements of the New Keynesian perspective. It analyses the implications of the micro evidence for distinguishing between competing theories of price stickiness and provides some brief reflections about the lessons for monetary policy.

JEL Classification: D4, E1 and E3

Keywords: monetary policy, New Keynesian models, price setting and price stickiness

Vítor Gaspar  
Bureau of European Policy Advisors  
European Commission  
B-1049 Brussels  
BELGIUM  
Email: [vitor.gaspar@ec.europa.eu](mailto:vitor.gaspar@ec.europa.eu)

Andrew Levin  
Division of Monetary Affairs  
Federal Reserve Board  
Mailstop 22  
20th and C Streets NW  
Washington, DC 20551  
USA  
Email: [andrew.levin@frb.gov](mailto:andrew.levin@frb.gov)

For further Discussion Papers by this author see:  
[www.cepr.org/pubs/new-dps/dplist.asp?authorid=107010](http://www.cepr.org/pubs/new-dps/dplist.asp?authorid=107010)

For further Discussion Papers by this author see:  
[www.cepr.org/pubs/new-dps/dplist.asp?authorid=115378](http://www.cepr.org/pubs/new-dps/dplist.asp?authorid=115378)

Fernando Manuel Martins  
Economist  
Banco de Portugal  
Avenida Almirante Reis, 75  
1150-012 Lisboa  
PORTUGAL  
Email:  
Fernando.Manuel.Martins@bportugal.pt

Frank Smets  
Deputy Director General  
European Central Bank  
Kaiderstrasse 29  
D-60311 Frankfurt am Main  
GERMANY  
Email: frank.smets@ecb.int

For further Discussion Papers by this author see:  
[www.cepr.org/pubs/new-dps/dplist.asp?authorid=165739](http://www.cepr.org/pubs/new-dps/dplist.asp?authorid=165739)

For further Discussion Papers by this author see:  
[www.cepr.org/pubs/new-dps/dplist.asp?authorid=127091](http://www.cepr.org/pubs/new-dps/dplist.asp?authorid=127091)

\* This paper will appear as Chapter 15 in Fabiani, S., C. Loupias, F. Martins and R. Sabbatini (2007), Pricing decisions in the euro area: How firms set prices and why, Oxford University Press. The views expressed are those of the authors and should not be attributed to the European Central Bank, the Bank of Portugal, the European Commission or the Federal Reserve Board.

Submitted 06 March 2007

# **Evidence from surveys of price-setting managers: Policy lessons and directions for ongoing research<sup>1</sup>**

Vítor Gaspar	Andrew Levin	Fernando Martins	Frank Smets
European Commission	Federal Reserve Board	Banco de Portugal	European Central Bank

Understanding the determinants of individual price setting behavior is crucial for the formulation of monetary policy, especially in an economy experiencing ongoing structural change. These behavioral mechanisms play a fundamental role in influencing the characteristics of aggregate inflation and in determining how monetary policy affects inflation and real economic activity. Thus, this line of research can strengthen the conceptual foundations of general equilibrium models with sticky prices, enabling these models to provide monetary policymakers with an increasingly useful framework for interpreting and forecasting the evolution of the macroeconomy.

These considerations provided a strong impetus for the Inflation Persistence Network (IPN), a collaborative research effort of the national central banks of the Eurosystem together with the European Central Bank (ECB). Fabiani, Loupias, Martins and Sabbatini (2007) provides a comprehensive report on the surveys of price setting managers that were conducted in nine euro area countries, covering a total of roughly 11,000 firms. In addition, as described in chapter 14 of Fabiani et al. (2007), the IPN analyzed a number of huge panel datasets of individual price records used in constructing producer as well as consumer price indices. Clearly, these two sources provide complementary types of information: the micro price data provides a means of quantifying individual price setting behavior, and the survey data facilitates the development of

---

<sup>1</sup> This paper will appear as Chapter 15 in Fabiani, S., C. Loupias, F. Martins and R. Sabbatini (2007), *Pricing decisions in the euro area: How firms set prices and why*, Oxford University Press. The views expressed are those of the authors and should not be attributed to the European Central Bank, the Bank of Portugal, the European Commission or the Federal Reserve Board.

coherent explanations for those findings. Taken together, these two data sources represent a unique opportunity to document and interpret the characteristics of individual price setting behavior in the euro area. Furthermore, the breadth and scope of this evidence is unprecedented by international standards, with coverage that goes well beyond the data available for the United States or any other industrial economy<sup>2</sup>. The main results on price setting coming from the analysis of these data sources are summarized in the introduction of Fabiani et al. (2007).

In this chapter, we introduce the Walrasian model as a benchmark for comparison, and we discuss the extent to which recent micro evidence provides significant support for some basic elements of the New Keynesian perspective. We then proceed to analyze the implications of the micro evidence in distinguishing between competing theories of price stickiness. Finally, we conclude with some brief reflections about the lessons for monetary policy and potentially fruitful directions for further research.

### **1. The Walrasian Benchmark**

The Walrasian model provides an invaluable benchmark for understanding resource allocation and price determination in general equilibrium<sup>3</sup>. This model provides us with a precisely formulated set of conditions under which the equilibrium allocation of goods and services emerges as the outcome of a decentralized price mechanism—the “invisible hand” of Adam Smith. For example, the Walrasian model assumes that all markets are perfectly competitive and that every agent has the same information about the economy; furthermore, all prices adjust freely and continuously without any cost to ensure the equilibration of supply and demand of every product at every moment in time.

In general terms, the Walrasian model demonstrates that the price mechanism is capable, at least in principle, of yielding a resource allocation that satisfies some basic normative criteria. In particular, the first fundamental theorem of welfare economics indicates that every competitive

---

<sup>2</sup> For example, Blinder et al. (1998) only obtained responses from about 200 United States firms.

<sup>3</sup> See Debreu (1959) and Arrow and Hahn (1970).

equilibrium is Pareto-optimal; that is, no individual's welfare can be strictly improved without a decline in someone else's welfare. Indeed, with some additional regularity conditions, it can also be shown that *all* Pareto-optimal resource allocations can be decentralized as competitive equilibria.

Of course, the assumptions underlying the Walrasian model are highly stylized and hence open to debate. For example, Fisher (1972) emphasized that the Walrasian framework "describes nobody's actual behavior in most markets." Okun (1981) argued that "models that focus on price-takers and auctioneers and that assume continuous clearing of the market generate inaccurate microeconomics as well as misleading macroeconomics." and Kreps (1990) stressed that the Walrasian model provides no description of "who sets prices, or what gets exchanged for what, when and where."

Thus, it is essential to determine the extent to which the Walrasian framework provides a useful description of the actual economy. Perhaps it is not surprising that some specific assumptions can be relaxed without causing the resource allocation to deviate substantially from the benchmark of Pareto optimality<sup>4</sup>.

## **2. Support for the "New Neoclassical Synthesis" and "New Keynesian" Perspectives**

Stimulated by Lucas' (1976) critique of the existing crop of structural macroeconomic models, the subsequent research agenda of "New Neoclassical Synthesis" or "New Keynesian" economics have sought to provide more rigorous microeconomic foundations for the existence of nominal rigidities. These foundations explicitly consider the decision-making problems of firms and consumers in the context of specific departures from the Walrasian benchmark. The recent micro evidence provides significant support for two fundamental elements of such an approach, namely, the infrequent adjustment of prices and the role of imperfectly competitive markets.

---

<sup>4</sup> See Foley (1994).

## **2.1 The Prices of Many Goods and Services Are Adjusted Relatively Infrequently**

The micro evidence for the euro area indicates that retail and producer prices are only adjusted about twice a year on average. Of course, the prices of some items—such as automobile fuel, fresh fruits, and unprocessed meat—do change on a daily or weekly basis. In contrast, the prices of all other retail goods (excluding food and energy) have an average duration of about ten months, and the prices of consumer services typically remain unchanged for a year or longer. Indeed, as described in Fabiani et al. (2007), surveys of price setting behavior (in the euro area as well as other industrial economies) have consistently found that a majority of firms tend to adjust the price of their main product no more than once a year.

The relatively infrequent adjustment of retail and producer prices is particularly striking in contrast to the evolution of the macroeconomy, which exhibits continually changing levels of aggregate spending, employment, raw materials prices, asset prices, and so forth. Thus, in contrast to the Walrasian framework, it would seem evident that the adjustment of individual prices must be hindered by some sort of costs or constraints; otherwise, even the slightest change in an individual firm's environment would cause a corresponding change in the prices of its products. Furthermore, the fact that price changes tend to be quite large—with a median adjustment exceeding 10% for many categories of the consumer price index—suggests that a firm's decision to change its price is typically driven by sectoral or firm-specific considerations rather than the state of the macroeconomy.

## **2.2 Monopolistic Competition Is a Characteristic of Most Product Markets**

Imperfect competition plays a crucial role in providing a rationale for sticky prices. Under perfect competition, each good is produced by many identical firms, all of which must charge exactly the same price (determined by the marginal cost of production) at every moment in time; any firm charging a lower price would operate at a loss, and any firm charging a higher price would have no sales at all. In such a market, all firms earn zero profits in equilibrium, and the price of the item adjusts continuously in response to even the slightest change in its marginal cost,

whether due to a fluctuation in the cost of raw materials, the price of electricity, wages, interest rates, or other cause. In contrast, in an environment of monopolistic competition, each individual firm's products are distinct from those of its competitors. In this case, the firm can earn positive profits by charging a price for each item that incorporates a positive markup; that is, the price of the item exceeds its marginal cost of production. The widespread incidence of markup pricing was originally highlighted by the survey of Hall and Hitch (1939), who found that "an overwhelming majority of the entrepreneurs thought that a price based on full average cost (including a conventional allowance for profit) was the 'right' price, the one which 'ought' to be charged." Along similar lines, Okun (1981) indicated that "the setting of prices by marking up costs is a good first approximation to actually observed behavior in most areas of industry, trade, and transportation."

Of course, because the profit maximizing level of the markup depends on the elasticity of demand and on the relative prices of its competitors, the firm's optimal price will vary over time in response to these factors, as well as in response to movements in marginal cost. However, a crucial insight of the New Keynesian approach is that a monopolistic competition framework combined with unsynchronized price setting implies that the firm does not have to adjust its price instantaneously in response to changes in marginal cost or the prices of its competitors: the firm still has substantial sales even if its price is a bit too high, and still earns positive profits even if its price is a bit too low.

The survey evidence provides strong support for the view that imperfect competition characterizes most product markets in the euro area. First, only about one-fourth of the firms report that their prices are primarily set to match the prices of their competitors—as one might expect in the case of a perfectly competitive market—and roughly the same proportion of firms indicate that a price reduction by at least one competitor would be considered "highly important" in determining whether the firm should cut its own price. In contrast, roughly half of the firms describe their prices as being determined by a markup over unit variable cost—consistent with the

stylized assumption of a monopolistically competitive market with a constant elasticity of demand—whereas the remainder indicate that their prices are determined by a different approach that is still suggestive of imperfect competition, perhaps with a more complex elasticity of demand.

Second, roughly two-thirds of the firms in these surveys indicated that long-term customers accounted for the bulk of their sales. The predominance of long-term relationships is entirely consistent with product differentiation and specialization, but would be virtually inconceivable in a perfectly competitive market (such as that observed for commodities such as gold) where the match between an individual buyer and an individual seller is random and transitory.

Third, it should be noted that only about 20% of the firms in these surveys report that the price of their main product is the same for all customers, as one would expect in a perfectly competitive market. The remaining 80% indicate that the actual price of their main product varies across customers, either on a case-by-case basis or as a function of the quantity sold. It should be noted that this pattern of price discrimination does not fit neatly into the stylized framework of monopolistic competition, which implies that all customers pay the same price for a given item at a given point in time (just as in the case of perfect competition). Nevertheless, this survey evidence is certainly consistent with the notion that most product markets comprise highly differentiated goods and services and hence exhibit relatively complex forms of imperfect competition.

Finally, as reported in chapter 13 of Fabiani et al. (2007), the perceived degree of market competition is statistically significant in explaining cross-sectional variations in the use of markup pricing strategies and in the frequency of price reviews and changes; this evidence highlights the thorough implications of interactions between imperfect competition and nominal price rigidity (for instance, due to the existence of implicit and explicit contracts, menu costs, informational problems, unsynchronized price setting, or interaction between price and wage setting).

### **3. Evidence on Competing Theories of Price Setting Behavior**

The recent micro evidence is also invaluable for performing an empirical assessment of various theories of price setting behavior, especially because many of these theories are difficult to distinguish based on macroeconomic data alone.

#### **3.1 Downward Nominal Price Rigidity**

This theory reflects the notion that firms may be reluctant to reduce the nominal prices of their products, perhaps because a cut in the nominal price would send an adverse signal to customers regarding a decline in the quality of the product. This form of nominal inertia might be inconsequential in an economy with high aggregate inflation, because a firm seeking to reduce its relative price could do so without actually cutting its nominal price. In contrast, in an economy with low aggregate inflation, one might observe an asymmetric pattern of price increases for those firms seeking to raise their relative price, and unchanged prices for the remaining firms that are constrained by the downward nominal rigidity. Nevertheless, this mechanism is generally inconsistent with the micro evidence. In the euro area, price reductions comprise roughly 40% of all changes in consumer prices and roughly 45% of all changes in producer prices, and the average magnitude of price cuts is nearly identical to the magnitude of price hikes; similar patterns are also evident in retail price data for the United States<sup>5</sup>. And even these modest asymmetries may simply reflect the influence of a non-zero aggregate inflation rate. Furthermore, surveys in the euro area obtained little support for the notion that firms are reluctant to cut their prices due to fears that customers will make judgments about product quality based on price; indeed, this hypothesis was dismissed out of hand by the respondents in the survey conducted for the United States.

Finally, it should be noted that asymmetry in price setting is somewhat more evident in the service sector, where price decreases only account for about 20% of all price changes. This outcome might simply reflect upward trends in the price of services relative to consumer goods

---

<sup>5</sup> See Bils and Klenow (2004).

(corresponding to underlying sectoral differences in productivity growth), as well as lower volatility of shocks to the service sector. Alternatively, because labor costs constitute a high share of total cost in many service industries, the apparent asymmetry in the adjustment of service prices might result from downward nominal wage rigidity; thus, further research is evidently needed to investigate these hypotheses.

### **3.2 Smoothing Models of Price Adjustment**

Suppose that the typical firm incurs convex adjustment costs whenever it changes the nominal price of its product; that is, these adjustment costs rise at an increasing rate as a function of the absolute magnitude of the price change. Given these adjustment costs, the firm's optimal price setting behavior involves smooth and gradual adjustments, implying a persistent series of small consecutive adjustments rather than sudden large movements in either direction<sup>6</sup>. As shown by Rotemberg (1982), convex adjustment costs provide elegant microeconomic foundations for the New Keynesian Phillips Curve; thus, this approach has subsequently been used in numerous analytical and empirical studies. Despite its elegance and tractability, its implications are clearly inconsistent with the micro evidence. First, as noted above, both retail and producer prices tend to be adjusted relatively infrequently (apart from the unprocessed food and energy sectors). Furthermore, as emphasized in chapter 14, the average magnitude of individual price adjustments is quite large: about 8% for consumer price increases, and roughly 10% for consumer price reductions.

### **3.3 Sticky Information**

Mankiw and Reis (2002) have proposed an alternative framework in which information collection and processing is subjective to substantial fixed costs, whereas the actual adjustment of prices is completely costless. With sticky information and costless price adjustment, the firm's optimal strategy—apart from certain extraordinary circumstances—is to perform a relatively

---

<sup>6</sup> Convex adjustment costs were first considered in the context of physical capital accumulation as a means of analyzing Tobin's  $q$  theory of investment.

infrequent updating of its information set and then reoptimize the intended trajectory for its nominal price. This optimal trajectory typically involves some price adjustment in every period, but the trajectory itself remains settled until the next time that the firm updates its information set. As shown by Mankiw and Reis (2002), sticky information yields implications for aggregate inflation dynamics that differ from those of the benchmark New Keynesian Phillips Curve in several important respects<sup>7</sup>.

However, micro evidence is generally inconsistent with this form of price adjustment. As previously noted, most retail and producer prices are adjusted relatively infrequently, rather than changing every period as in the sticky information model. Furthermore, firm-level surveys in the euro area and several other industrial economies have consistently found that the respondents do not perceive that costly information plays a significant role in their price setting decisions. Indeed, the euro area surveys indicate that the frequency of price review generally exceeds the frequency of price changes; that is, many price reviews do not result in a price change.

Of course, as with each of the other mechanisms considered here, the sticky information hypothesis almost certainly contains some important grains of truth that should be incorporated into a more nuanced price setting framework. For example, the euro area surveys find that forward-looking considerations play little or no role in the price reviews of a substantial proportion of respondents, perhaps due to difficulties in constructing or updating forecasts on a regular basis. In addition, it could well be the case that some of these price reviews are mainly oriented toward product-specific news and place insufficient emphasis on changes in the macroeconomic outlook. These issues deserve further investigation, perhaps even involving a new set of firm-level surveys.

---

<sup>7</sup> Kiley (2006) compares the empirical implications of sticky prices versus sticky information by using United States macroeconomic data.

### 3.4 Staggered Nominal Contracts

Much of the New Keynesian literature has proceeded under the assumption that the price of each product is specified by an explicit or implicit multiperiod contract with the firm's customers, who can purchase any desired quantity of the product at the specified price throughout the duration of the contract. Following the seminal work of Taylor (1999) and Calvo (1983), the timing of new contracts is assumed to be evenly staggered across firms and to be invariant to changes in the aggregate economy; thus, a constant fraction of all price contracts are reset at each point in time<sup>8</sup>. Furthermore, the staggered contract structure implies that an aggregate demand shock (such as shift in the stance of monetary policy) will have effects on real economic activity that last longer than the duration of the typical contract.

The micro evidence is broadly consistent with some aspects of the staggered contracts framework. First, as we have already discussed, many retail and producer prices are adjusted only once or twice a year, and these adjustments tend to be staggered fairly evenly throughout the year (although some seasonality is observed in certain sectors). Second, most surveys of price setting managers indicate that nominal contracts play a key role in explaining why prices are not adjusted more frequently; indeed, implicit and explicit contracts were ranked as the two most important explanations by the respondents of the euro area surveys reported in this book. Finally, the evidence from disaggregated price records suggests that the overall frequency of price adjustment is reasonably stable, at least in environments of low and stable aggregate inflation<sup>9</sup>. Nevertheless, the micro evidence directly contradicts the notion that price setting behavior can be generally characterized by staggered contracts with a fixed duration, as in the analysis of Taylor (1999)<sup>10</sup>.

The basic problem here is not the observed degree of sectoral heterogeneity in the frequency of price adjustment: although Taylor's original formulation assumed an identical duration for all contracts, that formulation has subsequently been generalized to allow the

---

<sup>8</sup> See Ball and Romer (1989) for analysis of staggering versus synchronization of price setting behavior.

<sup>9</sup> See Klenow and Kryvtsov (2006).

<sup>10</sup> See King and Wolman (2004) and the analysis and references in Woodford (2003).

contract duration to vary across different groups of firms<sup>11</sup>. Rather, the fixed duration approach is clearly inconsistent with the findings of Aucremanne and Dhyne (2005), namely, relatively large variation in the duration of price spells for individual items in almost every product category in the consumer price index; that is, the interval between price changes tends to vary quite widely over time, even for a single item sold by an individual firm. Of course, it should be emphasized that fixed duration contracts may still provide a useful framework for modeling the determination of wages, especially in economies where labor unions represent a large fraction of the labor force. The micro evidence appears somewhat more consistent with the assumption that price contracts have a random duration that is invariant to the state of the aggregate economy, as in Calvo (1983) and numerous subsequent studies. In the special case where every firm faces the same probability in every period of being able to reset its price contract (regardless of how long its current contract has already lasted), this approach provides elegant and tractable foundations for the New Keynesian Phillips Curve<sup>12</sup>.

To capture the sectoral heterogeneity noted above, the random duration contracting framework can be readily extended to permit the adjustment probability to vary across broad groups of firms<sup>13</sup>. Furthermore, in contrast to the counterfactual predictions of the fixed duration framework, Aucremanne and Dhyne (2005) have found that Calvo style contracts yield roughly accurate predictions regarding the relationship between the mean duration and the coefficient of variation of individual price spells for most of the narrow categories of items in the consumer price index (apart from food and energy).

However, the recent evidence also highlights the extent to which the random duration contracting framework does not provide sufficiently deep microeconomic foundations for the analysis of price setting behavior. First, this framework starts from the premise that the contract

---

<sup>11</sup> See Taylor (1993), Guerrieri (2002), and Coenen and Levin (2004).

<sup>12</sup> See Yun (1996), Rotemberg and Woodford (1997), and Clarida et al. (1999), as well as the extensive bibliography of Woodford (2003).

<sup>13</sup> See Álvarez et al. (2005).

adjustment probability is a fixed parameter, without providing any interpretation for the extent to which the average duration of price spells varies markedly across different sectors of the economy and even across narrow product categories within each sector<sup>14</sup>. Nor does this framework provide any means of understanding the apparent differences in the frequency of price adjustment across major industrial economies, e.g. the euro area compared with the United States. Furthermore, surveys indicate that the timing of price adjustments typically reflects the incidence of substantial changes in production costs or the level of demand<sup>15</sup>. Finally, the rapid response of prices to specific macroeconomic events (such as indirect tax increases or the euro cash changeover) or shifts in monetary policy regime (such as a decline in aggregate inflation) demonstrates that the frequency of price adjustment is not invariant to the state of the aggregate economy. Clearly, accounting for this evidence requires a framework with elements of state-dependent pricing and some combination of idiosyncratic and aggregate shocks.

### **3.5 Menu Costs and State-Dependent Pricing**

Now suppose that the typical firm incurs a fixed cost (menu cost) whenever it changes the nominal price of its product; that is, the adjustment cost is invariant to the absolute magnitude of the price change, as well as to its sign (positive or negative). Given this fixed cost of adjustment, the firm will generally choose to leave its price unchanged until a single large firm-specific or sector-specific shock (or perhaps a sequence of smaller shocks) causes its optimal price to deviate sufficiently far from its actual price, at which point the firm resets its actual price to match the optimal one<sup>16</sup>.

The micro evidence is broadly consistent with several key predictions of the menu cost framework: most prices tend to remain constant for an extended period and then change by a

---

<sup>14</sup> For example, chapter 11 shows that price flexibility is positively associated with the cost share of raw materials and negatively associated with the cost share of wages.

<sup>15</sup> One revealing example is given by Stahl (2005), who finds that the incidence of price increases by German industrial firms exhibits significant peaks that coincide with hikes in negotiated wage rates.

<sup>16</sup> Theoretical analysis of menu costs and price setting behavior includes Barro (1972), Sheshinski and Weiss (1977), Dixit (1991), and Hansen (1999). An important finding is that even “small” menu costs may give rise to considerable nominal stickiness at the macro level; see, for example, Akerlof and Yellen (1985), Mankiw (1985), and Blanchard and Kyotaki (1987).

relatively large magnitude, and these characteristics are essentially symmetric for both positive and negative price adjustments. Indeed, Danziger (1999) and Golosov and Lucas (2003) have shown that the underlying parameters of the model can be calibrated to yield empirically reasonable values for the frequency and magnitude of price adjustments; Gertler and Leahy (2005) modify some of the auxiliary assumptions and then proceed to demonstrate that this framework can provide a satisfactory accounting for aggregate inflation dynamics and the persistent real effects of monetary disturbances.

It should be noted, however, that the micro evidence also highlights several dimensions for refinement and further development of the menu cost framework. First, although the average magnitude of price changes is quite large, it is nonetheless apparent that small price adjustments are also very common; this characteristic was initially noted by Carlton (1986) and Kashyap (1995) for specific retail items, but the recent micro evidence reveals the same pattern for virtually every item in the consumer price index. Specific assumptions about the idiosyncratic shock process might account for these small price adjustments, but it also seems plausible that the menu cost itself may exhibit cross sectional variation—related to firms’ size and other characteristics—and perhaps also seasonal or business cycle variations.

Furthermore, the notion of literal “menu costs” is clearly inconsistent with the micro evidence. For example, Kashyap (1995) documented that the prices of many individual items remain unchanged across multiple editions of a retailer’s catalog—an outcome that is evidently unrelated to typesetting or printing costs—and many barbershops and other small retailers have no printed pricelist at all. Furthermore, the incidence of temporary sales and promotions (after which the price returns to its previous level) cannot be easily explained in terms of a fixed cost of posting new prices. Finally, firm-level surveys in the euro area and other industrial economies have consistently found that “physical costs of adjustment” do not play a significant role in price-setting decisions. Thus, further research is needed to identify other sources of friction with implications broadly similar to those of fixed menu costs.

## **4. Implications for Monetary Policy**

When considering the policy implications of analytical or empirical research, it is advisable to draw lessons that are robust to a variety of modeling approaches and econometric methods, rather than relying on any particular formalization of the economy<sup>17</sup>. Thus, rather than trying to formulate any precise guidance for policymakers, we now focus on several broad lessons that can be inferred from the micro evidence.

### **4.1 The Monetary Transmission Mechanism**

In the idealized Walrasian framework with competitive markets and flexible prices, the central bank may define the unit of account but its actions have no substantive effect on real economic activity; that is, monetary policy is completely “neutral” in such an environment. In contrast, as discussed above, the recent micro evidence makes it plausible to argue in favor of the New Keynesian view that monetary policy exhibits short-run non-neutrality due to the influence of imperfect competition and sticky prices, and hence that the conduct of monetary policy can have significant consequences for the evolution of the real economy. The intuition for this implication is quite straightforward: when prices are sticky, the central bank can implement a change in the policy rate and thereby affect real interest rates and hence the level of real aggregate expenditures<sup>18</sup>.

In addition, recent analysis has highlighted the extent to which the frequency of price adjustment can play a key role in determining the short-run response of inflation to a shift in real economic activity. Indeed, in a comparison of the macroeconomic dynamics of the euro area vis-à-vis the United States, Altissimo et al. (2006) have found that the persistence of the inflation

---

<sup>17</sup> See Issing et al. (2005).

<sup>18</sup> See Bernanke and Blinder (1988) and Kashyap and Stein (1994). Christiano and Gust (1999) have formulated an alternative framework in which the non-neutrality of money arises from financial market imperfections rather than sticky prices; however, the subsequent analysis of Christiano et al. (2005) found that nominal rigidities play a crucial role in explaining the real effects of money in a dynamic general equilibrium model. Finally, it should be noted that some models of price stickiness lead to results very close to monetary neutrality. For example, expanding on the earlier work of Caplin and Spulber (1987), the analysis of Golosov and Lucas (2003) demonstrates that monetary policy may have very small real effects in an economy with menu costs and idiosyncratic shocks, because a change in the money stock simply shifts the distribution of firms that choose to adjust their prices in a given period. As shown by Gertler and Leahy (2005), the introduction of real rigidities is crucial for explaining the real effects of monetary policy for an empirically reasonable degree of nominal rigidity.

response to a cost push shock is quite similar for both economies, and the higher persistence of the euro area output gap response can be largely explained by the lower frequency of adjustment of prices in the euro area<sup>19</sup>.

#### **4.2 The Case for Price Stability**

The recent evidence also highlights the benefits of maintaining price stability over the medium run—an aspect of the New Keynesian approach that was largely missing from the “old Keynesian” analysis that reached a heyday in the 1950s and 1960s. In particular, the earlier analysis placed relatively little emphasis on the social costs of inflation (especially compared with the social costs of unemployment) and typically assumed a long-run downward sloping Phillips Curve, implying that the optimal monetary policy might involve a higher average level of inflation in exchange for a permanent reduction in the unemployment rate.

In contrast, the New Keynesian framework not only incorporates the long-run neutrality of money—whereby a permanent rise in the stock of money eventually generates a corresponding rise in the price level, and hence has no long-run real effects—but also emphasizes the degree to which price stickiness reflects underlying costs, thus implying that a permanent rise in the growth rate of money has adverse long-run effects on the real economy by distorting relative prices and wasting resources through excessively frequent price adjustments<sup>20</sup>.

#### **4.3 The Role of Expectations**

Finally, the micro evidence provides substantial support for the view that establishing credible policies and managing private sector expectations are crucial aspects of modern central banking<sup>21</sup>. In particular, in an environment with infrequent price changes, each firm has a strong incentive to assess not only current factors but also the future outlook whenever it resets its price.

Euro area surveys largely reinforce this view: about half of the firms report that forward-looking

---

<sup>19</sup> These results are obtained under the assumption that monetary policy responds optimally to the cost push shock; that is, the central bank minimizes a standard objective function that reflects the goals of inflation stabilization and output gap stabilization, as well as a smooth path for the short-term nominal interest rate.

<sup>20</sup> See, for example, Goodfriend and King (1997, 2001), Clarida et al. (1999) and Woodford (2003) for analysis in the case of sticky prices, and Ball et al. (2003) for corresponding analysis in the case of sticky information.

<sup>21</sup> See Goodfriend and King (1997, 2001), Clarida et al. (1999), and Woodford (2003).

considerations play an important role in their price setting behavior, whereas about one-third of them indicate that their assessments are mainly backward looking.

Along these lines, it should be emphasized that the credibility of a monetary policy regime oriented toward price stability is also helpful for stabilizing the economy in response to economic disturbances and hence improves the tradeoff between the variability of inflation and the volatility of other important macroeconomic variables such as output and employment. However, imperfect credibility may be associated with shocks to inflation—caused by “inflation scares” or revised beliefs about the central bank’s inflation objective—that may be quite costly to reverse in terms of foregone real economic activity. Moreover, the higher the degree of nominal rigidity, the higher this sacrifice ratio.

### **5. Directions for Further Research**

Recent research reveals a negative relation between the frequency of price changes and the importance of wages as a fraction of costs. In particular, the IPN found that those sectors with a higher labor share, such as services, are typically characterized by a lower frequency of price changes. This suggests that it is essential to look at wage setting in order to understand price dynamics. Given the crucial importance that labor market behavior assumes in explaining business cycle dynamics and the pervasiveness of elements of structural rigidity in labor markets in the euro area, further research is warranted. Empirical research is needed to establish the relevant facts about wage setting. Theoretical research is necessary to incorporate a structural representation of labor markets into stochastic general equilibrium models of growth and business cycles. A new Eurosystem research network on wage dynamics has recently been initiated to shed further light on these issues.

In more general terms, the findings from the surveys constitute a challenge to researchers. The availability of high-quality micro datasets holds the promise of stimulating researchers to further develop theories able to account for both micro and macro facts in a general equilibrium framework.

## References

- Akerlof, George, and Janet Yellen. 1985. A near-rational model of the business cycle, with wage and price inertia. *The Quarterly Journal of Economics* 100: 823–838.
- Álvarez, Luis J., Pablo Buriel, and Ignacio Hernando. 2005. Price setting behaviour in Spain: Evidence from micro PPI data. European Central Bank Working Paper No. 522. Frankfurt am Main: European Central Bank.
- Altissimo, Filippo, Michael Ehrmann, and Frank Smets. 2006. Inflation persistence and price setting behavior in the euro area: A summary of the IPN evidence. European Central Bank Occasional Paper No. 46. Frankfurt am Main: European Central Bank.
- Arrow, Kenneth, and Frank Hahn. 1970. *General Competitive Analysis*. San Francisco: Holden-Day.
- Aucremanne, Luc, and Emmanuel Dhyne. 2005. Time-dependent vs. state-dependent pricing: A panel data approach to the determinants of Belgian CPI. European Central Bank Working Paper No. 462. Frankfurt am Main: European Central Bank.
- Ball, Laurence, and David Romer. 1989. Are prices too sticky? *The Quarterly Journal of Economics* 104: 507–524.
- Ball, Laurence, N. Gregory Mankiw, and Ricardo Reis. 2003. Monetary policy for inattentive economies. NBER Working Paper No. 9491. Cambridge MA: National Bureau of Economic Research.
- Barro, Robert. 1972. A theory of monopolistic price adjustment. *Review of Economic Studies* 39: 17–26.
- Blanchard, Olivier, and Nobuhiro Kiyotaki. 1987. Monopolistic competition and the effects of aggregate demand. *American Economic Review* 77: 647–666.
- Bernanke, Ben, and Alan Blinder. 1988. Credit, money, and aggregate demand. *American Economic Review Papers and Proceedings* 78: 435–438.

- Bils, Mark, and Peter Klenow. 2004. Some evidence on the importance of sticky prices. *Journal of Political Economy* 112: 947–985.
- Blinder, Alan S., Elie R. D. Canetti, David E. Lebow, and Jeremy B. Rudd. 1998. *Asking about Prices: A New Approach to Understanding Price Stickiness*. New York: Russell Sage Foundation.
- Calvo, Guillermo. 1983. Staggered prices in a utility maximizing framework. *Journal of Monetary Economics* 12: 383–398.
- Caplin, Andrew, and Daniel Spulber. 1987. Menu costs and the neutrality of money. *Quarterly Journal of Economics* 102: 703–725.
- Christiano, Lawrence, and Christopher Gust. 1999. Taylor rules in a limited participation model. NBER Working Paper No. 7017. Cambridge MA: National Bureau of Economic Research.
- Christiano, Lawrence, Martin Eichenbaum, and Charles Evans. 2005. Nominal rigidities and the dynamic effects of a shock to monetary policy. *Journal of Political Economy* 113: 1–45.
- Clarida, Richard, Jordi Galí, and Mark Gertler. 1999. The science of monetary policy: A New Keynesian perspective. *Journal of Economic Literature* 37: 1661–1707.
- Coenen, Günter, and Andrew Levin. 2004. Identifying the influences of nominal and real rigidities in aggregate price-setting behaviour. European Central Bank Working Paper No. 418. Frankfurt am Main: European Central Bank.
- Danziger, Leif. 1999. A dynamic economy with costly price adjustment. *American Economic Review* 89: 878–901.
- Debreu, Gerard. 1959. *Theory of Value*. New Haven: Cowles Foundation.
- Dixit, Avinash. 1991. Analytical approximations in models of hysteresis. *Review of Economic Studies* 58: 141–151.
- Fabiani, Silvia, Claire Loupias, Fernando Martins, and Roberto Sabbatini. 2007. *Pricing decisions in the euro area: how firms set prices and why*. New York: Oxford University Press, forthcoming.

- Fisher, Franklin. 1972. On price adjustment without an auctioneer. *Review of Economic Studies* 39: 1–15.
- Foley, Duncan. 1994. A statistical equilibrium theory of markets. *Journal of Economic Theory* 62: 321–345.
- Gertler, Mark, and John Leahy. 2006. A Philips curve with Ss Foundation. NBER Working Paper No. 11971. Cambridge MA: National Bureau of Economic Research.
- Golosov, Mikhail, and Robert Lucas. 2003. Menu costs and Phillips curves. NBER Working Paper No. 10187. Cambridge MA: National Bureau of Economic Research.
- Goodfriend, Marvin, and Robert G. King. 1997. The new neoclassical synthesis and the role of monetary policy. *NBER Macroeconomics Annual* 12: 231–283.
- Goodfriend, Marvin, and Robert G. King. 2001. The case for price stability. In *Why Price Stability?*, ed. Alicia Garcia-Herrero, Vitor Gaspar, Lex Hoogduin, Julian Morgan, and Bernhard Winkler. Frankfurt am Main: European Central Bank.
- Guerrieri, Luca. 2002. Persistent issues in inflation persistence. *Review on Economic Cycles* 5, December.
- Hall, Robert L., and Charles J. Hitch. 1939. Price theory and business behavior. *Oxford Economic Papers* 2:12–45.
- Hansen, Per. 1999. Frequent price changes under menu costs. *Journal of Economic Dynamics and Control* 23: 1065–1076.
- Issing, Otmar, Vitor Gaspar, Oreste Tristani, and David Vestin. 2005. *Imperfect knowledge and monetary policy*. Cambridge: Cambridge University Press.
- Kagel, John, and Alvin Roth. 1995. *Handbook of Experimental Economics*. Princeton: Princeton University Press.
- Kashyap, Anil K. 1995. Sticky prices: New evidence from retail catalogs. *Quarterly Journal of Economics* 110: 245–274.

- Kashyap, Anil, and Jeremy Stein. 1994. Monetary policy and bank lending. In *Monetary Policy*, ed. N. Gregory Mankiw. Chicago: University of Chicago Press.
- Kiley, Michael. 2006. A quantitative comparison of sticky-price and sticky-information models of price setting. Federal Reserve System Finance and Discussion Series No. 45. Washington DC: Federal Reserve.
- King, Robert G., and Alexander L. Wolman. 2004. Monetary discretion, pricing complementarity and dynamic multiple equilibria. *Quarterly Journal of Economics* 119: 1513–1553.
- Klenow, Peter, and Oleksiy Kryvtsov. 2006. State-dependent or time-dependent pricing: Does it matter for recent U.S. inflation? *Quarterly Journal of Economics*, forthcoming.
- Kreps, David. 1990. *A Course in Microeconomic Theory*. Princeton: Princeton University Press.
- Lucas, Robert. 1976. Econometric Policy Evaluation: A Critique. *Carnegie-Rochester Conference Series on Public Policy* 1: 19–46.
- Mankiw, N. Gregory. 1985. Small menu costs and large business cycles: A macroeconomic model of monopoly. *Quarterly Journal of Economics* 100: 529–537.
- Mankiw, N. Gregory, and Ricardo Reis. 2002. Sticky information versus sticky prices: A proposal to replace the New Keynesian Phillips Curve. *Quarterly Journal of Economics* 117: 1295–1328.
- Okun, Arthur. 1981. *Prices and Quantities: A Macroeconomic Analysis*. Washington, DC: The Brookings Institution.
- Rotemberg, Julio. 1982. Monopolistic price adjustment and aggregate output. *Review of Economic Studies* 49: 517–531.
- Rotemberg, Julio, and Michael Woodford. 1997. An optimization-based econometric framework for the evaluation of monetary policy. In *NBER Macroeconomics Annual*, ed. Ben Bernanke and Julio Rotemberg. Cambridge MA: MIT Press.

- Sheshinski, Eytan, and Yoram Weiss. 1977. Inflation and the cost of price adjustment. *Review of Economic Studies* 44: 287–303.
- Stahl, Harald. 2005. Time-dependent or state-dependent price setting? Micro-evidence from German Metal Working Industries. European Central Bank Working Paper No. 534. Frankfurt am Main: European Central Bank.
- Taylor, John. 1993. *Macroeconomic Policy in the World Economy: From Econometric Design to Practical Operation*. New York: W.W. Norton.
- Taylor, John B. 1999. Staggered price and wage setting in macroeconomics. In *Handbook of Macroeconomics*, ed. John B. Taylor and Michael Woodford. Amsterdam: North-Holland.
- Woodford, Michael. 2003. *Interest and Prices: Foundations of a Theory of Monetary Policy*. Princeton: Princeton University Press.
- Yun, Tack. 1996. Nominal price rigidity, money supply endogeneity, and business cycles. *Journal of Monetary Economics* 37: 345–370.