From theory to practice in macroeconomic models: post-Keynesian eclecticism *

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1. Introduction

Paul Samuelson (1986, p. 1399) has observed that, even though the citation by the Swedish Royal Academy of Sciences accompanying the award of the Nobel Prize to Franco Modigliani mentioned neither his 1944 article nor that of 1963, both of those works had been fundamental in establishing the basic framework within which the "post-Keynesian eclecticism" of the later twentieth century developed.[1] One development in this regard was an approach to the generation of models for economic forecasting and policy making that was of the greatest importance, in particular for the analysis and conduct of monetary policy. We can again cite Samuelson (1975, p. 6) in noting that after the Second World War, as the use of econometric models became standard practice, we moved into the "era of [Lawrence] Klein". Here too a major contribution came from Franco Modigliani, constantly flanked in this project as in much of the analysis and testing of the hypothesis of life-cycle saving, by Albert Ando (and in the initial phase of the construction of the Federal Reserve model, which came to be known as the MPS model, by Frank de Leeuw).

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[1] According to the *Oxford English Dictionary*, the term 'eclectic' is "applied to those who combine elements derived from diverse systems of opinion or practice in any science or art".

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I shall here briefly consider two aspects of this contribution: 1) the conceptual evolution of the systemic approach, focusing on the relationship between the short and the long term; and 2) the use of the macroeconomic model for economic stabilisation policy, with special reference to the mechanisms of monetary policy transmission. Significant determinants of the aggregate course of the economy are the non-instantaneous adjustment of prices and wages and the existence of a long-term equilibrium growth path on which the economy can converge, though perhaps not rapidly and probably, in the absence of public intervention, with broad fluctuations. I shall conclude by offering some observations on this heritage from Franco Modigliani, and from Albert Ando, also in the light of recent proposals concerning the design and use of macroeconomic models for monetary policy, as, for example, in the inflation targeting approach.

2. A systemic approach

The starting point in both Klein's and Modigliani's models was the formulation, based on Keynes's *General Theory*, of a general system that could serve as a reasonable, realistic approximation of the workings of a modern capitalistic economy like that of the United States. However, their initial designs and the paths that they followed in constructing their various models differed sharply.

The development of Klein's models is well known. His initial contribution was the reading of Keynes offered in his doctoral thesis (*The Keynesian Revolution*, published in 1947). Klein maintained that the lesson of Keynes consisted essentially in the demonstration of the possibility of an underemployment equilibrium. That is, there is no guarantee that with a positive interest rate saving and investment will be equal; thus output and employment will be determined on the demand side, with a labour supply curve consisting solely in a "set of virtual points which are never observed" (Klein 1947, p. 117). The low elasticity of saving and investment with respect to interest rates (which in some way is empirically 'observed') characterised Klein's first models and also determined his initial scepticism over the stabilising effect of monetary policy, especially as against fiscal policy. On an empirical basis Klein also rejected the re-equilibrating function of

variations in the real value of wealth (the Pigou effect). These results are found in the first small models of the 1940s as well as in the famous, more ambitious Klein-Goldberger model of the early 1950s, from which several generations of models at the University of Michigan would descend. In these, as in the Wharton model of the 1960s, the economy is driven essentially by aggregate demand, albeit with a higher and higher degree of sectoral disaggregation. Also as a consequence of the explicit introduction of Leontief-style input-output tables, the models of the early 1970s increasingly reflected supply constraints, through the impact of relative prices – on the demand for factors of production and on aggregate output.

Like Klein, Modigliani too began with an interpretation of Keynes's *General Theory* of output and employment,[2] but in this version, with flexible wages and prices, there emerge full employment conditions like those dictated by general equilibrium. It is wage rigidity that – in a 'short' term that can last almost indefinitely – determines the involuntary unemployment highlighted by Keynes. This, as we know, is the 'neoclassical synthesis' version of Keynesianism,[3] which Modigliani himself extended and supplemented in the 1950s to take better account of monetary mechanisms.[4]

As regards the development of the quantitative representation of the economy that would ultimately take the form of the MPS model, there are two fundamental points to this approach: the description of the long-term equilibrium as the (possibly dynamic) version of a general economic equilibrium system characterized by the rational behaviour of economic agents and by the equilibrating mechanism of prices in different markets; and the existence in the real world of

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[2] Modigliani (1944).

[3] Modigliani's version differs not only from that of Klein, which posits rigid nominal wages as a sufficient but not necessary condition to produce a prolonged (equilibrium?) state of underemployment, but also (still within the neo-classical synthesis) from the famous version of Hicks (1937), for whom Keynes's essential innovation is the theory of liquidity preference and the associated liquidity trap, which is downplayed empirically by Klein (but not by Tobin, 1947, among others).

[4] Modigliani (1963). Klein and Modigliani only rarely had significant exchanges in writing. On one such occasion Modigliani (Klein 1964, p. 56), in discussing one of Klein's works, observed how weak the effects of monetary variables were in his models, and the effects on household consumption in particular. Klein (*ibid.*) replied that despite repeated empirical attempts he had never found significant attempts but emphasised that his "theoretical predilections are very much in favor of a theory of the *real* economy. The monetary economy, if in good housekeeping order, will not have a dominant influence on real affairs".

frictions, adjustment lags and market imperfections that can result in outcomes far removed indeed from general equilibrium. General equilibrium, in fact, is taken merely as a point of reference, while the effective focus is on the short-to-medium-run course of the key variables. Given the slowness of adjustments, which is to say the weakness of the general equilibrium as a pole of attraction, there may be a need for monetary and fiscal economic stabilisation policies, whose 'design' cannot but be determined empirically – that is, in the framework of a macroeconomic model estimated on the basis of the available observations.

The plan is set out lucidly in two works at the end of the 1950s, less noted than others of the same authors, perhaps, but certainly no less noteworthy: Albert Ando's doctoral thesis (1959) and an article by Ando and Modigliani (1959). The thesis is described as a

> "progress report on a project whose major aim is to begin with the behavioral hypotheses for individual decision makers in the economy and construct, as an implication of these hypotheses, a relatively complete model that would explain the variation over time of aggregative economic magnitudes" (Ando 1959, p. 1).

Ando recognises the pioneering work of Klein but criticises his model for making the level of employment depend exclusively on aggregate demand, with supply acting only indirectly as a constraint on decisions relating to productive factors. Further, in Ando's reading, Klein assumes instantaneous adjustment by economic agents, so that lags are only the consequence of an elasticity of expectations (in the Hicksian sense) smaller than one. In the same way, the joint article with Modigliani (1959, p. 501) notes that whereas

> "in the classical models, the major equilibrating device was the price mechanism [...] considered sufficiently effective to prevent significant and systematic departures from a situation in which all relevant markets are cleared",

in Keynesian-derived business cycle and growth models (e.g. Harrod) «the price mechanism is conspicuously absent» (*ibid.*).

Ando and Modigliani therefore start from the consideration that two extreme cases are possible, one in which the equilibrating price

mechanism works so badly that it can be completely disregarded[5] and the other, like the general economic equilibrium theory, especially the dynamic version contained in Solow's well-known growth model, in which the price mechanism is so strong that it always guarantees full employment. The authors propose starting from the assumption that "for all its shortcomings" (*ibid.*, p. 502) this mechanism has an influence on economic behaviour so that, at least in the long run, both the choice of production techniques and the propensity to save must be regarded not as parameters but as endogenous variables; they then proceed to specify the frictions and rigidities present in the short-to-medium term. From this they draw up a theoretical long-term growth model *à la* Solow (the only real difference being the introduction of a life-cycle saving function)[6] and examine the consequences of the observation that the stabilisation process (notably the adjustment of the capital/output ratio to its equilibrium level as a result of changes in the relative rate of return) is bound to take time (and therefore that "in the short run the parameters of both the consumption and the investment function, including the capital coefficient, can be largely regarded as historically given" – *ibid.*, p. 503). The result is an economy that can no longer follow a balanced growth path and in which income and employment move in fundamentally unstable fashion, engendering a series of cycles of varying depth and duration.

Although the results are very raw, they do seem to approximate the trend 'normally' observed in the US economy fairly well. As the authors remark (*ibid.*, pp. 522-23),

> "the price mechanism is not so efficient as to insure full employment of resources at every instant of time, but its impact is strong enough to prevent the economy from developing very substantial and prolonged unemployment under normal conditions".[7]

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[5] The lack of an equilibrating price mechanism therefore leads to unstable and cyclical economic trends. This is true not only of the Harrod-type growth models mentioned in Ando and Modigliani's article but also of Klein's early econometric models referred to in Ando's dissertation.

[6] Obviously this refers to the aggregate version of Modigliani and Brumberg's model, which had already been estimated in Ando's dissertation and was the subject of the famous article by Ando and Modigliani (1963).

[7] Ando and Modigliani note in particular that in their model the full-employment balanced growth path performs the same function as the capacity ceiling in

They also observe that in such a simple model the only thing capable of preventing the resumption of a full-employment growth path would be a negative, and permanent, shock to producers' or consumers' expectations. Ando and Modigliani were obviously aware that their full-employment growth model was highly simplified (postulating a single good, perfect competition, neutral technical progress, and so on) and likewise that it was hardly realistic to assume an economy with only saving and investment decisions and in particular without a disaggregation of the different types of products and capital goods and without the necessary institutional references for the functioning of the monetary system and government. They therefore referred the reader to forthcoming research.

In reality, as we know, later studies would come together in a complex and ambitious project spanning some three decades following its start in the mid-Sixties: the construction and the progressive theoretical and empirical refinement of the MPS model (whose theoretical structure was adopted, at least in significant parts, by several other models, including the Bank of Italy's quarterly model). Close attention would be paid to the mechanisms of monetary and fiscal (or budgetary) policy transmission. The same careful attention would be given to price and wage setting (bearing in mind, among other things, that Modigliani based his interpretation of Keynes's contribution to economic theory specifically on wage rigidity). These aspects are discussed briefly in the following section. On the methodological level, the constant reference to an equilibrium solution would remain, and the project would tackle one by one such issues as the heterogeneity and aggregation of various capital goods (along an equilibrium path),[8]

Hicks's well-known model of the economic cycle, with the difference that in their case the equilibrium growth path implies full employment.

[8] On this point see Ando (1964), which is a true theoretical and empirical *tour de force*. The essay contains an exemplary description of the project (p. 371):

> "[...] to construct a model in which the economy functions without any friction [...] and inquire whether such a model is capable of generating a reasonable growth path that conforms to the characteristics of the real economy when the data are adjusted for cyclical fluctuations. Then, if it does, a number of frictions can be introduced into such a model – for example wage rigidities, nonzero time required for adjustments in markets and in the relations involving stocks and flows, imperfect knowledge – and [one can] study the consequences".

the 'putty-clay' nature of investments from different vintages,[9] the presence of oligopolistic profits and their impact on capital formation,[10] the non-neutral nature of corporate taxation[11] and the conditions for long-term efficiency.[12] On the empirical level, in the specification of the actual paths of development of the main aggregates, efforts would focus on identifying the economic, institutional and technical factors that slow or prevent the economy's progress along balanced growth paths, and on estimating their effects. All this was covered in the many applied studies on different aspects of the model and in the general presentation of various estimated versions of the model as a whole.[13] Unfortunately, Ando and Modigliani's planned monograph on "The MPS model: its theoretical foundation and empirical findings", referred to explicitly in many of their works, never saw the light: what has survived is a series of typescripts and doctoral dissertations analysing the short- and long-term theoretical and empirical properties of the model.

3. Transmission mechanisms and stabilisation policies

I do not propose here to examine the wealth of estimates and econometric tests that accompanied the construction, the use and the 'maintenance' of the MPS model. During the life of the project many original and innovative contributions were made regarding firms' decisions

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[9] See Ando *et al.* (1974), which not only tackles such delicate theoretical questions regarding the definition of the cost of capital when there is a mark-up on average production costs but also deal with a series of econometric problems in estimating the various investment functions.

[10] A concise but thorough overview of the whole theoretical structure of the MPS model can be found in Ando (1974). Ando's discussion of the model's theoretical and statistical foundations is also important (1981).

[11] See Sturrock (1981), which is based on a set of Ando's unpublished notes and which draws from them an exhaustive description of the simplified model's formal structure.

[12] See Anderson, Ando and Enzler (1984).

[13] The last, detailed presentation of the MPS model, by economists of the Federal Reserve Board, was that of Brayton and Mauskopf (1985). An early presentation can be found in De Leeuw and Gramlich (1968) and in Rasche and Shapiro (1968). The list of the model's estimated equations, in its end-of-Sixties version, is presented in Ando, Modigliani and Rasche (1972).

on investment[14] and pricing[15] in situations of oligopolistic behaviour and with imperfect competition, regarding households' saving behaviour under the life-cycle hypothesis advanced by Modigliani, Brumberg and Ando, and regarding the working of banks and financial intermediaries.[16] Just as important, unflagging attention was paid to sometimes complex institutional details (ranging from the tax system to regulations of various type) and the balance-sheet constraints of the various economic agents. Apart from the specific contribution made by the model as a whole, one cannot forget its ability, particularly within the context of research carried out by central banks, to produce spillover effects that are essential to an understanding of the *modus operandi* of monetary policy.

More modestly, in this section I consider two fundamental contributions highlighted in the course of the specification and use of the MPS model: the identification of the transmission mechanisms of stabilisation policies and the conclusions regarding the overall stability of the economy. Both contributions are the outcome of lengthy confrontations with other points of view regarding the functioning of the economy, notably the so-called 'monetarist' approach, whose main advocate was Milton Friedman.[17] After these discussions, however, Modigliani (1977, p. 8) concluded that "every one of the monetarists' criticisms of early simple minded Keynesianism has proved in considerable measure correct". In fact, from his earliest theoretical work onwards, Modigliani never displayed much enthusiasm for concepts such as high interest elasticity of money demand with respect to the interest rate or heavy dependence of consumption on current income or, again, weak response of aggregate demand to monetary variables.

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[14] In particular, Bischoff (1969) and Ando *et al.* (1974).

[15] Based on Modigliani's theoretical contribution (1958), inspired by original research by Bain and Sylos Labini.

[16] See, among others, Modigliani, Rasche and Cooper (1970), Jaffee and Modigliani (1969) and, for a study of the term structure of interest rates and the working of the financial markets, Modigliani and Sutch (1967), Modigliani and Shiller (1973) and Ando and Modigliani (1975).

[17] The presentation of the monetarist point of view by Friedman and Meiselman (1963) was followed by a heated debate in the *American Economic Review*, with articles by Ando and Modigliani (1965) and by De Prano and Mayer (1965) and a reply by Friedman and Meiselman (1965). On this 'radio waves' debate – from the initials of the main participants, AM-FM – and the monetarist controversy in general, in which the Federal Reserve Bank of St. Louis played a leading role, see Hafer and Wheelock (2001).

As to the effects of prices and wages, although Modigliani had interpreted Keynes largely in terms of wage rigidity, he was certainly willing, as we have seen, to acknowledge the equilibrating role played in the long term by the price (and interest rate) mechanism. Clear evidence of this is to be found in the process that generated the MPS model, although it was the results of the simulation of the model that confirmed Modigliani in his opinion that the mechanism operates too slowly not to have need of stabilisation policies; nonetheless, he did not share the view (*ibid*., p. 9) "of a highly unstable economy in which fiscal policy has powerful and everlasting effects".

The most innovative contribution may be the study of the transmission of monetary impulses. Most of the previous models had had trouble detecting significant effects of interest rates or the monetary variables on the real consumption and investment demand of households and firms. By contrast, the effects identified in the MPS model are strong and widespread. They regard decisions to invest in plant and machinery, inventories and residential buildings, but they also concern spending on consumer durables and a quite unexpectedly large effect on household consumption.[18] In particular, Modigliani sheds light on the importance of 'wealth effects' in transmitting impulses from the money market to the real economy. These impulses are gradually transferred from short- to long-term interest rates and then influence equity market yields and values and, in principle, the value of land and houses. What is more, through this channel the elasticity of consumption to interest rates is empirically high – so much so that it accounts for up to half the total impact of interest rates on real demand – and the effect also appears to emerge rather quickly (for the part that goes from long-term rates to final demand). It is clear that changes in the value of wealth can also be due to factors unrelated to monetary policy, and that such changes, to be effective, must be perceived as non transitory and regard a substantial percentage of households. In this case, and in general in the entire model, the operation of expectations is captured through moving averages of the

[18] On the last-mentioned effect (household consumption being defined as expenditures on non-durable goods and services and the value of services rendered by durable goods), see Modigliani (1971). On the set of effects of interest rate changes on the different components of real demand, see the initial contribution of De Leeuw and Gramlich (1969) and Modigliani (1975).

variables involved, given the absence of the forward-looking element provided by, say, the rational expectations hypothesis.

In fact Modigliani, Ando and their collaborators on the MPS model are rather sceptical about rational expectations. They do recognise that in sophisticated markets information tends to be used rapidly and as efficiently as possible, so that some version of the hypothesis is introduced, for example, in the term structure of interest rates, but on the other hand they find it unlikely that in their demand and price decisions households and firms, though 'rational' on average in their fundamental behaviour, can completely discount the effects of stabilisation policies (for example, with reference to Barro's hypothesis[19] of 'Ricardian' behaviour by consumers who do not consider changes in the public debt due to budget deficits actual changes in wealth that can modify their individual budget constraints). Here 'post-Keynesian eclecticism' manifests itself in full, in combining – on the basis of assumptions adopted *a priori*, though tested and modified in the light of continuous observation of the performance of the economy – the long run of general equilibrium theory (in the practical application of the neoclassical growth model, essentially with technical progress and population growing at rates defined outside the model but with mark-up of prices on costs and the accumulation of oligopolistic rents) with the short run of adjustment lags, adaptive and regressive expectations, little though not negligible price and wage flexibility, and relatively slow transmission of changes in money market rates to long-term rates and from these to the components of aggregate demand (along with the operation of administrative rules and other institutional constraints).

For Modigliani, the long-run equilibrium constitutes not so much an act of faith as a useful and reasonable starting hypothesis that serves to focus attention on short and medium-term developments, those that are relevant for stabilisation policies, making it possible at least conceptually to separate the spontaneous effects of the working of price-equilibrating mechanisms from those of the multipliers of economic policy impulses. The differences with the monetarists basically concern the effects of fiscal policy, what Modigliani (1977, p. 9) calls their vision of a "highly stable economy in which shocks hardly make a ripple and the effects of fiscal policy are puny and fast vanish-

[19] Barro (1974).

ing". In other words, the working of the market mechanisms is acknowledged, the tendency of economic agents towards rational (optimising) behaviour is accepted, and there is agreement that an increase in public spending cannot have permanent effects on long-run equilibrium real income. Hence,

> "there is no significant disagreement on the proposition that, by the time a new 'long-run equilibrium' is reached, the macro fiscal actions will have no significant effect, at least on real income"

but

> "this long-run equilibrium outcome will require a very long time (if not forever); it is, therefore, hardly more than a *curiosum* which tells us nothing about the response in the span relevant to the design of policy – say the first one to three years" (Modigliani and Ando 1976, pp. 18-19).[20]

The system, therefore, can be considered to be stable, in the sense of returning in the long run to an equilibrium position, but this may take so much time that in the shorter run it tends to be equivalent to a system destined to remain in an equilibrium far from the full employment of productive resources. Thus, though the MPS model bows in principle to the working of the price-equilibrating mechanism, in the relevant time span it still possesses the properties of a demand model, eclectic and, in Samuelson's words, 'post-Keynesian'. This point is further borne out if we consider the evolution, in the model's construction, not so much of the specification of firms' pricing decisions (the flexible mark-up on average production costs, mentioned earlier) but of the equation that summarises the determination of the wage rate. The reference is to the well-known (expectations-augmented) 'Phillips curve', adopted in the MPS model to represent the process of determination of nominal wages.

Here, however, a short detour down a byway of the history of economic thought may be of interest. We have seen that in the 'neoclassical synthesis' (of Hicks, Modigliani and Tobin) the Keynesian case, though extremely relevant in the short run, which is what interests us here, can be inscribed in the wider paradigm of the general

[20] As for the absence of 'permanent' effects on real income, it would be "relevant, at best, in the proverbial Keynesian long run" (*ibid*., p. 22).

economic equilibrium. According to Klein, by contrast, although 'classical' economics (in Hicks's definition) and 'Keynesian' economics are fundamentally similar in their methodology at a microeconomic level, both being based on the rational behaviour of consumers and producers, they differ at the macroeconomic level since one may find elasticities (essentially in the response of saving and investment to interest rates and income) that can produce even opposite aggregate results: in one case the full-employment equilibrium, in the other the under-employment equilibrium (like the one that took hold in the Great Depression).[21] In the latter case, which Klein now explicitly calls 'neoclassical-Keynesian synthesis',[22] there is no money illusion (or non-homogeneity) since labour demand and supply still may depend on real wages, but the full-employment equilibrium may not exist in the dynamic evolution of the economic system. A different equilibrium level is therefore determined, one associated with a non-nil unemployment rate. How does all this come about? According to Klein (the Klein of the 1947 article, of the first econometric models of the late 1940s and of the Klein-Goldberger model of the early 1950s),[23] simply through a wage determination function that has the form of an adjustment (collective bargaining) equation in the labour market. This function is nothing but a relation between the change in nominal wages and the unemployment rate; in fact, bargaining takes place in money terms. According to Klein (1954, p. 286):

> "This, I contend, is realistic behaviour. It may be argued that wage bargaining is affected by price movements, but institutionally we observe a lag between price movements and wage adjustment; thus one could consider lagged price changes as another variable [in the relation that links the change in wages and unemployment]. Nevertheless, with or without a lagged price change, the dynamic system is not homogeneous. Dynamic wage change introduces money illusion, but of a type that vanishes in the stationary form of the model"

(where the change in nominal wages is equal to zero).

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[21] See Klein (1947, p. 117).

[22] See his reply to Phelps, in Klein (1992, p. 42). See also Klein (1994, particularly pp. 65-70).

[23] See Klein (1950) and Klein and Goldberger (1955). For a detailed analysis of the role and implications of the wage adjustment function, see especially Klein (1954, pp. 285-89).

And so well before Phillips, Samuelson and Solow, well before the introduction into the MPS model of a realistic specification in place of the original simplified hypothesis of rigid nominal wages formulated in Modigliani's 1944 article,[24] here we have a 'Phillips curve' *ante litteram*, one fully operating also at the empirical level. *In nuce*, we also have the basis for a discussion on the problems posed by a dynamic solution with money illusion and a static model that has, as Klein (*ibid*., p. 286) observes, "the classical homogeneity properties". In a way, then, all the necessary elements were already present to identify the problem later pinpointed by Friedman and Phelps in their discussion of the natural rate of unemployment, the basis of the attack by Lucas and the 'new classical macroeconomics' on stabilisation policies and the use of macroeconomic models like the MPS for designing such policies.[25] In effect, the dynamic system too may not be characterised by money illusion if in the wage determination equation the partial elasticity between wage changes and price changes is equal to one. Klein was aware of this, but in the 1990s he still maintains (1974, p. 67) that "it is an empirical matter whether economic estimates of this equation indicate no money illusion". Actually, money illusion was present in the first formulations of the MPS model,[26] only to be gradually eliminated in the long run with the hypothesis of a vertical Phillips curve and an 'equilibrium' unemployment rate below which prices and wages would tend to accelerate (the non-accelerating inflation rate of unemployment, NAIRU). The latter concept was first introduced in an article by Modigliani and Papademos (1975), who originally called it NIRU. We may well wonder, in any case, why the two great 'post-Keynesian' schools that produced the most important applications in terms of econometric models for economic policy – that of Klein and that of Modigliani – had so few points of contact up to the 1970s in discussing their respective models' underlying theoretical hypotheses.

As both Modigliani (1977, pp. 4-8) and Tobin (1999) remark, there are significant differences between the NAIRU and the natural rate of unemployment: the former is hard to reconcile completely

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[24] See Phillips (1958), Samuelson and Solow (1960) and the discussion in Ando and Modigliani (1969, pp. 310-11).

[25] See Friedman (1968), Phelps (1968) and Lucas (1972a and 1972b).

[26] De Menil and Enzler (1972).

with the Walrasian equilibrium, it being, according to a possible 'microfoundation' by Tobin (1999, p. 39), the unemployment rate

> "at which the inflation-increasing effects of the excess-demand markets just balance the inflation-decreasing impact of the excess-supply markets".

Although it is part of the long-run equilibrium implicit in the MPS model, it is not easy to interpret the NAIRU in terms of the general economic equilibrium from which Modigliani had started out in his 1944 article and to which he so often referred during the construction of the econometric model. In any event, even if it did not necessarily mean an 'equilibrium' level of unemployment towards which the economic system 'naturally' tends, the NAIRU soon became an important concept in economic policy discussion and a constraint to be taken into account in order to avoid falling into conditions of price instability.

A large part of Modigliani's arguments in favour of monetary and fiscal policy measures to stabilise the economy turns on the question of the system's 'stability' (a term that lends itself to diverse interpretations). Obviously, there are various possible causes of instability, but in this case instability is generally the result of unanticipated 'demand' shocks that are propagated in the system and can cause even large and long-lasting deviations from the 'equilibrium' path (today we would call it the economy's 'potential' output growth path). The dynamic characteristics of the different versions of the MPS model, like every macroeconomic model of 'Keynesian' derivation, depend on a few fundamental parameters. These include: the elasticity of consumption and investment demand to real interest rates (high in the MPS model); the elasticity of money demand to nominal short-term interest rates (low); and, in the subsystem that comprises the specification of firms' pricing decisions and the determination of nominal wages, the (possibly non-linear) response to the unemployment rate (or to the output gap) as well as the elasticity linking current to past inflation (or, in the case of forward-looking models, future expected inflation, which can even be the result of 'rational' expectations or, in the deterministic case, a 'perfect forecast'). In the MPS model, this elasticity is equal to one. In models in which wage rates are essentially determined by a real wage 'level' tending to an equilibrium value, this elasticity is zero. This is a crucial difference for the system's capacity

to return to equilibrium following a shock either rapidly or slowly, and with larger or smaller fluctuations – that is, for determining its response to an economic policy impulse.

The differences between models in this regard, which of course reflect deep-going differences in the way the working of the economy is perceived, can be substantial,[27] although at a purely statistical level there is an evident strong correlation between current and past inflation. For the 'consolidated' MPS model of the late 1980s, the conclusion is that

> "the form of the Phillips curve [...] is an important source of instability for the MPS model as a whole [...]. In response to any shock the model tends to generate moderately unstable cyclical trajectories with long periodicity if monetary policy is defined as a fixed path for a monetary aggregate. Some type of countercyclical policy rule is needed, therefore, to keep the economy from eventually experiencing serious recessions or inflation".[28]

4. Inheritance and progress

In the last thirty years various attacks have been launched against activist economic stabilisation policies and the use of econometric models like the MPS to design them. This is not the place to evaluate the grounds for these attacks nor to examine possible responses. At the theoretical level, there has been a shift from the 'new classical macroeconomics', associated in the first place with the name of Bob Lucas (but also, among others, with those of Sargent and Barro), to the models of the 'real business cycle', on which much has been written since the original contributions of Kydland and Prescott, countered by those of the 'new Keynesian economics' put forward by Mankiw, Rotemberg, Woodford and others. At the empirical level, in addition

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[27] See Visco (1991).

[28] Ando, Brayton and Kennickell (1991, p. 220). A detailed presentation of the theoretical foundations and empirical specifications of the determination of prices, wages and employment in the MPS model is contained in Ando and Brayton (1995). For an original attempt at defining a 'realistic' reaction function of monetary policy within the MPS model, see Anderson and Enzler (1987).

to various attempts to give applicative content, in estimates and simulations, to the rational expectations hypothesis, two main methods of econometric modelling have been proposed, associated respectively with the names of Sims ('vector autoregressions') and Engle and Granger ('cointegration analysis'). Lastly, at the economic policy level, starting again from the contributions of Kydland and Prescott and those of Barro and Gordon on discretionary policy, credibility and 'time inconsistency', many proposals have concerned the framework within which to define possible monetary policy actions (in particular, 'flexible' or less flexible 'inflation targeting', for which the reference is to Svensson and Woodford).

It is worth asking what is left today of the contribution made by Modigliani, Ando and their associates in the MPS model project and, obviously, of that made by Klein through the macroeconomic models based directly or indirectly on his work. The answer is not easy, not least because there are not many direct references in the recent literature. In this section I shall restrict myself to putting forward – somewhat apprehensively, to be sure – just a few considerations serving to identify, perhaps in a rather impressionistic manner, several essential points.

In the first place it should be noted that scientific (and technological) progress tends, although not always, to follow an evolutionary course. It is sufficient to recall the famous phrase by Newton (with numerous precedents): "If I have seen further, it is by standing on the shoulders of giants". It also needs to be remembered that, suitably adapted, models such as those of Ando, Klein and Modigliani, although no longer on the frontier of academic research, are still used in various ways by international institutions, governments and central banks for forecasting and for designing alternative scenarios for changes not only in economic policy variables but also in independent variables for which it is desired to have an idea of the range of possible effects. This underscores the usefulness of such models as a flexible means of quantitative evaluation, open to intelligent and non-mechanical use. In addition, they appear able to take account of the proposals concerning specification and econometric estimation put forward in the last few years.

In the second place, again without going into detail, both the models deriving from the 'new classical macroeconomics' and those based on the 'real business cycle' approach have been rather unsatisfac-

tory, inasmuch as they have proved unable to generate values of the main economic variables close to those observed in practice (even when recourse is made to the *deus ex machina* of impulse and propagation mechanisms *à la* Slutzky and Frisch). Recently, new attempts have been made that, even though they are still based on models of general economic equilibrium with representative agents who behave rationally (including in the formation of their expectations), refer to an explicitly dynamic and uncertain context. Compared with the small 'real business cycle' models – which lack the 'free parameters' (relative to rigidities, adjustment lags, market imperfections and limited knowledge, etc.) present on an *ad hoc* basis, and for this reason fiercely criticised by Lucas, in the large traditional macroeconomic models – the specification of the so-called models of 'dynamic and stochastic general equilibrium' has recently undergone significant changes. In particular, dynamic adjustment, imperfections and frictions of various kinds have been introduced to account for the fact that in practice their divergence from an ideal 'general equilibrium', even a 'stochastic and dynamic' one, is far from negligible.[29] In this respect there are notable similarities with Modigliani and Ando's original project. The short-term structure appears to be largely determined by demand, with a Phillips curve and prices and wages that adjust slowly, while in the long run income is determined, as in the MPS model, primarily on the supply side. Unlike the MPS model, these models are still essentially lacking in non-linearity, in part, but not exclusively,[30] so as to be able to apply some simple solution algorithms in the case of rational expectations. In both cases the intrinsic dynamics of the models is extremely complex, reflecting the numerous, interrelated, lags present in the specification of the demand decisions of households and firms, the latter's pricing decisions, and the determination of wages and salaries.

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[29] See, in particular, the contributions of Christiano, Eichenbaum and Evans (2005) and Christiano, Motta and Rostagno (2003) and the model for the euro area put forward by Smets and Wouters (2003).

[30] It is worth noting the importance given (for example by Smets and Wouters 2003) to the comparison between the structural estimates of the model and estimates of a linear reduced-form system (VAR) obtained with reference to the same endogenous variables and on the basis of the same time sample. Ando and Modigliani themselves attributed a certain importance in the monetarist debate to the comparison between the results obtained with the structural model (MPS) and those obtained with reduced forms such as those estimated in the model of the St. Louis Federal Reserve Bank; see, for example, Modigliani and Ando (1976, pp. 30-42).

One substantial difference is the sharp distinction between the lags due to adjustment costs or fundamental parameters of the production and utility functions and those due to the working of expectations, since the latter are defined by the general adoption of the rational expectations hypothesis. Without necessarily going so far as to predict that, in order to be realistic, these models will have to continue to draw closer – in terms of size, institutional detail and the inclusion of (Keynesian?) frictions and imperfections of various kinds – to the structure of traditional models like the MPS model or the quarterly model used by the Bank of Italy, which beyond a certain point are hard for anyone but insiders to master, it may be more helpful here to stress the many similarities, above all in the overall research project.

A third consideration concerns the fact that in the current discussion of economic policy (in the context, among other things, of 'flexible inflation targeting'),[31] in the interpretation of macroeconomic developments and in the examination of alternative forecasts by international institutions, economic policy authorities, private research centres and individual commentators, concepts such as 'wealth effects', NAIRU or the output gap and the term structure of interest rates (to whose definition and application Modigliani and the MPS model actively contributed) are in common use. Also in common use are the 'databases' that have derived from the construction, application and maintenance of large econometric models both *à la* Klein and undoubtedly *à la* Ando-Modigliani. Lastly, this is also the case of methodological suggestions and operational proposals concerning the specification and statistical estimation of complex functional relationships, the use of simulation and control techniques, even in a stochastic context, and the wealth of contributions aimed at properly accounting for institutional details, which are sometimes responsible for complicated non-linearities and often essential to a more thorough understanding of economic developments.

It might also be interesting to ask how Modigliani and Ando, after sharply criticising the hypothesis of rational expectations, would view it and the central role it tends to play in the most recent macroeconomic models. I believe that they would still be sceptical of the hypothesis, although they would not reject it outright as a potentially useful way to describe how information is used in financial markets,

[31] See, for example, Bean (2003).

to perform alternative simulations aimed at taking the effects of monetary policy regime changes into account, and to optimise our understanding of the 'equilibrium' properties of that imperfect, necessarily approximate but evidently useful instrument constituted by an econometric model of the entire economy. It is also likely that they would express serious if not necessarily equally emphatic reservations about the current widespread use in macroeconomics of the figure of the representative agent, and hence about the uncritical adoption of the hypothesis of rational behaviour (perhaps with some acknowledgement of Simon's teachings on bounded rationality and of the propositions of behavioural economics).[32] They would probably also suggest more extensive use, in estimating the effects of expectations and identifying the main ways in which they are formed and revised, of direct observation of the expectations formulated by individual and collective agents.

To conclude, there is certainly eclecticism, as Samuelson noted, in co-ordinating different elements, such as the rational behaviour of economic agents, the frictions and imperfections that prevail in the real world of the economy, the lags and instability in adjusting to equilibrium conditions and the need for stabilisation policies. It appears to me, however, that this represents a considerable wealth, the ability, one could say, to make determined use of the instruments offered by theory, to come to grips with the observations available, to understand what really happens in the economy and intervene to correct the most obvious distortions. In addition, the overall design, which can already be glimpsed in Franco Modigliani's early theoretical contributions and in his applied works together with Albert Ando, is enlarged over time and the 'project' is carried forward methodically and consistently. The long-term equilibrium only sketched out and, underlying both the early formulations and the construction of the MPS model, has a basically instrumental purpose; in other words it serves to identify, in the best possible way from a quantitative perspective, the shortcomings and the delays to be made good through stabilisation policies. Yet to my mind there is little or no doubt that – as

[32] On behavioural economics, one cannot fail to recall the name of Bob Shiller, the co-author with Modigliani of important works that were incorporated in the MPS model, or to note that for most of the 1950s Modigliani and Ando participated in numerous wide-ranging joint projects with Herbert Simon, Charles Holt and John Muth at the Carnegie Institute of Technology.

their own works testify – Klein, Modigliani and Ando were perfectly well aware of the need not only for sound economic stabilisation policies but also for action to improve the underlying structure (the 'long run') of our economies, so as to increase their capacity to respond to the challenges posed, today especially, by demographic developments, technological innovation, environmental issues and the global economy.

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