Monetary Analysis and Policy: An Aggregated Model for the Italian Economy

I. Introduction

At the end of a recent article on the "Theoretical Foundations of Monetary Policy", Clower concludes that "the foundations don't exist" for the lack of "a reasonably precise, logically coherent, and empirically acceptable conception not merely of the role of money in economic activity but also of related dynamic interrelations among real and monetary magnitudes".[1]

It remains true, however, that there have been notable developments in monetary theory, particularly in the last twenty years, which have done much to clarify the role of monetary variables in economic activity and the related "transmission mechanism" of monetary policy. Even so, there are still conflicting theories and correspondingly lively debates between their proponents.[2]

Clower's pessimistic conclusion should probably be seen in the light of his earlier remark that the "statement of a definitive monetary theory is still a long way off". We may well wonder if there exist any "definitive" theories in the social sciences — or indeed if they are conceivable. It is no accident that the development of monetary theory has gone with far-reaching changes in the financial structures of a number of countries (in which there have been elements particular to individual countries as well as those common between them). From this point of view, then, there is an obvious element of truth in Friedman's comment that "the basic differences among economists

1 R. W. Clower, "Theoretical Foundations of Monetary Policy", in G. Clayton, J. C. Gilbert, R. Sedgwick (eds.), *Monetary Theory and Monetary Policy in the 1970s*, Oxford University Press, Oxford, 1971, p. 25.

2 The controversy between the "monetarists" and the "keynesians" has recently been summarised by Johnson, but in such a witty and parodying manner as to minimise the real contrast. See H. G. Johnson, "The Keynesian Revolution and the Monetarist Counter-Revolution", *American Economic Review*, May 1971.

are empirical, not theoretical",[3] if by "empirical" is meant the testing of a theory's interpretative value against the reality of a particular country.

In this article, firstly, within a general analytical framework of the mechanism of monetary policy, we look at the relation between the results of these developments and their successive approximations used in empirical analyses of the effects of monetary policy. We then put forward an aggregated model of the Italian monetary sector [4] designed for short term forecasting and policy, and consider the results of the econometric estimates, its predictive performance, and its policy implications.

II. The Definition of Monetary Policy

The renewed emphasis on the efficacy of monetary policy — which by now belongs to "conventional wisdom" — seems to run up against two main limitations. Firstly, monetary policy does not exert its effects evenly on the various components of aggregate demand, so perhaps causing or aggravating sectoral disequilibria in the economy. Secondly, its macroeconomic effects may occur only after long delay,[5] thus possibly causing or accentuating instability in the economy. These two, partly interdependent, factors are of undoubted importance in determining the usefulness of monetary policy, but, as we shall see, they have also theoretical implications for the design of models to determine the monetary variables.

We may so define the workings of monetary policy in general terms: explicitly or implicitly, the monetary authorities make use of a model which "explains" the behaviour of the economic system, and decide upon their policy as a reaction to this behaviour and on the

3 M. Friedman, "A Theoretical Framework for Monetary Analysis", *Journal of Political Economy*, March-April 1970, p. 234.

4 This article is part of a broader research project — co-ordinated by G. Fuà and financed by the C.N.R. — into quantitative analytical techniques for short term forecasting and policy in the Italian economy. An earlier version of the "monetary sector" has been put forward in my "Politica monetaria: previsione e programmazione a breve", *Moneta e Credito*, September 1972.

5 These lags were first "discovered" by the critics of monetary policy, the first of whom being Friedman. They have, however, also been confirmed by later research promoted by the monetary authorities themselves of several countries. For Italy see G. F. Caligiuri - A. Fazio - T. Padoa Schioppa, "Demand and Supply of Bank Credit in Italy", *Journal of Money, Credit and Banking* (forthcoming).

basis of their preference function. Through their intervention they affect the intermediate monetary variables which, together with the behaviour of the economy, determine the final monetary variables. These latter, along with other exogenous and political factors, affect the economy itself. There are thus several conditions for an "optimal" monetary policy: an acceptable preference function, complete control of the instrumental variables, and intervention which is appropriate both in degree and timing and is consistent with other economic policies. A final condition is a reliable model of the economy which furnishes knowledge of the effects (and the speed of the effects) of the monetary variables on the real system.

A model for analysing the mechanism of monetary policy should therefore be based on the following sectors:

1. A *reaction function* for the monetary authorities — derived from their preference function — which determines the value of their instrumental variables, given the divergence between the behaviour of the target variables and their "desired" path (the aim of policy being to minimise the divergence). Much has been written about the need to include the monetary authorities' intervention as endogenous in a complete structural model.[6] But from the literature it is clear that there remain substantial theoretical and empirical difficulties still to be resolved. We may mention two of these. First how far can we take such intervention as endogenous? It is indeed obvious that the aims of the monetary authorities may change over the period considered,[7] and whilst this could be "at random", it is quite reasonable to assume that the monetary authorities practise what economists have christened as "learning by doing". In other words, the preference function itself would become at least partly endogenous. Secondly, let us assume that the authorities have indeed obtained their reaction function, maximising their preference function given the constraint

6 For Italy as well. See my "I ritardi delle autorità monetarie", *Rivista Internazionale di Scienze Sociali*, May-August 1970; P. Ranuzzi de Bianchi, "La funzione delle preferenze delle autorità monetarie in Italia dal 1958 al 1969", *Moneta e Credito*, June 1971; J. L. Lucia, "Objectives of Monetary Policy in Italy, 1961-66", *Economia Internazionale*, May 1972.

7 That this has been the case for Italy appears to be confirmed by the remark of Baffi (General Manager of the Bank of Italy) that monetary policy in Italy "has proceeded from *overcaution* in the late forties to *caution* in the fifties and to *ambition* in the sixties" (our italics). P. Baffi, "Ways and Programmes of Monetary Action in Italy: A Glance at Two Decades", in *Verstehen und Gestalten der Wirtschaft*, J. C. B. Mohr, Tübingen, 1971, p. 243.

of a model of the economy; and that their intervention in the economy is based on the reaction function itself. If all this is the case, then it can be shown that it is no longer possible to independently identify the model of the economic system.[8]

2. A *monetary sector* which, given the instrumental variables, determines (through the joint action of a vector of intermediate monetary variables and the effects of the real variables themselves) the final monetary variables which influence the real sector.

3. A *real sector* which determines the behaviour of the economy, given the final monetary and other exogenous variables amongst which the effects of other economic policies are particularly important.

In this analytical scheme we must identify the relevant monetary variables, specify their links with the real sector as well as the structure and the level of aggregation of the monetary sector needed to determine them. The resulting structural equations may then be estimated econometrically and the whole model used to plan monetary policy.

There are in this context two possible alternatives. We can emphasise the workings of the monetary sector in order to see how the individual instrumental monetary variables transmit their effects onto the intermediate and final monetary variables. Or else we can just explain the final monetary variables which influence the real sector, using appropriate "reduced forms" for the different financial markets, or simply leaving them out of the analysis on the assumption that they reach equilibrium anyway.

Carried to the extreme, the two alternatives bring us to the recent debate — still alive — between the proponents of the "structural" approach and those of the so-called "reduced form" approach. The former wish to identify the actual transmission mechanism of monetary policy, building it into "structural equations" and subjecting it to econometric estimation. The "reduced form" approach takes the transmission mechanism to be too complex and too concealed to be reliably measured, and so instead it aims to estimate directly the effects of monetary variables on national income. Here, the structure of the monetary sector remains implicit because of the assumption that the monetary authorities are in com-

8 See A. W. Phillips, "Models for the Control of Economic Fluctuations", in *Mathematical Model Building in Economics and Industry*, Griffin, London, 1968, pp. 159-165.

plete control of an intermediate monetary variable (the monetary base) or a final monetary variable (the stock of money).

The proponents of this second approach [9] claim that it produces results better than those obtained from far more complex analyses, and they conclude that monetary policy is much more powerful than would appear from "structural" models. However, there is still much uncertainty about its theoretical and empirical validity [10] as well as about its usefulness for short term planning.

There is in fact a tendency, at the theoretical level, to confuse this approach with the "quantitative" view that there is a direct relation between the quantity of money and national income at current prices. When we more correctly view it instead as a simple reduced form of a complex and unspecified structural model, then there remain doubts about the consistency of the underlying structure, and also about the assumption that the monetary variables are exogenous. But if we do not allow that these variables are under the complete control of the authorities, then we can learn nothing about monetary policy's effects.

On close observation, to the extent that the difference between the two approaches is at all significant, this is a result of their different assumptions about how the monetary variables bear on the real sector, and about how they are in turn determined by the authorities.

III. Financial Markets and Economic Activity

In recent years monetary analysis has been overshadowed by the controversy between the so-called "monetarists" and "keynesians". The dispute, which crept in during the mid-1950s and blew up ten years later, has led to the rapid accumulation of theoretical and empirical work, but only lately has anyone managed to fully evaluate the terms of the problem.[11]

Once the dust has settled, it clearly emerges that the whole problem cannot be brought down to minor empirical differences, because there exist primarily substantial theoretical differences, which lead back ultimately to a fundamental ideological and political contrast.[12]

9 L. C. Andersen - J. L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization", *Federal Reserve Bank of St. Louis Review*, November 1968.

10 E. M. Gramlich, "The Usefulness of Monetary and Fiscal Policy as Discretionary Stabilization Tools", *Journal of Money, Banking and Credit*, May 1971.

11 However the Symposium in the September-October issue for 1972 of the *Journal of Political Economy* hardly indicates an imminent end to the controversy.

At the heart of the matter is the contrast between the neo-classical *optimism* of a general equilibrium walrasian model and the keynesian *pessimism* of a disequilibrium non-walrasian model. The "theoretical" contribution of Keynes' *General Theory* is today being reappraised in these terms; and it is into these terms that the controversy between Keynes and the "classics" may be rewritten.[13]

These two approaches were initially clarified by Hicks and Patinkin — two economists whose work has dominated the development of monetary theory in the last thirty years. It is striking that both, quite paradoxically, claimed to be "more keynesian than Keynes", even if in different contexts!

Hicks, in a famous article,[14] reinterprets the still classical Keynes of the *Treatise,* laying the foundations for the integration of the theory of value and monetary theory, in marginalist terms ("What is wanted is a marginalist revolution!"). It is in this context that he declares: "I am being more keynesian than Keynes".[15] The ideas then advanced by Hicks were later used in the redesigning of monetary theory for the analysis of the factors which determine portfolio equilibrium. This has led to the formulation of general equilibrium models for monetary analysis to determine the interest rate structure which — given the degrees of substitution between the different assets (including money) — directly or indirectly influences economic activity.[16] In this way, the fundamentally neo-classical integration of

12 See J. Robinson, "The Second Crisis of Economic Theory", *American Economic Review*, May 1972.

13 The contrast between "monetarists" and "keynesians" instead appears slight. Compare the following remarks of Friedman and Klein. Friedman — the self-appointed prophet of monetarism — has claimed to feel "extremely sympathetic" toward the view expressed 120 years previously by John Stuart Mill: "There cannot, in short, be intrinsically a more insignificant thing in the economy of society than money; ... it only exerts a distinct and independent influence of its own when it gets out of order". In turn, Klein — who would certainly call himself a keynesian — has stated: "The monetary economy, if in good housekeeping order, will not have a dominant influence on real affairs". See M. Friedman, "The Role of Monetary Policy", *American Economic Review*, March 1968, p. 12; L. R. Klein, in *Models of Income Determination*, N.B.E.R., Princeton, 1964, p. 56.

14 J. Hicks, "A Suggestion for Simplifying the Theory of Money" (1935), reprinted in *Critical Essays in Monetary Theory*, Oxford University Press, Oxford, 1967, pp. 61-82.

15 *Ibid.*, p. 64.

16 J. Tobin, "A General Equilibrium Approach to Monetary Theory", *Journal of Money, Credit and Banking*, February 1969.

portfolio decisions (analysed in the capital account) and spending decisions (analysed in the income account) was born.

The orthodox form of these capital account models implies distinguishing between different (interdependent) "sectors" each with its own balance sheet (at any time, the sum of the assets equals the sum of the liabilities). The assets of each sector (liabilities of other sectors) are transacted in different (interdependent) "markets". Each market is thus explained by structural equations and equilibrium conditions. The typical portfolio behaviour equation is based on the hypothesis of partial adjustment, under short term constraints, of a portfolio structure toward its "desired" structure — the latter being defined in terms of a vector of relevant yields.

This dynamic assumption, that portfolios adjust toward a "desired" structure does not allow, on the other hand, the possibility of disequilibria in the different markets. This results from the assumption that the stock-adjustment process maintains consistency across portfolios, and that interest rate variations always ensure the clearing of the markets.[17]

In contrast to this neo-classical analysis of general equilibrium, Patinkin[18] has reinterpreted Keynes' *General Theory* as an analysis "of the dynamic workings of an economy in disequilibrium"; and it is here that he affirms: "we are more keynesian than Keynes".[19]

This interpretation of Keynes, which has enjoyed a growing consensus in recent years, points out the essence of the "Keynesian Revolution" as a general theory of disequilibrium where prices adjust slowly, markets fail to clear; and where, since actual quantities transacted differ from those planned, there are quantity constraints which limit transactions. All of which was largely ignored by those who, though calling themselves keynesians, still clung to the theory of general equilibrium.

Linking up with this "re-edited" Keynes of the *General Theory*, there is the recent development of an alternative monetary analysis

17 Brainard and Tobin analyse "the laws governing the system in disequilibrium" and propose "a *general disequilibrium* framework for the dynamics of adjustment to a *general equilibrium* system". In fact they are mainly concerned to emphasise that all the equilibrium conditions are still satisfied during this so-called disequilibrium process. Their definition of disequilibrium has not therefore to do with markets which fail to clear. See W. C. Brainard - J. Tobin, "Pitfalls in Financial Model Building", *American Economic Review*, May 1968.

18 D. Patinkin, *Money, Interest and Prices*, Harper & Row, New York, 1965, Chaps. XIII & XIV.

19 *Ibid.*, p. 340.

which examines the behaviour of monetary variables in financial models in disequilibrium.[20]

It is thus clear that the real theoretical differences are not those between the "monetarists" and the "keynesians", but instead are those between the different interpretations of Keynes: that is to say, between those who, departing from the *Treatise,* extend his analysis in general equilibrium terms, and those who reinterpret his *General Theory* as an analysis of disequilibrium.

The contrasting analyses of equilibrium and disequilibrium therefore involve all the factors relevant to the workings of monetary policy: how the intermediate monetary variables are controlled; how they in turn determine the final monetary variables; and how the latter influence the real sector.

There are in this context three distinct problems: what these variables were, what they might be, and what they should be. To answer the first would require an *ad hoc* analysis of the actual behaviour of the authorities. Let us restrict ourselves to briefly answering the last two questions, for the final monetary variables,[21] assuming that the authorities control the supply of the monetary base.

In the equilibrium models of financial markets it appears that any change in the monetary base supply (whose rate of return is zero or at least exogenous) is accompanied by portfolio readjustments with variations in the interest rate structure (which will be the less, the greater is the substitutability between the monetary base and alternative assets) until the demand for the monetary base is once more in equilibrium with the supply. In other words, let us assume that the authorities increase the monetary base supply to excess in this market. The consequent excess demand for alternative assets will lead to a

20 This is what Clower proposes in the fore-mentioned article. The same approach is further pursued in D. Tucker, "Macroeconomic Models and the Demand for Money under Market Disequilibrium", *Journal of Money, Credit and Banking*, February 1971. See also H. I. Grossman, "Money, Interest and Prices in Market Disequilibrium", *Journal of Political Economy*, September-October 1971.

21 The same questions have been put for the intermediate monetary variables controlled by the monetary authorities. Indeed, every possibility has been looked at in the studies lately accumulated: monetary base, total reserves, unborrowed reserves, excess reserves, free reserves. See R. Davis, "Short Run Targets for Open Market Operations", in Federal Reserve System, *Open Market Policies and Operating Procedures*, Washington, 1971, pp. 37-69.

The choice between these variables depends on the ability of the monetary authorities to predict variations of their endogenous components (e.g., borrowing by the banks) and on their decision to offset such changes through intervention.

fall in their rates of return, and this will raise the demand for the monetary base to the necessary level. In this way the financial markets will be cleared by interest rate adjustments which equilibrate the quantities supplied and demanded.

However, if we assume that the variations in the interest rate structure are not quick enough in the short run to ensure equilibrium, then the financial markets will fail to be cleared. There will remain excess supply and demand (in a "notional" sense only): the actual quantity of assets — and not their rates of return — will appear as the final monetary variables.[22]

To some degree, both of these possibilities are present in the more recent econometric models of financial markets where the effects of monetary variables on economic activity are found to be not negligible.[23]

In the last twenty years the analysis of the channels which transmit the effects of monetary policy has been steadily widened. Previously, only two financial assets entered the analyses — money and bonds (all other assets being assumed perfectly substitutable with one of these) — in determining, at equilibrium, the rate of interest and its (usually slight) influence on investment. In later analyses the quantity of money (or net wealth) of the private sector was included as an element in expenditure functions (and generally as a highly important one). The modern standpoint, shared by most economists and embodied in the most recent econometric models,[24] is an "eclectic" one and considers a number of channels (such as cost-of-capital, wealth, and rationing) as determinants of the different components of aggregate demand.

22 There are obvious analogies with the traditional theory of the "money multiplier", where it is assumed that changes in interest rates have no place in explaining the monetary base demand, and that any change in monetary base supply is reflected in a proportional change in the money stock. Here then, adjustment in the quantity of money ensures equilibrium in the monetary base and money markets. This may be reinterpreted in the light of the disequilibrium "Keynesian multiplier" analysis, proposed by Clower and generalised by Leijonhufvud.

23 As Gramlich (*op. cit.*, p. 513) has remarked: "Possibly, there is some lesson in the fact that monetary influences are stronger, the harder the model-builders seem to have looked for them"!

24 See P. A. Samuelson, "Money, Interest Rates and Economic Activity: Their interrelationship in a Market Economy", in American Bankers Association, *Proceedings of a Symposium on Money, Interest Rates and Economic Activity*, Washington, 1967, pp. 45-60; and Y. C. Park, "Some Current Issues on the Transmission Process of Monetary Policy", *IMF Staff Papers*, March 1972.

The present view of the transmission mechanism of monetary policy is thus a very general one.

Within financial markets there are sectors in deficit (Government and firms) which offer their liabilities to the sectors in surplus (families) to hold as assets. In equilibrium an interest rate structure is determined such that the structure and volume of the liabilities desired by the former coincides with that desired by the latter. The level of these rates — which depends on the position and slope of the different demand and supply functions — at equilibrium determines a corresponding level of economic activity.

However, if institutional rigidities in the interest rates are taken into account, as well as limited substitutability between the various assets and liabilities,[25] then it is possible that the volume and/or structure of the assets demanded and supplied do not match. There would then be only a partial adjustment of interest rates toward equilibrium; there remaining a divergence between the quantities demanded and supplied, with the actual quantities the smaller of the two.

It should be noted that in recent studies of monetary policy channels it is assumed that the above is true to different degrees in the different financial markets.[26] In some markets the rates are flexible enough to guarantee that there is always equilibrium. While in other markets (particularly those for mortgages and commercial loans) the rates are instead assumed to be fairly rigid, and there is hence reference to "rationing".[27] It is further supposed that changes in interest rates (determined in those markets which reach equilibrium) affect some elements of aggregate demand, while the actual quantity of assets created (in markets of persistent disequilibrium) affect other elements.

We can here make some comments.

Firstly, it is noteworthy that the effects of monetary variables on economic activity have always been found to be greater for actual quantities (the quantity of money, credit, etc.) than for interest

25 For instance, firms may dislike being in debt — beyond certain levels — however low the cost.

26 See F. de Leeuw - E. M. Gramlich, "The Channels of Monetary Policy", *Federal Reserve Bulletin*, June 1969.

27 The most complete analysis, even though limited to one market with only comments on the interdependence among the different financial markets, is that of D. M. Jaffee, *Credit Rationing and the Commercial Loan Market*, Wiley, New York, 1971.

rates. This is understandable if we reckon that interest rates are relevant to the long run equilibrium solution, and the quantities to short run disequilibrium. [28] It should be stressed however that up to now there has been no general disequilibrium analysis of financial markets. In all the models so far, there have been some markets assumed to be in equilibrium and others not. The disequilibrium of some markets partly affects the equilibrium solution of the others,[29] and partly has direct influence on the expenditure functions in the real sector. This solution may represent a useful empirical approximation — as well as a means of overcoming the well known difficulties in estimating structural equations in disequilibrium — even though it is in need of theoretical support.

Finally, there is the question of evaluating how much of all this is relevant in designing an "optimal" monetary policy. Traditionally, the choice has been limited to two alternatives: stabilising the quantity of money, so leaving interest rates to fluctuate procyclically, or else stabilising interest rates, so leaving changes in the money stock as endogenous. It has been shown [30] that the choice is a result of the uncertainty about the causes of instability in the economy. This instability is due either to changes in the demand for money or else to changes in the investment function. With unpredictable shifts in the "real" sector, it has been shown that it is better to keep the money stock constant (the procyclical changes in interest rates will be stabilising) and vice versa. However, these conclusions have not been verified in the context of a general analysis of financial markets, nor in one allowing for the possibility of their disequilibria.

IV. An Aggregated Model of the Italian Monetary Sector

The preceding analysis has served to clarify the theoretical background to the workings of monetary policy. Whilst aware that there remain theoretical questions yet to be answered, we can illustrate

28 There is a clear analogy with the "monetarist" view that changes in the quantity of money have only short run real effects.

29 The excess demand not eliminated by interest rate changes in one market should explicitly appear in the structural equations for the other markets. In practice this occurs on the portfolio balance sheets, where there appear together some assets determined in disequilibrium and others in equilibrium. This therefore exerts its effect on the monetary variable which is residually determined by the balance sheet equation.

30 See B. J. Moore, "Optimal Monetary Policy", *Economic Journal*, March 1972.

the structure of a model of the Italian monetary sector, designed to show up the main impact on the final monetary variables [31] exerted by the possible policies of the monetary authorities. It will be seen that the model is an aggregate and highly simplified one,[32] but nonetheless, despite many limitations, is sufficiently predictive and leads to some interesting implications for monetary policy.

1. *Specification of the Structural Model*

The monetary authorities aim to control the growth of the financial assets and liabilities of the "private sector" and their rates of return, either directly, or indirectly through the banking system, given changes in the size of the Treasury deficit and of the balance of payments, both of which are uncontrollable in the short term. There are thus five sectors to be analysed: the *Foreign Sector,* the *Treasury*, the *Bank of Italy*, the *Banks*, and the *Private Sector*. With some simplifications the equations for the balance sheets of these five sectors are shown in Table I, in flow terms.

Table I

1.	*Foreign sector*	BP = POSBI + POSB
2.	*Treasury*	(G − T) = CRBITES + TES + BOT + DEPOS
3.	*Bank of Italy*	POSBI + CRBITES + RB = CIRC + RR
4.	*Banks*	RE + RR + CR + TB + POSB = D + RB
5.	*Private sector*	CIRC + DEPOS + D + TP = CR + TEC + (G − T) + BP

1. *The Foreign Sector.* From the balance of payments position (BP) we have the changes in the net foreign position of the central bank (POSBI) and of the banks (POSB). This results analytically

31 The wider study, of which this article forms a part, has led to the estimation of a model of the "real sector" of the Italian economy, which — in its present version — does not include monetary variables since there is no resulting improvement in the predictive capacity of the individual equations. See M. Crivellini, *Settore reale: struttura e simulazione*, ISCO, Rome, 1972. However, for several functions — private consumption, industrial investment, in the tertiary sector and in stocks, and capital movements in the balance of payments — the effects of monetary variables — the money stock, rates of interest, liquid assets of the public — have been identified.

32 The three main limitations are: yearly data (the real sector model is annually based, there being in Italy no quarterly data for the national accounts); a limited number of them (the estimates refer to the last 20 years); with only one interest rate (because only in recent years have the rates on bank credit and deposits been published).

from the sum of the net official reserves and foreign assets on the consolidated balance sheet of the Bank of Italy; and for the credit institutions it is the sum of their foreign liquid assets (tied and freely convertible), plus foreign credit and minus borrowing from abroad. The Italian monetary authorities give instructions to those banks enabled to engage in foreign transactions, in order to control their net foreign position and either allow as freely convertible, or hold as inconvertible their foreign liquid assets. Through such intervention the impact of the balance of payments on internal liquidity is kept under control.

2. *The Treasury.* The Treasury deficit (G — T) is financed by credit from the Bank of Italy (CRBITES), by Post Office deposits (DEPOS), and by the issue of medium or long term securities (TES) and of treasury bills (BOT).

3. *The Bank of Italy.* The assets appearing on the consolidated account of the Bank of Italy-Italian Exchange Office are: reserves and net official foreign assets, credit to the Treasury and loans to the banking system (RB). While the liabilities are: currency in circulation (CIRC) and the compulsory reserves of the banks (RR).

4. *The Banks.* On the account of the credit institutions appear the following assets: excess reserves (RE), compulsory reserves (RR), loans (CR), investments in bonds (TB), and the net foreign position. And as liabilities: deposits (D) and borrowing from the central bank (RB).

5. *The Private Sector.* The balance sheet of the private sector (firms and households) consists of the following domestic financial assets: currency in circulation, postal deposits, bank deposits and bonds (TP). And liabilities: bank loans and bonds issued (TEC). A complete account of this sector must also include investment, savings, and foreign financial assets and liabilities. Now the difference between savings and investment is equal to the Treasury deficit plus the net balance on current account of the balance of payments; and the difference between foreign financial assets and liabilities is equal to the net capital movement in the balance of payments. This then amounts to including the Treasury deficit and the balance of payments among the liabilities of the public.

The five sectors, whose balance sheet equations have been briefly described, allow us therefore to identify the entire vector of relevant

financial assets. Within the monetary sector the Treasury deficit and the balance of payments appear as exogenous variables; and so does the behaviour of the Bank of Italy, in the absence of a reaction function for the monetary authorities. Hence it is convenient to combine the first three sectors, so leaving only the financial assets and liabilities of the banks and the public to be explained.

By combining the balance sheet equations 1., 2., and 3. of Table I we obtain:

$$[1] \qquad [BP - POSB] + [(G - T) - TES] + RB = BOT + RR + CIRC + DEPOS$$

This equation points out the *sources* and *uses* of the monetary base, or of the sight debts (or debts so convertible) of the monetary authorities. It is clear from equation [1] that the *sources* of the monetary base lead back to the balance of payments (the monetary base increases if the balance of payments surplus increases, or if POSB is reduced — i.e. if the banks' foreign debt increases); to the Treasury deficit (the monetary base increases if there is an increase in the share of the Treasury deficit which is not financed by long term securities: a decline in TES may come about either through a reduction in issues, or through greater purchases by the Bank of Italy); and also leads back to the credit allowed to the banks by the central bank. The *uses*, on the other hand, refer to the use of the monetary base by the banks for compulsory and excess reserves (we can thus write $BMB = RE + RR$), and to its use by the public (we can thus write $BMP = CIRC + DEPOS$).

This last equation, together with the balance sheet equations for the banks and the public, shows that the assets to be "explained" within the monetary sector involve four markets: those of the monetary base (BMP, BMB), bank deposits (D), bank credit (CR) and bonds issued by firms (TEC) and purchased by the banks and the public (TB and TP respectively).

The specification which has been adopted for the monetary sector, and subjected to econometric estimates, is thus shown in Table II.

The first three equations define the balance sheet equations of the three sectors considered. The exogenous or instrumental variables are indicated by the bars overhead. The fourth equation determines the equilibrium condition of the bond market, where the supply originates

from the Treasury (net of purchases by the Bank of Italy) and from firms, and the demand is by the public and the banks. It is clear that one of the four equations is linearly dependent on the other three: that is to say, the fourth is satisfied automatically when the other three are. One equation is thus redundant and to be left out (in the simulation of the model equation [3] was left out, but the results would have been just the same had it been any other of the four).

TABLE II

1. $[\overline{BP}-\overline{POSB}]+[(\overline{G-T})-\overline{TES}]+\overline{RB}=BMP+BMB$
2. $BMB+CR+TB+\overline{POSB}=D+\overline{RB}$
3. $BMP+D+TP=CR+TEC+(\overline{G-T})+\overline{BP}$
4. $\overline{TES}+TEC=TP+TB$
5. $BMP=f\ (\overline{HY},\ IO)$
6. $D=f\ (\overline{HY},\ IO)$
7. $CR=f\ (BMB,\ \overline{HI},\ \overline{HCPR})$
8. $TP=f\ (HY,\ \overline{PY},\ \overline{IO})$
9. $TB=f\ (D,\ IO)$

The last equations in Table II specify the demand for five assets. It should be emphasised that one interest rate alone — the rate of return on bonds (IO) — appears explicitly in four demand equations. That is to say, the rates for the monetary base, deposits and credit are missing: this is mainly due to the limited statistical data available for these rates for the whole period under consideration. It is tantamount to assuming that the substitutability between the different assets is not reflected in variations in those rates, but mainly in variations of the rate of return on bonds. This approximation has however been a valid one for the best part of the period considered, the yields on the monetary base and on deposits being fixed exogenously. The bank credit equation does not include the interest rate on bank credit, the equation being estimated as a "reduced form" of the market itself. This is indeed equivalent to assuming that this rate always settles at the level equilibrating supply and demand (even though it doesn't appear as an alternative interest rate in the other demand functions). Such a restrictive assumption should also be taken into account when it comes to evaluating the results obtained.

The public's demand for the monetary base and for bank deposits is made to depend upon income at current prices (HY) and upon the yield on bonds (IO).[33] The expected signs are positive for income, and negative for the rate of interest — the latter being a measure of the substitutability that exists between these two assets and the only other asset implicitly assumed — bonds.

The bank credit equation appears as a "reduced form" of a supply which depends on the banks' monetary base (BMB, i.e. their total reserves) and of a demand which depends separately on investment (HI) and on private consumption (HCPR).[34]

The demand for bonds in the public's portfolio depends again upon the rate on bonds (though in this case the sign expected is a positive one),[35] upon income, and upon the movement of prices (PY). This latter variable measures the degree of inflation — and possibly of inflationary expectations — and has a negative sign on the assumption that the monetary rate of return does not adjust itself to price increases.

The banks' demand for bonds depends on the rate of interest, again with a positive sign, and on the amount of funds available, approximated by the volume of deposits.[36]

The model made up by the eight independent equations specified above allows the determination of the eight endogenous variables: BMP, BMB, D, CR, TP, TB, TEC, IO; given the exogenous variables: HY, HI, HCPR, PY, (G — T), BP, and the possible instrumental variables: TES, RB, POSB.

The structure of the model does appear highly aggregated and the specification of the functions simplified. Both of these limitations

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33 The identification of the effects of changes in prices, income distribution, and the composition of aggregate demand has also been attempted. However these variables have not turned out to be significant, other than for equations estimated on stocks rather than flows (this probably being a result of common trends among the variables).

34 An attempt was made to take into account the effect of variations in "alternative sources", as indices of profits, on the demand for credit. These variables appeared as scarcely significant, and indeed with a positive sign such as to indicate complementarity, rather than substitutability, between profits and bank credit.

35 In fact, the "level" of the interest rate exerts its effect on the demand for bonds with a positive sign, whilst "variations" of the rate itself take on a negative sign. In other words the variability of the rate has a negative effect on the demand for bonds.

36 Price variations did not turn out to be significant. Instead, just on the limits of significance, appeared (with a negative sign) an index of competing uses given by CR.

could, at least partly, be overcome.[37] However, whilst aware of the many limitations already imposed on the estimates,[38] it was not considered that such modifications would have resulted in any significant improvements. As will appear from the econometric estimates and from the tests of the predictive performance of the equations themselves, this structure produces satisfactory results only in part; in recent years it is less well able to predict the growth of the financial assets under consideration. For in this period the market has been disturbed by a series of disequilibria with which the model — in its simplest form — cannot cope.

2. *Estimates: 1952-1971*

The five structural equations have been estimated by *ordinary least squares,* for the following periods: 1952-67, 1952-68, 1952-69, 1952-70, 1952-71. The results obtained for the period 1952-67 are recorded in Table III.[39]

TABLE III

	$\bar{R}^2$	DW	SEE
1. BMP = .2371 HY − 133.53 ΔIO (27.3) (2.7)	.910	1.24	79
2. D = .7601 HY − 753.84 ΔIO (14.4) (2.6)	.762	1.22	479
3. CR = −.360 + .96 BMB + .755 HI + .595 HCPR (2.1) (2.2) (3.9) (5.7)	.892	1.72	253
4. TP = .3758 HY − 135.91 PY + 34.06 IO (9.3) (6.1) (2.8)	.834	1.66	141
5. TB = −1277 + .4154 D + 158.69 IO (3.8) (13.5) (3.3)	.924	1.98	109

37 It is easy, for instance, to disaggregate bank deposits into sight deposits and savings, the total reserves of the banks into compulsory reserves and excess reserves, and so on.

38 The disaggregation referred to in the above footnote would have little sense in the absence of the different relevant interest rates. Whilst, on the other hand, the annual nature of the data prevented any examination of the time-lag structure.

39 *Statistical sources*: for the "monetary" variables the series has been derived from the *Bulletins* and *Reports* of the Bank of Italy (various years); and for the "real" variables from: ISCO, *Quadri della contabilità nazionale italiana per il periodo 1951-1971*, Rome, 1972.

As can be seen from Table III, the results of the estimates are satisfactory (we note that the variables are all in first differences except IO in functions 4. and 5., while PY is a percentage rate of change) for the coefficients of determination and for the significance of the parameters (the *t*-values are in brackets). However, it turns out that the significance of the estimated equations declined when the last two years (1970 and 1971) were included in the sample period. This is especially true for the equations relating to the demand for deposits, and for bonds in the portfolios of the public and the banks. This is because the specification adopted is not able to allow for three factors which have played a notable part in this last period. In the first place, during the second half of 1969 the Bank of Italy abandoned its "pegging policy" which it had pursued for the previous three years and let the rate of interest rise sharply (in order to counter the growing flight of capital abroad). The high level reached by the interest rate was no longer significant in the demand for bonds but instead the significant variable was the variation of the rate itself — with a negative sign. Furthermore, in the same period, there was increased rationing by the banks, and by the monetary authorities in consenting to the issue of bonds (TEC). The demand for deposits was not, however, restrained by the increase in the rate of interest, because at the same time there was a rise in the rate paid on deposits (this is a variable which has been left out of the estimates of the functions).

These considerations should be taken into account when we evaluate the predictive performance of the estimated equations, and we should also try to allow for them in the simulation of the whole model.

3. *Predictive Performance: 1968-1971*

The predictive performance of the individual functions may be measured by a simple exercise of prediction outside the sample period. In this way we obtain the value of the dependent variable given the actual values of the independent variables, and the parameters obtained by estimates up to the year before the one being considered.[40] The results for the five estimated equations are recorded in Table IV, for the years 1968-71.

40 Obviously, had we used the parameters derived from the estimates which included the year to be "predicted", the results would have been better; but the test would in this

TABLE IV
(billions of lire)

	1968		1969		1970		1971	
	AV	PV	AV	PV	AV	PV	AV	PV
1. BMP	576	801	1153	1056	985	1194	1782	1192
2. D	3668	2542	3665	3635	5560	3554	7205	4039
3. CR	2012	2118	3103	2395	3328	4589	3531	2998
4. TP	1347	1309	1029	1444	754	1586	1795	888
5. TB	1545	1284	1134	1396	803	2427	2316	1925

In the column headed AV are the "actual values", while the column headed PV shows the "predicted values", based on the parameters obtained from the estimates for the periods 1952-67, 1952-68, 1952-69, and 1952-70.

It is clear from Table IV — and it was indeed predictable from what has already been said about the stability of the estimates — that the predictions derived from the individual equations for the years 1970-71 are of poor accuracy.

To test the predictive capacity of the model, the whole structure (see Table II), was "simulated", obtaining the parameters for the five equations from the estimates until time $t-1$, in order to "predict" the four years 1968-1971, using the actual values of the exogenous and instrumental variables for these years. Once more, the model turns out to be satisfactory for the years 1968 and 1969, while the predictions get distinctly worse for the following years. We can, however, quite easily reduce these errors to within acceptable limits, if for 1970-71 we introduce modifications into the simulation — which are plausible *a priori* — which allow for the abnormal increase in bank deposits and the related fall in the demand for bonds observed in this period. The precise modifications introduced are the following:

— for 1970 the parameter relevant to ΔIO in the demand function for deposits has been put equal to zero (on the assumption

case have been considerably less stringent. This prediction exercise is of crucial importance if the model is to be used for short term forecasting and policy-making. For the model would be used at time t to predict the situation at time $t+1$, while the most recent data, and hence estimates, being available would be those of time $t-1$.

that the simultaneous rise in the rate of interest on deposits cancelled the negative effects due to the increase in IO). In place of the equation for TP in Table III, is substituted the alternative equation estimated for the period 1952-70, where it is the variation in the interest rate, with a negative sign, rather than its level, with a positive sign, which is the significant variable; [41]

— for 1971 we have kept the same TP equation which was used to predict 1970, and left out the bank deposit equation. This is on the assumption that in this year the issue of bonds by the private sector was rationed by the monetary authorities (thus the variable TEC becomes "instrumental", while the variable D now comes to be determined residually: the model has one less endogenous variable).

With these corrections — which seem the most plausible to take into account the factors mentioned above — the main endogenous variables are simulated by the model with satisfactory accuracy even for the last two years. The results for the four crucial variables — i.e. the interest rate IO, the quantity of money M,[42] the total volume of credit obtained by the private sector CR + TEC, and the total bond portfolio of the public and the banks TP + TB — are recorded in Chart I (where the solid line indicates the actual values and the broken line the predicted values). The first three variables referred to represent the *final monetary variables* of this model, while the bond portfolio of the public and the banks represents an important *intermediate target* of the Bank of Italy, which in the past few years has been predominantly concerned to guarantee a growing sale of public securities.

We may conclude that the model's usefulness for interpretation is not seriously impaired by the level of aggregation which has been chosen. But still there are limits to its "mechanical" application to situations where changes in variables which usually exert no effect come into play.

41 The equation estimated for the period 1952-70 is the following:

$$TP = .3409\ HY - 66.62\ PY - 365.14\ \Delta IO \quad \bar{R}^2 = .711\ DW = 1.62\ SEE = 206$$
$$(9.3) \qquad (2.5) \qquad (3.9)$$

42 The quantity of money is defined as the sum of the monetary base and the deposits of the public (M = BMP + D): it is therefore the widest definition possible, including even postal deposits and bank savings deposits, usually not included among the "means of payment".

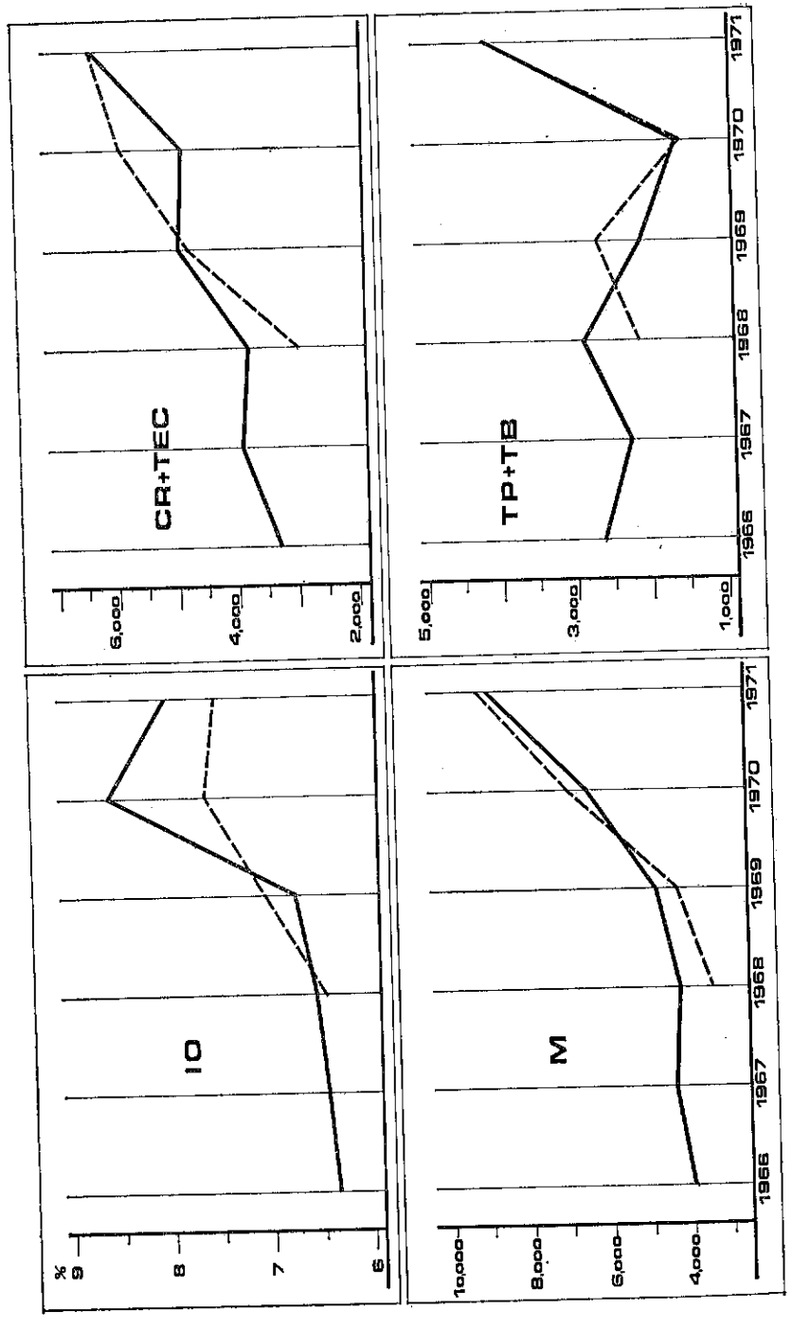

CHART I

Since it is practically impossible to include all these factors in the estimates of the equations, ex-post adjustments may be made, which should in turn be explained.

4. *Policy Implications*

The monetary sector model may be used either for prediction (with suitable assumptions about the exogenous variables and the behaviour of the monetary authorities) or for short term policy-making. In the latter case it is supposed that the authorities wish, by intervening, to determine a vector of final monetary variables whose values correspond to those implied by the "desired" values of the target-variables: income, investment, prices, etc.

We can briefly look at the implications for monetary policy which derive from this model. We have said that as final monetary variables can be considered the interest rate (IO), the quantity of money (M) and the total volume of funds available to the private sector (CR + TEC). We have also noted that the instruments available to the authorities can all be subsumed under their control of the monetary base supply.[43] The monetary base enters the financial markets through three channels, each of which is subject to control by the authorities. The first channel is that of the monetary base originating from the Treasury deficit, and here the authorities may intervene by the buying or selling of bonds (TES). The second is fed by the balance of foreign payments, and this is "corrected" by the authorities' manipulating of banks' foreign debt (POSB). The third channel is that represented by the banks' debt toward the central bank. In Italy this has been directly "rationed" by the authorities.[44]

The "reduced form" of the model allows us to evaluate the

43 Obviously, the authorities also have control on the monetary base "multiplier", by varying the coefficient of compulsory reserves. This occurred several times over the period examined (and also indirectly, to the extent that the banks were allowed to hold bonds, rather than monetary base, as their compulsory reserves). There was therefore some variation in the multiplicative effect of the base created. This factor was not explicitly allowed for in the estimates but it appeared implicitly in the variations of the corresponding parameter of the CR function.

44 It is clear that if the monetary sector were integrated with the real sector then variations in income, and also in monetary base creation, arising from the Treasury deficit and the balance of payments, would be at least partly endogenous. This should be taken into account when evaluating the predictive results of the model (estimated on annual data) and thus also the "multipliers".

impact multipliers of these different sources of the monetary base on the final monetary variables. These multipliers are recorded in Table V, for 1968.

TABLE V

	PV	Δ[(G−T)−TES]	Δ[BP−POSB]	ΔRB	ΔHY
1. IO . . .	6.45	− .0023	− .0018	−.0011	.0011
2. M	3424 (*)	2.018	1.598	.988	.061
3. CR+TEC .	2924 (*)	1.294	.944	.950	.471

(*) Billions of lire.

The first column in the Table shows the predicted values (PV) of the different endogenous variables for 1968. These were obtained by solving the model for the actual values of the exogenous and instrumental variables of that year. The next three columns show the policy submatrix — i.e. the effects on the endogenous variables of variations in the different sources of the monetary base from the values assumed for the prediction itself. The last column shows the multipliers relating to variations in money income.

Two general remarks may be made. Firstly, it is apparent that the sizes of the multipliers are less than would have been expected *a priori*: this is a result of the *cushion* effect in the model of the banks' monetary base. In the short run, this absorbs a significant part of variations in the total base created, thereby reducing the multiplicative effect on credit and deposits. Secondly, there are notable differences in the multipliers relating to variations in the different sources of the monetary base.

The information shown in Table V (which, it should be remembered, is derived by solving the model and so faces its same limitations) allows us to answer some interesting questions about an "optimal" strategy for monetary policy.

Let us assume that the quantity of monetary base entering the system, from the Treasury deficit or the balance of payments, is considered excessive by the authorities. We can see that their choice of action has significance. They may offset the excess liquidity, arising, for instance, from a balance of payments surplus, by an equivalent reduction in the central bank's bond portfolio, or by reducing the credit allowed to the banks. But the effects on the

final monetary variables will be different. By analogy, the same goes when the authorities wish to allow an increase in money income without provoking an increase in interest rates. In this case, the size of the necessary increase in the monetary base depends upon which of the various channels are used.

These differences between the multipliers render more complex the design of monetary policy. If we compare their ratios along the rows of the Table, we can evaluate the size of each measure necessary to attain the desired value of each target-variable, and hence their interdependence.[45] Instead, by comparing the ratios of the multipliers down the columns we can see how much the relationships between the different target-variables vary for each policy measure.[46]

V. Conclusions

We should obviously view with some caution these last remarks about the use for monetary policy of this aggregate model for the Italian monetary sector. It was plain from the previous theoretical considerations, that there remain numerous problems unresolved — and this was indeed confirmed by the results of the econometric estimates.

At the most general level, the need was insisted to explicitly allow for the possibility that the different financial markets would not be held in equilibrium by corresponding interest rate variations. Yet this is nowhere allowed for in the model itself. Since, for various reasons, the functions had to be estimated on annual data, it was assumed (once more!) that the length of the period considered justified the simplifying assumption that the markets were in equilibrium.[47] Even more restricting is the assumption that equilibrium

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45 Let us suppose that the authorities aim to stabilise the interest rate when the increase in the monetary base originating from the Treasury is excessive. Then to offset this by reducing credit to the banks will bring about a fall in credit that would not instead have occurred with the selling of bonds.

46 If, for example, the authorities wish to increase CR+TEC with the minimum increase in the quantity of money, then the "best" policy measure is an increase in credit to the banks.

47 Without distinguishing, therefore, the case where equilibrium is attained by adjustments in the real sector because of the constraints represented by the actual quantities of assets determined in the monetary sector.

is attained in the different markets through adjustments in one rate of interest alone — the rate on bonds. This appears an adequate approximation to reality in some periods, but not in the last two years considered (to simulate which there were necessary some ex-post adjustments in the model's structure).

A further problem lies in the assumption made about the variables under the control of the monetary authorities. This is not just because there was no reaction function for the authorities built into the monetary sector to make their intervention endogenous. The problem arises instead because it is quite possible that the authorities made use of different instruments at different times.[48] Thus to have assumed that certain variables were "instrumental" and not endogenous, using their actual values for the simulation of the model instead of using structural equations, may have helped to artificially improve the results got from the model itself. This alone might not be very worrying. After all, it has been insisted that the monetary authorities *should* manipulate just those monetary variables which allow the most reliable prediction of the effects of their policy. Of course this assumes that the predictions are derived from theoretically and empirically sound analyses.

Ancona

GIACOMO VACIAGO

48 They sometimes even make use of instruments which do not appear explicitly among the monetary variables, such as their direct influence over the banking chiefs, otherwise euphemistically known as "moral suasion".