

Macroeconomic theory and monetary policy: the contributions of Franco Modigliani and the ongoing debate

LUCAS PAPADEMOS

1. Introduction

A conference honouring Franco Modigliani and focusing on his contributions to economics is an event that is both exciting and challenging. For Modigliani was that rare economist whose work was extensive, original and versatile, leading to major advances in economic theory, as well as in econometric modelling and testing. Moreover, Modigliani was deeply interested and involved in the application of his theoretical and empirical work to important policy issues. Indeed, policy relevance was both the initial trigger and the inevitable final outcome of most of his research and analysis.

Modigliani's most celebrated contributions, which earned him the Nobel Prize for economics, were his life-cycle hypothesis of saving (its theoretical formulation and empirical testing) and his 'efficient market' analysis of corporate finance, which resulted in fundamental insights and propositions regarding the leveraging and dividend policies of corporate firms. In addition, Modigliani made seminal contributions to macroeconomic theory and econometric modelling, focusing on the role of money and financial markets in determining the dynamics of aggregate output and the price level and on the role of monetary policy in stabilising economic fluctuations. He played a leading role in the development of the FMP econometric model¹ at the

□ European Central Bank, Frankfurt am Main (Germany).

¹ The model was named after the three institutions involved in its construction: the Federal Reserve Board, MIT and the University of Pennsylvania. It was later

Federal Reserve Board, which provided a useful tool for policy analysis over a long period of time. He was, in collaboration with Antonio Fazio, also instrumental in the design of the Banca d'Italia's first macroeconomic model.

In my article, I will address several issues pertaining to macroeconomic theory and monetary policy and relate them to the contributions and views of Franco Modigliani. First, I will review a number of major advances in macroeconomics over the past 60 years that have enhanced our understanding of the role and effects of monetary policy. I will discuss, in particular, the structure and main features of theoretical frameworks capable of adequately describing the role of money in the macroeconomy and the effects of monetary policy on aggregate output and the price level. One such framework, which encompasses the theoretical advances reviewed earlier, can be considered to reflect the consensus view regarding the key components and the functioning of the monetary transmission mechanism. I will also point out remaining uncertainties and unresolved questions concerning some structural and dynamic features of this model.

A second subject I will briefly address is the nature and robustness of the empirical relationships linking major economic variables – such as the price level and aggregate output – to monetary policy instruments. These relationships are derived either from macroeconomic models or by alternative statistical methods, which try to capture the dynamic responses of these aggregate variables to monetary policy changes or various types of shock. Specific issues to be examined are: *i*) the extent to which the empirical relationships identified in the euro area have features that are broadly similar to those obtained by Modigliani and his collaborators in the period from the late 1960s to the early 1980s, and more recently by other economists in the United States, and *ii*) the implications of the stochastic and dynamic properties of these empirical relationships for the conduct of monetary policy.

Finally, I will discuss the consequences of both the present state of our knowledge regarding the theoretical macroeconomic framework and the pertinent empirical results concerning policy objectives'

renamed MPS, which is an abbreviation of MIT, the University of Pennsylvania and the Social Science Research Council.

links to instruments for the choice of an appropriate policy strategy and for the effective conduct of monetary policy.

2. Macroeconomic theory for monetary analysis

The roles of money as a medium of exchange, an asset and a store of value and a unit of account determine its effects on the functioning of the economy and, consequently, the influence of monetary policy on economic aggregates. Central banks can directly control a certain narrow measure of the quantity of money, the so-called “high-powered money” or “monetary base”, which comprises cash held by the public plus banks’ reserves. Central banks also directly control the very short-term interest rate, which defines the opportunity cost of holding (high-powered) money and/or the cost of financing financial intermediaries’ holdings of such money (borrowed reserves). By changing the very short-term interest rate and/or the quantity or rate of growth of (high-powered) money, a monetary authority can influence, through a variety of mechanisms and channels, the demand for and supply of goods, services and assets, including broad measures of money, by households, firms and financial intermediaries, at least in principle. That qualification needs to be emphasised, because the nature, magnitude and time profile of these influences are the subject of theoretical and empirical analysis.

Economic theory has tried to explain at a micro-level, on the basis of the optimising behaviour of agents, how and to what extent the demand for and supply of goods and assets by individual households, firms and financial intermediaries are influenced by the interest rate and the stock of money controlled by the central bank. The links are complex, largely indirect and involve not only time-lags, but also expectations of future values of pertinent variables. The macroeconomic framework for monetary policy analysis is then obtained by aggregating the micro-relationships using many simplifying assumptions about the nature and homogeneity of preferences and technologies, market structures and adjustment mechanisms, and the available information and its processing by individual agents. These simplifying – often heroic – assumptions are necessary in order to derive relatively simple aggregate relationships describing the effects of policy-con-

trolled variables on broad economic aggregates such as the gross domestic product and the price level.

Macroeconomic theory originally developed by directly postulating the existence of simple aggregate relationships, without great concern for, or detailed analysis of, the underlying micro-foundations. This fact, however, cannot be interpreted as implying that macroeconomic theorists, including Keynes, Friedman and Modigliani, were not fully aware of the inherent limitations of this approach. On the contrary, they often tried to explain macroeconomic relationships, qualitatively or analytically, in terms of the rational, optimising behaviour of economic agents. These general remarks are worth keeping in mind when interpreting and assessing theoretical developments in macroeconomics and the theoretical framework for monetary analysis to be outlined later on.

In the almost 70 years since Keynes' *General Theory* (1936), analytical contributions and empirical research have enhanced our understanding of the role of money in the functioning of the macroeconomy and the effects of monetary policy on aggregate output and the price level. This understanding can be usefully and succinctly represented by a theoretical framework for monetary analysis which can be regarded as reflecting the consensus view about the main features and the functioning of the monetary policy transmission mechanism. Before outlining this framework, however, I will summarise a number of significant advances in macroeconomics and relate them to the contributions of Modigliani.

An important development in macroeconomics and Modigliani's first theoretical contribution 60 years ago was the integration of Keynesian with classical economics. Keynes' *General Theory* and its formalisation by Hicks (1937) in the so-called "IS-LM paradigm" was at the time considered revolutionary, a radical departure from mainstream classical economics. Modigliani, in a seminal article in 1944, his first published work, "Liquidity preference and the theory of interest and money", showed the crucial role of nominal wage rigidity in explaining the effects of monetary policy on economic activity and the existence of unemployment equilibria. He demonstrated that if firms' demand for labour was a function of real wages, and if wages were sticky in the face of unemployment, money was non-neutral, while if wages were perfectly flexible, the classical conclusions of full employment and money neutrality would hold. He therefore showed that

Keynesian theory was not a radically different approach which could not be reconciled with classical economics, but rather that the latter was a special case of a more general formulation.

This 'neoclassical-Keynesian synthesis' became the standard textbook paradigm for a generation of economists. The conceptual framework for monetary analysis has been extensively elaborated and further refined since then. However, the existence of at least some degree of downward wage rigidity has remained a salient feature of the macroeconomy in the view of many economists. Modigliani himself repeatedly emphasised its policy relevance, *inter alia* in one of his last published articles (Modigliani 2003).

A second milestone in the development of macroeconomics with implications for monetary policy is directly linked to Modigliani's Life-Cycle Hypothesis of saving (LCH), which he advanced together with Brumberg in 1954, and the roughly contemporaneous Permanent Income Hypothesis of Milton Friedman (1957). The two models have certain similarities, but also differences, including their implications for monetary policy. I would like to point out three policy implications of the LCH that are significantly different from those derived from the conventional Keynesian specification of aggregate consumption. First, since according to the LCH wealth influences consumption, monetary policy can affect aggregate demand not only through its effect on the cost of capital and investment, but also by affecting the market value of assets and thus consumers' spending. Second, as consumption depends on expected life-cycle income, expectations of future income become important determinants of current consumption and thus current income (see Ando and Modigliani 1963 and Modigliani 1971). Thus, the LCH added another wealth channel to the monetary transmission mechanism and extended the standard macroeconomic framework through the inclusion of forward-looking expectations of income. A third implication of the LCH relates to the issue of whether government debt should be considered part of private wealth. According to the LCH, aggregate saving should be largely independent of the government budget stance and private wealth should not, therefore, depend on the national debt (see Modigliani and Sterling 1985). This conclusion contrasts with the Ricardian Equivalence Proposition, according to which the private sector adjusts its saving to offset the unfavourable effects of a government budget deficit on future generations (see Barro 1974 and Seater 1985).

From the mid-1950s to the early 1960s, economic theory focused on elaborations of the determinants of the various components of aggregate demand and their relationships with policy instruments. In another seminal article published in 1963, Modigliani presented an extension of the standard macroeconomic model, which included a more elaborate specification of the determinants of consumption and investment and incorporated a banking system that allowed for the distinction between inside and outside money and for an analysis of the role of credit rationing in the transmission of the effects of monetary policy. That model also included two further innovations: a government budget constraint that defined the intertemporal relationship between fiscal and monetary policies, and a first, albeit brief, discussion of mark-up pricing as an alternative to the price-setting mechanism implicit in the Keynesian supply function emphasised by Modigliani 20 years earlier, according to which the output supplied is a decreasing function of the real wage. This more sophisticated model allowed Modigliani (1963) to analyse and assess key features of “the monetary mechanism and its interaction with real phenomena” more thoroughly than in the past. Perhaps more importantly, this model provided the basic framework and the building blocks that were further elaborated and estimated in the FMP/MPS macroeconomic model of the United States.

The 1960s and 1970s were the heyday of macroeconomic modelling and policy analysis. Econometric models were built in order to obtain more detailed, concrete and realistic specifications of macroeconomic relationships which could also capture the observed statistical regularities between economic aggregates and, more specifically and importantly, between policy objectives and instruments. The FMP/MPS model, which was constructed under the guidance of Franco Modigliani, Albert Ando and Frank de Leeuw by a group of economists at MIT, the University of Pennsylvania and the Federal Reserve Board, was especially important and influential for a long time. It was initially estimated in 1966 and was by 1970 fully operational at the Federal Reserve Board for forecasting and policy analysis. Although its general structure remained broadly the same for many years, it was a ‘living model’ that was modified and refined over the years – for example to capture more adequately inflation-wage dynam-

ics and international linkages.² It remained operational until the mid-1990s.

What made the MPS model relatively unique and particularly useful for monetary analysis was that it was built to include a variety of mechanisms and channels through which money and financial markets and monetary policy instruments could affect economic activity and price developments. For example, monetary policy could influence aggregate demand through its effects both on the cost of capital and investment, and on wealth and consumption, and also as a result of credit rationing in the housing market. Moreover, the money market and the financial sector were specified in some detail, allowing for the modelling of interest rates at different maturities. The MPS model was a sophisticated and detailed elaboration and embodiment of the neoclassical-Keynesian synthesis. It had classical properties in the long term: money was neutral and a change in the monetary policy stance had no permanent effects on aggregate output. Over the short and medium term, monetary policy could have a considerable effect on economic activity, depending on the initial state of the economy. That effect would gradually increase over time and reach a peak after a period of between one and two years, before eventually dissipating. Moreover, the structure and the dynamic and stochastic features of the model implied that monetary policy could play a stabilising role and help mitigate economic fluctuations.

An important limitation of macroeconomic theory and econometric modelling until the early 1970s was the relatively simple specification of the determinants of aggregate supply and the functioning of labour markets. Econometric models, including the MPS, did incorporate neoclassical production functions and derived factor demands, as well as Phillips curve inflation-unemployment relationships augmented to take into account the effects of expectations. Nevertheless, the Phillips-type inflation-output trade-offs were mainly considered empirical relationships, reflecting market adjustment mechanisms; their theoretical underpinnings were few and limited, while it was invaria-

² See Brayton *et al.* (1997) for a comprehensive description of the evolution of macroeconometric models at the Federal Reserve Board since the mid-1960s. The early versions of these models, referred to as Federal Reserve-MIT and Federal Reserve-MIT-Penn (FMP), are described in Ando and Modigliani (1969), de Leeuw and Gramlich (1968 and 1969) and Rasche and Shapiro (1968). The structure and properties of the MIT-Penn-SSRC model used at the Federal Reserve Board in the mid-1980s are presented in Brayton and Mankopf (1985).

bly assumed that inflation expectations were backward-looking and had been formed adaptively.³

The rising inflation in the late 1960s and early 1970s coincided with, and contributed to, a resurgence of classical-monetarist views on the relationship between output and inflation and the role of monetary policy. Friedman (1968) and Phelps (1968) independently advanced theories based on the notion of the natural rate of unemployment (or level output) to explain deviations of output from its potential level or growth trend not as a consequence of changes in aggregate demand, but rather as a result of mistaken price expectations and misperceptions regarding the real wage. Two major conclusions emerged from this analysis: first, that no inflation-output trade-off exists in the long run and, second, that expectations and their nature are of crucial importance in generating short-term output fluctuations and in determining the effectiveness of monetary policy in stabilising output.

The rational expectations school of Robert Lucas and other economists developed the Friedman-Phelps theory further and reached remarkable conclusions about the stabilising role of monetary policy. On the basis of the propositions that expectations are ‘rational’ and that wages and prices are sufficiently flexible, they showed that output fluctuations around long-term equilibrium levels – which are caused by demand shocks – are transient, randomly distributed and likely to be small. They also demonstrated that monetary policy cannot systematically mitigate economic fluctuations by exploiting short-term Phillips curve trade-offs. They therefore concluded that it is neither necessary nor feasible for monetary policy to stabilise the economy. Furthermore, they warned of the risk of mistakes on the part of policy-makers, a risk inherent in an excessively pro-active monetary policy.⁴

The policy implications of the two hypotheses concerning the ‘natural rate of unemployment’ and the ‘rationality of expectations’

³ See de Menil and Enzler (1972) for a presentation of the structure and performance of the initial price-wage block of the FMP/MPS model. Ando and Brayton (1995) review and assess the determination of prices, wages and employment in the US economy on the basis of alternative models. They show that the wage-price block in the MPS model performed well and remained “little changed” from the mid-1970s until the mid-1990s.

⁴ See, for example, Lucas (1972, 1973 and 1976) and Sargent and Wallace (1975).

triggered a plethora of important theoretical analyses on the functioning of labour markets and the role and nature of expectations, as well as new econometric approaches to the testing of optimising models. In addition, the inflationary environment of the 1970s and 1980s stimulated extensive research on the effects and distortions of high and variable inflation, including those resulting from the interaction between inflation and tax structures, and on the effectiveness of alternative forms of monetary control in reducing inflation and stabilising the price level. In these areas, Modigliani made several significant contributions, of which I will highlight two: 1) the notion and empirical testing of the non-inflationary rate of unemployment (NIRU) and 2) the development of a broader macroeconomic framework for the monetary transmission mechanism, which incorporates various effects of inflation on product, labour and financial markets, includes a fairly general specification of aggregate supply, inflation dynamics and expectations, and allows for the analysis of the effectiveness of alternative forms of monetary control in an inflationary environment under conditions of uncertainty.

The NIRU was introduced by Modigliani and Papademos in 1975 as a generalisation of the natural rate of unemployment. The NIRU is defined (p. 142) as “a rate such that, as long as unemployment is above it, inflation can be expected to decline” given, of course, the influence of other determinants of inflation. The NIRU concept has been interpreted by some as the equilibrium outcome of wage-price models that draw on the bargaining framework of wage determination (Layard, Nickel and Jackman 1991). The original formulation was based on a search-theoretic approach, also including the Beveridge curve along the lines developed by Holt (1970). Accordingly, the NIRU is the rate of unemployment at which unemployment, the associated rate of vacancies and the duration of the search for employment are such that there is no significant upward or downward pressure on wages. Implicit in this model is a possible asymmetry in the response of wages to labour market conditions when the unemployment rate is above or below the NIRU value, reflecting the ‘non-homogeneity of labour’. The NIRU concept has often been referred to subsequently as the non-accelerating inflation rate of unemployment (NAIRU), a term that highlights its links to the accelerationist version

of the Phillips curve.⁵ What should be emphasised for the purposes of macroeconomic analysis is that the existence of the NIRU (or NAIRU) is consistent with “both the vertical and the non-vertical schools of the Phillips curve” (Modigliani and Papademos 1975, p. 142), as generalised to take into account the effects of inflation expectations and other factors, including supply shocks.⁶

Estimates of the NIRU or NAIRU provide a useful indicator for the assessment of inflationary developments in the short run, since, other things being equal, inflation can be expected to rise when unemployment is below the NIRU and to fall when unemployment is above the NIRU.⁷ Since the NIRU is non-observable, it has to be estimated using observable variables related to it. Estimates of the NIRU have been obtained using various methodologies.⁸ Every method has its virtues and shortcomings. Regardless, however, of the methodology used, the estimated values of the NIRU are characterised by two common features: some imprecision and variability over time. The degree of uncertainty surrounding NIRU estimates is, of course, relevant for policy, as it has implications for the reliability of the ‘unemployment gap’ in the assessment of inflationary pressures.⁹ The value of the NIRU can be expected to vary over time on theoretical grounds and this variability was indeed stressed in the original formulation by Modigliani and Papademos. The available evidence suggests that changes in demographics, labour participation rates, productivity growth and real inter-

⁵ Baily and Tobin (1977) referred to the NIRU concept as the non-accelerating inflation rate of unemployment (NAIRU) and presented a model of its determinants.

⁶ Modigliani and Papademos (1975) emphasised that the NIRU concept is consistent with alternative theories about the trade-off between inflation and unemployment. They also pointed to and empirically accounted for the effects on this trade-off of several factors, notably of changes in the age-sex composition of the labour force and in real oil prices. The concept of the natural rate of unemployment is defined in Friedman (1968). See Ball and Mankiw (2002), Staiger, Stock and Watson (1997a) and Estrella and Mishkin (1999) for discussions of the concept of the NAIRU and its role in macroeconomic analysis and monetary policy.

⁷ Since the concepts of the NIRU and NAIRU are essentially the same, I will use the original acronym which is both simpler and more general, as it is not restricted to the accelerationist version of the Phillips curve.

⁸ These can be grouped into two categories: those using a structural approach on the one hand, and those employing a more direct approach on the other, including a purely statistical method that decomposes unemployment into a trend and a residual component.

⁹ Staiger, Stock and Watson (1997b) assess the precision of the estimates of the natural rate of unemployment (and the NAIRU).

est rates, as well as certain institutional factors, explain the evolution of the NIRU over time. Despite the methodological difficulties encountered in estimating the NIRU, there is evidence that inflation forecasts based on this indicator in the context of extended Phillips curve relationships have been fairly accurate, especially when compared with forecasts based on alternative macroeconomic indicators.¹⁰

In the case of Europe, there is ample evidence that structural or institutional changes in the early 1970s contributed to a significant increase in the NIRU. According to the most recent estimates,¹¹ the NIRU in the euro area rose to a maximum of around 10-11% in the mid-1990s and subsequently declined slowly, reaching values ranging, depending on the estimation method used, between 8.3 and 8.8% in 2000 and 2004. The available evidence suggests that changes in the structure of labour markets and in productivity growth, the interaction of supply shocks and labour market institutions, technological advances, unemployment benefits and 'hysteresis phenomena' have significantly influenced the evolution of the NIRU in Europe over the last 30 years.¹² The estimated gradual decline in the euro area NIRU since the mid-1990s can be largely attributed to the favourable effects of the labour market reforms implemented in several euro area countries over the past decade. At the same time, the fact that the estimated NIRU is currently above 8% and thus approximately equal or only slightly lower than the actual unemployment rate of 8.8% (in May 2005) underlines the need for further structural reforms for addressing the unemployment problem in Europe and highlights a limit imposed on the conduct of the stability-oriented monetary policy of the ECB.

The other contribution made by Modigliani in the 1980s to macroeconomic theory and the analysis of monetary policy to which I would like to refer was the development of a set of models which

¹⁰ Such indicators include the output gap, capacity utilisation, job vacancies, business confidence indicators and interest rates. See, for example, Stock and Watson (1999) and Logeay and Tober (2004).

¹¹ See Fabiani and Mestre (2000 and 2004), Turner *et al.* (2001), IMF (2001), and Logeay and Tober (2004). The ECB's *Monthly Bulletin* (August 2005) provides a brief overview of the evolution of the NAIRU in the euro area.

¹² The role of institutions in determining developments in unemployment and the NIRU in the euro area and OECD countries since the 1960s is examined by Blanchard and Wolfers (2000), Fitoussi *et al.* (2000), Nickell (2003) and Nickell *et al.* (2003). The effects of hysteresis in unemployment on the natural rate of unemployment or the NIRU in Europe are discussed and estimated by Blanchard and Summers (1987).

examine the role of the economy's financial and fiscal structure in shaping the monetary mechanism and in determining the effectiveness of alternative forms of monetary control in an inflationary environment and under conditions of uncertainty.¹³ These models that we jointly developed include: 1) a fairly comprehensive representation of the economy's financial structure, 2) a specification of elements of the tax structure which can influence the impact of inflation on the real economy and have implications for monetary policy and 3) an explicit modelling of the corporate sector's investment and financial decisions. Moreover, these models capture the effects of inflation on the product, labour and financial markets, incorporate a general formulation of the determinants of aggregate supply (which can be interpreted as an expectations-augmented Phillips curve or a Lucas-type aggregate supply specification) and allow for alternative hypotheses regarding the nature and formation of expectations (e.g. rational or adaptive expectations).

These more comprehensive models were employed to investigate a variety of issues, for instance: 1) the potential non-neutral effects of fully anticipated inflation and predictable monetary policy on the long-term equilibrium of the economy and 2) the relative effectiveness of alternative forms of monetary control in stabilising unanticipated fluctuations in output and the price level (induced by demand and supply shocks) under alternative hypotheses about the nature of expectations and the degree of flexibility of prices. The analysis demonstrates that, under conditions of uncertainty, the relative effectiveness of alternative monetary and credit aggregates (as intermediate policy targets or indicators) in stabilising the price level and real output depends upon a host of factors: the origin and relative magnitude of shocks; the economy's financial structure; behavioural and institutional characteristics; and, in the case of certain disturbances, for instance supply shocks, the assessment of the welfare benefits resulting from the minimisation of output variability and the attainment of price stability.

The macroeconomic models for monetary analysis developed in the 1980s are richer and more elaborate in terms of the description of

¹³ See Modigliani and Papademos (1980 and 1987) and Papademos and Modigliani (1983 and 1990).

the economy's financial and institutional structure.¹⁴ They are also more general and eclectic with regard to the specification of aggregate supply and the formation of expectations. Inevitably, they are more complex. It is possible, however, to specify a simplified version of this type of model which retains the salient features of the more general models and still provides an adequate description of the economy's financial structure and the role of money in the macroeconomy. Such a theoretical framework, augmented to allow for the effects of nominal wage and price rigidities resulting from contractual arrangements, can be regarded as representative of the consensus view about the key components and modalities of the monetary transmission mechanism.¹⁵

This macroeconomic theoretical framework is broadly consistent with alternative views about the functioning and certain features of the product, asset and labour markets. The model has classical properties in the long run (monetary policy has no permanent effects on economic activity), but it can exhibit neoclassical or neo-Keynesian properties over the short and medium term. Thus, it can, accordingly, lead to different policy conclusions depending on 1) the values of key parameters capturing behavioural and institutional factors, 2) the features of market-clearing adjustment-mechanisms and 3) the nature and formation of agents' expectations about future developments and policies. Some economists may not accept that this type of model is representative of their approach to monetary analysis, while others

¹⁴ Macroeconomic frameworks focusing on the role of asset markets and financial intermediaries in the monetary policy transmission mechanism had also been developed in the 1960s and the 1970s by Tobin (1969), Tobin and Brainard (1963) and Brunner and Meltzer (1972 and 1976). These models, however, did not incorporate all the elements of the economy's financial and tax structures, the specification of aggregate supply and the effects of inflation expectations that were included in the models developed by Modigliani and Papademos in the 1980s.

¹⁵ See Papademos and Modigliani (1990) for a description of such a general framework for monetary analysis and simplified stochastic versions, as well as for an examination of the effectiveness of monetary policy in stabilising output and price fluctuations under conditions of uncertainty. Fischer (1987) presents another theoretical framework that extends Modigliani's 1963 model by introducing an aggregate supply specification (in the form of an expectations-augmented Phillips curve), debt dynamics and international transactions. Open-economy models that include elements of the economy's financial structure are presented in Papademos and Rozwadowski (1983) and in Dornbusch and Fischer (1984). The effects of nominal wage and price rigidities on aggregate output and inflation dynamics when expectations are 'rational' are examined in Fischer (1977), Phelps and Taylor (1977), Taylor (1980) and Akerlof and Yellen (1985).

may question its consistency with optimising general equilibrium models. Needless to say, such a framework can be generalised with regard to both its structure and its dynamic aspects. Nevertheless, it is capable of adequately describing the role of money in the economy and the effects of monetary policy. In my view, it can be considered a representative formulation of the consensus view regarding the main components and modalities of the monetary transmission mechanism.

Let me illustrate the policy implications of this model assuming that expectations are 'rational' and that wages and prices exhibit some intertemporal inflexibility caused by staggered contractual arrangements. An analysis or simulation of the dynamic responses of aggregate output and the price level to a change in the monetary policy stance (more precisely, to a change in the very short-term interest rate controlled by the central bank) supports the following three propositions.

1) In the short run, a change in the monetary policy stance affects the economy primarily via aggregate demand, but also, to a certain degree, via aggregate supply. Quantitatively, the effects on economic activity and the price level depend on *i*) the extent to which the change in the interest rate affects aggregate demand, which is determined by various factors in the asset and product markets and *ii*) the extent to which aggregate supply responds to demand in the short run and is directly affected by the change in the policy stance, which is influenced by the functioning of labour markets and the formation of expectations.

2) Over the medium term, money affects both aggregate output and the price level; its impact on aggregate output gradually increases and reaches a peak, before progressively declining as inflationary pressures build up and aggregate supply responds less to short-term variations of demand and more to longer-term determinants of productive capacity and labour utilisation.

3) In the long run, the effect of money on economic activity (both the level of aggregate output and its rate of growth) is nil; a change in the money stock affects only the price level.

This intertemporal profile of the output and price effects of monetary policy is very much in line with those generated by traditional macroeconomic models, including the MPS, which incorporate elaborate aggregate demand and detailed financial sector specifica-

tions, together with different hypotheses concerning the formation of expectations and the specification of aggregate supply. A crucial question is whether the qualitative results I have described are model-specific, that is whether they essentially reflect in-built features of the model, or whether they are general and representative of the 'stylised facts' characterising the monetary transmission mechanism.

3. Empirical evidence on the monetary policy transmission mechanism

I will endeavour to answer this question by briefly presenting the available empirical evidence concerning the effects of monetary policy on economic activity and inflation in the euro area. In recent years, the 'stylised facts' about the intertemporal effects of monetary policy on aggregate output and the price level have been established mainly by using vector auto-regressive models. In addition to the results obtained from vector auto-regressions, the pattern of responses has also been examined on the basis of simulations employing traditional econometric models, as well as stylised general equilibrium models.

A group of Eurosystem researchers worked on this topic for more than two years assembling a large body of empirical evidence.¹⁶ A wide range of macroeconomic and microeconomic data and models were used, partly in order to ensure that the empirical results would not be overly sensitive to arbitrary choices of models or data sets. The outcome of this research leads to a number of interesting conclusions.¹⁷

A first conclusion about the monetary policy transmission mechanism in the euro area is that a change in the policy interest rate seems to lead to an adjustment in output that reaches a peak after a period of between one and two years. The response of the price level is typically estimated to be much more gradual, but long-lasting. This broad qualitative pattern emerges consistently across a variety of empirical models. However, the exact time profile of these dynamic effects cannot be estimated precisely, particularly for the euro area.

¹⁶ See Angeloni, Kashyap and Mojon (2003).

¹⁷ See Angeloni, Kashyap, Mojon and Terlizzese (2003) and Papademos (2003).

Thus, the evidence available for the euro area confirms that the transmission lags in the effects of monetary policy are not only long, but also variable.

A second conclusion concerns the channels of influence of monetary policy through financial markets. Looking at all the evidence, it appears that a set of simple links across the structure of interest rates, together with the estimated responses of private expenditure to those rates, is sufficient to account for the main patterns of the euro area response to policy changes. Thus, the interest rate channel seems to work reliably. This does not mean, however, that other influences reflecting the structure of financial markets are not relevant.¹⁸

A third conclusion is that there are important similarities in the cyclical behaviour of the euro area and US economies, as well as in their responses to monetary policy. The time sequences of lead and lagged reactions to monetary policy which characterise prices, output and the main components of aggregate demand appear to be remarkably similar in the two economies.¹⁹ This should perhaps not be surprising, given that the size, degree of openness and output structure of the two economies are not very dissimilar. This suggests that the inner workings of the world's two largest market economies may not be all that different.

A fourth important issue that needs to be considered is whether the effects of monetary policy on output and the price level are linear and symmetrical, i.e. whether the effects of monetary policy are the same regardless of the cyclical condition of the economy, the level of interest rates and the direction of change in the policy stance. The existence of such non-linearities or asymmetries obviously has implications for the impact of monetary policy over the economic cycle. Our findings are – on this issue – tentative, mainly owing to the limitations of statistics. However, the evidence available shows that in euro area countries and the United States the response of output to changes in the policy interest rate is stronger during recessions than during booms.

¹⁸ See, for example, B.M. Friedman (1983), Blinder (1985), Bernanke and Gertler (1995) and Meltzer (2001).

¹⁹ For a review and assessment of the empirical evidence on the monetary transmission mechanism in the United States, see Mishkin (1995).

This reading of the empirical evidence on the monetary transmission mechanism is also supported by simulations based on highly stylised dynamic general equilibrium models. Several theoretical contributions have shown that these models, provided that they included some form of nominal wage or price rigidity, would deliver the previously described output and price responses to a change in the monetary policy stance.²⁰ It is remarkable that the empirical relationships identified for the euro area linking major economic variables to monetary policy instruments, whether derived from macroeconometric models or by alternative statistical methods, have features that are broadly similar to those obtained by Modigliani and his collaborators in the past for the United States.

4. Monetary policy

Overall, the preceding review of the empirical evidence confirms the conclusions of theoretical analysis concerning the effects of monetary policy on the price level and economic activity. It also confirms the validity of the ECB's views with regard to the objectives and the role of monetary policy, as well as the choice of an appropriate strategy for achieving these objectives. The adoption of price stability as the primary objective of monetary policy reflects not only the important economic and social benefits that such stability entails, but also the fact that central banks can control the price level effectively over the medium and long term. Monetary policy can, in principle, influence economic activity, but its effects are largely transitory and the magnitude of these effects on aggregate output over the medium term de-

²⁰ See, for example, Smets and Wouters (2003). Christiano, Eichenbaum and Evans (1999) examine the dynamic response of various economic aggregates to a monetary policy shock under alternative identification schemes and review a particular approach to assessing the empirical plausibility of structural economic models that can be used to study systematic changes in monetary policy. Goodfriend and King (1997) present a model which combines elements of Keynesian theories of prices stickiness and imperfect competition with the application of intertemporal optimisation and rational expectations to determine the behaviour of economic agents in a dynamic stochastic environment. Aiyagari and Gertler (1985) have shown that intertemporal general equilibrium models with rational expectations can have features that are not inconsistent with those of non-optimising macroeconomic frameworks, including the conventional IS-LM model.

pend on a number of conditions and constraints, to which I will return later.

The empirical evidence and the state of our knowledge about the monetary transmission mechanism also confirm the appropriateness of the main features of the ECB's strategy for achieving the price stability objective. The long time-lags in the effects of monetary policy on the price level clearly imply that monetary policy should be forward-looking over a medium- and long-term horizon. Of course, central banks cannot predict future events with accuracy, especially over the medium and long term. Also, by definition, they cannot predict unanticipated shocks. However, they can – and should – carefully take into account the time it takes for various factors, underlying forces or past disturbances to affect the price level, as well as the time it takes for monetary policy to counteract the expected undesirable consequences for prices of various factors or other policies. Monetary policy must therefore be both forward-looking and preemptive. Moreover, the uncertainty surrounding the effects of a change in the monetary policy stance on the price level (on the basis of alternative models) supports the adoption of an eclectic approach that uses all available information and alternative methods of analysis in order to reach conclusions about the appropriate monetary policy stance. The ECB's strategy employs both economic and monetary analyses not because it is impossible to integrate them conceptually into a single theoretical framework, but because in practice it has to date proved difficult to capture statistically, in a sufficiently reliable way, the longer-term price effects of monetary policy on the basis of available macroeconomic models.

A central issue for monetary policy-making, which was at the heart of Modigliani's theoretical contributions and policy advice, is the effect of monetary policy on economic activity. The available evidence supports the view, also espoused by Modigliani, that monetary policy actions can in general have significant medium-term effects on aggregate output. This is contrary to the views of adherents to the pure and strict branch of the “rational expectations” and “perfectly flexible prices” school of thought. For the monetary policy-maker, however, there is another important and relevant question, which goes beyond the issue of whether money is neutral over the short and medium term. The question is: can monetary policy affect economic activity in a sufficiently predictable and reliable way over the medium

term and in a way which is consistent with its primary responsibility to maintain price stability? Theory tells us that this may be possible. The empirical evidence and policy-makers' experience suggest that it is feasible under certain circumstances and with some caveats. In practice, the answer to this question depends on the nature, size and persistence of shocks affecting the economy, the dynamics of markets' adjustment to disequilibria, and the nature of economic agents' expectations about future events and policies. Experience shows that a central bank's commitment to its primary objective and its credibility in implementing policy in a manner consistent with this objective are crucial in shaping the effectiveness of monetary policy in terms of the achievement of its goals and the potential performance of an output-stabilising role.

There is little doubt that industrialised countries' macroeconomic policies have, on the whole, succeeded in steering their economies away from deep and prolonged recessions or deflation. The Japanese experience has been the only notable exception over the last 60 years. An assessment of the type and relative magnitude of the shocks that have affected a number of economies (whether demand or supply shocks, real or financial) has led some economists to conclude that the additional welfare gains that can be expected as a result of the conduct of a more active monetary policy in order to stabilise output fluctuations are very small (see Lucas 2003). Moreover, these potential welfare gains have to be weighed against the risk – and the resultant welfare loss if this risk materialises – that an inappropriate or inconsistent policy will aggravate the economic cycle. These considerations imply that monetary policy should avoid being activist and should aim to minimise the uncertainty that economic agents face by providing a stable and predictable policy framework that guides market expectations. This could be achieved either by the adoption of very simple policy rules, such as the constant money-growth rule advocated by Milton Friedman,²¹ or by the application of more sophisticated feedback rules (linking the interest rate policy instrument to policy objectives), such as those proposed by John B. Taylor.²²

Throughout his professional life, Modigliani adopted a very strong stance in favour of a stabilising role for monetary policy. In his

²¹ See Friedman (1968).

²² See Taylor (1996 and 1999).

Presidential address at the annual meeting of the American Economic Association, Modigliani (1977) made the case for stabilisation policies in general and monetary policy in particular. He forcefully argued what he also considered to be the fundamental practical message of Keynes' *General Theory*, namely that "a private enterprise economy using an intangible money needs to be stabilised, can be stabilised, and therefore should be stabilised by appropriate monetary and fiscal policies" (*ibid.*, p. 1). His arguments were based, first, on an evaluation of the key adjustment mechanisms determining the dynamic behaviour of output and prices and their responses to external shocks and monetary policy actions and, second, on an assessment of the evidence regarding the effectiveness of stabilisation policies over the 40-year period from the mid-1930s to the mid-1970s. He did not presume that the economy was inherently unstable in the event of significant disturbances and he did accept, as had been the case in all of his work, that a monetary policy stimulus would be neutral in the long run. His analysis and arguments focused on demonstrating that the macroeconomy would be characterised by greater instability in the absence of an active output-stabilising policy, particularly when economic fluctuations were due to demand shocks. But he also advocated a stabilising role for monetary policy in dealing with supply shocks. Modigliani did, however, acknowledge that "in a stochastic world, discretionary stabilisation policy could get into trouble, and might conceivably even yield a less stable economy than one with rules" (Dornbusch, Fischer and Bossons 1987, pp. 261-62). But he concluded that this was a purely empirical issue that had to be assessed on the basis of the available evidence.²³

In my view, neither the adoption of fixed rules nor an activist, fine-tuning, stabilising approach is an appropriate and effective means of conducting monetary policy. The potential effectiveness of an activist monetary policy does not depend solely on market-clearing adjustment mechanisms and agents' expectations which influence the path and speed of the economy's return to full-employment. Equally important are the nature and degree of the uncertainty faced by policy-makers. This uncertainty is not limited to exogenous shocks, which are generally observable (at least *ex post*), although some of

²³ See Modigliani's comments on Fischer (1987) in Dornbusch, Fischer and Bossons (1987, pp. 261-62).

them – for instance those associated with technological advances – may be difficult to discern. It is primarily the uncertainty associated with behavioural and structural parameters of the economy, their variance over time and their possible response to policy that complicates the assessment of the economic outlook and the choice of an appropriate policy stance. As economists and policy-makers, we know – indeed, we have learned – quite a lot about the structure and behaviour of the macroeconomy. But our knowledge is far from perfect. And when we presume that we know more than we actually do, the potential for policy errors increases and so does the probability of a well-meaning activist policy having a destabilising effect.

Let me give two related examples of the potentially destabilising effects of an activist monetary policy employing rules or discretion. First, a reasonably accurate knowledge of potential output growth, in real time, is crucial to the effectiveness of feedback rules. In the absence of such knowledge, the use of these rules can actually produce worse results than a more cautious, discretionary approach (see Orphanides 2001). Second, the NIRU is difficult to estimate with precision and varies over time. Taking into account the time-lags involved in the effects of monetary policy on aggregate demand and employment, an activist, overambitious policy aiming to steer the economy close to the NIRU may actually result in unintended inflationary pressures that will be costly to eliminate later. Clearly, the effectiveness of an activist policy hinges on the uncertainty surrounding quantities and parameters that are not directly measurable, as well as on the magnitude of the exogenous shocks that have caused output to deviate from its long-term potential or full-employment path. The larger the shock, the smaller the probability, given our imperfect knowledge of aspects of the economic structure and dynamics, that errors of measurement or judgement will be made and a mistaken ‘stabilising’ policy will be pursued.

In addition, there is the important issue of commitment to the primary objective of price stability and the credibility of the central bank, in the eyes of the markets and the public, in its pursuit of this objective, especially in the case of disturbances, real or nominal, which may confront policy-makers with trade-offs and dilemmas. As I stressed earlier, a central bank’s commitment and credibility are crucial determinants of the effectiveness with which it is able to achieve its primary objective and potentially perform an output-stabilising role.

5. Concluding remarks

In conclusion, I would like to stress some general points about the conduct of monetary policy and relate them to the views of Modigliani. The effectiveness of monetary policy in maintaining price stability and fostering economic growth depends on several factors: first, on a correct understanding of the nature and functioning of the monetary transmission mechanism; second, on reliable methodologies and empirical analyses that can help us to estimate reasonably accurately the relationships between policy objectives and instruments; and third, and more generally, on the efficient use of all available information and methods of analysis to assess the economic outlook and the risks surrounding the attainment of policy objectives. Modigliani's theoretical and empirical work greatly contributed to the enhancement of our understanding of the monetary transmission mechanism and our knowledge of its empirical modalities. His contributions have been many, varied, profound and long-lasting.

The advances in macroeconomic theory and the empirical analysis of economic aggregates over the past 60 years have not only helped us to obtain a more solid foundation for monetary policy-making. They have also increased our appreciation of the complexity of the monetary transmission mechanism and the factors – partly uncertain and time-varying – which influence the economy's response to a change in the monetary policy stance. Expectations about future developments and policy actions play an important role in the monetary transmission process. Policy effectiveness therefore also depends on the public's confidence and trust in the central bank's commitment to its objectives and the credible implementation of its policies. I believe that Modigliani would agree with these propositions.

Modigliani was deeply interested in social welfare issues. His views on the conduct of monetary policy were driven by his great concern about the economic and social consequences of high unemployment, rather than an underestimation of the benefits of price stability. The fact that he held different views on the appropriate monetary policy stance in Europe did not reflect differences on fundamental economic principles, or disagreements as regards the theoretical framework for monetary analysis, or the need to achieve both price stability and full employment. Rather, it reflected his different

assessment of the quantitative significance of certain behavioural or structural factors and his different value judgements about the risks associated with external factors and alternative policy responses, as well as about the appropriate means and pace of achieving higher growth and employment. We all agree on the desirability of achieving this objective. But with regard to the most effective means of attaining it, we may agree to disagree. We should, however, agree to pursue the necessary reforms, which are indispensable and urgently needed in order to achieve stronger, sustainable growth in Europe through increased productivity and labour utilisation. The implementation of these reforms in an appropriate and timely fashion will resolve the dilemmas perceived by some about the role of monetary policy in supporting faster, durable growth; it will also enhance the effectiveness of monetary policy in maintaining price stability while minimising output and employment volatility. I am sure that Modigliani would not disagree with these conclusions.

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