STAGFLATIONARY EFFECTS OF

MONETARIST STABILIZATION

POLICIES

A thesis presented

by

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to

The Department of Economics

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

in the subject of

Economics.

Harvard University

Cambridge, Massachusetts

April 1977

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Summary

by Domingo F. Cavallo

This study is devoted to analyzing the effects of changes in credit conditions on the short-run aggregate supply of commodities. It is argued that it is because of this kind of financial influence that monetarist stabilization policies, when applied in economies with persistent inflation, so often produce "stagflationary" results.

The phenomenon under analysis has been observed in some Latin American countries, especially in Argentina, Brazil, Chile and Uruguay during the last three decades. The kind of inflation observed in these countries' economies is characterized by deeply-rooted expectations of high and volatile rates of change of prices on the part of economic agents. At every moment of time there are some nominal prices (typically factor prices with some sort of institutional mechanism for their periodical adjustment) that are being revised upwards with the intent of restoring recurring losses in relative position. These adjustments, together with the previous history of inflation, feed in turn inflationary expectations for subsequent periods. These phenomena do not seem to be deterred significantly by such forces as the behavior of other monetary or real variables. The pattern seems to repeat itself over time for very long periods. This kind of chronic economic problem is referred to in this study as <u>persistent inflation</u>.

The experience of these countries shows that wage and price controls help in reducing inflation for a while, but that their positive effects do not endure in the medium and long run. On the other hand, monetary restrictions which, according to a generally accepted opinion, would eventually lower inflation rates in the long run, have strong perverse effects in the short run, especially when relied upon as the basic instruments to fight inflation unaccompanied by wage and price controls. These perverse effects consist of a fall in real output and sometimes an acceleration of inflation. It is more or less evident that with the money supply growing, say, at 30 percent per year, there will be persistent inflation of around 25 percent a year. It is also more or less clear that if some day the state of persistent inflation is successfully eliminated, the monetary expansion necessary to preserve price stability will have to average the expansion of real GNP. But for an economy in a state of persistent inflation, neither of these two propositions is useful. What is needed is a socially permissible way of moving from one state to the other.

The perverse stagflationary effects observed in the initial stages of stabilization plans based on monetary restrictions greatly reduce the social acceptability of such plans. During the period in which real growth is falling and inflation continues at its previous rate or even accelerates, the government faces strong pressures against the restrictive policy and must give it up before the (presumably positive) "second run" effects begin to flourish. This study is devoted to identifying the economic mechanism behind the effects of monetary restriction. It is hope that once the mechanism through which the perverse effects of monetary restrictions operate has been identified, it will be possible to design stabilization plans with a higher probability of success.

The starting point of the theoretical explanation advanced is to recognize that there exists a factor or production that, while partaking of the nature of capital, is a variable factor even in the short run. This factor of production is labeled "working capital" and it exists because production takes time and the payments to the factors of production have to be made in advance of the time at which output is sold. It is different from fixed capital because it can be changed at any time without significant lags. And it is also different from surplus or speculative inventories because working capital is essential to the production process, while those inventories constitute rather a way of allocating wealth but not an essential factor of production.

When the firm faces a tightening of credit conditions, it may decide to cut investment in working capital, or investment in fixed capital or both. It is the central point of this paper that this decision is quite relevant for the final effects of monetary policy on the real variables of the economy. It is argued that in the short run, investment in working capital is likely to be more sensitive to changes in monetary policy than investment in fixed capital. It is then shown that, while the effect on output and employment is always a fall whenever any kind of investment is reduced, the impact on prices is an increase whenever the reduction occurs in investment in working capital instead of investment in fixed capital.

In analyzing problems of inflation, the distinction between labor and commodity markets becomes very important. While inflation is the outward appearance of a disequilibrium in the commodity market, unemployment means disequilibrium in the labor market. Both markets are naturally linked, and it may even be true that a disequilibrium in the labor market (in particular, unemployment) may finally eliminate the inflationary pressure that exists in the commodity market by successive reduction in money wages. But it is widely known that these forces work rather slowly, even in stable economies.

It is emphasized in this study that whatever the kind of investment that is affected by monetary policy, the impact effect on the labor market always comes from the demand side. If firms decide to produce less in order to reduce working capital they will demand less labor. If the final demand of capital goods is reduced because fixed investment is curtailed, there will also be a reduction in the demand for labor. But in relation to the commodity market, a change of investment in working capital (which, like labor, is a variable factor or production even in the short run) brings about a decrease in the supply of commodities (consumer and capital goods), while a change of investment in fixed capital (which is a fixed factor in the short run) produces a decrease in demand for commodities (capital goods). The difference lies in the fact that reducing investment in working capital means demanding less factors of production because it has been decided that less final commodities will be supplied, while reducing investment in fixed capital means a fall in demand for final commodities. Of course, change in investment in fixed capital will also affect supply, but this effect takes time because new investment can be actually used in production only after a certain period of time. Therefore, in the short run, even if in both cases total output will decrease, the impact effect of a reduction in working capital will be an increase in prices (acceleration of inflation) while a reduction in investment in fixed capital will produce a decrease in prices (deceleration of inflation).

Thus articulated, the explanation of the "perverse" impact effect of monetary restriction implies the existence of a specific financial influence on the non-financial economy. Such influence should exist, at least potentially, in every monetary economy, and not only in economies with persistent inflation.

This first part of the formal discussion undertaken in chapters II and III refers to an imaginary economy that in all respects resembles that of the micro- and macroeconomy textbooks, the only changes being those that result from introducing working capital by assuming a time-lag between the moments at which inputs are paid and output price is perceived.

It is shown that within the context of this imaginary economy the existence of working capital has the following consequences:

(1) Short-run aggregate supply of commodities depends on the real interest rate (defined as the difference between the nominal interest rate and the expected rate of inflation) and on the variance of the expected rate of inflation. (Of course, it also depends on the stock of fixed capital and the real costs of the variable factors of production, as usually stated.);

(2) The real growth of output will necessarily decline as a consequence of applying a restrictive monetary policy designed to eliminate inflation; and

(3) For certain values for the structural parameters of the economy, the restrictive monetary policy may at first accelerate inflation.

Conclusion (3) will not hold if the real interest rate is completely insensitive to monetary policy, or if the real wage rate (and more generally the real costs of variable factors of production) is sensitive enough to unemployment. In the context of a model of the Keynesian type, that is, a model in which: (a) real output is determined by effective demand; (b) the supply of labor is infinitely elastic at a level of nominal wages which, while periodically adjusted according to expected inflation, does not fully compensate for past gains or deterioration of real wages; and (c) commodities and asset markets are only linked through the interest rate; an additional interesting conclusion is derived:

(4) If within the relevant period the real-interest-rate-elasticity of aggregate supply is larger than the real-interest-rate-elasticity of aggregate demand, then stabilization policy based upon monetary restriction will necessarily decrease real wages, even if the economy were initially in a long-run equilibrium with the "right" real wage rate ("right" in the sense of a real wage rate compatible with the "full employment" of "natural" rate of unemployment).

In a more general model, such as the one used to derive conclusions (2) and (3), proposition (4) will be true under the same conditions that lead to accelerated inflation as a result of restrictive monetary policy, provided that the elasticity of the real wage rate with respect to unemployment is greater than zero. Proposition (4) means that whenever the initial supply side effects of changes in credit conditions are stronger than the demand side effects, stabilization plans based on monetary restriction will impose the burden of the adjustment to a non-inflationary path, mainly on wage-earners.

None of these conclusions requires very unusual assumptions about institutional arrangements or market imperfections. It is shown that they hold under the <u>conventional assumptions</u> of macroeconomic theory with the sole addition of working capital as a factor of production. But the thesis is not only that the mechanism exists as a logical possibility, but that it becomes more important in economies with persistent inflation. This is so, in part because more drastic changes in monetary policy are observed and also because some specific institutional features of economies with persistent inflation increase the absolute value of the elasticity of the short-run supply of commodities with respect to the relevant indicator of the "credit conditions."

Persistent inflation brings about many modifications in the working of actual economies. The effects on the working of the capital and credit markets are especially relevant to the present purposes. The market for long-term bonds tends to disappear and only the stock market seems to be able to survive the destructive effects of persistent inflation on the capital markets. As a consequence, a great proportion of firms find their access to long-term sources of funds seriously limited; their profits along become an important source of capitalization, except for those firms which are able to use the stock market actively. The credit markets become more imperfect because the difficult access of the firms to the capital markets pushes the short-term leverage of the firms to the point where bankruptcy risks become the most serious concern. It also happens that the demanders of loans become a more heterogeneous set from the point of view of the lenders; as a consequence, the credit market is splintered into different segments among which the firms have to shift their demands for funds according to their particular financial position at different moments in time. The more difficult access to capital markets for newcomers and the deterioration of the informative role of prices due to their continuous changes, tend to reduce the competitiveness of the economy, and firms in an initially stronger financial position find more opportunities for monopolistic practices. As a consequence, the role of leading firms in price setting becomes more important.

Chapter IV is devoted to analyzing the effect of these characteristics of inflationary economies on the interest rate elasticity (or, more generally the "credit conditions" elasticity) of the supply of commodities. It is shown that in general such features contribute to a higher value of that elasticity.

Finally, Chapter V is devoted to the formal testing of the theory in the context of the Argentinian economy.

Regarding the monetary influence on aggregate supply, the main thesis is confirmed by the statistical results. Due to lack of direct statistical information, the real marginal cost of credit for firms is taken to be determined by a measure of monetary disequilibrium in the money market. Not only are the coefficients of the monetary disequilibrium variable in the supply equation statistically significant, but if this variable is omitted, the sign of the real wage rate variable reverses and its coefficient becomes insignificant. In other words, it is only after introducing the monetary disequilibrium variable that the supply equation comes close to resembling the conventional short-run supply of the theory of the firm.

Monetary influences on the demand equation are weaker, but this is so because expected inflation (which is assumed to be formed by people using all the information available to them at the moment of decisions) already accounts for the effects of monetary expansion, especially of that expansion which took place one and more quarters earlier.

The demand side efffect of monetary disequilibrium is insignificant within the initial quarter, while the supply side effect is strong. This means that the <u>first</u> effect of monetary <u>contraction</u> is to depress manufacturing output, which in turn increases the rate of inflation within the same quarter. In other words, "stagflation" is the initial effect of monetary restriction on the market for manufacturing commodities. Setting aside the effects of this initial acceleration of inflation on factor price inflation over the next quarters, the <u>direct</u> supply-side effect will still be strong one quarter ahead and will tend to peter out from there on. The deflationary demand-side effects begin to operate with a lag of one-quarter; and, taking into consideration the role that such effects play in the regression used for generating expected inflation, they increase in importance from there on.

The econometric approach is limited in that it only focuses on the market for manufactured commodities, and it does not analyze the response of factor prices in future quarters to the current and past monetary and fiscal policies of the government. Nevertheless, it strongly suggests that the perverse effects of monetarist stabilization policies are explained by the supply-side effects of monetary restrictions.

The weight of these disadvantages of stabilization policies based on monetary restrictions is closely related to the duration of the perverse effects analysed in this paper. We have found that the supply-side effects of monetary restriction in a given quarter are strong within the same quarter and also during the next one, but the effects seem to vanish after that. This does not mean that inflation will begin to decelerate and output to recover two quarters after the stabilization policy has been inaugurated. It all depends on the response of factor prices (a) to the initial acceleration of inflation, and (b) to the fall in real output. Apparently, in the case of Argentina, it is easier for accelerated inflation to result in increased factor prices than for a fall in output to translate into factor price reductions. Thus, in the second quarter the rate of monetary expansion will again fall short from the rate of growth of money demand, and this additional monetary restriction will replicate the effects of that of the initial quarter. The same will happen with monetary restriction in the third quarter, and so on. By this process, the perverse stagflationary effects may continue for several quarters.

In trying to find a way out of the dilemma posed by the perverse effects of monetarist stabilization policy, the possi'ility that naturally arises is that of controlling the rate of growth of factor prices. In turn this means control of the rate of devaluation (which largely determines the rate of growth of agriculture prices and import prices), the rate of change of prices for services such as transportation, electricity, and gas (which in fact are produced, or at least priced, by the government), and the rate of change of nominal wages. According to the discussion of the preceding sections, it is mainly the vehavior of these prices that charts the course of expected inflation. On the other hand, cuts in the rate of growth of money supply produced the perverse effects here described <u>only</u> to the extent that there is no simultaneous decrease in the growth of money demand, which in turn largely deper's on expected inflation.

A set of policies which includes compulsive decreases in the rates of growth of factor prices together with <u>accomodating</u> decreases in money supply will obviously diminish the risk of stagflationary effects. Still, the solution is not as easy as it sounds because (a) expected inflation will not automatically fall in the same proportion as the rate of growth of factorprices due to the influence of past rates of inflation and monetary expansion, and (b) the government may find that it is easier to cut the rate of growth of prices for certain factors than for others. In letting these considerations influence its decisions, the government may create serious distortions in relative prices.

Coordinating monetary policy with pricing and income policies is no simple task. One way of ensuring that monetary policy is accomodating is by trying to keep the <u>real</u> rate of interest at its long-run equilibrium level. The practical way for the Monetary Authority to do this would be to issue an indexed bond with an equilibrium real return $\bar{\rho}$ and to keep its market value growing exactly at the pace of price inflation. The Monetary Authority can do this by supplyin any amount of bonds demanded by the public at that price. With reasonably efficient financial markets, the nominal rate of interest will be equal to $\bar{\rho}$ plus the economy-wide expected rate of inflation. Interesting enough, interest rates will behave exactly the same as in a monetarist rational-expectations world, but in the course of reaching this result the policymaker will have lost his basic anti-inflationary instrument: money supply will become completely endogenous!

Having done this, monetary policy is busy enough trying to keep $\bar{\rho}$ at its long-run equilibrium level. Wage-price controls and/or guidelines have to be used to try to reduce inflationary expectations, otherwise the rate of inflation will perpetuate itself around its initial level. The interesting aspects of combining wage-price controls and/or guidelines with a monetary policy based on a fixed real rate of interest is that, should the former be successful in reducing inflationary expectations, money supply will automatically be accomodating. In other words, such a combination of policy instruments deliberately avoids the kind of inconsistent monetary policies that have been observed in periods of price controls (for example, a large monetary expansion devised to keep an artificially low nominal interest rate).

Managing price controls so as to maintain relative prices reasonably close to their long-run equilibrium levels is probably a more difficult task than that of achieving an accomodating monetary policy. The economic history of Argentina is full of examples of short-run deceleration of inflation based on the expedient measure of allowing some crucial relative price to deteriorate extremely. Invariably, such experiences ended in a revival of inflation originating in the real effects of that distortion. The analysis of this paper, however, suggests that achieving such a difficult combination of price-management and monetary policy may be the only way out of the perverse stagflationary marsh in which stabilization plans are usually mired in their initial stages.

To Sonia, and to our children.

Thinking back over three years spent at Harvard's uniquely stimulating environment, any short acknowledgement could only be perfunctory in comparison with the author's true feeling of indebtedness. The guidance received from the members of my thesis committee, Professors Benjamin Friedman and Martin Feldstein, made it possible for the basic questions in this study to be appropriately formulated and handled with exhilarating ambition. That the questions were at all asked in an adequate context reflects not only the author's interaction with those two scholars, but also previous contacts with others who commented on earlier versions of this work. In that group there are professors and colleagues, from Harvard as well as from other institutions. Among those teachers who helped at various stages, special thanks are due to James Duesenberry, Yair Mundlak, Michael Bruno, Glen Jenkins and Bronwin Hall (that sorceress of computer technology) at Harvard, as well as to Stanley Fisher from MIT, and Arnold Harberger from the University of Chicago. No less crucial was the contribution of my compatriots, Professors Aldo Dadone, Aldo Arnaudo and Armando Petrei of the University of Córdoba (Argentina); Camilo Dagum of the University of Ottawa; and Juan Carlos de Pablo of Boston University.

Among my colleagues, most of them fellow graduate students in the Cambridge-on-the-Charles community, I received helpful comments at different points from Jorge Desormeaux, Antoine Auquier, Juan Luis Vendrell-Alda, Edgardo Barandiaran, Alvaro Pachón, and Roque Fernández. Luis Székely's help deserves special gratitude, for not only did he offer valuable comments of substance as well as of form, but he also edited the English manuscript in a way that helped close the frustrating gap between my ability to write Spanish and English prose.

I must single out my acknowledgement of the special circumstance of having worked with Professor Richard A. Musgrave on the Project of Fiscal Reform for Bolivia. Not only was my work for the project in areas closely related to the subject of this thesis, but also I had the opportunity to receive Professor Musgrave's keen criticism of the macroeconomic model for Bolivia. There are numerous matters in which this had considerable bearing upon my work on Argentina, and specific aspects of my dissertation were much improved thanks to that experience.

Thanks are also due to Marta Fisher and Linda Heinsohn for their job in editing and typing. Their labors were efficiently performed while working against a very tight deadline.

The OAS and the Ford Foundation provided financial support for the author's graduate work, which is gratefully acknowledged here.

I am also grateful to the Central Bank of Argentina for supplying most of the information used here, which was conveniently made available in punch-card form.

It is in order now for me to take the sole and final responsibility for any and all errors remaining in this work. But the last words should be of loving gratitude to Sonia and my children, who helped sustain the energy needed to address myself to this enterprise and to chisel away more errors than the reader could count.

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Chapter I.

THE SETTING OF THE PROBLEM

A. Introduction

The main objective of this study is to argue that there exists one kind of financial influence on the non-financial economy which has generally been overlooked in Post-Keynesian Macroeconomic Theory.[1] This influence can be characterized as the effect of changes in credit conditions on the short run aggregate supply of commodities. We hope to show that it is because of this influence that monetarist stabilization policies, when applied in economies with persistent inflation, so often produce "stagflationary" results.

We have deliberately chosen to focus on an economy with such a particular kind of chronic economic problem. An economy that has been subject to strong and persistent disequilibrating forces may function in a way that differs radically from that of an economy that fairly closely approximates a path of price-stable full equilibrium. The

[1] The term Post-Keynesian Macroeconomic Theory refers to the comparative static kind of analysis as presented, for example, in Patinkin's book, and to the more dynamic analysis that evolved around the monetarist controversy and the Phillips Curve. See Patinkin [1955] and the September/October 1972 issue of the Journal of Political Economy on Professor M. Friedman's Monetary Framework.

differences may show up in the form of different responses to economic policies.[2]

Our propositions will be clearer if we devote a few words to the meaning of "persistent inflation." The kind of real world phenomenon we have in mind has been observed in some Latin American countries, especially in Argentina, Brazil, Chile and Uruguay during the last three decades. The following characterization of inflation in Argentina by Mallon and Sourrouille[3] impresses us as particularly sharp:

> "During the period 1949-1965, the cost of living index rose at an average annual rate of over 28 percent.... Maintenance of such a rapid, sustained rate of inflation that neither explodes nor is brought under control over time is a rather novel phenomenon in economic history that observers have had difficulty explaining. That the Argentine economy has been under almost constant inflationary pressure over the last twenty years is of course not difficult to explain: attempts by Person to bring about a radical shift in the distribution of income, the slow growth of agriculture, the development of domestic industries behind high import barriers, and other 'structural' causes constitute sufficient condition for generating such pressure. What is uncommon is for this kind of pressure to lead to very high and prolonged rates of inflation."

Compare this with the following passage from Keynes' General Theory, which could very well be taken as character-

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2 The latter finding has been pointed out repeatedly by many economists. For an early reference focused especially on monetary policy and the difficulties it faces when used to restore price stability after a sizable disequilibrium has been allowed to develop, see Keynes [1930] Volume 2, Chapter 37, page 113.

3 [1975], page 113.

rizing the Keynesian state of "persistent unemployment":

> "It is an outstanding characteristic of the economic system in which we live that, whilst it is subject to severe fluctuations in respect to output and employment it is not violently unstable. Indeed it seems capable of remaining in a chronic condition of sub-normal activity for a considerable period without any marked tendency either toward recovery or towards complete collapse."[4]

Persistent inflation is, in our view, a state of the economy different from the most commonly discusses cases of "cyclical" and explosive "hyperinflations".[5] Neither can it be identified with the steady, balanced inflation of the "Money and Growth" neoclassical literature[6] because one of the most important features of persistent inflation is that abnormally large changes in relative prices and a non-steady course of the general price level over time are combined. If a single feature had to be selected for a definition, we would argue that persistent inflation is characterized by deeply rooted expectations of high and volatile rates of change of prices on the part of economic agents. If we were to add a second feature, we would say that at every moment of time there are some nominal prices (typically factor prices with some sort of institutional mechanism for their periodical adjustment) that are being revised upwards

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4 Keynes [1936], page 249.

5 By "cyclical" we mean the inflation which is explained mainly through the inflation-unemployment Phillips trade-off of the Neokeynesian Literature (which is mainly the kind of inflation that Keynes discusses in Chapter 21 of his General Theory) and the term "hyperinflation" is used in Cagan's sense. See Cagan [1963].

6 See, for example, Tobin [1965] and Sidrauski [1967b].

with the intent of restoring recurring losses in relative position. These adjustments, together with the previous history of inflation, feed in turn inflationary expectations for subsequent periods. These phenomena do not seem to be deterred significantly by such forces as the behavior of other monetary or real variables. The pattern seems to repeat itself over time for very long periods.

We have chosen Argentina as our case study, obviously because of the author's own interest but also on objective grounds. Ours is a good selection if one is trying to draw a more or less general picture of the behavior of a modern industrial mixed economy that has been subjected to strong and prolonged disturbing forces capable of generating what we have characterized as persistent inflation. Over the last three decades a number of countries have gone through states of their economies which undoubtedly can be classified in this category.[7] Among these, Argentina is perhaps the one that has an economic and social structure as well as an economic organization most similar to the modern industrial economies of the non-Communist world. During the period under analysis, Argentina did not experience serious problems of economic dualism, demographic explosion, rigid social structure, low level of literacy or lack of entrepreneurial ability, which are characteristic of other

[7] A comparative statistical study of inflation in several countries may be found in Adekunle [1968].

developing countries. Neither was her productive structure and national sentiment affected by wars or other kinds of international conflicts or threats which undoubtedly introduce special features in the economic process.[8] And during the years of the Second World War and the immediate post-war period, Argentina went through radical changes in the economic and social structure which were, qualitatively, not very different from the changes experienced in the past few years by more advanced countries, stemming from concern with environmental preservation, poverty and the oil crisis. It was during those transformations that the inability of government to avoid inflation, or to some extent, the deliberate use of inflation as a method to facilitate the changes, created the strong initial disequilibria that brought about the state of persistent inflation.

There is, nevertheless, at least one important respect in which the Argentinian economic organization was radically different from the economic organization of the developed Western economies in the post-war period: practically speaking, in Argentina, since the Great Depression of the 'thirties, foreign trade has been restricted by very high tariff barriers, capital movements have been almost permanently

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8 The struggle between the regular army and terrorist groups during the last two years is obviously an exception, but its economic effects can be located in a relatively short and definite period of time. By and large, during the last three decades the Argentinian economy was free from this kind of phenomena.

under tight direct controls and, from time to time, the rate of exchange has been adjusted (the frequency and magnitude of the adjustments differed among periods). These policies restricted competition in the commodity markets. On this score alone, market imperfections were more likely to be present in the Argentinian economy than in the open developed economies of the Western world. On the other hand, monetary policy could be used in a much more independent way than in the fixed-exchange-rate, small, open economies. From this point of view the Argentinian economy resembled more the closed economy of the textbook macromodels or that of large countries or regional blocks than those of developed or underdeveloped open economies with much lower ability to pursue an independent monetary policy.

Of course, we do not mean to say that the Argentinian economy can be fruitfully viewed as a closed economy for all analytical purposes.[9] But in this paper we argue that one of the main reasons for the persistence of inflation in Argentina relates to the ability of domestic monetary

[9] On the contrary, we fully agree with those who view the "mismanagement" of the foreign sector as one of the main causes of Argentina's relatively poor growth performance during the postwar period. We also agree that a good part of the explanation of the last three decades' periodic crises can be found in the working of the foreign sector and that the open-economy aspects of the Argentinian economy deserve the attention that they have received, and perhaps even more. But the persistence of inflation, and the failure of the price stabilization plans also admit an explanation that is largely unrelated to the foreign sector difficulties. Argentina's recurrent foreign sector difficulties in the

policy in the short run to influence the real interest rate, of (with an eye to Argentinian specific institutions rather than to macroeconomic theory) to influence the real marginal cost of credit faced by firms. In order to analyze this mechanism on theoretical grounds, as simply as possible, it is convenient to think of a closed economy, and when going back from the theory to reality, to reintroduce the open economy features relevant to the actual work-

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postwar period resulted basically from applying to an economy with persistent inflation the rules of exchange rate management adopted by non-inflationary economies (fixed exchange rates) and also from substituting direct controls on movements of goods and capital for the continuous adjustment in the rate of exchange that would have been needed to keep domestic costs of production in line with the price of internationally traded goods. Typically, directly controlled imports and capital outflows sooner or later failed to keep in line with price-discouraged exports. Eventually the government was forced drastically to correct the rate of exchange. Such a decision was usually followed by a new period of fixed-exchange rate with progressively increasing direct controls until another big adjustment was considered inevitable, and so on. To this basic explanation of foreign sector difficulties in terms of wrong policies, the influence of "structural" imbalances should be added; but it is hard to believe that these could not have been taken care of with a system of tariffs and export taxes and subsidies like the ones that most of the countries usually apply. In other words, a movement toward a system of more flexible and gradual exchange rate policy like the one that is taking place today in Argentina will very likely tend to eliminate already legendary recurrent foreign sector problems. But even after these will have disappeared, persistent inflation will still be a problem and its solution will still face the same basic difficulties as when the foreign sector problems were unsolved.

ing of the Argentinian economy during the specific period covered by the statistical information. Finally, as the stage of deriving policy implications is reached, the restrictions imposed by the need for the policymaker permanently to keep an eye on the balance of payments must, of course, be taken into account.

While one of our aims is to analyze a phenomenon that was particularly important for the Argentinian economy during the last decades, we have in mind a more ambitious objective. We hope to show that the kind of financial influence on the non-financial economy that we discuss in this paper is not the result of very specific institutional arrangements of the Argentinian economy but has a rather general underpinning, and, consequently, may be relevant for other economies, especially in these days when persistent inflation seems to become more and more a widespread economic phenomenon.

B. Financial Markets in an economy with persistent inflation

Throughout this essay, we are going to discuss financial influences on the non-financial economy. Our discussion will mainly refer to economies with persistent inflation. It seems then natural to begin by forming an idea of the special features that persistent inflation introduces into the working of financial markets themselves. We shall try to get this from a description of the Argentinian experience.

Before the Second World War, i.e., before persistent inflation set in, Argentina had a fairly well-developed financial system. The economy was fully monetized, the banking system performed all the operations that were then known in the most advanced economies, and the government had shown a surprising ability to reduce the adverse effects of the world depression of the 'thirties. The Commercial Bank owned by the Federal Government (Banco de la Nación) before 1935, and the Central Bank after 1935, performed actively as lender of last resort and succeeded in avoiding the bankruptcies that deepened the crisis in other countries. There existed a very active market for government and corporate bonds as well as a market for corporate stocks that, although not as important as in more advanced economies, was fairly active considering the size of the corporate sector in the Argentinian economy at that time. In addition to this well-developed capital market, the banks issued long-term certificates of deposit which allowed them to raise funds to grant long-term loans to farmers and businessmen.[10]

During the entire decade 1940-1949, the monetary authority increased the money supply at an accelerating rate in order to facilitate the rise of relative prices

[10] For a well-documented description of monetary policy during this period, see Banco Central de la República Argentina [1972], especially "Conversaciones en el Banco de México S.A.," by Dr. Raúl Prebish, Vol. I.

of manufactured goods that was resulting from the operation of the import constraint created by the war. At the same time a rapid process of industrialization was taking place, and during the last five years of the period, the government promoted radical redistribution of income in favor of workers. There can be no doubt that it was during this ten-year period that the economy was subjected to the strong desequilibriating forces that were critical in inaugurating the state of persistent inflation. The effect of these events on financial markets is the central topic of this section.

The Money Market

Starting with Cagan's work on hyperinflation,[11] theoretical literature provides certain specific assumptions about the effect of inflation on the demand for money. Cagan's hypotheses have been used for several econometric studies specifically applied to the Argentinian economy. All these studies had trouble finding a stable money demand relationship. The most discouraging feature of these findings is that the average lag of the actual rates of inflation involved in the expectations model actually increased during the last decades (particularly during the 50's and 60's). This led Mallon and Sourrouille to argue that, in Argentina, "instability of the demand for cash balances is a serious impediment to effective control of inflation

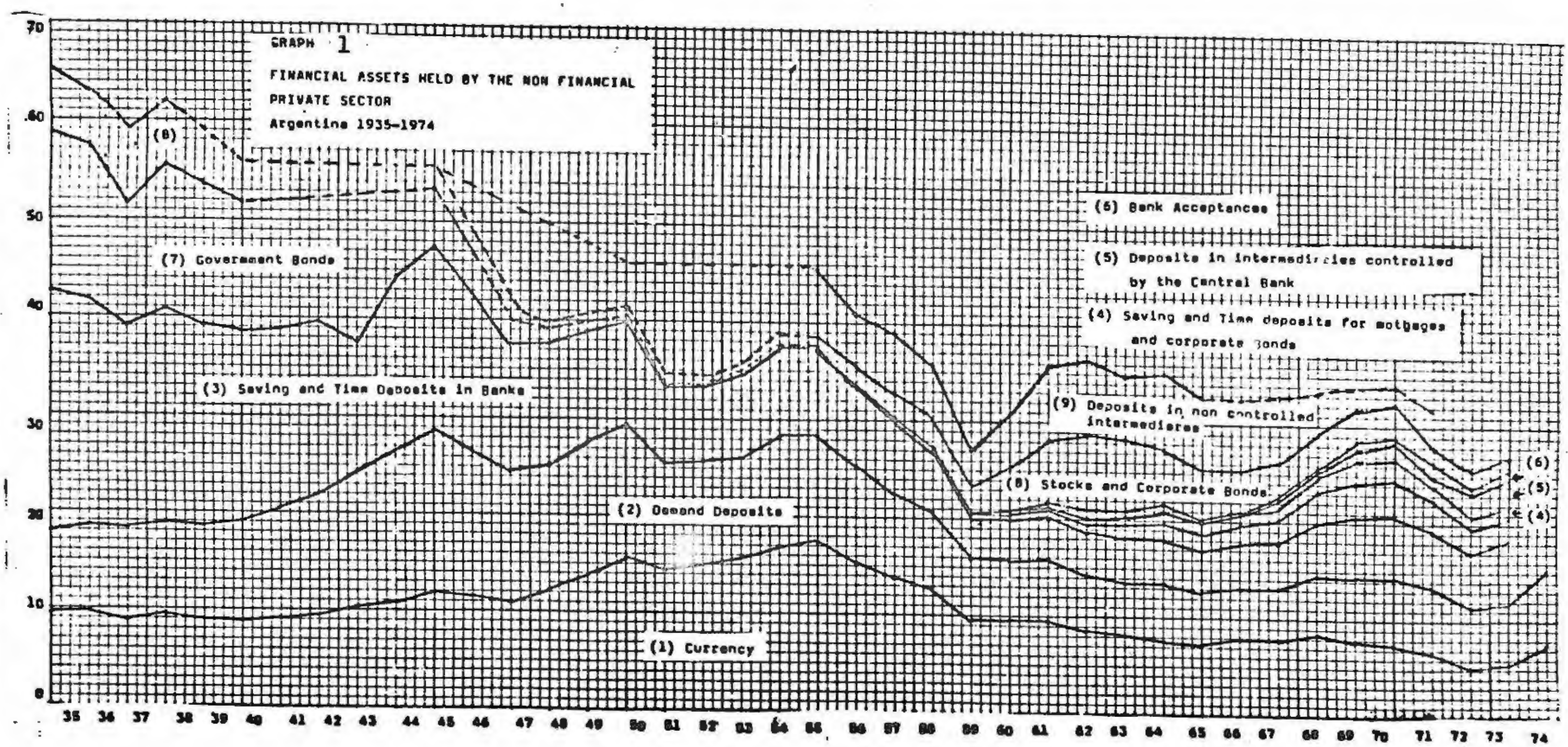
[11] See Cagan [1963].

[12] See, especially Diz [1970].

through monetary policy."[13] We think that these econometric studies are troublesome, at least in two respects: the periods chosen for the statistical estimation are unsuitable, and the consideration awarded to certain institutional changes has been insufficient. While we pursue a more pedestrian kind of analysis, we take into account certain considerations that should usually prcede the econometric work.

Graph 1 shows the stock of financial assets held by the non-financial private sector, as a percentage of GNP. In particular, drawings (1) and (2) represent currency, and currency plus demand deposits (the second drawing can be seen as depicting the observed value of the Cambridge <u>k</u>). It is seen that <u>k</u> was approximately .18 in the pre-war period and it fell to around .14 since 1960, being relatively stable during both periods. Between these two situations the behavior of <u>k</u> was rather surprising. It increased rapidly between 1940 and 1945. This is the natural outcome of a very expansionary monetary policy in an economy that had no inflationary expectations as yet. However, what is not very natural is that the <u>k</u> remained at the high level of 1945 for ten years, even after a period of rapid and accelerating inflation occurred, which should have created inflationary expectations. After 1955, however, <u>k</u> decreased rapidly as inflation kept increasing. This is the predicted

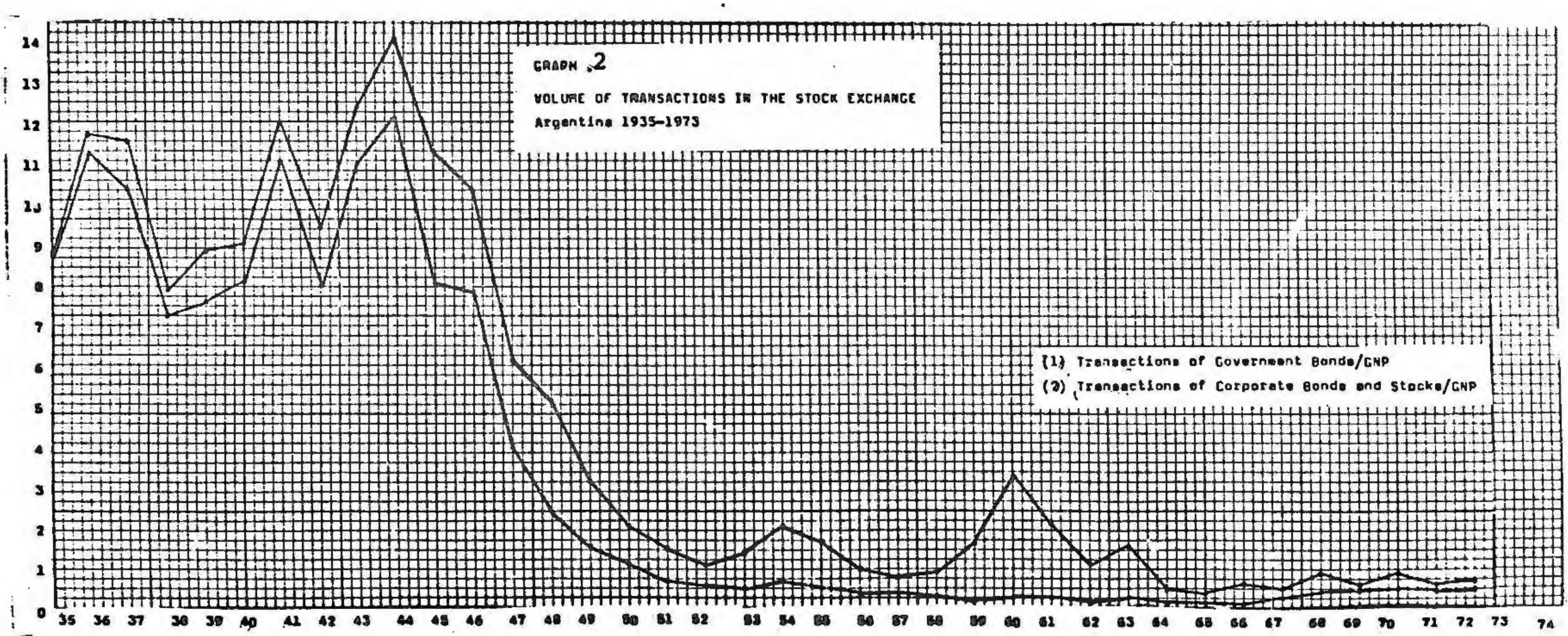
[13] See Mallon and Sourrouille [1975], pag. 116.



GRAPH 1

FINANCIAL ASSETS HELD BY THE NON FINANCIAL PRIVATE SECTOR

Argentina 1935–1974



GRAPH 2

VOLUME OF TRANSACTIONS IN THE STOCK EXCHANGE

Argentina 1935–1973

behavior according to the theoretical model outlined above. But after 1959, even when inflation decelerated, k never again reached levels similar to those of the pre-inflationary period. It is evident that this behavior cannot be easily reconciled with Cagan's model for demand for money.

Diz estimated the demand for money using data for the period 1935-1962, and he found difficulties in explaining what happened during the 'fifties, when the average weighted lag of past inflation rates that best adjusted to the data increased in length. Dagnino Pastore[14] had already observed that the relationship between prices, income and the demand for money broke down in the 'fifties (his study covered the period 1935-1960). The more recent estimations by Mallon and Sourrouille[15] used quarterly data for the period 1956I to 1967II and faced the same trouble that Diz's did in relation to the model of adaptive price expectations. The period chosen by the latter authors must clearly yield a high correlation between average past inflation and demand for money (except for the last years), but 1956 does not seem to be a satisfactory starting period, especially if one takes into account that at that point there was a sharp change in the trend of k.

At least two basic phenomena that are not taken into account in the regressions must account for the observed values of k between 1945 and 1955: the radical redistribu-

[14] See Dagnino Pastore [1966].

[15] Mallon and Sourrouille [1975].

tion in favor of workers of very low income, and the rules under which the banking system operated between 1946 and 1955. Low income workers for the first time had the possibility of saving some proportion of their income. Those savings would be used later one, mainly for seasonal consumption (such as tourism), for future acquisitions of durable goods, or for other contingent expenses. A great proportion of those savings were held in the form of currency because people were not accustomed to more sophisticated ways of hoarding. In addition, the banking system was not eager to capture deposits. Banks could not use deposits for granting loans, as the latter could only be funded with special funds provided by the Central Bank in a way that was generally unrelated to the size of the deposits received by each institution. Such lack of involvement on the part of the banks prevented a rapid learning process that would surely have occurred under other circumstances. As a result, currency, and not demand deposits, increased significantly throughout this period. From 1956 on, real wages of low income workers deteriorated rapidly and the banking system began to have strong incentives for increasing deposits. Although the reform of the Banking Legislation came in 1957, the Central Bank had already begun to grant authorizations to lend that were linked with the balance of a bank's deposits since the early months of 1956. As a consequence, the Currency/GNP ratio went down very rapidly and the velocity of demand deposits increased as banks competing for deposits organized efficient systems of regional clearings and other ways for speedier liquidation of values. This whole change was probably completed by 1960 when k reached the level around which it stayed during the last 15 years.

The preceding description shows that one should not expect a stable relationship between velocity and rate of inflation, for sample periods such as those used for the econometric estimations of the demand for money mentioned above. Yet, when one looks at the behavior of velocity after 1960, it seems very clear that it fluctuated around a rather constant average level. In addition, the short run movements seem to be neither too large nor without relation to the history of inflation during the period.[16] We can venture the guess that the velocity of money function is not much more unstable in Argentina than it is in non-inflationary economies. Moreover, although velocity was sensitive to the expected rate of inflation, the value of the corresponding elasticity was sufficiently small that it enabled the government to resort for a very long time to expansion of the money supply as a source for financing a constant or even an increasing proportion of its budget, without bringing about an explosive hyperinflation.[17]

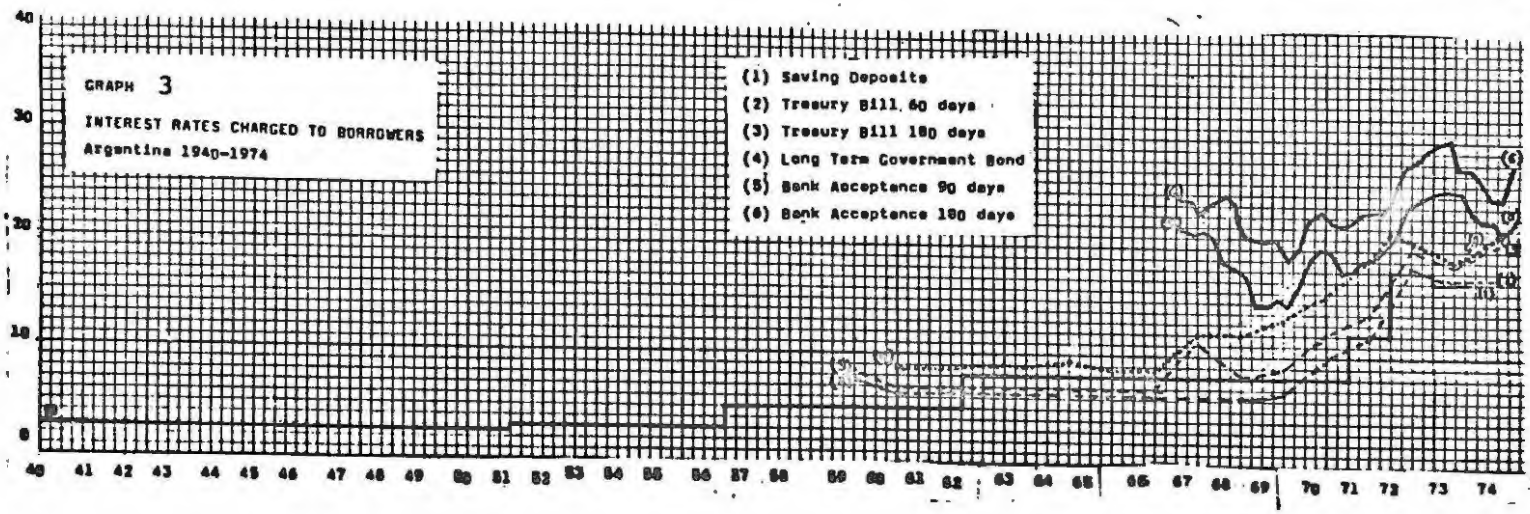
16 Our econometric analysis in Chapter V supports this.

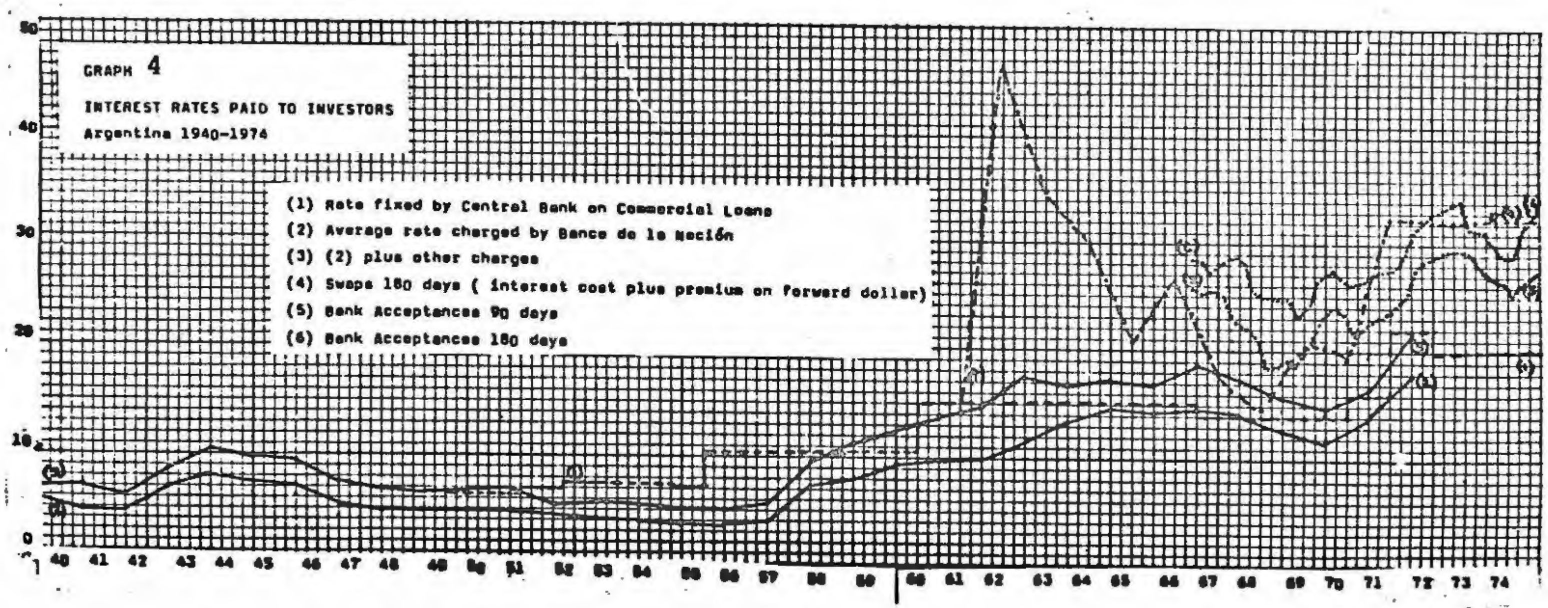
17 The dynamic stability of the inflation generating process which results from the interaction between the way in which inflationary expectations are formed and

Savings and time deposits

Savings and time deposits decreased pari-passu with the increase in the rate of inflation. This is not the necessary outcome of persistent inflation but mainly the result of nominal interest rates being held fixed by decision of the Central Bank. The interest rates paid on deposits are shown in Graph 3. They were maintained at very low levels until 1968 (in comparison with the "planned" rate of inflation as measured, for example, by the rate of monetary expansion). As a logical consequence, the ratio of savings and time deposits in the banking system to GNP decreased until 1959 and it has remained fairly constant since 1960. There remains the question of where all those savings went instead of being deposited in bank savings accounts. There is much evidence that, since the early 'fifties, persistent inflation and fixed interest rates paid on savings deposits combined to bring about the development of markets for rather short term funds (3 months up to 2 years) which was beyond the control of the Central

the way in which the demand for money responds to expected inflation, can be analyzed in the context of a simple model like that of Cagan [1963]. Ben Friedman [1977] has shown that the necessary and sufficient condition for stability in Cagan's model is $(\alpha+1)\beta<1$ where $-\alpha$ is the elasticity of the demand for money with respect to expected inflation, and β is the coefficient of adaptation in the adaptive price expectation model. This means that a small enough value of α (namely, $\alpha<\frac{1}{\beta}-1$) can explain why acceleration of monetary expansion may occur without ending in explosive hyperinflation.


GRAPH 3
INTEREST RATES CHARGED TO BORROWERS
Argentina 1940-1974
(1) Saving Deposits
(2) Treasury Bill 60 days
(3) Treasury Bill 180 days
(4) Long Term Government Bond
(5) Bank Acceptance 90 days
(6) Bank Acceptance 180 days
40
30
20
10
0
40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74


GRAPH 4
INTEREST RATES PAID TO INVESTORS
Argentina 1940-1974
(1) Rate fixed by Central Bank on Commercial Loans
(2) Average rate charged by Banco de la Nación
(3) (2) plus other charges
(4) Swaps 180 days (interest cost plus premium on forward dollar)
(5) Bank Acceptances 90 days
(6) Bank Acceptances 180 days
50
40
30
20
10
0
40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74

Bank. These markets operated with freely-determined interest rates and they were a highly important source of funds for those firms whose demands were not completely satisfied by the banking system. Since the mid 'sixties the Monetary Authority permitted the activity of non-banking financial intermediaries such as Credit Unions, Savings and Loan Associations, and Financial Corporations, which (although sujbect to maximum interest rate regulations) used to overlook the restrictions more often than the banks did. Finally, since 1967 an almost completely free market of bank acceptances was legalized. Graph 1 shows that the assets originated in all these markets increased gradually since 1960, mainly at the expense of the informal markets mentioned above.

Almost all these changes occurred because the rate paid on deposits was not permitted to reflect the higher expected inflation rates, and it is safe to assume that had the former limitations not been enforced by the Monetary Authority, a significant difference would not have developed between the way these markets worked in Argentina and the way they work in economies with more stable prices.

The Capital Market

While the money market and the market for short term savings and time deposits do not seem to introduce particular features on the workings of an economy in a state of persistent inflation, something completely different happens with the markets for long-term government and corporate bonds and to a lesser extent with the equity market. These capital markets virtually disappeared as is shown by areas (7) and (8) in Graph 1 which represent the stock of long-term government bonds, and the stock of long-term corporate bonds plus equities, respectively. Graph 2 singles out this phenomenon by representing indices of transactions (as ratios of GNP) in the two kinds of securities. Two explanations are pertinent. Until 1949, long term government bonds included certain securities issued mainly by federally-owned banks which had as their ultimate objective to provide long-term funds (20 to 30 years) to the private sector. Secondly, the proportion of long-term bonds is negligible within the volume of long-term securities issued by corporations, especially during the last two decades.

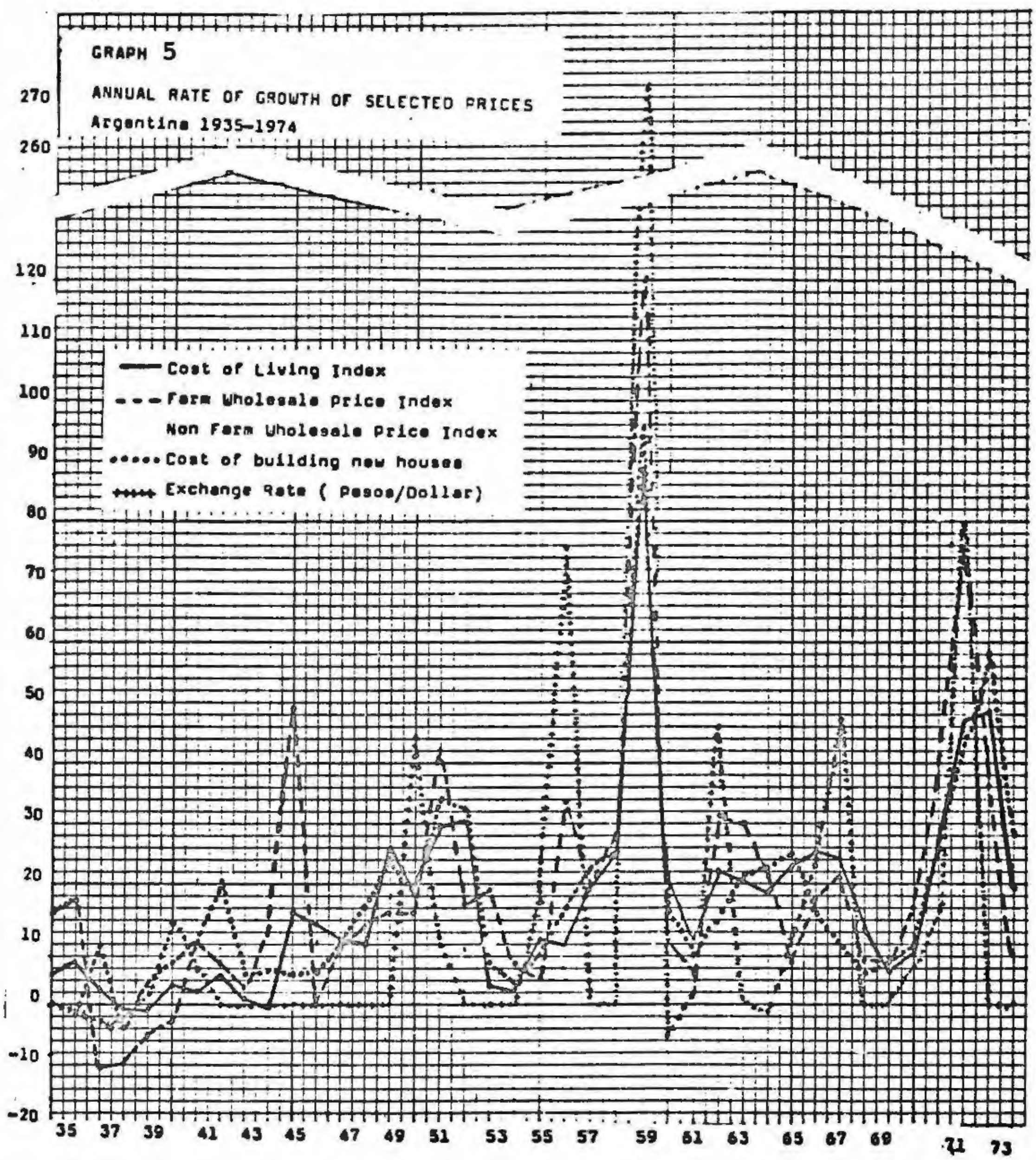
The disappearance of the long-term bond market began in 1945 and was practically completed by 1950. The market for equities was never very important in the Argentinian economy, but on the other hand it never disappeared totally. On the contrary, it experienced two short-lived booms around 1954 and 1960. Unfortunately these booms, especially the latter one, had the characteristics of "speculative bubbles." Equity prices went up by almost 300 percent during a period of two years and then suddenly declined to their pre-boom levels, remaining there in spite of inflation for almost 6 years. The long-lasting feeling that ensued after these speculative booms prevented the subsequent development of the equity market. It is dangerous to draw general conclusions about the effect of persistent inflation on the equity market from the Argentinian experience, but if a tentative inference might be advanced, we would argue that persistent inflation is rather neutral with respect to the already-existing equity market, though it does not seem to help in promoting a rapid development of this market as a substitute for the declining long-term corporate bond market. In other words, it seems neither to aggravate nor to compensate for the collapse of the other components of the capital market.

Why did the long-term bond market collapse? One is tempted to blame the maximum interest rate regulations set by the Central Bank, but this is clearly not the main reason. It is possible that the disappearance of long-term securities issued by the banks that were traded in this market during the earlier period was accelerated by the failure to increase the interest rate paid on new issues of such bonds. It is also clear that during the immediate postwar period, the government found a source of cheap financing by way of selling low-interest, non-indexed bonds to the pension funds managed by the government itself (which becomes a sort of tax financing, since whenever the accumulated resources of pension funds proved insufficient to fulfill the current commitments, the premium charged to the captive affiliates was increased). But neither of these reasons can explain the total disappearance of corporate bonds which were not subject to interest rate regulations.

It is well known that under the assumptions of risk-averse investors in two-period bonds, the minimum term premium required by the investors is negatively correlated with the variance of the expected second period spot interest rate.[18] This variance surely increases with persistent inflation (because the spot interest rate is sensitive to changes in inflation), and consequently the minimum term premium required moves up. On the other side, the maximum term premium that risk-averse suppliers of two-period bonds are willing to pay will be smaller when the correlation between the rate of inflation of their sale prices and the expected spot interest rate decreases, because the bankruptcy risks involved in long-term commitments will increase. If persistent inflation is associated with large relative price changes, it will probably reduce the correlation between expected spot interest rates and expected own sale-price inflation by the firms. Therefore, it may be perfectly possible that for longer-period bonds, while investors would require positive term premiums, suppliers of bonds would be willing to pay — as a maximum — negative term premiums. This obviously would produce the complete disappearance of the long-term bond market.

[18] See, for example, Nelson [1972].

If persistent inflation is associated with larger relative price changes than those that normally occur in stable economies, the correlation between spot interest rates (which will probably move close to the rate of inflation measured by some index of the general level of prices) and the specific rate of inflation relevant to each firm (probably its own sale-price rate of inflation) will be smaller. Graphs 5 and 6 suggest that persistent inflation is associated with larger than usual changes in relative prices. In Graph 6 the excess of the rate of change of whosesale prices with respect to the rate of change in cost of living is shown for Argentina and the United States from 1948 to 1973. The graph suggests that persistent inflation is clearly associated with sudden changes in relative prices which are not present in more stable economies. Graph 5 shows the rate of inflation in Argentina as measured by different price indices. It can be reasonably argued that the shift in relative prices would not have been so intense had the government followed a "crawling peg" rule for the exchange rate instead of maintaining it fixed during very long periods interrupted by sizable devaluations. This argument is also valid for all long-term contracts, but in any case, even with a very active policy of small adjustments for basic prices, a state of persistent inflation may still be characterized by large changes in relative prices brought about by the struggle among sectors for imporving their respective positions in the


GRAPH 5
ANNUAL RATE OF GROWTH OF SELECTED PRICES
Argentina 1935-1974
Cost of Living Index
Farm Wholesale Price Index
Non Farm Wholesale Price Index
Cost of building new houses
Exchange Rate (Pesos/Dollar)
270
260
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
35
37
39
41
43
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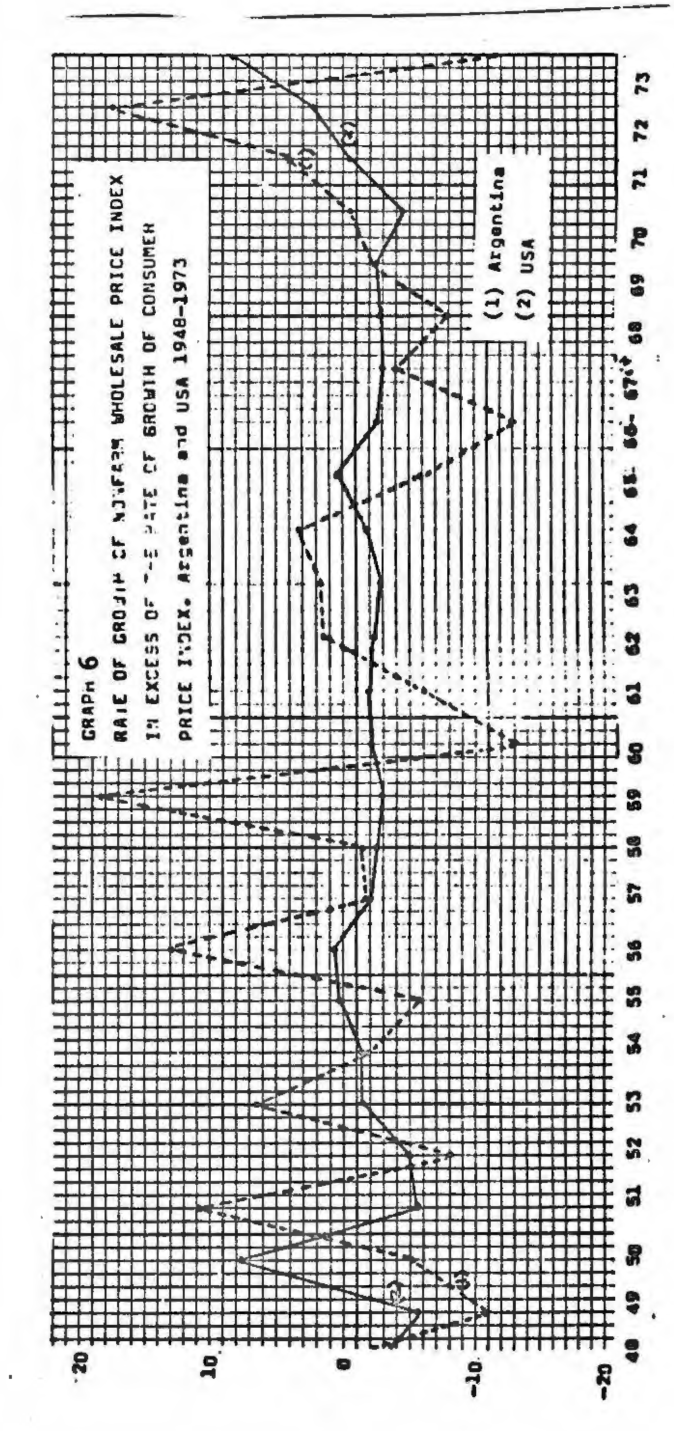
GRAPH 6
RATE OF GROWTH OF NONFARM WHOLESALE PRICE INDEX
IN EXCESS OF THE RATE OF GROWTH OF CONSUMER
PRICE INDEX. Argentina and USA 1948-1973
(1) Argentina
(2) USA
20
10
0
-10
-20
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73

distribution of income.[19] Finally, but no less important, there is the "structuralist" argument that large relative price changes derived from rapidly shifting demands and price unresponsive supplies in a world of downward inflexible prices constitute the origin of persisten inflation.[20] According to this theory, persistent inflation by its very nature will be asssociated with large relative price changes.

We have emphasized the strong shifts in relative prices that are associated with persistent inflation in order to argue not only that the market of long-term bonds tends to disappear, but also to show that the introduction of variable interest rate bonds or indexation by a general price index may not be sufficient for a vigorous revival of the long-term bond market. It may be that only by introducing specific price-indexed bonds and a sort of investment funds managed by banks or other financial institutions will

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19 The following paragraph by Joan Robinson [1971] is an excellent description of the social climate created by persistent inflation:

"The distribution of income thrown up by the market economy can be tolerated as long as every individual feels that his position in it is due to fate or to his own merits. When it becomes clear that the relative incomes of individuals are mainly determined by the bargaining position of the group to which they belong, the ethics of the system — a fair day's work for a fair day's wage — disintegrates, industrial discipline is undermined, and the tradition of public service gives way to a general scramble for advantage — even doctors and schoolteachers are exasperated at the erosion of their position to the point of striking for more pay."

20 See Sunkel [1958]. For a clarifying formalization of the argument, see also Olivera [1967].

it become possible to reconcile the requirements of investors (in terms of a general price adjustment), with those of issuers of bonds (in terms of specific price adjustments).[21] In any case, neither of the two possibilities materialized in the Argentinian economy, and there are reasons to suspect that they will not result from spontaneous decisions by firms but only from a strong determination of financial intermediaries or of the Monetary Authority.

So far we have given a possible theoretical explanation for the collapse of the long-term bond markets, but we have not shown evidence that this was in effect the valid explanation. Clearly, it is difficult to find conclusive empirical evidence in favor of such a behavioral hypothesis, but it is possible to given some indirect evidence. Table 1 shows the term structure of interest rates in the market for Bank Acceptances and the distribution of operations by terms during a period of accelerating inflation.

As inflation accelerated, the estimated term premium for one year paper went from 50 to 350 basic points, and the volume of operations for paper of more than six months maturity that averaged 17 percent of the total in 1971 went down to 7.8 percent and to 6.1 percent in 1972 and 1973 respectively.[22] The market for bank acceptances is not the market for long-term bonds, but it suggests that the

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[21] Although based on different reasons, Alan Blinder has recently proposed such a combination of specific price indexation and investment funds. See Blinder [1976].

[22] The meaning of this numerical exercise is severely limited as a consequence of its reliance on an assump-

Table 1.

Term premiums in the market for bank acceptances. 1971-1973 [23]

	1971	1972	1973
Distribution of operations (% over total)			
Bank acceptances 180 days	93.0	92.2	93.9
Bank acceptances 360 days	17.0	7.8	6.1
Interest rates and term premiums (% per year)			
Interest rate 180 days (average rate of the first semester of each year)	21.4	24.8	27.2
Interest rate 360 days (average rate of the first semester of each year)	23.2	26.2	28.7
Implied forward rate (for the second semester)	24.6	27.6	30.2
Spot rate actually observed (average six-month rate in the second semester of each year)	24.1	26.3	26.7
Estimated Term Premium	.5	1.3	3.5

[23] The source of the basic data of the table is: Banco Central de la República Argentina,"Memoria Anual", 1973.

term premium required by investors may be too high (relative to what firms are willing to pay) to allow for the existence of an active long-term bond market.

Overall financial disintermediation

We shall presently discuss the consequences of the virtual collapse of organized capital markets on the allocation of resources among the sectors of the economy, but it seems useful first to sum up the whole effect of persistent inflation on the financial markets of the economy.

Once basic feature is an economy-wide phenomenon of financial disintermediation. The figures for Argentina given in Table 2 below are particularly illustrative.

In the earlier periods the financial system allocated around 80 percent of net savings. After persistent inflation destroyed the long-term bond market and reduced the size of other organized markets for saving deposits, however, the financial system allocated not more than 51 percent of net savings, and its role as intermediator in the allocation of savings fell to a strikingly low 30 percent by 1975. The recovery from 34 percent in 1965 to 51 percent in 1970 is explained by the deceleration of inflation during the preceding five year period. That improvement was lost after 1970 as inflation accelerated again.

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tion of unbiased forecasting. But note, on the other hand, that because inflation was accelerating and interest rates rising, any kind of autoregressive expectations on future interest rates would imply a still sharper increase in term premiums from 1971 to 1973.

Table 2.

Overall degree of financial intermediation in Argentina, 1935-1975.[24]

(millions of 1960 pesos)

Year	Percentage of increase in financial assets with respect to net domestic savings	Average annual inflation during the preceding 5-year period
1935	78	-1.0
1940	79	1.8
1945	80	3.0
1950	48	18.4
1955	45	20.2
1960	35	41.0
1965	34	24.0
1970	51	19.0
1975	30	35.0

24 The figures where elaborated by the author using Central Bank information published in several issues of the "Memoria Anual".

Savings that did not go through the financial markets consisted in part of savings generated by each firm (non-distributed profits) and in part of household savings that were directly allocated in firms linked to the household by family ties, friendship, or habitual "business connections".

This financial disintermediation has consequences on the efficiency of the resource allocation process and on the saving behavior of the households. It actually provides a plausible explanation of the weakness of the financial wealth effect on consumption that has been observed by a number of authors.[25] In economies with persisitent inflation, total financial wealth becomes less important as a component of total wealth of the households; each household, if it saves at all, ends up becoming a partner in one or several (usually small) firms; feelings about wealth are much more dependent upon the economic performance of the particular businesses to which wealth is linked than upon the price of financial assets exchanged in organized markets.

Effects on resource allocation

The effect of financial disintermediation upon the allocation of resources amongst the sectors of the economy

[25] See, for example, Dagnino Pastore [1966], and Gay [1967].

is probably the most perverse of all the distortions created by persistent inflation in a modern economy. That the economy reduces significantly its efficiency in the allocation of resources can be well documented in the case of the Argentinian economy. Fortunately there is available very careful and detailed research on the rates on return on physical capital for 591 randomly selected manufacturing corporations, covering the period 1961-1967.[26] The research was done by Petrei who looked at the dispersion of the rate of return across industries.[27] The average rate of return was 11 percent with a standard deviation across industries of around 70 percent of the mean. One of the questions set by Petrei is the following:

> "To what extent is it true that the industries with a high(low) rate of return, compared with the average, in any single year of the period also had high(low) rates of return in the other years? That is, to what extent did the inequality in rates of return persist over the period?"

His answer is the following:

> "The data indicate that over this seven-year period the tendency toward equality of rate of return was not strong... The correlation across industries ... between the rates of return for the extreme years 1961 and 1967 is almost 0.6."[28]

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[26] Actually, the research used the balance sheets of the corporations back to 1940, because the physical capital stock of each firm was recomputed in order to eliminate the distortion on book values created by inflation and to use economic rather than fiscal rates of depreciation.

[27] See Petrei [1971].

[28] See Petrei [1971], pp. 43-44.

The methodology used by Petrei is similar to that used in a study by Stigler for the United States, so that a comparison is possible.[29] Stigler reports correlation coefficients between rates of return of manufacturing industries corresponding also to the beginning and the end of a seven year period, but he has disaggregated figures for "Concentrated," "Unconcentrated" and "Ambiguous" industry structures. The correlation coefficients are 0.57, 0.26 and 0.38 respectively. This means that the overall correlation coefficient reported by Petrei for Argentina is similar to that of the "concentrated" industry structures in the United States and it is well above those which correspond to less concentrated sectors of American manufacturing industry.

The weakness of the tendency toward the equalization of rates of return across industries observed in Argentina clearly indicates that the capital market was not performing well in the process of resource allocation. This is not a surprising result. Financial disintermediation means that the portfolio decision made by each individual considers only a very small set of alternative investment opportunities, restricted to firms with which he is linked formally or informally. Moreover, while the high proportion of savings generated within the firms creates a high correlation between availability of funds for investment and rate of return, it does not help in bringing about an expansion

[29] See Stigler, G.J. [1963], Table 18, p. 71.

of production large enough to move those rates of return toward the average. On the contrary, it increases the possibility of monopoly or oligopoly market configurations which will tend to preserve the situations that produced the abnormally high profits.

The state of persistent inflation, by bringing about this inefficient process of resource allocation, decreases the price elasticity of supply by producing sectors of the economy. This is the phenomenon strongly emphasized by the "structuralist" theory of inflation.[30] It is evident that this structural stickiness of the economy feeds back into the inflationary process and contributes in transforming it into a persistent phenomenon.

Conclusion

So far we have suggested that a low enough elasticity of the demand for money with respect to expected inflation seems to explain empirically why persistent inflation does not end in an explosive hyperinflation. We argued also that the financial disintermediation that inflation brings about feeds the process (in addition to the conventional feedback mechanisms) enforcing the tendency toward persistency. On the other hand, we have shown that for fairly long periods of time income velocity of money was rather stable. This suggests that the government had a very simply way of con-

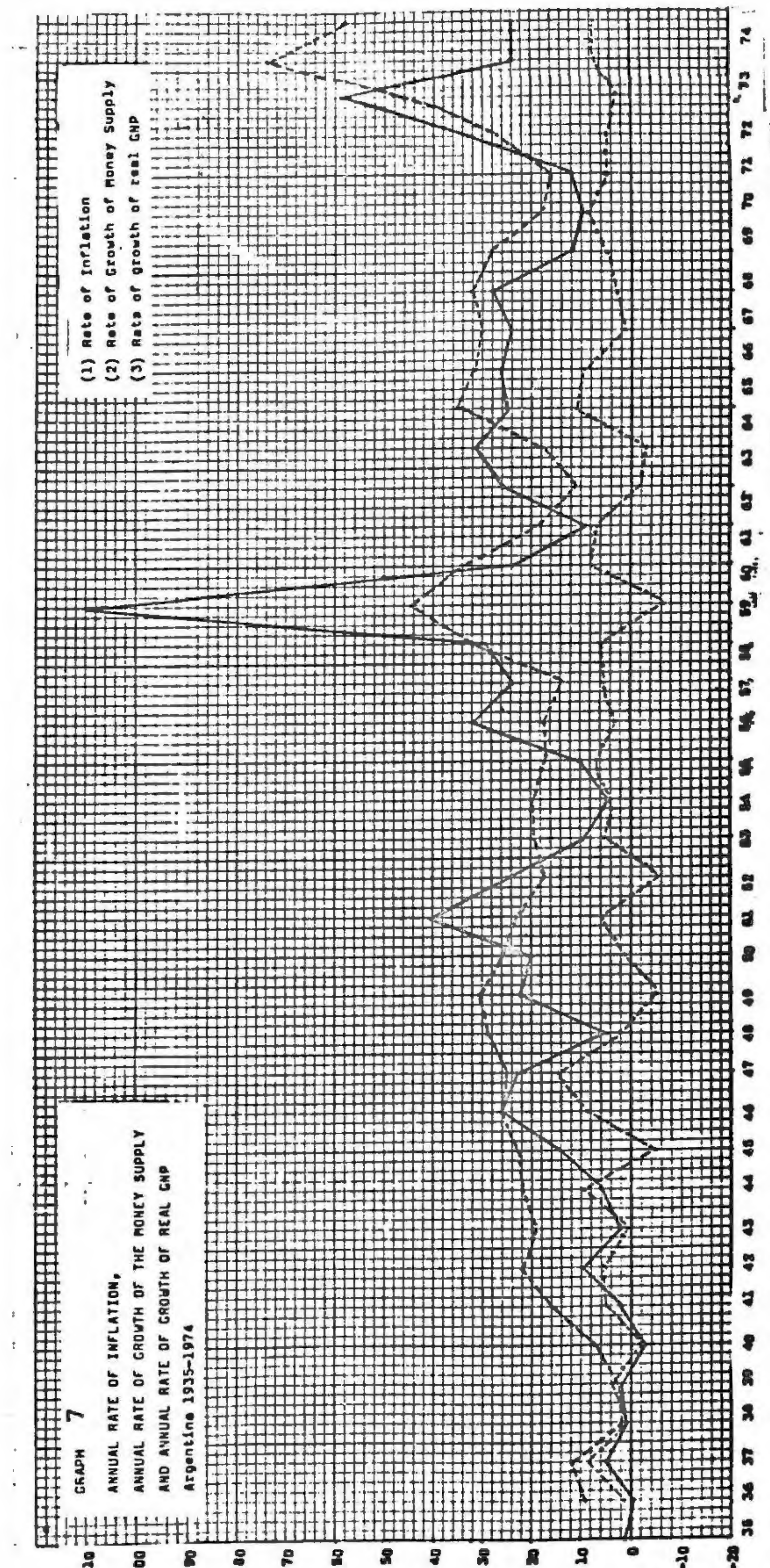
[30] See Sunkel [1958].

trolling nominal income, namely, controlling the rate of growth of the money supply. If this is so, why did it not succeed in eliminating inflation? It is possible to identify a number of mechanisms capable of feeding back into inflation when the government uses a "passive money" rule,[31] i.e., when it simply fulfills the economy's "ex post" requirements of nominal money. Yet, was the actual monetary policy so passive? In any case, why would government maintain such behavior during such long periods, even when a concensus seemed to exist among the policymakers about the undesirability of persistent inflation? These are the topics of the next section.

C. Money Supply, inflation and real growth

Let us begin with a schematic description of the monetary policies applied in Argentina by going through Graph 7. It was already seen that during the period 1940-1949 the Central Bank of Argentina increased the supply of money at accelerating annual rates and that at the same time, other important changes in the structure of the economy were occurring. Most observers agree that it was during this period that the state of persistent inflation began. Although there are no clear statements on the subject by the Monetary Authority, it is difficult to avoid thinking that the government intentionally used inflation as an easy way of producing the social and economic changes

[31] For the concept of "passive money" and its theoretical consequences, see Olivera [1970].


GRAPH 7
ANNUAL RATE OF INFLATION,
ANNUAL RATE OF GROWTH OF THE MONEY SUPPLY
AND ANNUAL RATE OF GROWTH OF REAL GNP
Argentine 1935-1974
(1) Rate of Inflation
(2) Rate of Growth of Money Supply
(3) Rate of growth of real GNP
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
35
36
37
38
39
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that actually occurred. But by the first year of the 'fifties early signals of governmental worries about inflation began to appear. At that time inflation was already showing its negative effects in terms of social upheaval, while the dramatic deceleration(and even absolute decrease) in real GNP that occurred in 1948 and 1949 suggested that inflation was not the panacea for economic growth.

Throughout the 'forties, the exchange rate and agricultural prices were kept very low relative to wages and manufacturing prices. The export boom of the final years of the war and the immediate post-war period delayed the balance of payments crisis that had to be the natural result of those policies. But the crisis was already showing up in the early 'fifties. The peso was devalued; the rate of growth of money supply began to decrease slowly but the rate of inflation reached a record value (40 percent) in 1951 and its decelerationin 1952, which was helped with wage restraints and price controls, was associated with a very sharp fall in real GNP, induced in part by a severe drought.

After that year the government did not continue slowing down the rate of growth of money supply, but it maintained (or even increased slightly) the rate of 1952 (around 19 percent). Instead, the government implemented a strong wage and price control policy and intensified a selective credit policy that had been initiated during the previous years. The rate of inflation went down to 10 percent in 1953 and 5 percent in 1954 while the real GNP was growing again. Altogether, real wages were kept at their relatively high level of the late 'forties and agricultural prices and the exchange rate improved only slightly.

From late 1955 to 1957 a new government, although one equally concerned with fighting inflation, decided to apply more orthodox measures. The price controls were relaxed and finally eliminated, the peso was devalued several times and the rate of growth of the money supply was decreased slightly. In spite of the fact that the nominal wages were prevented from increasing as they would have in a more normal political situation, the rate of inflation went up to 32 percent in 1957 and 24 percent in 1956, while real output was practically stagnant and the share of wages in national income declined from 55 percent in 1954 to 47 percent in 1956. The social upheaval generated by this economic policy facilitated the access to power (through the national elections of 1958) of the political party that had promised a significant increase in nominal wages and other measures demanded by the trade unions. The new government inaugurated its economic policy with a huge increase in nominal wages (around 60 percent). Money supply was expanded by 30 percent during 1958 and inflation also averaged 30 percent.

During the last days of 1958 the government approved a plan of rapid industrial development and price stability that received the support of the International Monetary Fund. The first measure consisted of allowing the exchange rate to reach feely its equilibrium level. For some imports the rate of exchange (pesos/dollar) was raised as much as 300 percent. The real wage rate deteriorated significantly, the share of wages went down to 41 percent of national income and real GNP dropped by 7 percent, while inflation reached a record level of 110 percent per year. Money supply had increased 45 percent during 1959, but it is important to note that between 1956 and 1959 the velocity of money was increasing mainly due to the institutional changes commented on in the previous section. Beginning with 1959, but mainly during 1960 and 1961, there was a very important influx of foreign capital and a boom in the stock market. Under strong tax incentives, firms embarked on ambitious investment plans. Real GNP, which during the inflationary explosion of 1959 had declined almost by 7 percent, increased by 7.9 and 6.5 percent during 1960 and 1961 respectively. During these two years the government was actively involved in preventing high increases in nominal wages; the rate of growth of the money supply was declining; the exchange rate remained constant thanks to an exceptionally high influx of foreign capital; and the rate of inflation went down to 9 percent in 1961.

So far monetary policy, while playing a role in each one of the stabilization plans had not constituted their cornerstone. In fact, the rate of growth of the money supply had been systematically maintained above the planned rate of growth of nominal income (except, perhaps, for 1959), and at that time, orthodox monetarists could safely argue that monetary policies had been the weak side of the stabilization program. Furthermore, income velocity of money had remained fairly constant since 1959. This argued in favor of a more active monetary policy toward price stabilization. The program of 1962 was built on this conception. Money supply (which by 1961 was still growing at a 19.7 percent annual rate) was increased by only 10.7 percent and the peso was undergoing devaluations once again due to the interruption of the influx of foreign capital induced by political instability. Prices, which in 1961 had increased only by 9 percent, went up by 20 percent in 1962 while GNP declined sharply. In 1963 the rate of growth of the money supply was increased but still remained below the rate of 1961. Inflation continued accelerating while GNP declined again.[32] In 1964, the government returned to higher rates of growth of the money supply. These remained more of less stable (around 30 percent) until 1967. Inflation first decelerated and then stabilized at around 25 percent a year while the rate of growth of GNP became positive. During this period the government tried to keep the exchange rate, as well as other administered prices, proceeding <u>pari-passu</u> with inflation.[33] The period 1964-1966 can probably be seen as one in which the

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[32] For detailed descriptions of these stabilization plans, see Ferrer, Brodersohn, Eshag and Thorp [1969].

[33] For a description of this period see Mallon [1968].

economy was very close to a path of long-run equilibrium with a rather steady rate of inflation of around 25 percent per year.

In 1967 the government decided to attempt a new stabilization plan. The exchange rate — after an initial devaluation partially compensated for by changes in export and import taxes — was kept constant; wages were frozen and prices were indirectly controlled through agreements between the government and the leader firms. The rate of growth of the money supply declined, but much more gradually than in 1962. During 1968 and 1969 the rate of inflation declined to 12 percent and 10 percent respectively, and real GNP accelerated. In 1970 the rate of growth of money supply declined more sharply, but at the same time the rate of inflation tended to accelerate again. During these three year periods, agricultural prices, especially those of cattle, were kept at a low relative level compared with the preceding years, and real wages also deteriorated a little as wage controls were more effectively enforced than manufacturing price agreements.

During 1971, high inflationary pressures revived, as a fall in the supply of cattle provoked both an important increase in the domestic price of meat and a fall in exports. At the same time there was increasing social unrest. The peso was devalued and the Monetary Authority, having first attempted to keep the money supply growing at the previus year's rate, finally decided to keep a more passive policy. Prices went up 35 percent in 1971 and the economy was again immersed in a process of accelerating inflation which continued during 1972, producing a rate of inflation of 59 percent.[34]

During the second quarter of 1973, the Peronist Government designed a new stabilization plan based upon strong price and wage controls that followed a relatively moderate initial increase in nominal wages. The rate of growth of the money supply was not simultanously reduced but increased! It went from 39 percent in 1972 to 74 percent in 1973 and 71 percent in 1974. Abundant bank credit, low prices for energy and public utilities, and cheap foreign exchange for intermediate imports were the instruments through which the government hoped to compensate firms for the sacrifice of profits that the system of price controls would mean to them. Inflation went down from 59 percent in 1972 to 49 percent in 1973 and 24 percent in 1974. But by the end of 1974 a dramatic balance of payments crisis was beginning to develop. Successive, relatively small adjustments of the exchange rate and a drastic deceleration of monetary expansion that began to be implemented in the third quarter of 1974 were not able to reverse the rapid loss of foreign exchange that was already underway. In the second quarter of 1975, while collective bargaining for wage increases was taking place, the government decided to change

[34] For a description of this stabilization program, see De Pablo [1970].

its policies drastically. It increased the price of energy and the exchange rate by around 200 percent. Trade unions adjusted their demands upward and collective agreements were signed with wage increases ranging from 130 to 200 percent. An attempt by the government to annul those agreements was strongly resisted by the trade unions and failed. As a result, the average level of prices during 1975 ended at 180 percent above that of 1974, and the economy was again immersed in an accelerating inflation, while for the first time in 10 years the GNP was experiencing an absolute reduction in real terms. The rate of growth of real GNP was -2.1 percent in 1975. With the government now attempting to avoid a fall in real wages (by allowing quarterly increases in nominal wages) and running a record deficit that fueled monetary expansion, inflation revolved between the second quarter of 1975 and the second quarter of 1976 around a new record level of 400 percent per year. In the second quarter of 1976, a new military government froze nominal wages while eliminating all other price controls. Monetary expansion was still growing relatively fast, but inflation decerated drastically this time at the expense of a record fall in real wages. After the third quarter of 1976, a significant improvement in fiscal discipline allowed the Central Bank to reduce the rate of growth of money supply. Inflation began accelerating again, to such an extent that the government, in spite of the commitment of its economic team to freedom of prices and monetary orthodoxy, has recently decided to complement the already strict control of wages with a 120-day absolute freeze of all other prices.

Several features may be singled out from this rapid glance at the Argentinian experience:

1) Stabilization plans based upon wage or price controls, whatever the accompanying monetary policy, have been successful in reducing the rate of inflation during periods as long as one to three years, but after such periods a balance of payments crisis or social unrest, or a combination of both, induced policy changes which ended up by reviving inflation. These crises are closely related to severe relative price distortions created during the period of strict wage and price controls, and to the lack of coordination between price and monetary policies. Examples of these phenomena are the stabilization plans of 1953-54, 1967-70, and 1973-74.

2) Monetary policy does not seem to have been continuously adjusted to actual inflation but at several times it has been actively used either to fight inflation or to induce improvements in real GNP.

There seems to be a certain association between downward changes in the rate of growth of the money supply and downward changes in the rate of growth of real GNP, except during the years where the stabilization plans were based on price and wage controls (as in 1968-69), or when the rate of monetary expansion, while increasing, lagged behind changes in wages or other costs that were rather autonomous in nature (as in 1959 and 1975). On several occasions, especially after a sharp fall in real GNP, the relaxation of previous monetary restrictions appears to be associated with an increasing real GNP, as was the case in 1953, 1964 and 1973. This kind of evidence has been used by several authors, especially Brodersohn[35] and Eshag and Thorp,[36] to argue that monetary policy is "effective in changing aggregate demand" (especially by restricting private investment) and producing changes in output and employment. This opinion contrasts with the results presented by Lucas[37] in a paper in which he compares the "effectiveness" of monetary policy in several countries using a "rational expectations" model. He found that in Argentina, monetary policy did not explain changes in real output, a fact that he uses to support his hypothesis that the effectiveness of discretionary monetary policy declines when it becomes very "volatile." However, the econometric model used by Lucas is a simple regression of real output on the rate of growth of money supply, which does not take into account other relevant factors such as wage and price controls and devaluations and autonomous changes in wages, which obviously need to be singled out in order to observe

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35 See Brodersohn [1972].

36 See Ferrer, Brodershon, Eshag and Thorp [1969].

37 See Lucas [1973].

the net effect of monetary policy.

3) When monetary restrictions are used as the main instrument of the stabilization plan, their desired effects on the rate of inflation do not seem to occur during the first two years of such a policy. On the contrary, downward movements in the rate of growth of the money supply which are not accompanied by strong wage and price controls began accelerating inflation. This has occurred with drastic restrictions like those of 1962, but also with mild ones like those of 1951, 1971, end of 1974, beginning of 1975, and end of 1976. While in some cases the acceleration could be attributed to a rising trend in monetary expansion during preceding periods, as in 1951 and 1974, in others (notably in 1962 but also 1970-71 and 1976) the acceleration of inflation subsequent to monetary restriction followed a period of decelerating rates of inflation and monetary expansion. The impact of monetary restriction in the guise of a decrease in GNP and an increase in unemployment (which, with less intensity, is also observed in more stable economies) is then associated with accelerating inflation which cannot always be explained by acceleration of monetary expasion in previous periods. This "stagflation" phenomenon seems to persist for several quarters (in 1962, which is the most clear case, it lasted almost 6 quarters). During such periods the government faces strong pressures against the restrictive policy and must give it up before the presumaly positive "second run"

effect begins to flourish. That governments behave this way is not surprising in a "pluralistic-conflict-society" in which, as Mallon and Sourrouille put it, "the feasibility of economic measures is largely determined by the need of regimes to mobilize and retain shifting coalition support."[38]

Summing up, wage and price controls help in reducing inflation for a while, but their positive effects do not endure in the medium and long run. Monetary restrictions, which according to a generally accepted opinion, would end up reducing inflation in the long run, has strong perverse effects in its initial stages. It is evident that with the money supply growing, say, at 30 percent per year, there will be a persistent inflation of around 25 percent per year. It is also more or less clear that if some day the state of persistent inflation is successfuly eliminated, the monetary expansion necessary to preserve price stability will have to average the expansion of real GNP. But for an economy in a state of persistent inflation, neither of these two propositions is useful. What is needed is a way, socially permissible, of moving from one state to the other. Once the mechanism through which the perverse effects of monetary restrictions operate has been identified, it may be possible to design a stabilization plan with a higher probability of success.

The main purpose of this study is to identify the

[38] See Mallon and Sourrouille [1975], Preface.

economic mechanism behind the perverse effects of monetary restriction. In other words, we want to derive a structural description of the markets where those effects show up and to identify the routes of monetary policy influences on those markets. The finding that there exist lags in the effects of monetary expansion on the rates of inflation and real growth, and even the description of a given lag structure (whatever the sophistication of the statistical technique used), constitutes an interesting descriptive observation but by itself does not tell anything about the economic mechanism that explains those lags and their particular structure. Nor is such finding revealing about the possibility of affecting those aspects of the lag structure which are most damaging for the success of stabilization policies. Thus in this study we emphasize the need for a structural analysis of the effects of monetary policy on inflation and real growth.

D. The Principal Thesis: an informal presentation

To present our main thesis, we need to introduce a classification of capital goods and investment that was worked out by Keynes in his A Treatise on Money, but which is absent both from The General Theory and from Post-Keynesian literature.

Under the title "Classification of Capital" in Chapter 9 of A Treatise on Money, Keynes writes:[39]

[39] Keynes [1930], Vol. I, pp. 115-116.

"The stock of real Capital or material wealth existing at any time is embodied in one of three forms:

(1) Goods in use, which are only capable of giving up gradually their full yield of use or enjoyment.

(2) Goods in process, i.e., in course of preparation by cultivation or manufacture for use or consumption, or in transport, or with merchants, dealers and retailers, or awaiting the rotation of the seasons.

(3) Goods in stock, which are yielding nothing but are capable of being used or consumed at any time.

We shall call goods in use fixed capital, goods in process working capital, and goods in stock liquid capital."

In Chapter 28 Keynes gives a more precise characterization of working capital:[40]

"I define working capital as being the aggregate of goods (and the cost of working capital as the cost of the aggregate of goods) in the course of production, manufacture, transport and retailing, including such minimum stocks, whether of raw materials or of finished products, as are required to avoid risks of interruption of process or to tide over seasonal irregularities. It does not include surplus stocks, which constitute liquid capital."

[...]

"Fluctuations in investment in working capital will be closely correlated with fluctuations in the volume of employment."

It is evident that, faced with a credit-tightening situation, the firm may choose to reduce either the investment in fixed capital or the investment in working capital

[40] Keynes [1930], Vol. II, p. 103 and p. 91.

or both (we are leaving aside for the moment the existence of liquid capital, which is not generally very important). It is our central point that this decision is quite relevant for the final effects of monetary policy on the real variables of the economy. We will argue that in the short run, investment in working capital is likely to be more sensitive to changes in monetary policy than investment in fixed capital. We will then show that, while the effect on output and employment is always a fall whenever any kind of investment is reduced, the impact on prices is an increase whenever the reduction occurs in investment in working capital instead of investment in fixed capital.

In analyzing problems of inflation, the distinction between labor and commodity markets becomes very important. While inflation is the outward appearance of a disequilibrium in the commodity market, unemployment means disequilibrium inthe labor market. Both markets are naturally linked, and it may even be true that a disequilibrium in the labor market (in particualr, unemployment) may finally eliminate the inflationary pressure that exists in the commodity market by successive reduction in money wages. But it is widely known that these forces work rather slowly, even in stable economies. In any case, when the elimination of disequilibrium in one market has to come through events that must occur initially in other markets, there is always the possibility of "perverse dynamic" and "information failures" that have been discussed extensively by Leijonhufvud in economies in a state of persistent unemployment and price deflation.[41]

We want to emphasize that wheatever the kind of investment that is affected by monetary policy, the impact effect on thelabor market always comes from the demand side. If firms decide to produce less in order to reduce working capital they will demand less labor. If the final demand of capital goods is reduced because fixed investment is curtailed, there will also be a reduction in the demand for labor. But in relation to the commodity market, a change of investment in working capital (which, like labor, is a variable factor of production even in the short run) brings about a decrease in the supply of commodities (consumer and capital goods), while a change of investment in fixed capital (which is a fixed factor in the short run) produces a decrease in demand for commodities (capital goods). The difference lies in the fact that reducing investment in working capital means demanding less factors of production because it has been decided that less final commodities will be supplied, while reducing investment in fixed capital means a fall in demand for final commodities. Of course, changes in investment in fixed capital will also affect supply, but this effect takes time because new investment can be actually used in production only after a certain period of time. Therefore, in the short run, even if in both cases total output will decrease, the impact

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41 See Leijonhufvud [1968].

effect of a reduction in working capital will be an increase in prices (acceleration of inflation) while a reduction in investment in fixed capital will produce a decrease in prices (deceleration of inflation).

Thus articulated, the explanation of the "perverse" impact effect of monetary restriction implies the existence of a specific financial influence on the non-financial economy. Such influence should exist, at least potentially, in every monetary economy, and not only in economies with persistent inflation.

For this reason, we will begin the formal discussion of our thesis in Chapters II and III by simply searching for the theoretical implications of introducing working capital in:

(a) a very conventional model of the firm (micro-economic analysis), and

(b) an aggregate model of output and price level determination and dynamics that in all other aspects involves also very conventional assumptions (macroeconomic analysis).

This first part of the formal discussion will refer to an imaginary economy that in all respects resembles that of the micro- and macroeconomy textbooks, the only changes being those that result from introducing working capital by assuming a time-lag between the moments at which inputs are paid and output price is perceived.

We will show that within the context of this imaginary economy the existence of working capital has the following consequences:

(1) Short-run aggregate supply of commodities depends on the real interest rate (defined as the difference between the nominal interest rate and the expected rate of inflation) and on the variance of the expected rate of inflation. (Of course, it also depends on the stock of fixed capital and the real costs of the variable factors of production, as usually stated);

(2) The real growth of output will necessarily decline as a consequence of applying a restrictive monetary policy designed to eliminate inflation; and

(3) For certain values for the structural parameters of the economy, the restrictive monetary policy may at first accelerate inflation.

Conclusion (3) will not hold if the real interest rate is completely insensitive to monetary policy, or if the real wage rate (and more generally the real costs of variable factors of production) is sensitive enough to unemployment. In the context of a model of the Keynesian type, that is, a model in which: (a) real output is determined by effective demand; (b) the supply of labor is infinitely elastic at a level of nominal wages which, while periodically adjusted according to expected inflation, does not fully compensate for past gains or deterioration of real wages; and (c) commodities and asset markets are only linked through the interest rate; we derive an additional interesting conclusion which is also formally shown in Chapter III:

(4) If within the relevant period the real-interest-rate-elasticity of aggregate supply is larger than the real-interest-rate-elasticity of aggregate demand, then stabilization policy based upon monetary restriction will necessarily decrease real wages, even if the economy were initially in a long-run equilibrium with the "right" real wage rate ("right" in the sense of a real wage rate compatible with the "full employment" or "natural" rate of unemployment).

In a more general model, such as the one used to derive conclusions (2) and (3), proposition (4) will be true under the same conditions that lead to accelerated inflation as a result of restrictive monetary policy, provided that the elasticity of the real wage rate with respect to unemployment is greater than zero. Proposition (4) means that whenever the initial supply side effects of changes in credit conditions are stronger than the demand side effects, stabilization plans based on monetary restriction will impose the burden of the adjustment to a non-inflationary path, mainly on wage-earners.

None of these conclusions require very unusual assumptions about institutional arrangements or market imperfections. We will show that they hold under the conventional assumptions of macroeconomic theory with the sole addition of working capital as a factor of production.

Our thesis is not only that the mechanism exists as a logical possibility, but that it becomes more important in economies with persistent inflation. This is so, in part because more drastic changes in monetary policy are observed and also because some specific institutional features of economies with persistent inflation increase the absolute value of the elasticity of the short-run supply of commodities with respect to the relevant indicator of the "credit conditions."

An informal presentation at this stage of these institutional features should help the reader make empirical sense of the more technical discussion of the same issues addressed in Chapter IV.

E. Some Special Features of Economies with Persistent Inflation

As before, we now try to single out these special features by looking at the Argentinian experience. By observing the statistics of Table 3 on the sources and uses of funds by manufacturing corporations in Argentina

Table 3. Sources and uses of funds by Manufacturing Corporations in the U.S. and Argentina, 1969-1969.[42]

	U.S. Corporations	ARGENTINA (Manufacturing Corporations) Large	Middle Size	Small
USES				
Increases in:	100.0	100.0	100.0	100.0
1. Cash and marketable securities	3.9	6.1	8.5	3.6
2. Inventories	8.9	18.6	20.5	22.7
3. Receivables	13.4	23.0	27.1	30.0
4. Gross Fixed Assets	64.8	41.4	34.5	36.5
5. Other Assets	9.0	10.9	9.3	6.7
SOURCES				
Increases in:	100.0	100.0	100.0	100.0
6. Trade credit	5.8	5.0	18.9	22.1
7. Accrued taxes	0.1	1.8	0.7	0.7
8. Bank loans	8.1	22.5	13.8	10.8
9. Mortgages and other loans	7.7	13.3	11.1	8.0
10. Other liabilities	5.5	5.7	4.0	7.7
11. Retained earnings and capital consumption allowances	59.1	50.0	52.3	43.8
12. Net new security issues				
13. Bonds	11.9	0.0	0.0	0.0
14. Stocks[43]	1.7	1.6	(0.8)	6.9
15. Short run credit	14.0	25.2	32.2	36.4
16. Long run credit	26.8	17.1	8.6	9.1

42 The source of the figures for Argentina is Fundación de Investigaciones Económicas Latinoamericanas [1971]. The figures for the U.S. were taken from the Federal Reserve Bulletin, August, 1970, Table A 71.4.

43 In the Argentinian case, new issues of stocks include mainly dividends distributed in the form of equities.

and the United States for the period 1967-1969, we may draw some conclusions.

Let us first compare the figures for the three sizes of corporations reported for Argentina. It can be seen that for all three categories retained earnings and capital allowances are the most important source of funds. Among the external sources, there is in general a high proportion of short-run credit which, for the large corporations, comes primarily from the banking system, and for the middle and small corporations, comes mainly from sellers of inputs (commercial credit). All three kinds of corporations use a certain proportion of financial and other credit. As for the uses side, it is interesting to see that the investment in fixed assets amounts to only a little more than one-third of the total. Investment in inventories and credit to customers becomes more important when going from large to small corporations.

In order to get an idea of those characteristics of these tables of uses and sources of funds for Argentinian corporations which result from the state of persistent inflation, it is useful to compare them with the corresponding statistics for a mroe stable economy, such as that of the United States. In addition to the comparative figures provided by Table 3 sources, the following comparison of balance sheets of manufacturing corporations in Argentina and the Unites States is instructive (see Table 4.).

Table 4.

Balance sheet of manufacturing corporations
in the United States and Argentina[44]

(% of totals)

	United States		Argentina	
	1966	1969	1966	1969
Liabilities	100	100	100	100
1.Equity capital	61	55	43	51
2.Long term bonds	16	20	8	8
3.Short term debt	23	25	49	40
Assets	100	100	100	100
4.Long term investment	47	50	30	38
5.Working capital[45]	53	50	68	60
6.Other assets	-	-	2	2

44 The source of the Table is Brodersohn[1972c] for Argentina, and Federal Trade Commission and Securities and Exchange Commission, Quarterly report for manufacturing Corporations,Third Quarter 1967 and 1970 for the United States.

45 This is working capital plus liquid capital in Keynes terminology.

The following differences between the finances of Argentinian and American corporations are neat and relevant:

(1) Argentinian corporations relay more on financial sources external to the firms thatn do American corporations. This can be seen in line 11 of Table 3 and line 1 of Table 4.

(2) Financing by long-term bonds is practically nonexistent in Argentina (line 13 of Table 3 and line 2 of Table 4). Consistent with this, reliance on short-term financing is much more important in Argentina than it is in the United States (line 15 of Table 3 and line 3 of Table 4).

(3) The share of working capital in total uses of funds and in assets is much larger (and consequently that of fixed capital is smaller) in Argentina than in the United States (lines 2, 3 and 4 of Table 3 and lines 4 and 5 of Table 4).

With this brief description and the discussion of section B as introduction, we can now present each one of the topics discussed more formally in Chapter IV.

<u>Leverage does matter</u>

In economies with fairly efficient credit and capital markets and freely determined interest rates, one would expect quantity credit rationing not to be a very important phenomenon. Therefore, the relevant indicator of "credit conditions" in such eocnomies would surely be some average real interest rae. Furthermore, the more efficient the markets and the less the distortions created by differential tax treatment of returns on different financial assets, the more one would expect that the relevant real interest rate would be approximately the same for firms with very different leverages (as stated by the Modigliani-Miller Theorem[46]). But there are several reasons that make things different in economies with persistent inflation.

First of all, the equity market is not very active. Firms usually do not have the alternative of issuing new equities; neither do they have the alternative of borrowing long. They have to use short-term credit in proportions which make bankruptcy risks an important concern of lenders.[47] As a consequence, the real cost of credit faced by each firm is very likely related to its "leverage". This means that the "credit conditions" will have to be represented by some "basic" real interest rate (for unlevered firms) and a "leverage charge." It is conceivable that a tighter credit situation will show up as a combination of increases in both the "basic rate" and the "leverage charge". The more the concern of the lender with minimizing bankruptcy risks, the large the proportion in which changes in credit conditions will show up in the form of

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[46] See Modigliani & Miller [1958] and [1963]. For a different view, even in price stable economies, see Hicks [1939].

[47] In the Modigliani-Miller theorem this risk is assumed away.

increase in the "leverage charge" rather than in the basic rate. This may make for a stronger effect of credit conditions on working capital and production, because at a time of tight credit markets a small difference in "leverage" associated with a change in the level of production may mean a big difference in the real cost of credit faced by the firm.

More Working Capital relative to Fixed Capital and More Short Term Debt relative to Long-term

It has been shown that the balance sheet of the Argentinian corporations differs considerably from that of the American corporations in that the share of liabilities represented by debt is lower for Argentina, as is the share of assets represented by capital goods.

Obviously, the second comparison says that the size of working capital relative to fixed capital is larger in Argentina. This may in part result from higher dependence on short-term debt (which induces the firms to choose technologies employing relatively shorter lived assets) and in part from the predominance of middle and small firms in the Argentinian economy. It is generally observed that small firms usually adopt techniques using a smaller proportion of fixed capital. The greater importance of working capital in this kind of economy in itself provides an explanation for a higher responsiveness of aggregate supply of commodities with respect to credit conditions. But there is still another reason for such a higher responsiveness. This is directly related to the reliance of firms on short term debt.

The predominance of short-term financing is the result of the disappearance of the long-term bond market that was commented on in Section B. It has been observed that firms tend to maintain certain fixed proportions between long-term investment and long-term funds, and of course, between short-term financing and investment in working capital. In an economy in which the market for long-term bonds does not exist and the only source of long-term financing are profits and equity capital raised from households with special links to the firms, monetary policy will basically affect the availability of short-term financing. Therefore firms may prefer to adjust their short-term investment rather than modify their plans for long-term investment. A rationale for this behavior is the following: firms will generall re-invest their profit flows because there are not many alternatives in the capital markets. The dependence of the cost of credit on the leverage of the firm determines the existence of a leverage ratio which is optimal, namely, that at which the marginal cost of credit equals the marginal rate of return on the fim's assets. The amount of accumulated profits (plus whatever other source of own capital may exist) and the optimum leverage ratio determine the overall size of the funds invested in the firm. The distribution of those funds between working capital and fixed capital will be such that the marginal return on each of them are equalized. But as the building up of a given stock of fixed capital takes time, this decision has to be adopted according to "long-term expectations" about returns. To the extent that long-term expectations are more sticky than short-term expectations, firms will try to keep a rather stable relationship between their expected net worth and the planned stock of fixed capital. Consequently investment in fixed capital will move in proportion to profits, while changes in credit conditions which are expected to be short-lived, will mainly affect working capital.

Bank credit rationing

It has already been commented that in economies with persistent inflation, the government very often fixes the bank rate at a level below equilibrium; consequently, bank credit is rationed. It is evident that the amount of bank credit will always be relevant to the determination of the free market interest rates — but does it have a direct influence on working capital and production decisions? In other words, shouldn't the amount of bank credit be taken as one of the basic indicatrors of "credit conditions" in the explanation of production and supply of commodities? This question is not easy to answer. We are tempted to say, simply, that if bank credit is not the marginal source of credit for firms, it shouldn't play any direct role on production decisions other than that related to its effect on the free market interest rate.

But this answer seems to contradict so many opinions[48] that a more detailed examination of the Argentinian experience is clearly in order.

As can be seen in Graph 3, the maximum interest rates fixed by the Central Bank have always been below the market interest rates, at least as long as there is information available. It is also seen that the banks have been able to get a higher effective interest rate by some additional charges; but even so, interest plus other charges is below, say, the interest rate of the Bank Acceptances market. This means that the banks had to ration credit by criteria other than the interest rate.

One question that has been widely discussed in Argentina relates to the distortions in the allocation of resources that the interest rate on bank loans fixed by the Central Bank may have created. It has been argued that the negative interest rates which predominated during long periods may have induced investment with a negative social rate of return.[49] This argument is easily dismissed by observing that the interest rate relevant for investment decisions is the marginal rate, which in almost all circumstances and for almost all the firms was not the bank rate but the interest charged by other lenders who were

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48 See the references on the dependence of aggregate supply on real bank credit to the private sector in section F of this chapter.

49 See Simone [1969] and Rivas [1975].

usually not subject to the interest rate limitations.[50]

The second source of distortion is the set of criteria actually applied in the rationing process. On this subject, it is necessary to distinguish between two levels of rationing: the sectoral level and the customer level.

From 1944 on, the Central Bank of Argentina has been concerned with the sectoral allocation of bank credit, which has been called "selective credit policy". We have described elsewhere[51] the instruments used (from simple orientative instructions to an absolute control, sterilizing deposits and distributing authorizations to grant credit for each specific sector of the economy), and the allocationdecided by the Central Bank in different periods. A general idea can be obtained from Graphs 8 and 9.

Graph 8 shows the proportion of credit allocated to Government, to Mortgages for Housing Investment, and to the rest of the Private Sector. In Graph 9 this last component is broken down into Loans to Customers, Wholesale and Retail Businesses, Building Industry, Manufacturing Industries and Farms. It is interesting to note some major changes. From 1951 on, there is an important shift in favor of farms (which had suffered a virtual stagnation during the 1930's and during the Second World War). The increased proportion of loans to farms came from a propor-

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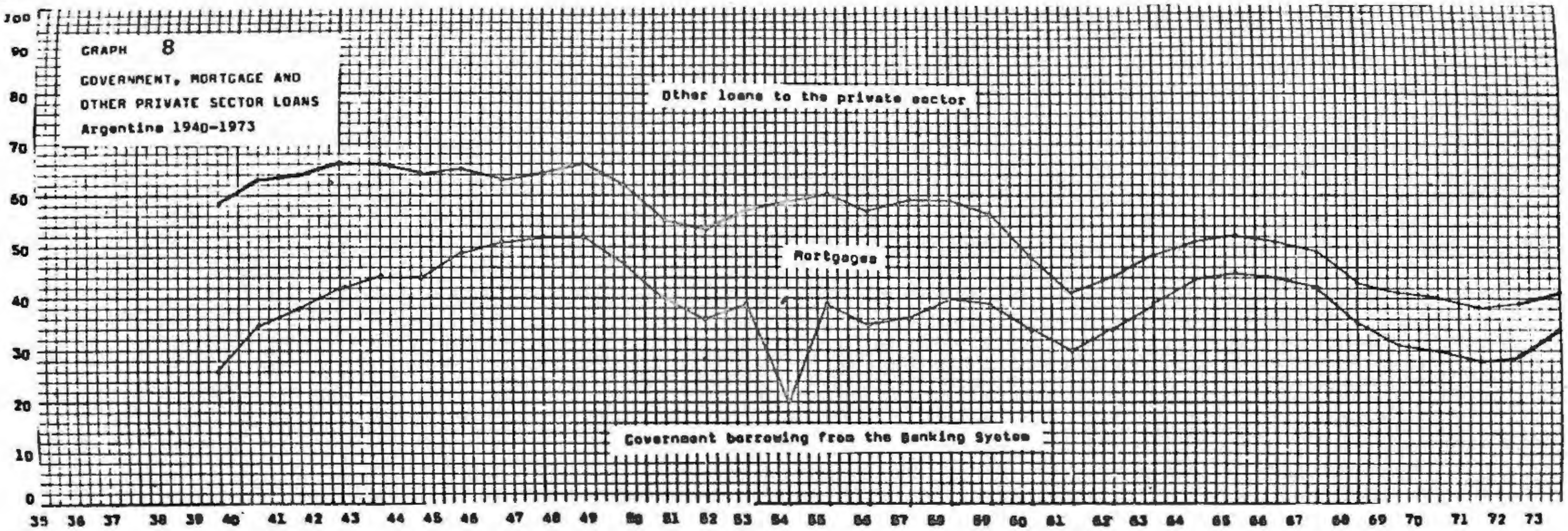
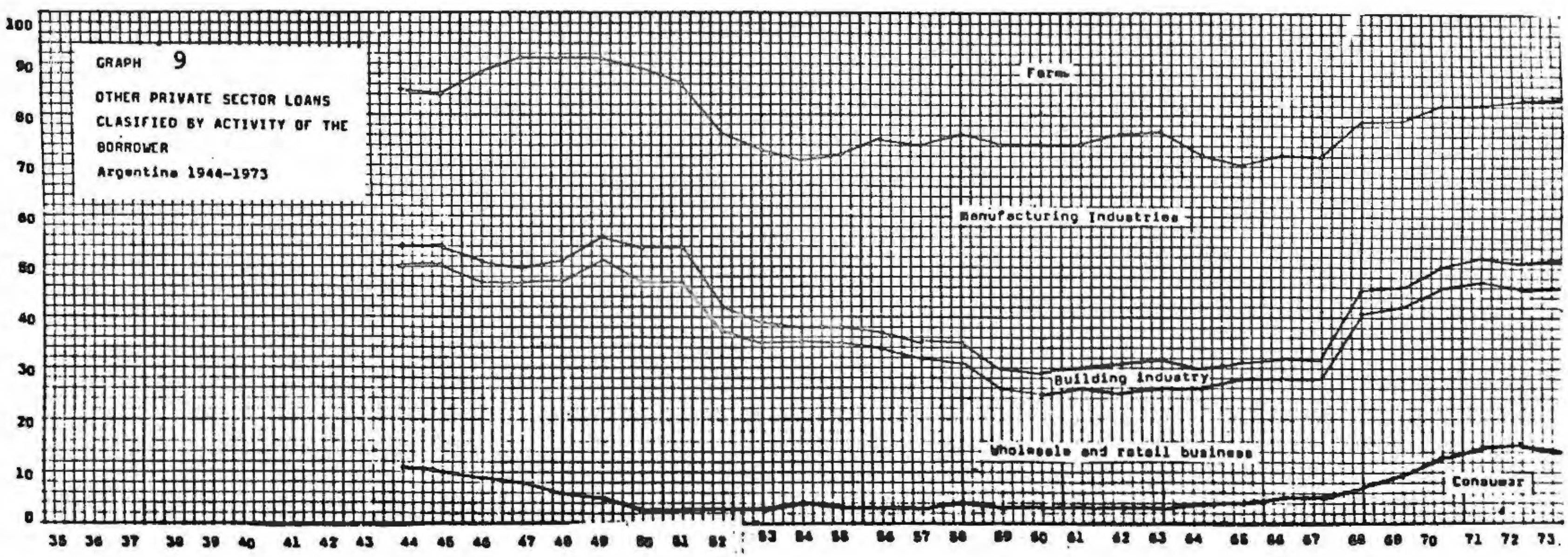
50 This argument was worked out by Brodersohn, using Duesemberry's sources of funds theory of investment. See Brodersohn [1972b].

51 Dadone, A., and Cavallo, D. [1974].


GRAPH 8
GOVERNMENT, MORTGAGE AND
OTHER PRIVATE SECTOR LOANS
Argentina 1940-1973
Other loans to the private sector
Mortgages
Government borrowing from the Banking System
100 90 80 70 60 50 40 30 20 10 0
35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73


GRAPH 9
OTHER PRIVATE SECTOR LOANS
CLASIFIED BY ACTIVITY OF THE
BORROWER
Argentina 1944-1973
Farm
Manufacturing Industries
Building industry
Wholesale and retail business
Consumer
100 90 80 70 60 50 40 30 20 10 0
35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73

tional reduction of loans to Wholesale and Retail Businesses. From 1959 on, there was a further reduction of the latter sector's share in favor of Manufacturing Industries.

The third important change came in 1968. It is interesting to analyze this period because it is the only one in which credit was rationed mainly by the interest rate (whcih was above the inflation rate) or the criteria of each bank, without interference from the Central Bank. There is a drastic increase in loans to Wholesale and Retail Businesses at the expense of farms, in the first place, and to Manufacturing Industry, in the second. There are many reasons to think that the consequences of this particular allocation may have been especially harmful for the stabilization plan that the government was implementing. The reduction in loans to farms (especially to cattle producers) may have contributed to the liquidation of cattle stocks that, in 1968 and 1969, produced a decrease in the price of meat (contributing to a reduction of inflation), but in 1970 and 1971 brought about a strong reduction in production, creating new inflationary pressures directly within the meat market, and indirectly in the balance of payments.

This rapid analysis of the sectoral rationing by the Central Bank during almost all of the period 1945-1973, and by the individual banks (through interest rates) in the period 1968-1970 suggests that the evaluation of Monetary Authority intervention trying to modify the allocation pattern of credit produced by the market (or by the individual decisions of the banks) has to be related to other government policies as well. In a "first best" world, there can be no doubt that this kind of Monetary Authority intervention will be harmful or, at best, ineffective. But when the government is controlling the prices in some other markets (as happens in Argentina, at least with the market for exportables, due to the discretionary policies related to the exchange rate), a sudden and complete decontrol of the sectoral allocation of credit or the interest rate charged by banks may be harmful. In such a situation wholesale and retail businesses are very likely to be in better condition than farmers, whould they have to pay higher interest rates to the banks, offer higher compensatory balances, or promise an easier liquidation of the loan in case the bank has to reduce its assets. This is so because firms other than farms were already using more expensive sources of credit and had been quantitatively constrained in the bank credit market. On the other hand, farmers may have been using only subsidized bank credit because their rates of return (affected by the government controls) may have been below the interest rate charged in the free credit markets. Of course, this kind of situation may only happen when the degree of factor mobility between sectors is low; otherwise, no real resources would be allocated to the below-average rate-of-return sectors.

The second level of rationing, namely the allocation among specific customers, is done by each bank. The already-commented sources and uses of funds statistics show that banks tend to lend higher proportions to large corporations. Very likely this tendency becomes accentuated during periods of credit tightening, with the result that the main effect of monetary policy must come about through the decrease in bank credit granted to small and middle sized corporations. Access to bank credit being a privilege granted by supposedly experienced and well-informed bankers, bank credit indebtedness is usually seen by lenders outside the banking system as a symptom of good, rather than bad, financial health of the potential borrower. This means that leverage charges will be a function of the outside banking system indebtedness of the borrowers, rather than its total debt. If this is so, changes in bank credit will change the non-banking leverage required for each level of production and will have, for this reason, an effect additional to that of the changes in the free market interest rate.

Summing up, the amount and allocation of bank credit may have some relevant direct effect on aggregate supply of commodities, to the extent that it affects the credit accuring to sectors for which bank credit is the only source of financing, or to the extent that it is seen by non-bank lenders more as own capital of their potential borrowers than as true debt. In all other circumstances, the effect on firms' Central Bank decisions regarding changes in the amount of total credit (or of total money) has to come indirectly from its effect on the interest rate charged in the free markets; i.e., in the markets where the majority of firms procure their marginal funds.

<u>The role of leading firms</u>

Finally, there is another explanation, perhaps a more subtle one, that accounts for the supply side-effect of credit conditions being relatively high in economies with persistent inflation. Persistent inflation and its financial market implications create more opportunities for the emergence of leading firms with some degree of monopoly power. It is well known that monopoly pricing can explain higher <u>levels</u> of certain prices, but not higher rates of inflation. But, if the effect of credit tightening shows up first in the supply of the marginal (price takers) suppliers of commodities rather than in aggregate demand, the monopoly power of the leading firms will have increased and it is possible that, at least in the short run, they will decide to apply higher mark-ups over marginal costs of production. This can well add to the short-run intensity of the perverse effects of a restrictive monetary policy.

So much for an informal presentation of the topics; they will be addressed in a more formal and rigorous fashion in Chapter IV.

F. Existing Literature on Similar or Related Topics

The observation that tight credit conditions brought about by anti-inflationary monetary policy may sometimes add to (instead of reducing) inflation is not new. According to Hotson [1971], in the United States the observation that higher interest rates raise the price level by raising the "cost of doing business" has been, for a long time, a "man-on-the-street" argument. Horwich [1971] even provides a description of the position of American political parties on this issue, and Seelig's [1974] recent empirical research on the inflationary effect of rising interest rates originated in the desire to test Congressman Patman's[52] statement on the "senselessness of trying to fight inflation by raising interest rates." This has been a "man-on-the-street" argument outside the United States also. A very recent articlein The New York Times on Chilean economic policies reads:[53]

> "In Chile today, there is only one economic activity that continues to show remarkable profits, and that is speculation centered on the financial companies... The 'financieras', as they are called here, borrow money abroad and loan it out locally on a 30-day basis at 3 or 4 percent a month above the inflationary rate. Industries and businesses with no other access to loans are forced to turn to the financieras and the costs are passed on to consumers. As a result, prices continue to rise even thorugh most companies are operating below capacity. An increasing number of businessmen are calling on the Government to control the interest rates offered by finance companies."

[52] See U.S. Congress, Joint Economic Committee [1959], pp. 55-56.

[53] December 8, 1976, A18; article by Jonathan Kandell titles "Chilean Junta Under Fire as Economy Stagnates".

Despite the apparent persistence of the "man-on-the-street" argument, the topic does not seem to have interested professional economists. Only a few articles insisting on the empirical relevance of the phenomena in the United States can be cited: Hotson [1967a], [1967b], and [1971]; Ritter & Silber [1974]; Harvey [1972]. On the other hand there are two pieces of empirical research concluding that in the United States rising interest rates do not seem to have a significant inflationary effect (Seelig [1974] and Hall [1976]). Although these authors do not agree in their conclusions, they all discuss the topic on the basis that interest rates could eventually affect prices from the cost of production side, because they are an element of the rental price of fixed capital and, consequently, a determinant of the long-run average cost of production. Working capital in the form of advances to workers and other variable inputs prior to the actual sales is not generally taken into account and, therefore, the argument that firms may be setting their prices according to short-run variable costs of production usually provides a theoretical rationale for the lack of dependence of supply prices on interest rates. This is the kind of argument used by Horwich to formally demonstrate that higher interest rates should not increase prices (Horwich [1966], [1971]).

In Latin America (especially in Argentina and Brazil) professional economists have been frequently concerned with the probable dependence of supply of commodities on the amount of bank credit available to the private sector. The first reference to the possibility that in Argentina the tight monetary policy appl..d in 1962 may have accelerated inflation in the short run via the decrease of investment in working capital by the firms, belong to Smithies [1963]. Unlike the other Latin American observers, Smithies referred to the tight credit situation in general rather than to the amount of bank credit going to the private sector in particular. Since Mynard & Van Rijckeghem [1968], all other writers referring to Argentina and Brazil (Garcia [1973], Van Rijckeghem [1972], Morley [1971], Báez [1975], Reca [1969]), have emphasized the effect of real bank credit on the private sector (or on some of the private sectors) as one of the determinants of production and supply of commodities. Their works are essentially empirical, and almost all of them find a significant positive relationship between the two variables. A recent paper by Almonacid & Pastore [1975] can be seen as the theoretical formalization of this relationship. They postulate that real bank credit to the private sector is a factor of production in the aggregate production function of the economy. This kind of analysis leads to the conclusion that monetary restriction in the short run will affect manily supply and will exercise only a small deterrent effect on inflation if it comes about in the form of credit restriction to the private sector, but not otherwise. In other words, the anti-inflationary effects of monetary restriction can be significantly improved by cutting bank credit to government instead of reducing bank credit to the private sector.

The theory presented by McKinnon in his book Money and Capital in Economic Development is also within the same line of thought. His policy recommendation for a successful stabilization plan is to increase the real return on people's money holding (a concept which includes all kinds of existing financial assets held by the non-financial private sector) so as to induce an increase in the demand for real cash balances (in that broader sense). This increase in the demand for real cash balances, would come according to his theory from an increase in the overall propensity to save of the economy rather than from a substitution of money for productive physical assets in people's portfolios. Higher demand for the financial assets (McKinnon's "Money") will allow the banks to increase their loans to the economy. This would help to increase (or at least not to reduce) the supply of commodities because, on the one hand, there will be abundant bank credit to finance working capital and, on the other hand, the higher degree of financial intermediation will improve the allocation of resources and generate productivity gains. In relation to the working capital argument, the relationship that McKinnon has in mind is similar to that postulated by Almonacid and Pastore. What matters is the amount of real bank credit received by the firms. In his words, "to draw an imperfect analogy, precipitously cutting off or reducing the supply of real bank credit constricts aggregate output much like cutting off the supply of electric power, water, or some other vital input."[54]

To show McKinnon's propositions formally, Kapur [1976] uses a fixed-coefficient production function, with physical capital and real bank credit as factors of production. This means that, in the short run, downward changes in real bank credit will entail strictly proportional decreases in real output.

Besides the differences of interpretation, there is a formal similarity between the argument of McKinnon, and Almonacid and Pastore and that of the "optimum quantity of money" literature.[55] There is also a formal similarity between, on the one hand, introducing real cash balances in the production function (to show that there exists a positive marginal productivity of money) as has been frequently done in the United States,[56] and, on the other, Kapur and Almonacid and Pastore's interpretation of real bank credit as a factor of production. The main substantive difference between the two sets of literature relates

[54] McKinnon [1973], page 87.

[55] See M. Friedman [1969].

[56] See, for example, Fisher [1976] and the recent discussion about a paper by Sinai and Stokes [1972] in the Review of Economics and Statistics, Vol. LVII, may 1975, No. 7.

the reason for the presence of a monetary variable in the production function, and in the selection of the relevant variable. In one case, the introduction of such a variable in the production function is based in the belief that money provides commercial services which have a positive marginal productivity. Consequnt with that argument, the variable used has been total real cash balances. In the Almonacid & Pastore and McKinnon theories, the monetary variable is taken to represent the stock of working capital used by the firm, and therefore the relvant variable is the amount of real bank credit received by the sector to which the analysis pertains.

Almonacid & Pastore and McKinnon's argument, although oriented to a very different objective, is quite similar to that of Schmitt [1972], who suggests a "fundamental revision" to macroeconomic theory. He argues that, as long as banks create additional money to finance increases in working capital, it is non-inflationary. Only if banks were to create additional money to be spent directly on the commodity market, instead of financing additional hiring in the factor markets, would any increase in the money supply be inflationary, since it would raise prices realtive to money wages.[57] Schmitt presents this as the correct interpretation of Keynes' ideas in A Treatise on Money. Note that, in substance, his reasoning is very similar to the one used by the other authors in making a

[57] See Schmitt [1972], p. 156. See, also, Paul Davidson's review of this book in Economica, Nov. 1973, pp. 458-461.

case for taking the allocation of credit between the public and private sectors as a major determinant of the aggregate supply of commodities.

We have pointed out in the previous section that under some special circumstances (low factor mobility explaining the existence of sectors of production with below-average rate of return, which consequently can only use subsidized bank credit) the amount and allocation of bank credit may have a strong direct influence on production and on the supply of commodities. But as a general argument, a "technological" stable relationship between real output and the amount of real bank credit to the private sector, is a hard-to-swallow theoretical proposition. Why should financial resources channeled into the economy via the expenditure window of the government play a very different role in financing production, as compared to the financial resources originated in the discount window of the banks? One cannot disregard some possible "velocity" differences according to the origin of liquidity. But even if one accepts that such differences may exist, theoretical arguments cannot *a priori* determine which of the two financial sources will result in a larger supply.

The relationship between the articles mentioned in this section and our approach may be described in the following terms: our starting point is the same sort of empirical observation as that of almost all of the authors mentioned above. There seems to be a financial influence on the aggregate supply of commodities, and not only on aggregate demand as is usually postulated. We undertake a detailed discussion of the theoretical underlying issues of such a relationship; in this discussion we try not to use the simple and, in our view, misleading shortcut of introducing real credit into the technological production function. Instead, we model working capital by specifying a time lag between the moment at which variable inputs are paid and introduced into the production process and the moement at which output is sold and its proceeds are received. Then we address the same basic questions analyzed by the authors on the effect of credit conditions on real output and inflation during the course of the stabilization plan. In order to distinguish between general propositions from specific results associated with very particular institutional arrangements, we first discuss the issues in the context of a perfect commodity and credit market framework. Once this has been accomplished, we introduce a particular set of market imperfections and other institutional arrangements that seem to us especially relevant to economies with persistent inflation. This allows us to show that some of the conclusions of other authors are true only under specific circumstances, but that they are not generally valid. Our empirical testing is undertaken within the context of the previously developed theoretical framework. In our view, most of the empirical research on the same topics by other authors is difficult to interpret and inconclusive due to the absence of a theoretical discussion of the econometric specification. Finally, the policy implications derived from our analysis are substantially different from those of the authors whose views have been discussed in this section.

Chapter II.

CREDIT CONDITIONS AND THE SUPPLY OF COMMODITIES: MICROECONOMIC ANALYSIS

A. Introduction

It is generally accepted that credit conditions prevailing in an economy affect the process of capital accumulation and therefore the long-run aggregate supply of commodities. Monetarists would agree with the statement insofar as it refers to those credit conditions which reflect the saving behavior and the productivity characteristics of the economy. They would probably dismiss the possibility that credit affects the long-run aggregate supply of commodities through transitory changes in the credit conditions caused by discretionary monetary and fiscal policy.[1] Keynesians would accept even this possibility.[2]

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[1] It was one of Sidrauski's important contributions to economic theory to show that if one follows strictly the basic logic of neoclassical choice and growth theories, one has to conclude that money is "superneutral." This means that monetary policy cannot affect the steady state capital intensity (and real interest rate) of the economy and therefore it cannot affect the steady state level of consumption per unit of labor (measured in efficiency units). Of course, neither can it affect the steady state rate of growth of the economy. This is not due to the previously mentioned "superneutrality" but to the assumptions that the rate of population growth and labor augmenting technological change are exogenously determined. See Sidrausky [1967a], pp. 534-544. For a "real world" discussion, in the monetarist tradition of the same basic issues, see M. Friedman [1968].

[2] Tobin's "Money and Economic Growth" [1965] paper can be taken as the basic formal discussion of the "super-

Yet in duscussing the short-run effect of changes in the credit conditions, surely both would concentrate on the links between aggregate demand of commodities and the interest rate and/or the quantity of money.[3]

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neutrality" of money issue within the Keynesian-American tradition. Sidrauski's [1967b] paper follows the same line of reasoning. The amin difference between the "non-superneutrality" conclusion of these papers and the superneutrality result of Sidrauski [1967a] is due to the assumption about saving behavior. While the former use a constant-proportion-of-income saving function, Sidrauski's second paper is based on "an explicit analysis of individuals' saving behavior, viewed as a process of wealth accumulationaimed at maximizing some intertemporal utility function." See Sidrauski [1967a], p. 534. For a real world discussion, in the Keynesian-American tradition, of the same issues, see Tobin [1965]. The existence of a long-run, non-vertical Phillips curve that Tobin claims in this paper broadens the possibilities of monetary long-run influences on real phenomena because it means that higher rates of steady inflation permit higher rates of real growth of the economy. Formal discussion of this possibility cannot be undertaken within the framework of neoclassical growth models because the long-run full employment and exogenous population growth and technological change assumptions rule out the possibility of a long-run steady state rate of growth of real output different from the rate of growth of population plus technological change. But in growth models with institutionally determined wage rates and less than full employment, such as those of the Ricardian and Keynesian-British tradition, it is possible to have a long-run non-vertical Phillips curve if monetary policy (and inflation) can influence the determination of the real wage rate.

3 For a very good synthesis of what could be considered one of the most accepted view about the linkages between real and monetary phenomena in western developed economies, see Modigliani [1963] and Ando [1974]. For a similar syntehsis referred to Latin American economies, see Arnaudo, A. [1972], Chapter IX.

Recently there has been some reference to "aggregate supply" effects in the literature on the natural rate of unemployment.[4] It is argued that aggregate supply may be responsive to changes in the general level of prices (or its rate of change) insofar as suppliers are unable to distinguish between changes in the relative price of their goods and changes in the general level of prices. To be sure, this is only one of several alternative explanations for the short-run price elasticity of the aggregate supply function. In any case, if real income and price level change, supposedly it will be because aggregate demand has shifted due to changes in credit conditions or any other reason. There are also frequent references to aggregate supply changes due to "shocks" such as sudden increases in import prices or wages, or a crop failure.[5] It is more difficult, however, to find theoretical references to aggregate supply changes due to changes in credit conditions prevailing in the economy.[6]

Furthermore, it is not misleading to assert that macro-monetary theory in general assumes that the short-run aggregate supply of commodities is independent of current credit conditions.

This chapter discusses the rationale for this assumption on microeconomic grounds. We show that after

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4 See Lucas, R. [1972] and [1973]. For a very careful econometric application, see Fernández, R. [1975].

5 See, for example, Gordon, R.J. [1973] and Solow [1975].

6 Section E of Chapter I was devoted to a detailed examination of the references on this topic.

introducing working capital as a factor of production, the supply of commodities does depend on the real interest rate (the only relevant indicator of credit conditions in an economy with perfect credit and capital markets). Moreover, what is suggested here is that this effect can be important when one wants to analyze the short-run effect of anti-inflationary monetary policy in economies with persistent inflation.

B. The relationship between supply of commodities and credit conditions in a very simple model of the firm

Consider a very simple model based on the following assumptions:

A. The firm produces a composite commodity. It uses at least two factors of production. The level of the first factor can be changed at any time without any relevant lag between the moment of decision and the time of execution. This factor, which is variable in the short run, is named "Labor" and its unit price is the wage rate. The second factor is fixed in the short run, i.e., it can be effectively increased only with a definite and known lag after the decision has been made.[7] This lag will be taken to be two periods, except where some alternative assumption is explicitly indicated.[8] This second factor will be identified as "Fixed Capital" and its asset replacement price equals the cost of acquisition or construction of its component pieces. This price and the price of output will be assumed equal.

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7 The possibility of decreasing its level is limited to the rate of depreciation because the sale price (net of transaction costs) of its component pieces is so low as to be considered negligible within the relevant range of alternative decisions.

8 The investment of period t must be decided in period t-1 and it adds to capital for period t+1.

B. The technology is described by constant-returns-to-scale Cobb Douglas function.

C. 1. The firm is a price taker in every market and its objective is to maximize the present value of the whole stream of future profits.

D. 1. The wage rate is paid at the same time that the sale price of the output is received, that is, at the end of each period.

Under these assumptions the supply of commodities by the firm in the different periods is obtained by solving the following maximization problem:

$$\max_{Q_i, I_i, L_i} PV_t = \sum_{i=t}^{\infty} (P_i Q_i - I_i P_i - L_i W_i) \exp\left(-\sum_{j=t}^{i} r_j\right)$$

Subject to: $K_t = \bar{K}_t$; $K_i = K_{i-1}(1-d) + I_{i-1}$, $\quad i = t+1, t+2, \ldots$

$I_t = \bar{I}_t$; $Q_i = K_i^a L_i^{1-a}$.

The subindices are used to indicate the time period:

PV	is the present value of the firm;
P	is the end of period price of the output;
Q	is the level of output;
I	is the level of gross investment;
L	is the amount of labor input;
W	is the wage rate;
r	is the end of period wage rate;
d	is the rate of depreciation of fixed capital;
a	is the parameter of the production function.

Note that in order to compute the present value of the firm at period t, each period net cash flow (sales of output minus payments for investment and for labor input) has been discounted to the beginning of period t. All these discounted values are added up.

The supply of commodities for period t can be obtained from the first order conditions for a maximum. More precisely, one of the equations of the first order conditions states:

$$\frac{\partial PV_t}{\partial Q_t} = (P_t - \frac{\partial L_t}{\partial Q_t} W_t) \exp(-r_t) = 0$$

which leads to the following supply function for period t:

$$(1) \quad Q_t = (1-a)^{\frac{1-a}{a}} \bar{K}_t (\frac{W_t}{P_t})^{-\frac{1-a}{a}} \quad .$$

The supply function for period t+1 has the same form, with subindices t+1 instead of t and $\bar{K}_{t+1} = \bar{K}_t(1-d) + \bar{I}_t$.

The supply function for period t+2 and following can also be determined.

Among the first-order conditions for the existence of a maximum we have:

$$\frac{\partial PV_t}{\partial K_{t+2}} = -P_{t+1} \exp(-r_{t+1}) + [P_{t+2}\frac{\partial Q_{t+2}}{\partial K_{t+2}} + P_{t+2}(1-d)]\exp(-r_{t+1}-r_{t+2})=0.$$

replacing $\frac{\partial Q_{t+2}}{\partial K_{t+2}}$ and rearranging terms, we get:

$$a\frac{Q_{t+2}}{K_{t+2}} = \frac{P_{t+1} \exp(r_{t+2}) - P_{t+2}(1-d)}{P_{t+2}} = \exp(r_{t+2}-\Pi_{t+2})-1+d \doteq \rho_{t+2}+d$$

where $\Pi_{t+2} = \ln \frac{P_{t+2}}{P_{t+1}}$ and $\rho_{t+2} = r_{t+2} - \Pi_{t+2}$ is the real rate of interest for period t+2.[9]

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[9] The last right hand side is obtained by using ρ_{t+2} as a linear approximation of $\exp(r_{t+2} - \Pi_{t+2})$.

The marginal cost of production (equal to average, due to the constant returns to scale assumption) in period t+2 is

$$M_{t+2} = AC_{t+2} = \frac{TC_{t+2}}{Q_{t+2}} = \frac{K_{t+2}P_{t+2}(\rho_{t+2}+d) + L_{t+2}W_{t+2}}{Q_{t+2}} .$$

Taking into account the condition deduced above and

$L_{t+2} = Q_{t+2}^{\frac{1}{1-a}}/K_{t+2}^{\frac{1}{1-a}}$, we can write:

$$MC_{t+2} = aP_{t+2} + \left(\frac{\rho_{t+2}+ d}{a}\right)^{\frac{a}{1-a}} W_{t+2} .$$

At $P_{t+2} \geq MC_{t+2}$ the firm will supply an infinite amount, while at $P_{t+2} < MC_{t+2}$ it will not supply at all. Therefore, the supply function for period t+2 and following can be written:[10]

$$(2) \quad \begin{aligned} Q_j &= \infty, & \text{for } P_j &\geq \left(\frac{\rho_j+ d}{a}\right)^{\frac{a}{1-a}} \frac{W_j}{1-a}, \\ Q_j &= 0, & \text{for } P_j &< \left(\frac{\rho_j+ d}{a}\right)^{\frac{a}{1-a}} \frac{W_j}{1-a}. \end{aligned}$$

$j=t+2,t+3,...$

Formulae (1) and (2) are, respectively, the conventional short- and long-run supply curves under constant returns to scale. Note that while the long-run supply <u>does</u> depend on the <u>real</u> rate of interest, the short-run supply <u>does not</u>. This lack of dependence of the short-run

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[10] A more familiar expression is probably

$Q_j=\infty$ if $P_j \geq \left(P_j\frac{\rho_j+d}{a}\right)^{a} \left(\frac{W_j}{1-a}\right)^{1-a}$ and $Q_j=0$ otherwise.

supply of commodities with respect to the rate of interest can be taken as the microeconomic rationale for assuming, as it is commonly done in macrotheory, that the short-run aggregate supply of commodities does not depend on credit conditions prevailing in the economy.[11]

We are expecially interested in analyzing this rationale. For this reason, let us change assumption D.1.

C. Introducing working capital as a factor of production

We shall work now with assumption D.2:

D. 2. The wage rate is paid a fraction μ of a "period" in advance of the time the output price is received.

In order to keep the analysis at its simplest level, assume further that all prices remain constant through time. In other words, the rate of inflation is zero and real and nominal interest rates are equal.

The firm will maximize the present value of the whole stream of profits:

$$\max_{Q_i, I_i, L_i} PV_t = \sum_{i=t}^{\infty} [PQ_i - I_i P - L_i W \exp(\mu r)] \exp[(-i+1-t)r].$$

Note that besides eliminating the subindices from

[11] "Credit Conditions" has a broader meaning than "the rate of interest.: While the latter will be the only relevant indicator of the credit conditions in an economy with perfect credit markets, it is possible to find circumstances under which the "quantity of some type of credit" and other indicators can also be relevant. We will discuss some of these circumstances in Chapter IV.

the prices the only difference with the previous computation of the present value is that L_iW appears multiplied by $\exp(\mu r)$. This is so because of assumption D.2. — as wages are paid a fraction μ of a period in advance of the output, it must be transformed into the equivalent value at the end of the period by applying the corresponding interests.

The first order condition that yields the supply function for period t is:

$$\frac{\partial PV_t}{\partial Q_t} = [P - \frac{\partial L_t}{\partial Q_t} W \exp(\mu r)] \exp(-r) = 0.$$

and, therefore, the supply function for period t turns out to be:

$$(3) \quad Q_t = (1-a)^{\frac{1-a}{a}} \bar{K}_t \left[\frac{W \exp(\mu r)}{P}\right]^{-\frac{1-a}{a}}$$

Following the same procedure as before, the supply function for any period from t+2 on is:

$$(4) \quad \begin{array}{ll} Q_j = \infty & \text{for } P_j \geq \left(\frac{r+d}{a}\right)^{\frac{a}{1-a}} \frac{W \exp(\mu r)}{1-a} \\ Q_j = 0 & \text{for } P_j < \left(\frac{r+d}{a}\right)^{\frac{a}{1-a}} \frac{W \exp(\mu r)}{1-a} \end{array}$$

Note that the interest rate becomes a determinant of the short-run supply of commodities. This is so because in assuming that wages are paid in advance of the sale of the output we have introduced an additional factor which, as labor, is variable even in the short run. It is currently named working capital and, in our simple specification, it is strictly proportional to labor costs. The definition of working capital given by Keynes in his A Treatise on Money is particularly useful because it clearly distinguishes working capital from speculative or surplus inventories. This distinction is very important from an analytical point of view, but in practice it is rarely taken into account.[12]

Assumption D.2 is clearly more general than D.1 (the latter is the particular case $\mu = 0$). The independence of the short run aggregate supply of commodities with respect to credit conditions (i.e.: with respect to the interest rate, when the credit market is assumed perfect) which is so commonly assumed in macromonetary theory can therefore be rationalized in only two ways:

a) either μ is practically 0, i.e., there is no such thing as working capital, or

b) the changes in interest rates are negligible in comparison with the changes in other determinants of aggregate supply, mainly the wage rate.

Both are empirical questions, but the first impression one has is that explanation a) involves a misrepresentation of the real world. With the exception of services, it is difficult to think of instantaneous processes of production. A large part of goods have production that can be measured in months. This can be visualized by the stocks of goods

[12] See Chapter I, page 48.

in the course of production that exist at any moment of time. At least a proportion of the costs involved in producing these goods in process has already been paid to the owners of the factors of production, while the final consumer has not yet paid for the final goods. This generates financial costs. They are the costs of working capital which is a factor of production different from labor and fixed capital, in that while it partakes of the nature of capital it is a variable factor even in the short run.

Explanation b) deserves a closer look. But before discussing it, we must examine two important points.

D. Real or nominal interest rates?

In order to discuss this point we have to relax the assumption on the constancy of prices. Suppose that wages and prices increase at a rate Π_i and that $W_{i-\mu}$ and $P_{i-\mu}$ are the wage rate and price of output at moment t-μ respectively. The firm will maximize:

$$PV_t = \sum_{i=t}^{\infty} [P_{i-\mu} \exp (\mu\Pi_i) Q_i - P_{i-\mu} \exp (\mu\Pi_i) I_i$$

$$- W_{i-\mu} \exp (\mu r_i) L_i] \exp (-\sum_{j=t}^{i} r_j)$$

which differs from the previous computation of the present value in that the price of output is updated to the end of each period using the rate of balanced inflation.

This means that the short-run supply of commodities must be derived from

$$\frac{\partial PV_t}{\partial Q_t} = \{P_{t-\mu} - W_{t-\mu}\exp[\mu(r_t - \Pi_t)]\ \frac{\partial L_t}{\partial Q_t}\}\ \exp(-r_t) = 0.$$

Therefore the supply function is

$$\text{(5)} \qquad Q_t = (1-a)^{\frac{1-a}{a}}\ \bar{K}_t\ [\frac{W_{t-\mu}}{P_{t-\mu}}\exp(\mu\rho_t)]^{-\frac{1-a}{a}}$$

The real interest rate is an argument of the short-run supply of commodities, as well as of the long-run supply function. While this conclusion is intuitively appealing, it should be taken with some qualifications.

Note that in computing the present value of the whole stream of profits, the wage rate for period t was deflated by multiplying by $\exp(-\mu\Pi_t)$. In other words, it is assumed that the nominal wage rate, being paid a fraction μ of a period in advance of the price of output, is consequently lower according to the rate of balanced inflation. While this is quite reasonable, it is not impossible to imagine institutional arrangements under which nominal wages behave differently. It is possible to find cases in which the nominal, rather than the real rate of interest will matter for the short run supply of commodities. But in order to discuss this possibility we need to have a specific model of the labor market. We shall come back to this question in the next chapter.

E. The effect of uncertainty about the sale price of output

Uncertainty is present in almost every aspect of a firm's operations. There may be technological uncertainty, i.e., the amount of output that is obtained with given amounts of non-stochastic inputs may be stochastic. Consideration of this kind of uncertainty would be essential if we were trying to explain, for example, an entrepreneur's decision about what proportion of his firm's equity will be offered in the stock market or what mix of safe and risky activities he will undertake.[13] But with a given institutional arrangement (i.e., taking as a datum that markets do not exist for a given number of contingent commodities) and given unchanged risky characteristics of the technologies, the presence of technological uncertainty should not affect the basic relationship between short-run supply of commodities and the real interest rate that we are discussing in this paper. Therefore, for our present purposes, it is safe enough, as well as good for simplicity, to assume that there is no technological uncertainty.

But there may also be uncertainty about the sale price of output and the cost of inputs. We cannot dispose of these complications so easily - especially those derived

[13] The role of the stock market in the allocation of risk was first pointed out by Arrow (1965). For a formal discussion of these issues in case of technological uncertainty see Diamond (1967) and Douglas (1971).

from the uncertainty about the sale price of output - because, having assumed a time lag between the moment at which some inputs are paid and the moment output is produced and sold, it may be inconsistent to assume that the sale price of output is known with certainty at the time production is decided. It can be argued that if a future market exists for every commodity, the producer will always know the forward price with certainty, and this is the price he will consider in solving his maximization problem.[14] If this is so, our previous analysis of production behavior of the firm remains totally valid but P_t must be taken to be the forward price (i.e., the price of commodities to be delivered and paid at the end of period t) that is observed at the time production is being decided. Therefore, the real interest rate is known with certainty because the relevant rate of inflation to be subtracted from the nominal interest rate is obtained by comparing the forward and spot prices of the commodities, i.e., $\rho_t = P_t - \log \frac{P_t}{P_{t-\mu}}$ where P_t and $P_{t-\mu}$ are, respectively, the forward and spot prices at moment $t-\mu$. Note that under this interpretation, the real interest rate that enters into the short run supply function of the firm is - in Hicks' terminology[15] - the commodity interest rate.

[14] For a formal derivation of this conclusion see Douglas (1972). Note that while in taking its production decision the firm will use the non-random forward prices this does not mean that it will sell all its production in the forward market.

[15] See Hicks (1939) pp. 141-42.

In actual economies there are forward markets for only a few number of commodities. We will surely be closer to reality if we assume that forward markets do not exist. Under this assumption, our previous derivation of the firm's short run supply of commodities has to be modified in order to take into account uncertainty about the sale price of output. The effects of this kind of uncertainty on the usual conclusions of the theory of the firm have been discussed by Leland [1970]. In order to get more specific results, we will substitute C.2 for our previous assumption C.1:

C. 2. The firm is a price taker in every market and its objective is to maximize the expected utility of the present value of the whole stream of future profits. At the time it decides production of period t, it knows with certainty the wage rate, the nominal interest rate and the spot price of output (let's say, $W_{t-\mu}$, r_t and $P_{t-\mu}$). The rate of sale price inflation is a normally distributed random variable with mean Π_t^e and variance $\sigma^2_{\Pi_t}$. The utility function of the firm displays constant relative risk aversion.

As the capital stock and investment for period t are predetermined, it is possible to get the supply function for period t simply by maximizing the expected utility of the excess of sales proceeds over variable costs, i.e., by maximizing $E[U(V)]$ where $V=P_{t-\mu}\exp(\mu\Pi_t)Q_t-W_{t-\mu}\exp(\mu r_t)L_t$.

Look at $U(V)$ as a function of Π_t and compute the Taylor expansion around Π_t^e, that is:

$$U[V(\Pi_t)] = \sum_{n=0}^{\infty} \frac{1}{n!} U^n [\mu P_{t-\mu} \exp(\mu\Pi_t^e) Q_t]^n (\Pi_t - \Pi_t^e)^n$$

where $U^n = \frac{\partial^n U}{\partial V^n}\Big|\Pi_t^e$ i.e., it is the n-derivative of U with respect to V evaluated at the expected value of the rate of inflation.

Taking expected value in both sides and recalling that for normal variables $E[x-E(x)]^{2n-1} = 0$ and

$$E[x-E(x)]^{2n} = \frac{(2n)!\ \sigma^2 x^n}{2^n\ n!}$$

we can write:

$$E\ U[\quad] = \sum_{n=0}^{\infty} \frac{1}{2^n\ n!} [\mu P_{t-\mu} \exp(\mu\Pi_t^e) Q_t]^{2n}\ \sigma_{\Pi_t}^{2n} \quad .$$

The firm chooses Q_t and L_t so as to maximize $E\{U[\quad]\}$ subject to the constraint imposed by the production function. Let's take the derivative of $E\{U[\quad]\}$ with respect to Q_t and equate it to zero:

$$\frac{E\{U[\quad]\}}{Q_t} = [P_{t-\mu} \exp(\mu\Pi_t^e) - W_{t-\mu} \exp(\mu r_t) \frac{\partial L_t}{\partial Q_t}] \sum_{n=0}^{\infty} \frac{1}{2^n\ n!} U^{2n+1} [\mu P_{t-\mu} \exp(\mu\Pi_t^e) Q_t]^{2n} \sigma_{\Pi_t}^{2n} + \sum_{n=1}^{\infty} \frac{1}{2^n\ n!} U^{2n} [\mu P_{t-} \exp(\mu\Pi_t^e)]^{2n}\ 2n\ Q_t^{2n-1}\ \sigma_{\Pi_t}^{2n} = 0.$$

After some algebra, and recalling that $\frac{\partial L_t}{\partial Q_t} = \frac{L_t}{(1-a)Q_t} = \frac{1}{1-a} \left(\frac{\bar{K}_t}{Q_t}\right)^{\frac{a}{1-a}}$, we get:

$$(6) \quad Q_t = (1-a)^{\frac{1-a}{a}} \bar{K}_t \{\frac{W_{t-\mu}}{P_{t-\mu}} \exp \mu(r_t-\Pi_t{}^e)]\}^{-\frac{1-a}{a}} (1+A)^{\frac{1-a}{a}}$$

where:

$$A = \frac{\sum_{n=1}^{\infty} \frac{1}{2^{n-1}(n-1)!} U^{2n} [\mu P_{t-\mu}\exp(\mu\Pi_t{}^e)Q_t]^{2n-1}\sigma_{\Pi_t}^{2n}}{\sum_{n=0}^{\infty} \frac{1}{2^n \; n!} U^{2n+1} [\mu P_{t-\mu}\exp(\mu\Pi_t{}^e) \; Q_t]^{2n} \; \sigma_{\Pi_t}^{2n}}$$

Before going into more specific results, it is convenient to note that aggregate supply (5) is a special case of (6). The latter reduces to (5) — i.e., A becomes zero — where at least one of the following events occurs:

a) The firm is risk neutral, i.e., $U^{2n} = 0$ for $n>0$, or
b) There is no uncertainty about Π_t, i.e., $\sigma_{\Pi_t}^2 = 0$.

Observe how (6) reproduces one of Leland's basic results: if the firm is risk averse, U^{2n} and U^{2n+1} will have different signs; therefore, $(1+a)^{\frac{1-a}{a}}$ will be smaller than 1 and output will be smaller than in the certainty case. On the other hand, if the firm is risk loving, $(1+A)^{\frac{1-a}{a}}$ will be greater than 1 and output will be larger than under certainty.

We can get a more specific supply function by applying the constant-relative-risk aversion assumption, i.e., by making

$$U(V) = \frac{V^{1-\gamma}}{1-\gamma}, \qquad \gamma>0, \text{ and } \neq 1.$$

Note that $U^{2n} = - \prod_{i=1}^{n} (\gamma + 2i - 2)\, V^{-\gamma-2n+2}$

and
$$U^{2n+1} = \prod_{i=1}^{n} (\gamma + 2i - 1)\, V^{-\gamma-2n+1} .$$

Substituting these derivatives in A and making some simplifications, we get:

$$A = - \frac{\mu\, \gamma\, \sigma^2_{\Pi_t}}{1 - \frac{W_{t-\mu}}{P_{t-\mu}} \frac{L_t}{Q_t} \exp[\mu(r_t - \Pi^e_t)]}$$

which, for a first approximation, can be taken to be equal to $\frac{\mu\gamma\sigma^2_{\Pi_t}}{a}$. Substituting this value of A in (6) we get:

$$(7)\ Q_t = (1-a)^{\frac{1-a}{a}} \bar{K}_t \left\{\frac{Q_{t-\mu}}{P_{t-\mu}} \exp[\mu(r_t - \Pi^e_t)]\right\}^{-\frac{1-a}{a}} \left(1 - \frac{\mu\gamma\sigma^2_{\Pi_t}}{a}\right)^{\frac{1-a}{a}}$$

What does (7) tell us about the relationship between supply of commodities and credit conditions? First, other things being constant, the expected-real-interest-rate elasticity of the supply of commodities is the same for the certainty and uncertainty cases. Second, under uncertainty about the sale price rate of inflation, the variance of the rate of inflation is an additional argument of the supply of commodities unless working capital does not exist ($\mu=0$), or the firm is risk neutral ($\gamma=0$).

F. The supply-side effect of increased interest rates

To get an idea of the possible order of magnitude of the effect of changes in real interest rates on aggregate supply and prices, it is convenient to compute the elasticity of Q_t with respect to ρ_t. From (5) we get

$$E(Q_t, \rho_t) = (1-a)^{\frac{1-a}{a}} \bar{K}_t \left(\frac{W_{t-\mu}}{P_{t-\mu}}\right)^{-\frac{1-a}{a}} \left(-\mu \frac{1-a}{a}\right) e^{-\mu \frac{1-a}{a}\rho_t} \frac{\rho_t}{Q_t}$$

$$= -\mu \frac{1-a}{a} \rho_t .$$

This means that the percentage change in the quantity supplied at each price due to a $\Delta\rho_t$ change in the real rate of interest will be

$$\frac{\Delta Q_t}{Q_t} \doteq -\mu \frac{1-a}{a} \Delta \rho_t .$$

Assuming the typical period is a quarter, $\mu=1$ and $a=\frac{1}{3}$ are plausible values for the involved parameters. Therefore

$$\frac{\Delta Q_t}{Q_t} \doteq -2\Delta \rho_t .$$

In words, the percentage decrease in the quantity supplied at each price will be around twice the absolute change in the quarterly real interest rate. If the quarterly real rate of interest increases by a full percentage point, quantity supplied will be decreased by 2 percent.

If aggregate demand is unit elastic with respect to price and within the period it is not affected by the increased real interest rate, the price level should increase by around $\frac{2}{3}$ of the absolute change in the quarterly real interest rate. That is $\frac{2}{3}$ of one percent, in the numeral example introduced above This can also be computed from (5):

$P_t\ Q_t$, which is now considered constant, can be written:

$$P_t\ Q_t = (1-a)^{\frac{1-a}{a}}\ \bar{K}_t\ [W_t\ \exp(\mu\rho_t)]^{-\frac{1-a}{a}}\ P_t^{\frac{1-a}{a}}$$

differentiating with respect to ρ_t and P_t and rearranging terms, we get:

$$\frac{dP_t}{P_t} = (1-a)\ d\rho_t \simeq \frac{2}{3}\ d\rho_t\ .$$

But note that in this computation we are assuming suppliers will fully predict the change in the relative price $\frac{P_t}{W_t}$. If this change is not predicted and, as assumed before, aggregate demand in nominal terms remains constant, the rate of price increase will have to be equal to the percentage decrease in output, that is, around twice the increase in the quarterly real rate of interest. Note that this percentage price increase will add to the expected balanced inflation already incorporated into nominal wages and interest rates.

Is the magnitude of this effect empirically significant? This question can only be answered by comparison with other supply side effects. It is helpful to note that under the previous numerical example (quarterly periods with $\mu = 1$ and $a = \frac{1}{3}$) the within period effect of an absolute increase $\Delta\rho$ on supply it is equivalent to the effect of an identical percentage increase in nominal wages ($\frac{\Delta W}{W} = \Delta\rho$). Although expressive, this comparison should be taken cautiously: nominal wages can increase continuously at a rate $\frac{\Delta W}{W}$ while it is impossible to think of the real interest rate increasing by $\Delta\rho$ each period for very long. The supply-side interest rate effect that we are analyzing is essentially a short-run phenomenon. Nevertheless, we thing and we shall try to demonstrate that such effect can introduce distressing complications in the course of stabilization plans in inflationary economies. It is in that context that we see it as an empirically significant effect deserving theoretical analysis.[16] In any case, what we have done here in attempting to illustrate the order of magnitude of the supply side effect of an increase in the real interest rate is an

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16 While it is now widely accepted that in equilibrium the long-run real interest rate does not depend on monetary and fiscal policies, it is also widely accepted that in the short-run, the real rate of interest (not necessarily an equilibrium) is affected by macropolicies. What would otherwise be the meaning of empirical research on such topics as the interest elasticity of the demand for investment and the supply of savings?. The economies with persistent inflation, policy induced changes in the real interest rate are larger than in price stable economies because such economies are subjected to larger changes in monetary expansion and in inflationary expectations.

extremely limited partial equilibrium exercise. In the next chapter we place this interest-rate effect in the context of a general equilibrium macroeconomic model.

Chapter III

CREDIT CONDITIONS AND THE SUPPLY OF COMMODITIES: MACROECONOMIC ANALYSIS

A. Introduction

The microeconomic analysis of the previous chapter suggests that the aggregate supply schedule of conventional macroeconomic models should not be considered invariant to changes in credit conditions, at least when one is interested in analyzing the effects of monetary stabilization policies in economies with persistent inflation. Our previous discussion, however, remained strictly at the partial-equilibrium level of analysis. We performed an experiment in which some variables were exogenously changed and looked at the impact effect upon the supply behavior of firms. Of course, the supply-side effect thus identified may occur simultaneously with the widely-known and discussed demand-side effects. If so, one could think of "netting out" the former from the latter effect and ask whether the results alter the theory. One possibility is that even after carrying out the general equilibrium analysis in terms of a "net demand-side effect," the conventional qualitative conclusions would be preserved. In that case, introducing the supply side effects would, at best, have added some substance to the explanation of the fall in output that is generally observed in the initial phase of monetary anti-inflationary policy. That is but one possibility, however. Consider now the case of economies with persistent inflation in which monetary policy is being tightened. If supply-side effects dominate at least during their initial quarters, a perverse dynamics may be put in operation with the result that for a while unemployment will increase and inflation will accelerate.

The objective of this chapter is to carry out the general equilibrium analysis using a simple macroeconomic model with an aggregate supply function akin to the one suggested by the microeconomic analysis of the previous chapter. Of course, the model includes an aggregate demand function as well, and also a monetary sector, assumptions about formation of expectations, and short and long-run equilibrium conditions.

We begin with a sketch of the model in order to give the flavour of the argument. Next we undertake a more detailed examination of each one of the pieces of the model, its long-run equilibrium properties, and the short-run dynamics under alternative assumptions about expectations and the precise value of some key parameters. Finally, we introduce some complications such as real wage response to unemployment, and the possible dependence of aggregate supply with respect to the nominal (rather than to the real) interest rate.

B. A sketch of the macroeconomic model

In order to discuss our main thesis, we use an aggregate model of output and price level determination that includes the supply equation derived in hapter II, but that in all other aspects involves very conventional assumptions. A very simple version of the model is the following:

$$(1)\quad \log E = \log P^e + \log Q^e + e_\rho(\rho-\bar{\rho}) + e_m\,[1+(\ell\rho+e_\rho)\theta]$$

$$(\log MS - \log MD') \qquad e_\rho<0,\ e_m>0,\ \ell_\rho<0;$$

$$(2)\quad \log Q = \log K - \frac{1-a}{a}(\log W - \log P) - \mu\,\frac{1-a}{a}\,\rho$$

$$- \frac{\mu\ \gamma\ (1-a)}{a^2}\,\sigma^2_{\Pi_t} \qquad 0<a<1,\ \mu>0,\ \gamma>0;$$

$$(3)\quad \rho = \bar{\rho} + \ (\log MD' - \log MS) \qquad 0<\theta<-\frac{1}{\ell_\rho+e_\rho};$$

$$(4)\quad \log W - \log P = \bar{w} + \varepsilon(\log Q - \log Q^e) \qquad \varepsilon>0;$$

where:

E	is total expenditures;
P	is the price of output;
W	is the wage rate;
Q	is the level of output;
K	is the stock of fixed capital;
L	is the level of labor input;
MS	is money supply;

MD' is money demand evaluated at the long-run equilibrium real interest rate and at a level of expenditures equal to P^eQ^e;

ρ is the real rate of interest;

σ^2_Π is the variance of expected inflation;

w is the real wage rate;

e as a upper index means "expected";[1]

e_ρ, ρ_m, ℓ_2, a, μ, γ, θ and ε are parameters.

The bar above the letters indicates a long run equilibrium level.

Equation (1) is an expenditure equation in nominal terms which assumes unitary price elasticity of aggregate demand. In a more elaborate version we shall distinguish between demand for consumption, for investment, and for inventory, but in order to keep the present version simple, we assume that expenditure will equal expected nominal income whenever the real rate of interest is equal to a long run equilibrium level $\bar{\rho}$, and the money market is in equilibrium.

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[1] The perfectly competitive economies expections refer only to prices. We read Q as "expected real output" to simplify the exposition, but the rigorous reader will prefer to regard this as permanent real income or planned level of output implicit in investment decisions depending on the context of the discussion (consumption or investment theory, respectively).

If the actual real rate of interest is higher than that long run level, it will depress expenditures and conversely. The intensity of this effect is measured by e_ρ.

A positive excess supply of money will increase expenditures, while a negative excess supply of money will depress them.

It is assumed that only part of the excess supply of money spills over to the commodity markets. This is the excess that remains after the real interest rate has adjusted as far as it will to eliminate part of the monetary disequilibrium. That is why in (1) log MS - log MD' appears multiplied by $[1+(\ell_\rho+e_\rho)\theta]$ where ℓ_ρ is the elasticity of money demand with respect to the real interest rate, and θ is the proportion of log MS - log MD' by which the actual real interest rate differs from the long run equilibrium rate. This can be seen in equation (3). If, for example, it is assumed that the real interest rate will move all the way to the level necessary to restore equilibrium in the money market, then θ has to equal $-\frac{1}{\ell_\rho+e_\rho}$ and there will be no direct spill over effects on the commodity market. Yet, expenditures will be affected by the shift of the real interest rate away from its equilibrium value. Note that e_m is the elasticity of expenditures with respect to the monetary disequilibrium which remains after the real rate of interest has shifted away from $\bar{\rho}$ to close part of the initial gap that results from the monetary shock.

Equation (2) is the aggregate supply equation that results from taking logs in (7) of Chapter II and disregardingintercept and second and higher order terms.

As we already said, we assume that the real rate of interest will move away from the long-run level as a consequence of monetary disequilibrium. This assumption is formalized in equation (3).

Finally, equation (4) allows for the real wage rate to respond to unemployment (which for simplicity is measured by log Q - log Q^e) according to an elasticity .

Using (3) in substituting for $\bar{\rho}$- and (4) in substituting for log W - log P in (1) and (2), we get (1a) and (2a).

$$\text{(1a)}\quad \log E = \log P^e + \log Q^e + \{e_m \{e_m[1+(\ell_\rho+e_\rho)\theta]-e_\rho\theta\} (\log MS - \log MD')$$

$$\text{(2a)}\quad \log Q = \frac{a}{a+\frac{1-a}{a}\varepsilon}\log K - \frac{1-a}{a+\frac{1-a}{a}\varepsilon}\bar{w} + \frac{1-a}{1+\frac{1-a}{a}\varepsilon}\log Q^e_t$$

$$+ \mu\frac{1-a}{a+(1-a)\varepsilon}\theta(\log MS - \log MD') - \frac{\mu.\gamma.(1-a)}{a[1+(1-a)}\varepsilon]\sigma^2_{\Pi_t}.$$

Equation (1a) tells us that, given expectations, the elasticity of expenditures with respect to the supply of money is $e_m\,[1+(\ell_\rho+e_\rho)\theta] - e_\rho\theta$ (which is greater than zero because e_ρ is negative, e_m and θ are positive and θ is always smaller than $-\frac{1}{\ell_\rho+e_\rho}$). Equation (2a) says that the elasticity of real output with respect to money supply is $\mu\frac{1-a}{1+(1-a)\varepsilon}\theta$, which is also positive. If we further assume that the commodity market clears within the period of the analysis, but that expectations are not affected by current events, it is already possible to derive our two basic conclusions:

1) If working capital exists ($\mu>0$), and the real interest rate is affected by monetary policy ($\theta>0$), then the rate of growth of output will necessarily decline as a consequence of a restrictive monetary policy. The condition for this to happen is $\mu\frac{1-a}{1+(1-a)\varepsilon}\theta > 0$, which is always satisfied under the above assumptions.

2) If the supply-side effects of the restrictive monetary policy are large enough, namely if

$$\mu\frac{1-a}{a+(1-a)\varepsilon}\theta > e_m[1+(\ell_\rho + e_\rho)\theta] - e_\rho\,\theta ,$$

monetary restriction will begin accelerating inflation.

Note that the period of the analysis has to be short enough to render the assumption of unchanged expectations and capital stock acceptable. Therefore (1) and (2) should be interpreted as referring to the impact effects of monetary restriction on output and prices. In order to trace the dynamics of output and prices in future periods, it is necessary to specify the mechanism for the formation of expectations. We shall deal with this complication later on, but, even at the present state, conclusions (1) and (2) give the substance of our findings.

The existance of working capital and the sensitivity of the real interest rate to monetary restriction are enough to explain the fall of output that usually follows as a consequence of monetarist estabilization policies. Note that this conclusion has been derived without assuming price inflexibility, an assumption to which economists usually resort in order to explain that phenomenon.

A combination of fall in output and acceleration of inflation following monetary restriction can also be explained by the model. The likelihood of such an outcome increases along with the importance of working capital as well as with the sensitivity of the real interest rate to monetary restriction (θ), and with the elasticity of output with respect to labor ($1-a$). On the other hand, high sensitivity of real wage to a fall in output (a larger ε), and large elasticities of expenditure with respect to monetary disequilibrium and the real interest rate (large e_m and e_ρ) diminish the likelihood of a fall in output with accelerating inflation.

The following sections are devoted to a more detailed discussion of each one of the components of the model as well as the properties of the long run equilibrium and the short-run dynamics of output and prices.

C. Aggregate demand for commodities

In a more elaborate version of the model the expenditure function is assumed to be:

$$E_t = C_t + I_t + \Delta SI_t$$

where E_t is total expenditure in nominal terms;

C_t is consumption in nominal terms;

I_t is investment in nominal terms;

ΔSI_t is change in surplus inventories[2] in nominal terms.

$$C_t = cY_t^e = c\, Q_t^e P_t^e$$

C_t is taken to be a constant proportion of expected income which, by definition, is equal to permanent income in real terms (Q^e) times the expected price level (P_t^e). This specification can be justified either in terms of Modigliani's Life Cycle or of Friedman's Permanent Income theories of the Consumption Function.[3] For simplicity, we assume that, in the short run, c is independent of the interest rate[4]

2 We are using here Keynes' distinction between "surplus inventories" or "liquid capital" and "working capital." See Keynes [1930], Vol. VI, pp. 91 and 103. Normally, "change in inventories" as estimated in the national accounts includes some portion of changes in both surplus inventoreis and working capital. Changes in inventories of goods held by households are usually not included in the national accounts concept but they are in our definition of surplus inventories.

3 See Ando & Modigliani [1963], and M. Friedman [1957].

4 In order to be consistent with the superneutrality-of-money-assumption, later on to be introduced, we have to allow for the long-run steady value of c to vary along with that of $\bar{\rho}$ (the long-run equilibrium value of the real rate of interest corresponding to each path of steady growth). See Sidrauski [1967a]. Cf. Tobin [1965] and Sidrauski [1967b]. See also fnn. (1) and (2) of Chapter II.

and that there are no changes in the age structure of the population, but none of our results is crucially dependent upon these assumptions.

We now move on to the investment function:

$$I_t = P_t^e \left[a \frac{Q_{t+1}^{ee}}{\rho_{t+1}^{ee} + d} - a \frac{Q_t^{ee}(1-d)}{\rho_t^{ee} + d}\right] .$$

Investment in nominal terms is taken to equal the desired level of real investment, inflated by the expected price level.[5] The former is computed as the difference between the desired levels of capital stock for the beginning of periods t and t+1. It was assumed in the previous chapter that investment during period t is decided in period t-1, and it adds to capital stock for period t+1. Therefore Q_{t+1}^{ee} and ρ_{t+1}^{ee} mean output and real interest rate for period t+1 as "expected" in period t-1. (We use two e's as upper indices to indicate that expectations have been found two periods before.) Note that this investment behavior implies the assumption that at the time the aggregate of firms decide investment, they plan to build up just the stock of capital that is optimal, taking into account the expected level of output and real interest rate for two periods ahead, i.e., for the first period

[5] Production of capital goods is usually undertaken on the basis of long-run, indexed contracts. This means that whenever actual prices and expected prices differ, the nominal value of I_t must be adjusted accordingly, while the physical amount of investment remains fixed as stipulated in the contract. Allowing for this complication here would not alter the substance of the analysis significantly, but it would vastly complicate the arithmetic, so that we have chosen to retain the more simple version in the text.

during which investment will actually add to the productive stock of capital. It is shown in the previous chapter that from the first order conditions of profit maximization it follows that the optimal stock of capital must satisfy $a\frac{Q}{K} = \rho + d$. Therefore, $a\frac{Q_t^{ee}}{\rho_t^{ee}+d}$ is the optimal stock of capital for period t when planned at period t-2, and $a\frac{Q_{t+1}^{ee}}{\rho_{t+1}^{ee}+d}$ is the optimal stock of capital at period t+1 when planned at period t-1.

This investment function is basically Jorgenson's "Neoclassical Investment Function,"[6] the only difference being that expected instead of actual level of output is used in computing the marginal productivity of capital to be equated to the rental price of capital. We introduced this modification in order to take into account a suggestion by Mundlak[7] which turns out to be very useful in establishing a smooth bridge between short-run temporary equilibrium and long-run steady state equilibrium.[8]

Let us now specify the change in surplus inventories:

$$\Delta SI_t = \Delta SI_t + \Delta SI_t^m$$

where ΔSI_t is change in surplus inventories induced by changes in the real interest rate and ΔSI_t^m is the spill-

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6 See Jorgenson [1963] and [1972].

7 See Mundlak [1966] and [1967].

8 We assume that any possible fall in expected out-

over effect of the disequilibrium in the money market.

We will further assume

$$\Delta SI_t^{\rho} = (C_t + I_t)\ \{\exp[e_{\rho}(\rho_t - \bar{\rho})] - 1\} \qquad e_{\rho} \leq 0;$$

This means that ΔSI_t^{ρ} will be zero when the actual real rate of interest is equal to $\bar{\rho}$ (the long-run equilibrium real rate of interest); will be positive when the actual rate of interest is below $\bar{\rho}$; and negative when it is above $\bar{\rho}$. In other words, a low actual rate of interest will induce accumulation of surplus inventories and a high actual rate of interest will induce their liquidation. This is the conventional assumption on the influence of interest rate on inventories. The functional form adopted greatly simplifies the arithmetic but it is not essential to our conclusions.

With respect to ΔSI_t^m, we shall assume:

$$\Delta SI_t^m = (C_t + I_t + \Delta SI_t)\ [(\frac{MS_t}{MD_t^{"}})^{e_m} - 1], \quad e_m \geq 0;$$

MS_t is money supply;

$MD_t^{"}$ is money demand evaluated at a level of expenditures equal to $C_t + I_t + \Delta SI_t^{\rho}$ and the market real rate of interest.

We want ΔSI_t^m to be: zero when $MS_t = MD_t^{"}$, i.e., when the money market is in equilibrium; negative when $MS_t < MD_t^{"}$,

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put from full capacity level implies a fall in the optimum stock of capital smaller than capital depreciation. In other words, we are assuming that expected outputs will be so that in no case desired gross investment becomes negative.

and positive when $MS_t > MD''_t$. The rationale for this specification will become clear after the discussion of the monetary side of the model. For the time being, the following intuitive explanation should help: changes in surplus inventories are the result of economic agents' decisions about the asset composition of their total wealth. Here we are assuming that when there is some disequilibrium in the money market there will simultaneously be a disequilibrium of the opposite sign in the commodity market. This disequilibrium will adopt the form of changes in surplus inventories.[9] The particular functional relationship between ΔSI^m_t and $\frac{MS_t}{MD''_t}$ given above has been chosen because it satisfies the specification restrictions mentioned above, and also permits a simple reduction of the model to a pure monetarist version, and it simplifies the arithmetic.

Summing up, expenditure can be written

$$E_t = [c(Q_t P_e) + P^e_t \left(a \frac{Q^{ee}_{t+1}}{\rho^{ee}_{t+1}+d} - a\frac{Q^{ee}_t(1-d)}{\rho^{ee}_t+d}\right)]$$

$$\exp[e_\rho(\rho_t - \bar{\rho})]\left(\frac{MS_t}{MD''_t}\right)^{e_m}$$

9 We cannot yet discuss the relationship between the absolute sizes of these opposite sign disequilibria because we are going to introduce a third asset (namely, short-term commercial debt) and naturally we can not apply Walras' law but to the markets for the three assets taken together.

$$= P_t^e \; [cQ_t^e + a(\frac{Q_{t+1}^{ee}}{\rho_{t+1}^{ee}+d} - \frac{Q_t^{ee}(1-d)}{\rho_t^{ee} + d})] \; \exp[e_\rho(\rho_t-\bar{\rho})]$$

$$(\frac{MS_t}{MD_t^*})^{e_m}$$

and taking logs:

$$(5) \quad \log E_t = \log P_t^e + \log \; [cQ_t^e + a(\frac{Q_{t+1}^{ee}}{\rho_{t+1}^{ee}+d} - \frac{Q_t^{ee}(1-d)}{\rho_t^{ee} + d})]$$

$$+ e_\rho(\rho_t-\bar{\rho}) + e_m(\log MS_t - \log MD_t^*) \; .$$

Expression (5) is a somewhat more elaborate version of the expenditure equation (1). From here on we shall usually work with expression (5).

If we add the assumption of unitary elasticity of aggregate demand with respect to prices, then we can write the aggregate demand function as:

$$(6) \quad \log Q_t^d = -\log P_t + \log E_t.$$

Before going into aggregate supply, it should be emphasized that the specification adopted for aggregate demand allows for all the usual linkages between expenditure and monetary policy, (the only exception being the dependence of consumption upon the interest rate, which was ruled out for simplicity and which does not seem to be empirically relevant. Moreover, that specification models the direct link between expenditure and money market disequilibria that is a crucial piece of the Monetarist Quantity Theory of nominal income determination.[10] While this direct-link assumption works against the empirical importance of the main thesis in this paper, we decided that it should be adopted if we wanted to capture in the model the main characteristics of economies with persistent inflation.

D. Aggregate supply of commodities

We take our short-run aggregate supply from the previous chapter.

$$Q_t = (1-a)^{\frac{1-a}{a}} K_t \left[\frac{W_t}{P_t} \exp(\mu\rho_t)\right]^{-\frac{1-a}{a}} \left(1 - \frac{\mu\gamma\sigma^2_{\Pi_t}}{a}\right)^{\frac{1-a}{a}}$$

Applying our previous assumption about investment, K_t is equal to $a\frac{Q_t^{ee}}{\rho_t^{ee}+d}$. After substituting for K_t and taking logs and using a linear approximation of $\log\left(1 - \frac{\mu\gamma\sigma^2_{\Pi_t}}{a}\right)$, we get:

$$\text{(7)} \quad \log Q_t = \frac{1-a}{a}\log(1-a) + \log a + \log Q_t^{ee} - \log(\rho_t^{ee} + d)$$
$$- \frac{1-a}{a}(\log W_t - \log P_t) - \mu\frac{1-a}{a}\rho_t$$
$$+ \frac{\mu\gamma(1-a)}{a^2}\sigma^2_{\Pi_t}.$$

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10 See Grossman (1971). His differentiation between Expenditure and Quantity Theories relies in the excess supply (commodities or money) that is taken as the argument for the dynamic price equation. Our specification can be compatible with either of these two extreme cases. All that is needed is to adopt convenient numerical values for the parameters.

In order to complete our description of aggregate supply of commodities, we have to specify the supply of labor.

To begin with a simple assumption, we postulate an infinitely elastic supply of labor at a fixed real wage rate $\bar{w}$. Therefore:

$$W_t = \bar{w}\, P_t^e$$

and, after taking logs

$$\log W_t = \log \bar{w} + \log P_t^e \tag{8}$$

This assumption can be rationalized in three alternative ways:

a) The economy has surplus labor and $\bar{w}$ is a subsistence wage, or

b) There are strong trade unions which try to keep a constant real wage for their employed members, or

c) $\bar{w}$ is the long run steady state equilibrium wage rate of this economy compatible with full employment (or with a "natural rate of unemployment"), and, for some reason, workers and firms choose to make their contracts in such a way that $\bar{w}$ is kept constant.[11] If $\bar{W}$ has to be compatible with full employment (given in the factor price frontier of this economy) it has to correspond to a real

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[11] For a microeconomic rationale of such contracts, see Azariadis [1975] and Baily [1974].

interest rate $\bar{w}$ that brings about the propensity to save that is just necessary to keep the stock of capital growing at the rate of growth of thelabor force measured in efficiency units.

Interpretation c) will allow us to release the constant real-wage assumption when the economy is out of the long-run, steady-state equilibrium path, without changing the steady-state equilibrium properties of the model. In other words, we shall be able to assume that in the short run the supply of labor is an upward sloping function of the real wage; or, what is equivalent, that the wage rate will be responsive to deviations of unemployment away from the "natural" of "full employment" rate of unemployment. Formally: real wage = $w_t = f(u_t - \bar{u})$ where $\bar{u}$ is the "full employment" or "natural" rate of unemployment.

We will deal with this complication in a later section of this chapter. For the time being, we stick to (8).

Substituting (8) into (7), we get:

$$\text{(9)} \quad \log Q_t = \frac{1-a}{a} \log (1-a) + \log a + \log Q_t^{ee} - \log (\rho_t^{ee} + d) - \frac{1-a}{a} \log \bar{w} - \mu \frac{1-a}{a} \rho_t + \frac{\mu\gamma(1-a)}{a^2} \sigma^2_{\Pi_t}.$$

E. Monetary sector

From the point of view of the stock equilibrium (or LM side of our model), we shall work with three assets: money, bonds (which we fashion as a short-term commercial debt) and commodities. Therefore we need asset-demands for money, bonds and commodities. The conventional way to specify these asset-demands would be to assume that they are homogeneous of the first degree in total wealth, and that they are functions of the rates of return associated with each. But we have to consider two complications: on the one hand, commodities do not only play the role of a store of value but are also used to satisfy people's needs (consumption). On the other hand, money, in addition to being a store of value, is used as a means of exchange, i.e. as an essential input to generate the commercial services inherent to exchange economies (transactions motive to hold money). If we were assuming that the economy is always in steady-state long-run equilibrium, consumption and total transactions would be proportional to total wealth; and, by adding a constant-returns-to-scale assumption for the production of commercial services, we could still live with demands for money, bonds and commodities that are homogeneous of the first degree in wealth and are functions of the rates of return of the three assets. The solution is not so simple, however, when we are interested in allowing for the possibility of short-run temporary equilibria outside of the steady-state, long-run equilibrium path. In such a situation consumption and total transactions need not be a constant proportion of wealth. Therefore in specifying the demand for money and for commodities we have to decide whether we will keep wealth and add new arguments, or substitute new arguments for wealth, or simply forget about the new arguments. In order to keep our model simple we assume that the transactions-motive dominates in the demand for money and therefore we use the level of expenditure, rather than level of wealth as the main argument of this function. We also assume a unitary elasticity of money demand with respect to expenditures.

The demand for money is postulated to be

$$\frac{1}{V_t} = \frac{MD_t}{E_t} = \exp\ (\ell_\rho \rho_t + \ell_\Pi \Pi_t^e),$$

and in logs

$$\text{(10)} \quad \log MC_t - \log E_t = \ell_\rho \rho_t + \ell_\Pi \Pi_t^e .$$

Real cash balances demanded depend upon expenditures, the real interest rate, and the expected rate of inflation. Note that $\ell_\rho = \ell_\Pi = \ell$ implies that

$$\frac{MD_t}{E_t} \exp[\ell(\rho_t + \Pi_t^e)] = \exp\ (\ell\ r_t),$$

that is, real cash balances demanded are a function of expenditures and the nominal interest rate as it conventionally assumed. Therefore our assumption includes the conventional one as a special case. The only nonfamiliar feature of the specification we are adopting is that we use a doublelog linear function with exp(r) as argument instead of r. This means that the elasticity of $\frac{MD}{P}$ with respect to r will not be constant but equal to $\ell \frac{r}{1+r}$. This assumption does not affect the conclusions but greatly simplifies the arithmetic. That is the only reason why we have adopted it.[12]

Looking in retrospect at the expenditure function given in (5), one could think that, abstracting from the term $e_m(\log MS_t - \log MD_t^*)$, our consumption and investment functions are flow-demands, with the specification suggested by the most familiar theories of consumption and investment, but that an explicit consideration of the asset role of commodities is missing. This is not really so. The investment function has been obtained from an explicit stock demand for fixed capital to be used as a factor of produc-

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[12] It is possible to give a precise economic meaning to the specification adopted. The individual has to decide if he holds money, bonds or goods. The price of goods today is $\exp(-\Pi_t^e)$ and the price of bonds today is $\exp(-r_t)$. If we adopt the specification $\frac{MD_t}{E_t} = [\exp(-\Pi_t^e)]^{\alpha}\ [\exp(-r_t)]^{\beta}$, we are assuming the elasticity of demand of real money is constant with respect to the price of its substitutes. If we make $\alpha = -\ell_\rho$ and $\beta = -\alpha - \ell_\Pi$ then we get the specification adopted above.

tion, and it was specified in such a way that the expected marginal productivity of capital minus the depreciation rate (i.e., the expected net return of commodities as an asset) is equal to expected real interest rate (the expected net return of bonds). In steady-state long-run equilibrium there is no reason why somebody would want to hold commodities in deficit or excess of this optimal capital stock and therefore, the third component of aggregate demand (change in surplus inventories) has to be zero. In order to make clear why ΔSI_t (change in surplus inventories), out of steady-state long-run equilibrium can be different from zero, we need to look at the role of ρ_t in clearing the money market. Let's imagine that the economy has been in steady-state, long-run equilibrium and, of course, ΔSI was equal to zero. Now, in period t, the government decides to decrease the amount of money supplied, and for that reason engages in open market operations. We are interested in looking at the temporary equilibrium of this economy in period t given the inherited stock of capital and assuming that expectations, as formed at the beginning of period t, are not modified by current-period events.[13]

[13] This is the essence of "temporary equilibrium" as a dynamic method of economic analysis. See Hicks [1939], pp. 65-67. See also Arrow & Han [1971], p. 136.

Initially we have a net excess demand for money originated in the government's open market operations equal to the decrease in money supply decided by the government, i.e.,

$$ESM_t = M_t - (C_t + I_t) \exp(\ell_\rho \bar{\rho}) \exp(\ell_\Pi \Pi^e_t),$$

where ESM_t means excess supply of money (i.e., when there is a net positive demand for money, ESM_t has to be negative) and $\bar{\rho}$ is the long-run equilibrium real interest rate. Note that we replace E_t by $C_t + I_t$ in computing the demand for money because both ΔSI^ρ and ΔSI^m are initially assumed to be zero. Note also that this excess demand for money is an ex-ante concept and will not be observed because transactions in the bond market will not take place at the long-run equilibrium real interest rate $\bar{\rho}$ but at the actual real ρ_t (which very likely will not be equal to $\bar{\rho}$). This in turn will make ΔSI^ρ different from zero. It is conceivable that ρ_t will move all the way so as to clear the money market, i.e., so that the ex-post excess supply of money is zero. In such a case the temporary equilibrium will be such that every economic agent will be on its notional excess-suply curve in every market. This temporary equilibrium may lie outside of the steady-state long-run equilibrium path and expectations may be falsified, but, conditional to the expected values Q^e_t, P^e_t, and Π^e_t and the inherited capital stock, all excess supplies will be zero. In such a situation there is still no reason for

ΔSI_t^m to be different from zero,[14] although the difference between ρ_t and $\bar{\rho}$ has induced a change in the optimal level of current inventories. This was taken into account by ΔSI_t^{ρ}, which is now different from zero, and, together with the change in ρ itself, has helped in restoring equilibrium in the money market.

But let us now consider the case in which ρ_t does not move all the way to clear the money market (i.e., there is some sort of real-interest-rate rigidity). In such a case we will have "fix price" disequilibrium[15] and ΔSI_t^m would be the difference between the "effective" and "notional" demands for commodities.[16] In our specification of aggregate demand for commodities $C_t + I_t + \Delta SI_t^{\rho}$ would represent the

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[14] This is not strictly so. When we allow for the possibility of impoerfect foresight (i.e., expectations may end up being falsified) we are introducing uncertainty. One could argue that some proportion of people's wealth is going to be held in the form of commodities (in addition to the stock of capital needed for production) because of uncertainty about inflation, in the same way that one can demonstrate that some positive amount of money will be demanded (in addition to that neede for transactions purposes) due to uncertainty about the interest rate (see for example Tobin [1958]). For simplicity we are omitting this possibility.

[15] For a revision of this concept see Hicks [1965], pp. 76-93, or Barro & Grossman [1971].

[16] We are reasoning as if there existed a market for money where it can be traded against goods. Actually, there exist markets for commodities and bonds where each of them are traded against money. "Money buys goods, and goods do not buy money," In Patinkin words. See Patinkin [1955], p. xxiii. See also Grossman [1971], p. 951. For that reason, it would have seemed less artificial to specify demand functions for goods and bonds and let the money demand be derived from them and Walras' law. Had we done this we should have argued that the quantity constraint due to the fixed ρ_t is operative in the bond

the notional demand for commodities and $C_t + I_t + \Delta SI_t^{\rho}$ $+ \Delta SI_t^m$ would be the effective demand for commodities when the amount of money that can be obtained (gotten rid of) at the market interest rate ρ_t is constrained to a fixed amount smaller (larger) than the amount desired. If in a situation of tight monetary policy ρ_t does not increase enough, and people cannot build up the desired cash balances, they will probably decide on a smaller effective demand of commodities than otherwise (i.e., ΔSI_t^m will be negative). If in a situation of expansionary monetary policy ρ_t does not decrease enough and people can not get rid of the excess money at the market rate ρ_t, they will probably decide on a larger effective demand of commodities than otherwise (i.e., ΔSI_t^m will be positive). Let $\overline{ESM_t'}$ be the net amount of money that people are constrained to hod in excess or defect of their notional demand at the market rate ρ_t, and let ESB_t' be the effective excess supply of bonds at the market rate ρ_t; then, by Walras' law, we have:

$$\Delta SI_t^m + ESB_t' + \overline{ESM_t'} = 0$$

market and spills over to the commodity and money markets. This is the approach adopted by Grossman [1971]. To be in line with more conventional macro-models, we have chosen to specify the demand for money and commodities and let the demand for bonds to come out from them and Walras' law. Consequently, we shall reason *as if* the quantity constraints were present in the money market. This approach does not introduce logical mistakes into the argument and the whole story could be rewritten without substantive changes in the Patinkin and Grossman's way.

or

$$\Delta SI_t^m + ESB_t' = - \overline{ESM_t'} \quad .$$

It seems plausible to rule out the possibility of different signs for ΔSI_t^m and ESM_t' (i.e., to rule out the possibility of people buying <u>more</u> (less) commodities <u>or</u> bonds when they are not getting (disposing of) all the money they want). Therefore ΔSI_t^m must be zero when $\overline{ESM_t'}$ is zero and for all other values the sign must be the opposite of that of $\overline{ESM_t'}$. Note that

$$\overline{ESM_t'} = \bar{M}_t - (C_t + I_t + \Delta SI_t^{\rho}) \exp (\ell_{\rho}\rho_t) \exp (\ell_{\Pi}\Pi_t^e)$$

and differs from ESM_t because money demand is evaluated at ρ_t instead of $\bar{\rho}$. This means that in our specification of the expenditure function (5), MD_t'' has to be

$$MD_t'' = (C_t + I_t + \Delta SI_t) (\exp (\ell_{\rho}\rho_t) \exp (\ell_{\Pi}\Pi_t^e), \text{ or}$$

(11) $\log MD_t'' = \log (C_t + I_t + \Delta SI_t) + \ell_{\rho}\rho_t + \ell_{\Pi}\Pi_t^e$.

Now it is possible to see clearly the origin of the restrictions previously imposed on the specification of ΔSI_t^m.[17]

[17] As far as the functional form is concerned, it would seem more natural to assume that $\Delta SI_t^m = -\gamma \overline{ESM_t'}$ and $ESB_t' = -(1-\gamma) \overline{ESM_t'}$ with γ and $1-\gamma$ being spill over coefficients. (Still better, we could say $\Delta SI_t^m = \overline{ESB_t'}$ and $ESM_t' = (1-\theta) \overline{ESB_t'}$ where $\theta = \frac{\gamma}{1-\gamma}$ and look at the situation as one of a quantity constraint in the bond market due to a non-clearing rigid real interest rate that is spilling over to the commodity and money markets with proportions θ and $1-\theta$ respectively.) We have assumed instead that

We have not yet specified how is ρ_t determined. We assume:

$$\exp\,(\bar{\rho} - \rho_t) = \left(\frac{MS'_t}{MD'_t}\right)^{\theta}$$

or, after taking logs,

$$\text{(12)}\quad \bar{\rho} - \rho_t = \theta(\log MS_t - \log MD'_t) \qquad \text{with } 0 \leq \theta \leq - \frac{1}{\ell_\rho + e_\rho};$$

where

$$\text{(13)}\quad \log MD'_t = \log\,(C_t + I_t) + \ell_\rho \bar{\rho} + \ell_\Pi \Pi^e_t,$$

i.e., MD'_t is the demand for money, evaluated at the long-run equilibrium value of the real interest rate.

We impose the restriction $\theta \leq - \frac{1}{\ell_\rho + e_\rho}$, in order to prevent ρ_t from adjusting in excess of what is required in order to restore equilibrium in the money market. This can easily be seen by substituting $- \frac{1}{\ell_\rho + e_\rho}$ for in (12) and rearranging terms so as to get

$$\log MS_t = \log\,(C_t + I_t + \Delta SI^\rho_t) + \ell_\rho \rho_t + \ell_\Pi \Pi^e_t = \log MD''_t\,.$$

. comparing (11) and (13) we can see that an ex-ante disequilibrium in the money market due to an open market operation will affect the interest rate and, to the extent

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$$\Delta SI^m_t = \left[\left(\frac{MS_t}{MD''_t}\right)^{e_m} - 1\right]\,(C_t + I_t + \Delta SI^\rho_t)$$

because it permits a simple reduction of our model to a monetarist version and it simplifies the arithmetic. Since, however, there is nothing in the theory that would suggest that spill over coefficients are constant proportions, our specification is as plausible (or unplausible) as any other alternative.

that the change in the interest rate is not enough to clear the money market, it will aslo affect aggregate demand for commodities. The magnitude of the spillover effects of money market disequilibrium on bonds and commodity markets is not specified a priori. If $\theta = -\frac{1}{\ell_\rho + e_\rho}$ the interest rate will move all the way necessary to bring $MS_t = MD''_t$, and the direct effect of money disequilibrium on aggregate demand will be zero. If, on the other hand, $\theta = 0$, then the real interest rate will be unaffected by the money market disequilibrium (ρ_t will be always equal to $\bar{\rho}$) and it will probably have a large spillover effect on the commodity market (thiss spillover could still be zero if e_m is zero). In other words, if $\theta = 0$, the actual real interest rate would, even in the short run, would be a pure non-monetary phenomenon. On the other hand, if $\theta = -\frac{1}{\ell_\rho + e_\rho}$, it would be a pure monetary phenomenon.

Before leaving this section it is useful to look at a relationship between the two measures of monetary disequilibrium that we have been using. If we add and subtract $\ell_\rho(\rho_t - \bar{\rho})$ and $e_\rho(\rho_t - \bar{\rho})$ to $\log MS_t - \log MD''_t$, we get:

$$\log MS_t - \log MD''_t = \log MS_t - \log MD'_t + (\ell_\rho + e_\rho)(\rho_t - \bar{\rho})$$

and using (12), we get

$$\log MS_t - \log MD''_t = [1 + \theta(\ell_\rho + e_\rho)](\log MS_t - \log MD'_t)$$

$$= (\frac{1}{\theta} + \ell_\rho + e_\rho)(\rho_t - \bar{\rho}).$$

This identity enables us to rewrite aggregate demand (6) as follows:

$$(6) \quad \log Q_t^d = -\log P_t + \log P_t^e + \log [cQ_t^e + a(\frac{Q_{t+1}^{ee}}{\rho_{t+1}^{ee}+d} - \frac{Q_t^{ee}(1-d)}{\rho_t^{ee} + d} + \{e_m[1-(\ell_\rho+e_\rho)\theta]-e_\rho\theta]\}(\log MS_t - \log MD_t').$$

In the same way, aggregate supply (7) can be rewritten:

$$(7a) \quad \log Q_t = \frac{1-a}{a}\log(1-a) + \log a + \log Q_t^{ee} - \log(\rho_t^{ee}+d) - \frac{1-a}{a}(\log W_t - \log P_t) - \mu\frac{1-a}{a}\bar{\rho} + \frac{\mu\gamma(1-a)}{a^2}\sigma_{\Pi_t}^2 + \mu\frac{1-a}{a}\theta(\log MS_t - \log MD_t') .$$

F. Long-run equilibrium

Let us look at the model in terms of equations (6), (7), (8), (10), (12), and (13). The long-run equilibrium conditions are:

$$(14) \quad Q_t^d = Q_t; \text{ or } P_tQ_t = E_t$$

$$(15) \quad MS_t = MD_t$$

and all expectations are realized, i.e.:

$$(16) \quad P_t^e = P_t,\ Q_t^{ee} = Q_t^e,\ \rho_t^e = \rho_t,\ \rho_t^{ee} = \rho_t^e = \rho_t = \bar{\rho} .$$

Although we are interested in short-run equilibrium it is useful and instructive to analyze the characteristics of the long-run steady-state equilibrium.

If, in aggregate demand (6) we apply conditions (14), (15) and (16), we get

$$\log P_t + \log Q_t = \log P_t + \log \left[cQ_t + a\frac{Q_{t+1}}{\bar{\rho}+d} - a\frac{Q_t(1-d)}{\bar{\rho}-d}\right]$$

This implies that

$$\log \left[c + a\frac{Q_{t+1}}{Q_t(\bar{\rho}+d)} - a\frac{(1-d)}{\bar{\rho}+d}\right] = 0,$$

or

$$c + a\frac{Q_{t+1}}{Q_t(\bar{\rho}+d)} - a\frac{(1-d)}{\bar{\rho}+d} = 1, \text{ and solving for } \frac{Q_{t+1}}{Q_t}$$

$$\frac{Q_{t+1}-Q_t}{Q_t} + d = (1-c)\frac{\bar{\rho}+d}{a} = (1-c)\frac{Q}{K} \tag{17}$$

which is a variant of the well-known Harrod-Domar long-run equilibrium condition. Note that if $d = 0$, the rate of growth of the economy is equal to

$$\frac{Q_{t+1}-Q_t}{Q_t} = (1-c)\frac{Q_t}{K_t} = \frac{s}{v}$$

where s is the propensity to save and v is the capital/output ratio.

In the same way, if we apply (14), (15) and (16) to aggregate supply (7) we get:[15]

[15] In steady-state, long-run equilibrium Π will always be equal to Π^e, therefore we can set $\sigma_\Pi^2 = 0$.

$$\log Q_t = \frac{1-a}{a} \log (1-a) + \log a + \log Q_t - \log (\bar{\rho}+d)$$

$$- \frac{1-a}{a} (\log W_t - \log P_t) - \mu\frac{1-a}{a} \bar{\rho}$$

which implies

$$\log \{(1-a)^{\frac{1-a}{a}} a(\bar{\rho}+d)^{-1} [\frac{W_t}{P_t} \exp (\mu\bar{\rho})]^{-\frac{1-a}{a}}\} = 0,$$

or

$$(1-a)^{\frac{1-a}{a}} a(\bar{\rho}+d)^{-1} W_t^{-\frac{1-a}{a}} \exp (-\mu\frac{1-a}{a} \bar{\rho}) = P_t^{-\frac{1-a}{a}}$$

$$(18) \quad P_t = (\frac{\bar{\rho}+d}{a})^{\frac{1-a}{a}} \frac{W_t \exp(\mu\bar{\rho})}{1-a} \quad .$$

If we compare (18) with (4) in our previous chapter, we can see that we have got the long-run supply price of output. This is, of course, what we had to get in order to attain a long-run equilibrium position for the economy.

Rewriting (18) as

$$(\frac{\bar{\rho}+d}{a})^a [\frac{W_t \exp(\mu\bar{\rho})}{P_t (1-a)}]^{1-a} = 1$$

we can interpret it as the factor-price frontier for this economy.

If we now fix $\frac{W_t}{P_t}$ at $\bar{w}$ as was assumed in (8), then we can use (18) to determine the equilibrium real interest rate, $\bar{\rho}$. Once we have it, we can go back to (17) and see how the rate of growth of output is determined. In (17) we can observe another familiar result. If the propensity to save s is equal to the "share" of fixed capital (s=a), the rate of growth of the economy will be equal to the real rate of interest.[18]

Finally, if we apply (14), (15) and (16) to the demand for money (10), we get:

$$\log MS_t = \log P_t + \log Q_t + \ell_\rho \bar{\rho} + \ell_\Pi \Pi_t.$$

In order to see how $_t$ is determined, let us write $\bar{m} = \log \frac{MS_t}{MS_{t-1}}$, $\bar{\Pi} = \log \frac{P_t}{P_{t-1}}$, and $\bar{q} = \log \frac{Q_t}{Q_{t-1}}$.

$$\log MS_{t-1} + \bar{m} = \log P_{t-1} + \bar{\Pi} + \log Q_{t-1} + \bar{q} + \ell_\rho \bar{\rho} + \ell_\Pi \bar{\Pi}.$$

As (15) has to be satisfied in every period, we get

$$(19) \quad \bar{\Pi} = \bar{m} - \bar{q}$$

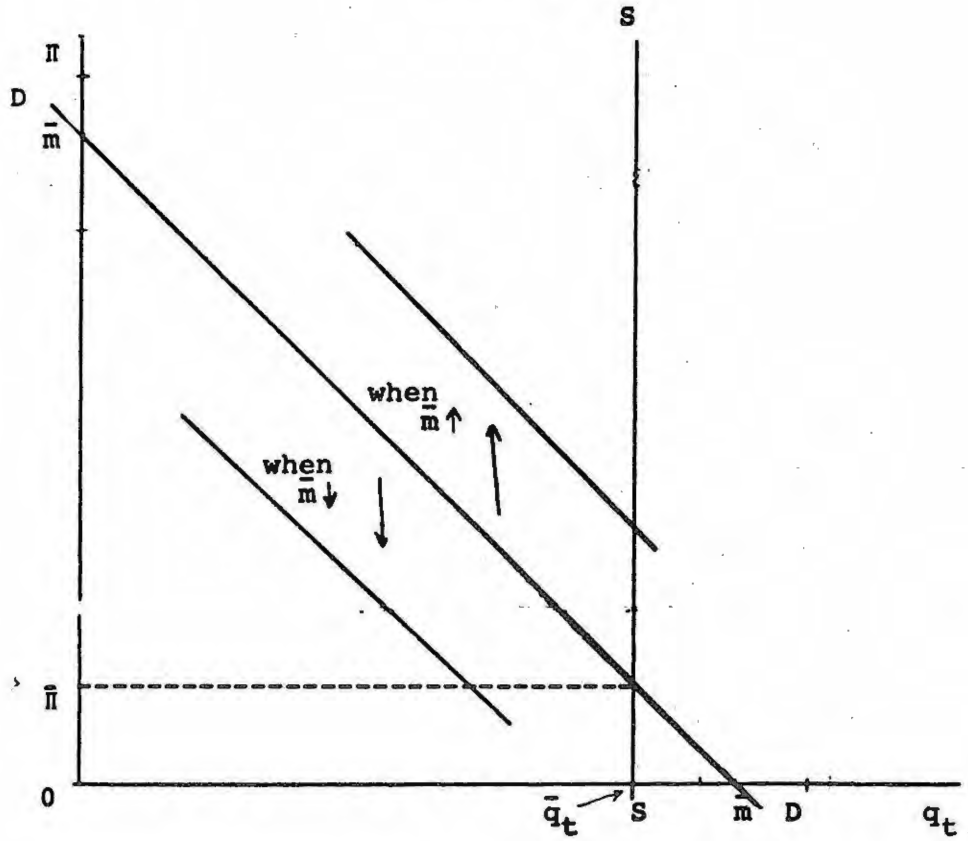
which is also a well known steady state relationship.

The determination of the long-run equilibrium of this economy can be visualized in a graph that will be useful in the next section. We shall work with coordinates ρ_t and q_t. (19) can be represented by a straight line. (18) and (17) together determine $\bar{q}$. They can be represented by a vertical line. DD is a negatively sloped 45° line.

---

18 It should be noted that our steady state results correspond to what Hicks calls a "full performance steady state" as different from a "full employment steady state." In the same way, our analysis of the trajectory or "traverse" between steady states will be a "fix wage path" as different from a "full employment path" because of our assumption on the supply of labor. See Hicks [9] Chapter V. If we adopt interpretation c) for our supply of labor assumption (see page 118), then our results can also be seen as properties of a "full employment steady state."

Graph 3.1



Changes in $\bar{m}$ move DD only, while SS remains unchanged. Therefore, the new long-run equilibrium will correspond to a different rate of inflation with unchanged rate of real growth.

So far we have met familiar steady-state results. While this analysis has not yielded new findings, it has been a useful exercise in order to check that the assumptions adopted bring about very conventional steady-state

$$q_i^e = \log \frac{Q_i^e}{Q_{i-1}}; \text{ and } q_i^{ee} = \frac{1}{2} \log \frac{Q_i^{ee}}{Q_{i-2}} .$$

Equation (6a) can be rewritten:

$$\text{(6b)} \quad \Pi_t + q_t = \Pi_t^e + \log \Big[c \exp(q_t^e + q_{t-1}) + a \frac{\exp(2q_{t+1}^{ee} + q_{t-1})}{\rho_{t+1}^{ee} + d}$$

$$- a \frac{\exp(2q_t^{ee})\ (1-d)}{\rho_t^{ee} + d}\Big] - q_{t-1}$$

$$+ \{e_m[1+(\ell_\rho + e_\rho)\theta] - e_\rho\theta\} \{m_t - \Pi_t^e$$

$$- \log \Big[c \exp\ (q_t^e + q_{t-1}) + a \frac{\exp(2q_{t+1}^{ee} + q_{t-1})}{\rho_{t+1}^{ee} + d}$$

$$- a \frac{\exp\ (2q_t^{ee})(1-d)}{\rho_t^{ee} + d}\Big] - q_{t-1} - \ell_\rho \bar{\rho} - \ell_\Pi \Pi_t^e$$

$$+ \sum_{i=-\infty}^{t-1} (m_i - \Pi_i - q_i)\}.$$

In the same way, (7a) becomes:

$$\text{(7b)} \quad q_t = \frac{1-a}{a} \log\ (1-a) + \log a + 2q_t^{ee} - q_{t-1} - \log\ (\rho_t^{ee} + d)$$

$$- \frac{1-a}{a} \log \bar{w} - \mu \frac{1-a}{a} \bar{\rho} + \frac{\mu\gamma(1-a)}{a^2} \sigma_\Pi^2 + \mu \frac{1-a}{a}\ \theta\ \{m_t - \Pi_t^e$$

$$-\log\Big[c \exp(q_t^e + q_{t-1}) + a \frac{\exp(2q_{t+1}^{ee} + q_{t-1})}{\rho_{t+1}^{ee} + d} + a \frac{\exp(2q_t^{ee})(1-d)}{\rho_t^{ee} + d}\Big]$$

$$- q_{t-1} - \ell_\rho \bar{\rho} - \ell_\Pi \Pi_t^e + \sum_{i=-\infty}^{t-1} (m_i - \Pi_i - q_i)\}.$$

From (6b) and (7b), once we know how expecations are formed, we can obtain the basic system of difference equations to study the dynamics of our economy.

Extrapolative expectations

Let us begin with the simplest case of unitary extrapolative expectations. These will refer to the rate of change of the variables for real output and price level, and to the absolute level for real interest rates. Thus

$$q_t^e = q_{t-1}$$

$$q_t^{ee} = q_{t-2}$$

$$\Pi_t^e = \Pi_{t-1}$$

$$\rho_t^{ee} = \rho_{t-2}$$

Note that these extrapolative expectations are a particular case of adaptive expectations:

$$q_t^e = q_{t-1} = q_t^e - q_{t-1}^e = \gamma(q_{t-1} - q_{t-1}^e) \quad \text{for } \gamma=1.$$

If we now substitute for all the expected values in (6b) and (7b), we get a system of two non-linear difference equations. The mathematics promises to be rather complicated, but it is possible to go into our main point in a very simply way.

Let us imagine that the economy was in a long-run equilibrium path until (and including) period t-1, with money supply growingat a constant rate m. This long-run equilibrium can be represented as in Graph 3.2. We reproduce the long-run DD and SS curves in Graph 3.1. The long-run equilibrium until period t-1 is represented by point A. In period t, the rate of growth of money supply is reduced to m^1, The new long-run equilibrium for this constant rate of monetary expansion will be B, i.e., it will imply a smaller rate of inflation and the same rate of real growth than in the old long-run equilibrium. Let us now see what happens in period t.

Equation (6a) in period t boils down to

$$(20) \quad \Pi_t + q_t = \Pi_{t-1} + q_{t-1} + \{e_m[1+(\ell_\rho+e_\rho)\theta] + e_\rho\theta\}\ (m-m^1).$$

In the same way, (7b) for period t is

$$(21) \quad q_t = q_{t-1}+\mu\frac{1-a}{a}\ \theta\ (m-m^1).$$

We can now plot (24) and (25) in Graph 3.2. First of all, we can see that the locus of possible short-run equilibrium positions for this economy is the shaded area. This is so because we imposed the restrictions $e_m \lesseqgtr 0$, $e_\rho \lesseqgtr 0$ and $\theta \geqq 0$. For e_m positive and e_ρ negative, equation(20) which we represent by dd, has to be parallel to the negatively sloped 45° line drawn through the point A and must be located to its left (the function we are representing is $\Pi_t + q_t$ = constant). In the same way, for θ positive, equation (21) which we represent by ss, has to be a left-hand side parallel to SS.

We can see that there need not be a fall in the rate of growth of the economy if either μ or θ are zero, that is, if there is no such thing as working capital (μ=0) or the real interest rate is always at its long-run equilibrium level (θ=0).

But if μ and θ are positive, the rate of growth of output will decrease as a result of the increased costs of working capital. In other words, $\mu\frac{1-a}{a}\theta > 0$, is a necessary and sufficient condition for q to fall in period t.

The behavior of the rate of inflation is different for different values of the parameters. If the demand-side effect of the reduction in the rate of inflation of money supply is higher than the supply-side effects, that is, if

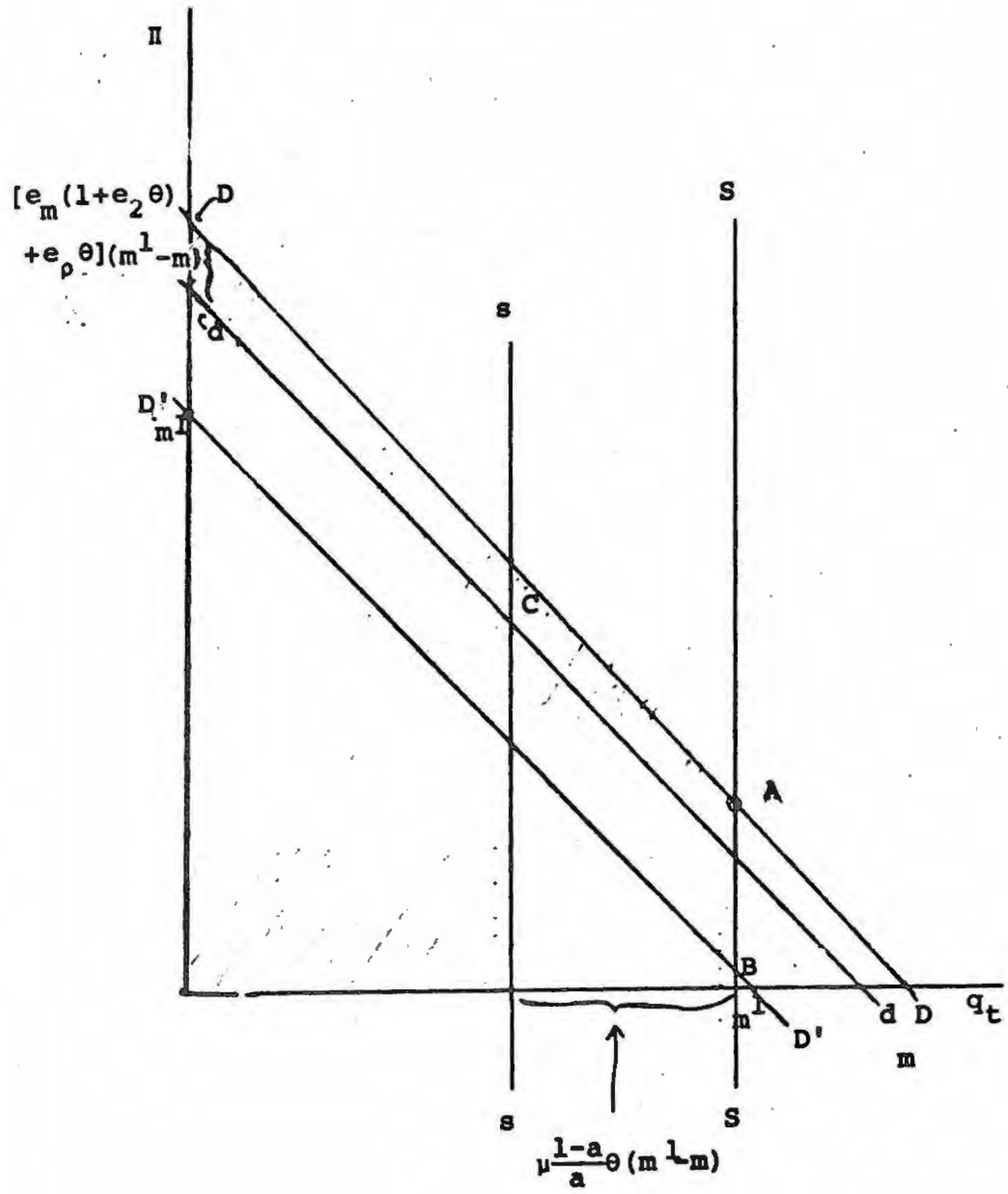
$$e_m[1+(\ell_\rho+e_\rho)\theta] + e_\rho\theta > \mu\frac{1-a}{a}\theta$$

i.e., if the supply-side effects are stronger than the demand-side effects, then inflation will accelerate in period t.

In Graph 3.2, dd and ss have been drawn to show precisely the relevant case in which inflation accelerates as a consequence of the monetary restriction.

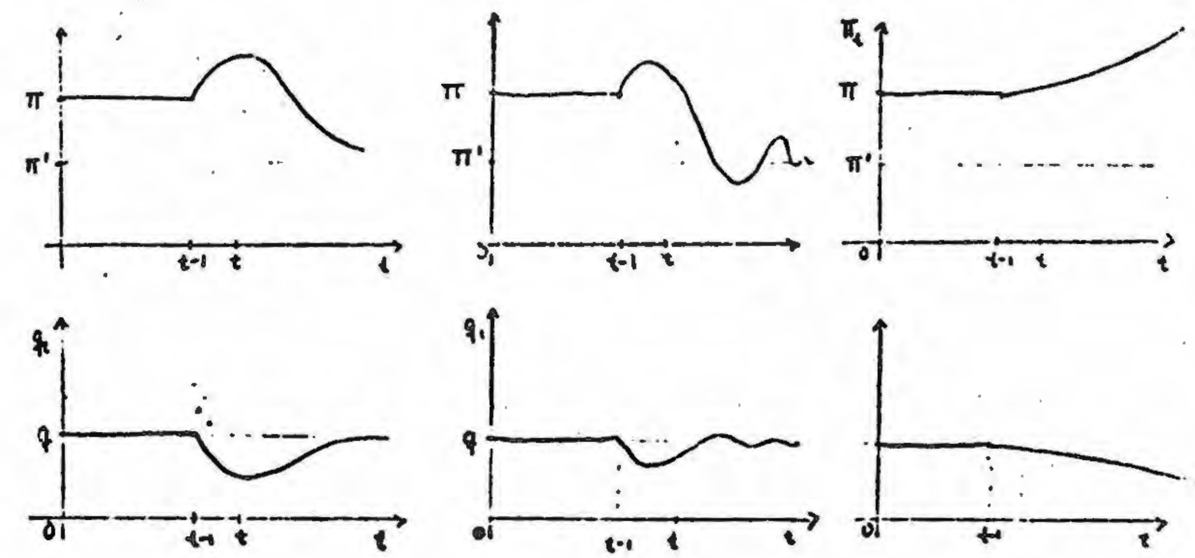
The graph does not help us to analyze the behavior of the economy in periods t+1, t+2... This has to be done mathematically. The dynamic behavior of the economy after period t can display different patterns according to the values of the parameters. Some of those patterns are

Graph 3.2

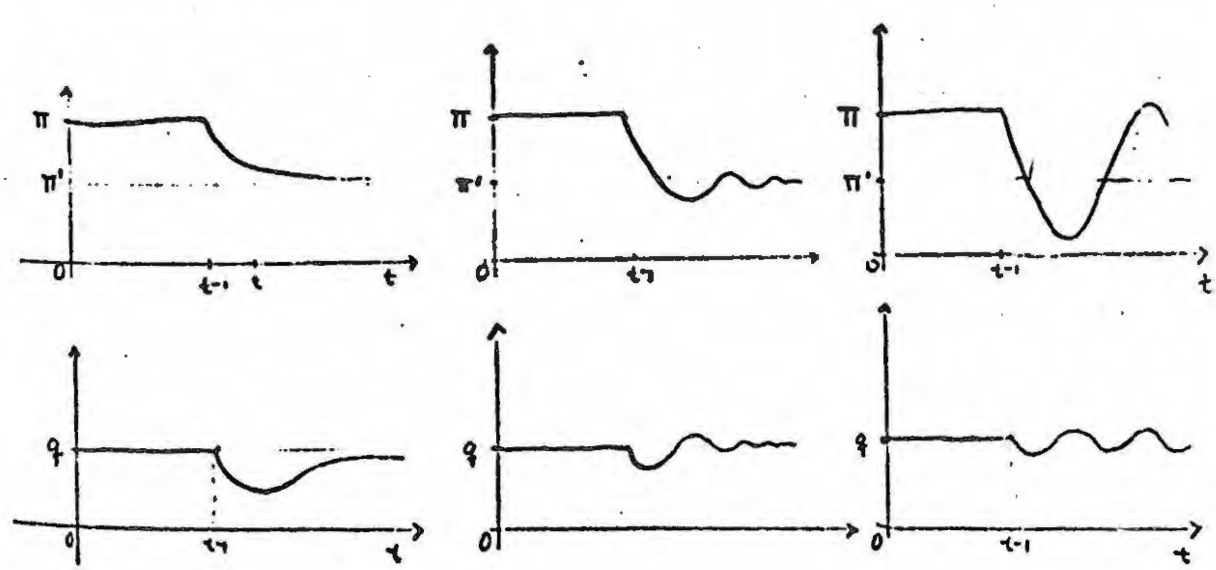

Π
$[e_m(1+e_2\theta)$
$+e_\rho\theta](m^1-m)$
D
d
D'
m^1
S
s
C
A
B
m^1
D'
d
D
q_t
m
s
S
$\mu\frac{1-a}{a}\theta(m^1-m)$

Graph 3.3

Supply side effects initially stronger:



Demand side effects initially stronger:



represented in graph 3. . The common feature of the first set of cases is that

$$e_m[1+(\ell_\rho+e_\rho)\theta] + e_\rho\theta < \mu \frac{1-a}{a} \theta .$$

The common feature of the second set of cases is

$$e_m[1+(\ell_\rho+e_\rho)\theta] + e_\rho\theta > \mu \frac{1-a}{a} \theta .$$

Fortunately it is not necessary to go into all these possibilities in detail because our main point issues from the analysis we did with the help of graph 3. , namely we have demonstrated that:

(1) The existence of supply-side effects like the one introduced in the previous chapter (namely $\mu\frac{1-a}{a}\theta>0$) is sufficent for the path to the new long-run equilibrium to begin with a fall in the rate of growth of real output.

(2) If the supply-side effects of monetary policy are high enough (namely, $\mu\frac{1-a}{a}\theta>e_m[1+(\ell_\rho+e_\rho)\theta]+e_\rho\theta$) then the path to the new long-run equilibrium begins with accelerated inflation and a large fall in the rate of growth of the economy.

Since our crucial points fall out from our analysis of short-run equilibrium in period t, we shall limit our discussion of alternative assumptions on formation of expectations by considering only the changes implied for the short-run equilibrium of period t.

The extension of our conclusions to the more general case of adaptive expectations is straightforward. It is easy to see that if we begin with the economy in long-run equilibrium up to period t, the expected values of q, Π and ρ in period t will be equal to the observed values of the same variables in period t-1, whatever the value of the coefficient of expectation. Therefore our previous analysis of the determination of short-run equilibrium for period t (in graph 3.) remains totally valid. Of course, the behavior of the economy from period t+1 on will not be identical to the behavior under unitary extrapolative expectations, but this obviously does not affect conclusions (1) and (2).

Perfect foresight[21]

If we assume every economic agent will perfectly foresee the behavior or the economy while taking for granted that all his fellow economic agents will do the same, then, from period t on (that is to say, from the very moment that m is cut to m^1) expectations will be identical to the new long-run equilibrium magnitudes, i.e.,

$$q_i^e = \bar{q}$$

$$\rho_i^{ee} = \bar{\rho}$$

$$\Pi_i^e = m^1 - \ell_1\bar{q} .$$

21 "Rational" expectations a la Muth-Lucas-Sargent is equivalent to perfect foresight in a non-stochastic model.

In such a case the economy will shift instantaneously from point A to point B and will remain always on a long-run equilibrium path.

While this sounds a bit fantastic as a description of actual economies, it is useful in thinking how a monetary stabilization policy should be designed and applied. Let us assume that it is possible to get the following combination of circumstances:

1) The economic agents have "rational" expectations and they have the right perception of the structure of the economy;

2) The government announces its policies and executes them exactly as announced;

3) Every economic agent believe that the government will do what is has announced and that all other economic agents will also have "rational" expectations.

Then all the burden of disequilibrium situations would be eliminated and the economy might be moved from an inflationary long-run equilibrium path to a non-inflationary one without costs in terms of real growth.

H. Keynesian-like version of the model

If we assume:

a) The consumption function depends on actual P_t and Q_t rather than on expected P^e_t, Q^e_t;[22]

[22] See Keynes [1936], pp. 46-51, expecially p. 50.

b) Economic agents have sticky long-run expectations;[23]

c) The interest rate will move all the way to clear the money market, i.e.,

$$\theta = -\frac{1}{\ell_\rho + e_\rho},$$

we get a version of the model which in several respects resembles a Keynesian model. To begin with a simple case we further assume $e_\rho = 0$.

Aggregate demand will then be

$$E_t = cP_tQ_t + P_t[a\frac{Q_{t-1}\exp(2\bar{q})}{\bar{\rho}+d} - a\frac{Q_{t-2}\exp(2\bar{q})(1-d)}{\bar{\rho}+d}] .$$

Adding the commodity market equilibrium condition $E_t = P_tQ_t$ we get

$$P_tQ_t(1-c) = P_t[a\ \frac{Q_{t-1}\exp(2\bar{q})}{\bar{\rho}+d} - a\frac{Q_{t-2}\exp(2\bar{q})(1-d)}{\bar{\rho}+d}]$$

$$Q_t = k[a\frac{Q_{t-1}\exp\ (2\bar{q})}{\bar{\rho}+d} - a\frac{Q_{t-2}\exp(2\bar{q})(1-d)}{\bar{\rho}+d}],$$

where k is the Keynesian multiplier.

Note that aggregate demand and the commodity market equilibrium condition determine real output Q_t.

Money demand, money supply and the interest rate adjustment equation (or, what is the same in this partic-

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[23] See Keynes [1936], pp. 147-153. In Keynes' theory $\bar{q}$ and $\bar{\rho}$ need not be the long-run equilibrium values of q_t and ρ_t. For our purposes it is simpler to assume they are.

So much for the simplest case. Let us now move on to a situation in which aggregate demand is not completely inelastic to the interest rate, i.e., where aggregate demand and the equilibrium condition give an "IS-like" curve:

$$Q_i = \{cQ_i + [a \frac{Q_{i-1} \exp(2\bar{q})}{\bar{\rho} + d} - a \frac{Q_{i-2} \exp(2\bar{q})(1-d)}{\bar{\rho} + d}]\}$$

$$\cdot \exp [e_\rho(\bar{\rho} - \rho_i)] \qquad \text{for } i=t,t+1,t+2,...$$

which can also be written

$$q_c + q_{i-1} = \log \{c \exp(q_i+q_{i-1}) + \exp (2\bar{q})$$

$$[1-c + a \frac{\exp(q_{i-1}-\bar{q})(1-d)}{\bar{\rho} + d}]\}+ e_\rho(\rho_i-\bar{\rho}),$$

$$\text{for } i=t,t+1,...$$

In particular for i=t, since the economy was in long-run equilibrium until t-1, this reduces to:

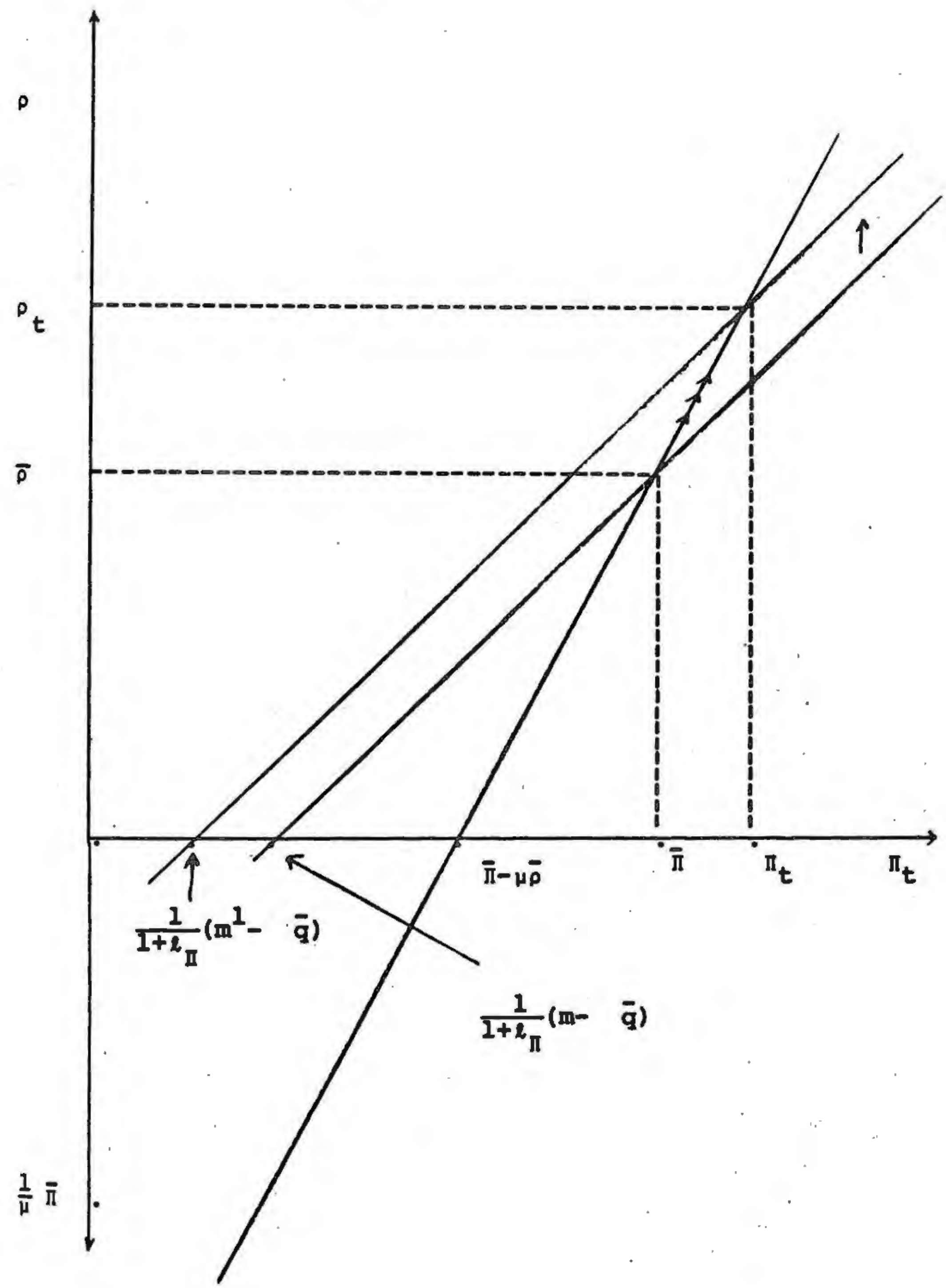
$$q_t = \log [c \exp(q_t) + (1-c) \exp(\bar{q})] + e_\rho(\rho_i - \bar{\rho})] \quad .$$

which after some algebra can be rewritten:

$$(24) \quad q_t = \bar{q} + e_\rho(\rho_t - \bar{\rho}) + \log(1-c) - \log \{1-c \exp[e_\rho(\rho_t-\bar{\rho})]\}$$

This is our "IS-like" curve for period t. In Graph 3.4 it is represented by "IS" in q_t, ρ_t space.

Graph 3.4



ρ
ρ_t
$\bar{\rho}$
$\frac{1}{\mu}\bar{\Pi}$
$\bar{\Pi}-\mu\bar{\rho}$
$\bar{\Pi}$
Π_t
Π_t
$\frac{1}{1+\ell_\Pi}(m^1- \quad \bar{q})$
$\frac{1}{1+\ell_\Pi}(m- \quad \bar{q})$

Using (24) to substitute for q_t in the short-run aggregate supply function we get:

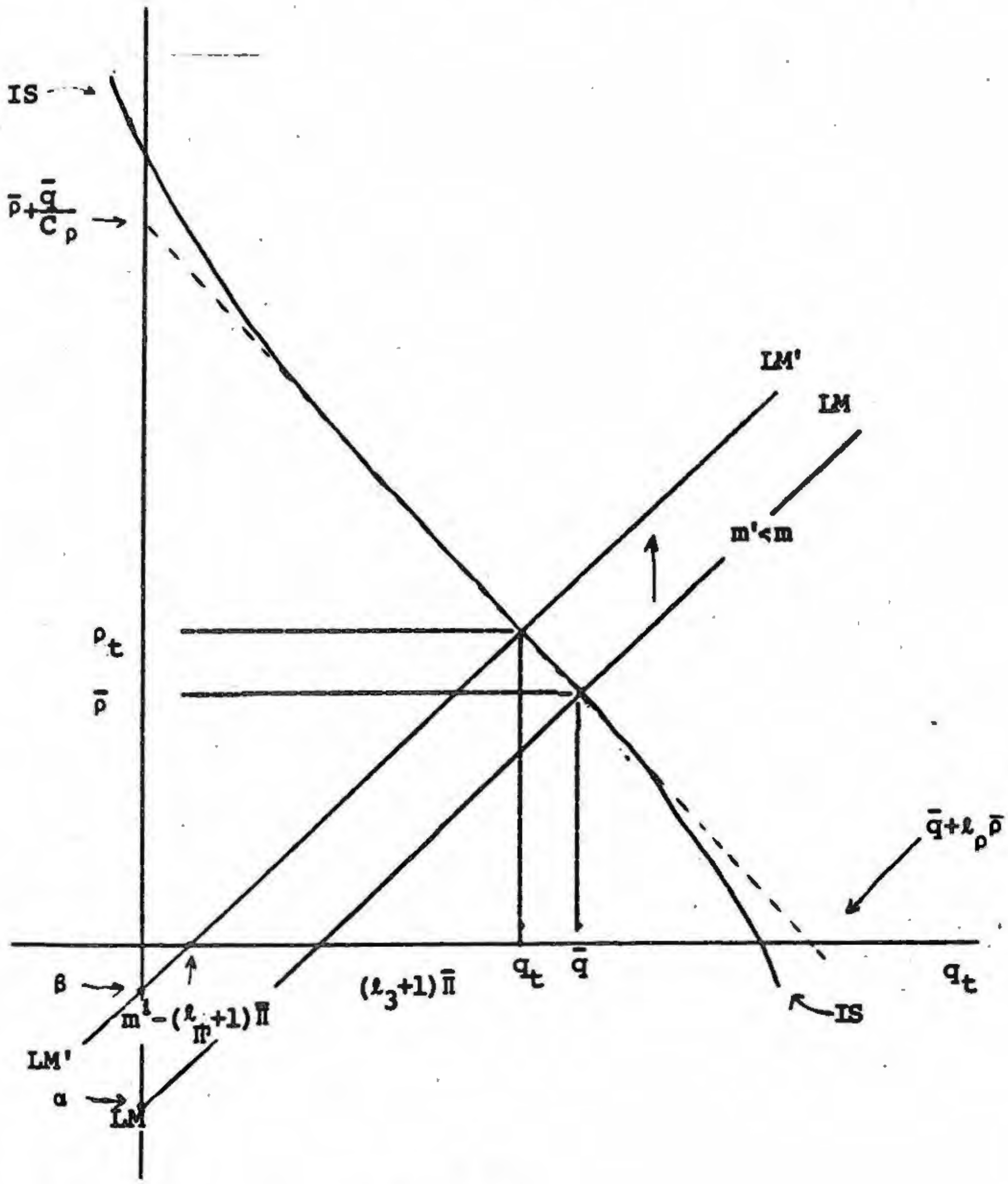
$$(25) \quad \Pi_t - (\mu + \frac{e_\rho a}{1-a}) (\rho_t - \bar{\rho}) = \bar{\Pi} ,$$

and using (25) to substitute for Π_t in (23) we get an "LM-like" curve:

$$(26) \quad [(\ell_\Pi + 1)(\mu + \frac{e_\rho a}{1-a}) + \ell_\rho] \rho_t + q_t = m^1 - (\ell_\Pi + 1) \bar{\Pi}.$$

Very likely $(\ell_\Pi + 1)(\mu + \frac{e_\rho a}{1-a}) + \ell_\rho$ is a negative number. If this is so, then (26) is an upward-sloping straight line as represented in Graph3.5. If the coefficient of ρ_t in (26) is negative, then the "LM-like" curve will be downward sloping, but stability conditions require that it cut "IS" from below. In any case, when the rate of growth of money supply declines, i.e. $m^1<m$, LM shifts to the left, decreasing the rate of growth of output and increasing the real interest rate. What happens with the rate of inflation? Looking at (25) we see that it will decrease if $\mu \frac{a}{1-a} < -e_\rho$ and increase in the opposite situation. In words, inflation will accelerate (and real wage rate will deteriorate) if the elasticity of aggregate supply with respect to the real rate of interest ($\mu\frac{a}{1-a}$) is larger than the absolute value of the elasticity of aggregate demand with respect to the real rate of interest ($-e_\rho$). Why does the real wage rate have to deteriorate in the latter case? The intuitive explanation is the same as before: real wages have to deteriorate to make room for the higher real rate of interest.

Graph 5



$$\beta = \frac{m' - (\ell_{\Pi} + 1)\bar{\Pi}}{(\ell_{\Pi} + 1)\mu + \ell_{\rho}} \qquad \alpha = \frac{m - (\ell_{\Pi} + 1)\bar{\Pi}}{(\ell_{\Pi} + 1)\mu + \ell_{\rho}}$$

With fixed nominal wages (fixed in a dynamic sense) this can happen only by way of a higher rate of price inflation.

I. Monetarist-like version of the model

If we now assume that in the original model any excess supply of demand for money at the market interest rate originates a proportional shift of actual expenditures away from planned expenditures (in terms of our model, $e_m=1$), we get a version of the model that resembles the conventional monetarist hypothesis of a direct link between commodity and money markets.

It is interesting to see how $e_m=1$ implies that the demand-side of the economy comes to be described by a velocity (or ex-post demand for money) equation. With $e_m=1$ our aggregate demand equation becomes:

$$E_t = (C_t + I_t + \Delta SI_t^{\rho}) \frac{MS_t}{(C_t+I_t+\Delta SI_t^{\ell})\,\mathrm{ext}(\ell_\rho \rho_t + \ell_\Pi \Pi_t^e)}$$

and applying the commodity market equilibrium condition:

$$P_t Q_t = MS_t / \exp(\ell_\rho \rho_t + \ell_\Pi \Pi_t^e),$$

which, after taking logs, can be written:

$$\text{(27)} \quad \log MS_t = \log P_t + \log Q_t + \ell_{\hat{\rho}} \rho_t + \ell_3 \Pi_t^e \,.$$

Note that (27) is the demand for money evaluated at the actual P_t and Q_t. Under the assumptions we chose to get a monetarist-like version of our model, the aggregate demand equation becomes an <u>ex-post</u> demand for money or velocity equation.

The model has, in addition, aggregate supply (7) and the wage equation (8), and the real interest rate equation that results from (12) and (13).

Let us now consider what happens when the economy was previously in the long-run equilibrium and the rate of monetary expansion is cut from m to m^1 in period t. For unitary-extrapolative or any other adaptive expectation scheme, expected rate of inflation for period t will be $\bar{\Pi}_{t-1}$ (i.e., the long-run equilibrium rate of inflation for the economy up to period t-1). Therefore, for period t aggregate demand (27) will be:

$$\Pi_t + q_t + \ell_\rho(\rho_t - \bar{\rho}) = m^1,$$

which can also be written:

$$\text{(28)} \quad \Pi_t - \Pi_{t-1} + q_t = q_{t-1} + \ell_\rho(\rho_t - \bar{\rho}) = m^1 - m.$$

For period t, aggregate supply (7), after applying the wage equation (8), reduces to:

$$\text{(29)} \quad q_t = \bar{q} - \mu\frac{1-a}{a}(\rho_t - \bar{\rho}).$$

Similarly, from (12) and (13), the real interest rate for period t becomes:

$$\text{(30)} \quad \rho_t = \bar{\rho} + \theta(m - m^1).$$

Using (30) to replace $\rho_t-\bar{\rho}$, we get:

$$(31) \quad q_t = \bar{q} - \mu \frac{1-a}{a} \theta \, (m-m^1),$$

which means that if working capital exists ($\mu>0$) and monetary policy has some effect on the real interest rate ($\theta>0$), then the real rate of growth will decrease when m is reduced to m^1.

Using (30), (31) and (28), we get:

$$\Pi_t - \bar{\Pi}_{t-1} = -(1 + \ell_\rho \theta - \mu \frac{1-a}{a} \theta)(m - m^1)$$

which means that the rate of inflation will usually decrease by less than the rate of monetary expansion if $\theta>0$; but if θ, ℓ_ρ and μ are large enough, inflation may accelerate. The condition for this to happen is $\mu\frac{1-a}{a}\theta>1+\ell_\rho\theta$. If in the short run ρ_t moves all the way to clear the money market (i.e., $\theta= -\frac{1}{\ell_\rho+e_\rho}$, as in the Keynesian case) Π_t will be necesarily higher than $\bar{\Pi}_{t-1}$ whenever $\mu\frac{1-a}{a}>e_\rho$, as we have shown before.

Actually, to be fully consistent with the spirit of monetarism, we should further assume that the real interest rate is a real phenomenon and independent of monetary policy, i.e., $\theta=0$.

This assumption rules out the supply-side effect of monetary policy; therefore, in the context of our model, there can be no short-run fall of real output due to the reduction in the rate of growth of money supply. For a given rate of growth of money supply, there may be changes in the rate of inflation due to changes in ρ_t, yet they will not be the result of monetary policy but of changes in the thrift and productivity characteristics of the economy.

J. Real wage rate response to unemployment

So far, our basic specification for labor supply implied a constant expected rate of real wages. We seek now to allow for some response of the expected real wage rate to unemployment. But in order to discuss this point, we shall go back to the general version of our model.

Let us say

$$\frac{W_t}{P_t} = f(u_t - \bar{u})$$

and let us write:

$$u_t - \bar{u} = g[\sum_{i=-\infty}^{t} (q_i - \bar{q})].$$

That is, we make the real wage rate a function of the difference between the rate of unemployment and the "full employment" or "natural" rate of unemployment. Moreover, we make this difference a function of the sum of all past differences between the actual rate of growth or output and the long-run equilibrium rate of growth of the economy. In order to simplify the arithmetic, let us adopt the following specification:

$$\frac{W_t}{P_t} = \bar{w} \exp \left[\varepsilon \sum_{i=-\infty}^{t} (q_i - \bar{q})\right].$$

We shall work out the unitary-extrapolative-expectations case only. We have now the following aggregate supply:

$$q_t = \frac{1-a}{a} \log (1-a) + \log a + q_{t-1} - \log (\rho_{t-2} + d)$$

$$- \frac{1-a}{a} \log \bar{w} - \frac{1-a}{a} \varepsilon \sum_{i=-\infty}^{t} (q_t - \bar{q}) - \mu \frac{1-a}{a} \rho_t .$$

Let us now see what happens in period t if until t-1 the economy was in long-run equilibrium and suddenly the government cut the rate of growth of money supply from m to m^1.

For period t, short-run aggregate demand will still be (24) but short-run aggregate supply will now be

$$q_t = q_{t-1} + \frac{\mu(1-a)\ \theta}{a+(1-a)\varepsilon} (m^1 - m).$$

It is still possible to get our two main results, but we have now new limiting conditions:

(1.1) Output will necessarily fall if

$$\frac{\mu(1-a)\ \theta}{a+(1-a)\varepsilon} > 0;$$

(2.1) If $\frac{\mu(1-a)\ \theta}{a+(1-a)\varepsilon} > e_m[1+ (\ell_\rho+e_\rho)\theta] + e_\rho\theta$, inflation will begin accelerating.

It should be pointed out that the higher ε is, i.e., the more responsive real wages are to unemployment, the less likely situation (2.1) becomes. It is of course an empirical matter which of these inequalities are met in any practical situation.

K. Aggregate supply dependent on the nominal interest rate

As indicated in the previous chapter, it may happen that aggregate supply has the nominal instead of the real interest rate as an argument. The conditions for this to happen can now be more clearly visualized. We have assumed that nominal wages will be changing in such a way that the real wage rate is always $\bar{w}$. In order to compute $\bar{w}$ we are taking both nominal wages and expected price level at the same point of time within the period (say, at the end of each period). But wages are paid a fraction μ of the period in advance to the receipt of the price of output. Therefore a constant $\frac{W_t}{P_t^e}$ implies a falling $\frac{W_{t-\mu}}{P_t^e}$ when Π_t^e is increasing:

$$w^* = \frac{W_{t-\mu}}{P_t^e} = \frac{W \exp\ (-\mu\Pi_t^e)}{P_t^e} = \bar{w} \exp\ (-\mu\Pi_t^e) \quad .$$

If instead of assuming constancy of the real wage rate defined as $\frac{W_t}{P_t^e}$ we assume constancy of $w^* = \frac{W_{t-\mu}}{P_t^e}$, that is, nominal wages will not make room for higher financial costs due to a higher expected inflation, then aggregate supply will be:

$$(9.1)\quad \log Q_t = \frac{1-a}{a}\log(1-a) + \log a + \log Q_t^{ee} + \log(\rho_t^{ee}+d) - \frac{1-a}{a}\log w^* - \mu\frac{1-a}{a}r_t + \frac{\mu\gamma(1-a)}{a}\sigma^2_{\Pi_t}$$

instead of (9).

Consider first the characteristics of the steady-state long-run equilibrium of a model formed by equations (5), (9.1), (11), (12), (13) and equilibrium conditions (14), (15) and (16).

Note that we end up with (17) and (19) exactly as in the previous model:

$$(17)\quad \exp(\bar{q}) - 1 = (1-c)\frac{\bar{\rho}+d}{a} - d$$

$$(19)\quad \bar{\Pi} = \bar{m} - \bar{q}\ .$$

$$(18.1)\qquad \left(\frac{\bar{\rho}+d}{a}\right)^a \left[\frac{w^*\left(1 + a\,\frac{\exp(\bar{q}) - 1+d}{1-c} - d\right)^{\mu}(1+\bar{\Pi})^{\mu}}{1-a}\right]^{1-a} = 1.$$

Combining (17) and (18.1) we can write:

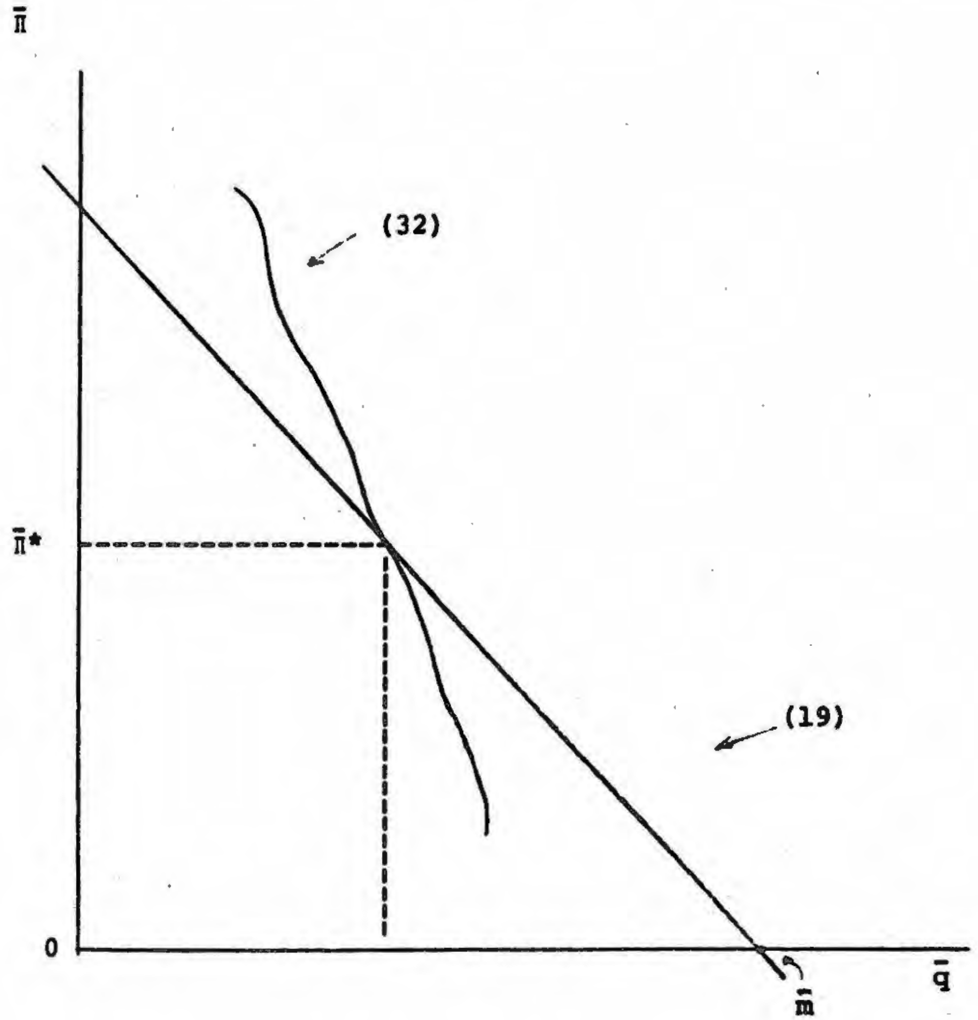
$$(32)\quad \left[\frac{\exp(\bar{q}) - 1+d}{1-c}\right]^a \left[\frac{w^*\left(1 + a\,\frac{\exp(\bar{q}) - 1+d}{1-c} - d\right)^{\mu}(1+\bar{\Pi})^{\mu}}{1-a}\right]^{1-a} = 1.$$

It is easily seen that in (34)

$$\frac{d\bar{q}}{d\bar{\Pi}} < 0.$$

Representing now (19) and (32) on axes $\bar{q}$ and $\bar{\Pi}$, we have:

Graph 3.6



properties for the economy. Now we have to face questions relative to short-run equilibria and the traverse[19] of the economy to the new long-run equilibrium when the policy parameter ($\bar{m}$) is modified.

G. Short-run equilibrium and traverse

For short-run equilibrium we do not require that expectations be fulfilled, neither do we require money market equilibrium,[20] but the commodity market must clear. Therefore, the short-run equilibrium condition is

$$(14) \quad E_t = P_t Q_t \ .$$

Now we can write down the model in a form which is more convenient for short-run equilibrium analysis. We use (14) and the following definitions:

$$\Pi_i = \log \frac{P_i}{P_{i-1}}; \ \Pi_i^e = \log \frac{P_i^e}{P_{i-1}}, \ q_i = \log \frac{Q_i}{Q_{i-1}},$$

---

19 This is the term introduced by Hicks to refer to the path of the economy when it is not in steady state but moving from one steady state to another. See Hicks [1965], Chapter XVI and Hicks [1971], Chapter VII.

20 Note that (6) specifies how the money market disequilibrium spills over to the commodity market. Only for $e_m=1$ could the money market be brought into equilibrium during the period. We prefer not to impose this restriction. Nevertheless we shall explore the consequences of requiring, for short-run equilibrium, both $E_t = P_t Q_t$ and $MS_t = MD_t''$. To impose this equality as a short-run equilibrium condition implies that (6) has to be dropped from this model.

The long-run equilibrium rate of growth of the economy is <u>smaller</u>, the <u>higher</u> the rate of monetary expansion (and the higher the rate of inflation). This is a long-run relationship between real growth and inflation that has exactly the opposite slope compared to a long-run Phillips Curve.

We shall not work out the short-run dynamics of this model for all the situations considered in the previous sections. The only interesting short-run dynamic feature of the model with aggregate supply function (9.1) is that the perverse results of monetary restriction can be reinforced after period t if inflationary expectations are adpative and if, even with constant real interest rate, the nominal interest rate increases. There is nevertheless a new situation that can be empirically relevant and can be analyzed in the context of the present model.

Let us adopt the monetarist framework but now with aggregate supply (9.1). That is, the model will consist of equations (27) and (9.1). If there is an autonomous increase in expected inflation while all other things remain unchanged, actual inflation has to accelerate because the demand for real money will decrease and, concurrently, aggregate demand for commodities will increase. This is the usual mechanism that is used to explain the acceleration of actual inflation when, due to some completely exogenous shock, expected inflation increases. Note, however, that such a mechanism cannot explain a simulof the lenders; as a consequence, the credit market is splintered into different segments among which the firms have to shift their demands for funds according to their particular financial position at different moments in time.

Another very common institutional characteristic of economies with persistent inflation is the setting by the government of interest rate ceilings on bank loans and the corresponding quantitative rationing of bank credit. This is not a necessary consequence of persistent inflation, but it is a very common policy applied by the government in such economies.

The more difficult access to capital markets for newcomers and the deterioration of the informative role of prices due to their continuous changes, tend to reduce the competitiveness of the economy, and firms in an initially stronger financial position find more opportunities for monopolistic practices.[2] As a consequence, the role of leading firms in price setting becomes more important.

This chapter is devoted to analyzing the effect of these characteristics of inflationary economies on the interest rate elasticity (or, more general, the "credit

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[2] For empirical evidences, see Chapter I, Section B.

conditions" elasticity) of the supply of commodities. It is shown that in general, such features contribute to a higher value of that elasticity.

B. Imperfect markets for credit and capital[3]

In order to introduce imperfect markets for credit and capital into the model of the firm presented in chapter II, we substitute for C.1 the following assumption:

C.3. Firms are price takers except in the credit market in which they are charged the following price:

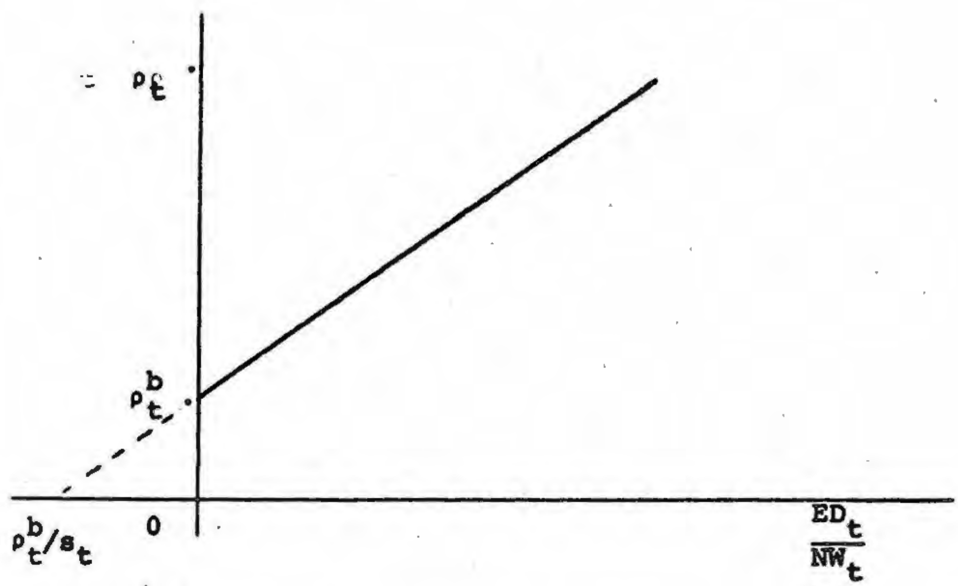
$$\rho_t = \rho_t^b + s_t \frac{ED_t}{NW_t}$$

where ρ_t^b is the basic real interest rate, ED_t is the amount of debt the firm will end up having, NW_t is the net worth of the firm, and s_t is a parameter which gives the proportional increase in the cost of credit for each unit increase in the leverage ratio of the firm. This supply of funds faced by each marginal firm is represented in Graph 4.1. An active stock market does not exist. Firms reinvest all their profits except when the rate of profit falls short of the basic interest rate ρ_t^b. The objective of the firm is to maximize the present value of the stream of profits discounted at the basic interest rate,

3 This section should be read together with the discussion under "Leverage does matter" of Section E, Chapter I.

Graph 4.1

Supply of External Funds
faced by each marginal firm.



This assumption means that in addition to the basic rate (that is, the net rate lenders will receive whatever the market their funds are channeled through), borrowers will have to pay a "leverage charge." This will include a risk premium[4] estimated by the lenders as a growing function of the leverage ratio, as well as additional transaction costs (because the lenders will want to know more about the actual situation of the firm the higher its leverage ratio), and the costs of offering additional guarantees. The linear relationship between the leverage charge and the leverage ratio of the firm is, of course, a simplifying assumption. The net income lenders will receive, whatever the total rate paid by the borrowers is, is ρ_t^b (the basic rate). Therefore ρ_t^b is the relevant rate to discount the stream of profits in the computation of the present value of the firm.

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[4] On theoretical grounds one could argue that the risk premium is not computed as an additional cost by the borrower, in the same way that it is not computed as an interest income by the lender. The argument would run as follows: if the lender charges 12 percent instead of 10% because he estimates a default probability of 2 percent, one could argue that the borrower will be repaying 112 percent of the original debt with probability 98 percent and zero with probability 2 percent which makes for a 10% expected cost of credit instead of 12 percent. We think, nevertheless, that this argument is not realistic. Default imposes on the borrower other costs which will surely offset the gain of not repaying the debt. Therefore he will always compute the cost of credit assuming he will be repaying the debt with 100 percent probability.

We keep assumptions A, B, and D.2 of chapter II. Substitution of C.3 for C.1 implies that credit conditions are now reflected by ρ_t^b and s_t. A credit tightening situation will probably show up as both an increase in ρ_t^b and an increase in s_t.

The supply functions for periods t, t+1, ...etc. can be obtained from the maximization of the present value of the whole stream of profits:

$$\text{Max } PV_t = \sum_{i=t}^{\infty} [P_iQ_i - dP_iK_i - L_iW_i - (\rho_i^b + s_i \frac{ED_i}{NW_i}) ED_i] \frac{1}{\prod_{j=t}^{i} (1+\rho_j^b)}$$

subject to $K_t = \bar{K}_t$, $I_t = \bar{I}_t$, $Q_i = K_i^a L_i^{1-a}$,

and $K_i = K_{i-1}(1-d) + I_{i-1}$,

(1) $ED_i = P_iK_i + \mu L_iW_i - NW_i$

(2) $NW_i = (NW_{i-1} + \Pi_{i-1}) \frac{P_i}{P_{i-1}}$

(3) $\Pi_i = P_iQ_i - dP_iK_i - L_iW_i - (\rho_i^b + s_i \frac{ED_i}{NW_i}) ED_i$.

Note that $(\rho_i^b + s_i \frac{ED_i}{NW_i}) ED_i$ is the total cost of credit[5] which is subtracted from gross income (P_iQ_i) to-

[5] Note that we are introducing a further simplification in comparison to our previous formula (3) of Chapter II. Instead of charging the interest rate for a proportion u of the period on a compound basis, we are taking the

gether with the depreciation (dP_iK_i) and labor costs (L_iW_i) to get profits of period i.

Net worth is obtained by accumulating profits and adjusting for price changes. The debt of each period (ED_i) is equal to total capital (fixed and working capital) minus net worth.

The optimal Q_t is obtained by solving the following system of equations (from the first order conditions):

$$(4) \qquad (i-a)\frac{Q_t}{L_t} = \frac{W_t}{P_t}\,(1 + \mu(\rho_t^b + 2\, s_t\, \frac{ED_t}{NW_t})]$$

$$(5) \qquad Q_t = \bar{K}_t^a\, L_t^{1-a}$$

It is not possible to get the general analytical solution for Q_t, but for our purposes it is sufficient to compute the elasticity of Q_t with respect to ρ_t^b and s_t.

$$(6) \qquad (Q_t,\, \rho_t^b) = -(1-a)\, \frac{\mu\rho_t^b}{1+\mu v_t}\, (a + \frac{\mu v_t^w}{1+\mu v_t})^{-1} \qquad 0$$

$$(7) \qquad (Q_t,\, s_t) = -(1-a)\, \frac{\mu(v_t^k + v_t^w)}{1+\mu v_t}\, (a + \frac{\mu\, v_t^w}{1 + \mu v_t})^{-1} \qquad 0$$

where $\quad v_t = \rho_t^b + v_t^k + v_t^w = \rho_t^b + 2\, s_t\, \dfrac{(PK_t + \mu L_t W_t - NW_t)}{NW_t}$

is the marginal cost of credit;

$$v_t^k = 2\, s_t\, \frac{(P_tK_t - NW_t)}{NW_t}$$

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linear approximation $L_tW_t(1+\mu\rho_t) \approx L_tW_t(1+\rho_t)^{\mu}$. This will introduce a small difference between the formulae of this chapter and those of Chapter II.

is the contribution of fixed capital to the marginal cost of credit, and

$$v_t^w = 2\ s_t\ \frac{\mu L_t W_t}{NW_t}$$

is the contribution of working capital to the marginal cost of credit.

It is interesting to note that the effect of a given increase in the <u>average cost of credit</u> (ρ_t) on the quantity supplied depends on how that change is brought about:

$$\varepsilon(Q_t, \rho_t) = -(1-a)\ \frac{\mu\rho_t}{1+\mu v_t}\ \left(a + \frac{\mu v_t^w}{1+\mu v_t}\right)^{-1}\ \left(1+\ \beta\frac{v_t^k+v_t^w}{2\rho_t}\right) < 0$$

where $\beta = \dfrac{\frac{ds_t}{s_t}}{\frac{d\rho_t}{\rho_t}}$.

Note that $d\rho_t = d\rho_t^b + ds_t\left(\frac{v_t^k+v_t^w}{2s_t}\right)$; if we assume that ρ_t^b and s_t cannot move in opposite directions, then

$$0 \le \beta \le 2\ \frac{\rho_t}{v_t^k + v_t^w}\ .$$

By now it is already possible to get a substantive observation:

> The higher the proportion in which tighter credit conditions show up as increased charges for leverage rather than as an increase in the basic rate, the larger the effect of the increased cost of credit on quantities supplied.

In order to gain a quantitative idea, let us look at the same quantitative example we used in Chapter II. If the period is a quarter, u=1 and $a=\frac{1}{3}$, the effect on quantity supplied of an increase $\Delta\rho_t$ in ρ_t is between the following limits:

$$\frac{\Delta Q_t}{Q_t} \simeq -2\ \Delta\rho_t \qquad \text{if } \Delta\rho_t = \Delta\rho_t^b, \text{ and } \Delta s_t = 0;$$

and
$$\frac{\Delta Q_t}{Q_t} \simeq -4\ \Delta\rho_t \qquad \text{if } \Delta\rho_t = \Delta s_t \frac{ED_t}{NW_t}, \text{ and } \Delta\rho_t^b = 0.$$

The effect on prices will be between

$$\frac{\Delta P_t}{P_t} \simeq \frac{2}{3}\ \Delta\rho_t \qquad \text{if } \Delta\rho_t = \Delta\rho_t^b, \text{ and } \Delta s_t = 0;$$

and
$$\frac{\Delta P_t}{P_t} \simeq \frac{4}{3}\ \Delta\rho_t \qquad \text{if } \Delta\rho_t = \Delta s_t \frac{ED_t}{NW_t}, \text{ and } \Delta\rho_t^b = 0.$$

In words, if the increase in the average cost of credit is due in part to increased leverage charges, the decrease in real growth will be higher than in the perfect credit market case analyzed in chapter II. If all the increase is due to extra leverage charges, the effect on supply is around twice the effect of the same increase on the basic rate.

The intuitive explanation of this result is the following: by increasing its leverage the firm is pushed to a more expensive credit market for all its debt[6]. Therefore the relevant cost of credit for the firm is the marginal cost which includes the average rate charged by lenders plus the additional costs on previous units of credit that are also a consequence of the decision to increase total debt. This "marginal cost of credit" increases by twice the increase in the leverage charges.

C. Investment in fixed capital and long run supply of commodities[7]

The imperfections of the credit markets and the lack of an active capital market have also important consequences on the investment decision of the firm and the long-run supply of commodities.

In chapter II, from the microeconomic analysis, we got only the long-run supply price because under constant returns-to-scale and perfect markets, the level of production

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6 If long term debt were important, it would be unrealistic to assume that a higher leverage rate will increase the interest rate paid on all the debt. But in some of the economies we are trying to model, very short term debt predominates.

7 An informal presentation of this discussion can be found under the title "More Working Capital relative to Fixed Capital and More Short Term Debt relative to Long-term" in Section E, Chapter I.

of each firm is indeterminate. In Chapter III, in order to specify an aggregate investment behavior we assumed that, somehow the economy as a whole invests just enough to build up the stock of capital that is optimal for the level of output and the real interest rate that are expected for two periods ahead. Now, we are able to obtain a microeconomic investment function because the firm faces an imperfect credit market and, due to the lack of an active capital market, it reinvests all its profits unless the rate of profit falls short from the basic interest rate. The way the investment decision is taken can be seen from the first order conditions for profit maximization in period t+2.[7']

We have:

$$P^{ee}_{t+2} \frac{\partial Q_{t+2}}{\partial K_{t+2}} - dP^{ee}_{t+2} - \rho^{b,ee}_{t+2} P^{ee}_{t+2} - 2s^{ee}_{t+2} \frac{ED_{t+2}}{NW_{t+2}} P^{ee}_{t+2} = 0$$

$$P^{ee}_{t+2} \frac{\partial Q_{t+2}}{\partial K_{t+2}} - W^{ee}_{t+2} - \rho^{b,ee}_{t+2} \mu W^{ee}_{t+2} - 2s^{ee}_{t+2} \frac{ED_{t+2}}{NW_{t+2}} \mu W^{ee}_{t+2} = 0$$

and $Q_{t+2} = K^{a}_{t+2} L^{1-a}_{t+2}$.

From this system we get:

$$a \frac{Q_{t+2}}{K_{t+2}} = d + \rho^{b,ee}_{t+2} + 2s^{ee}_{t+2} \frac{ED_{t+2}}{NW_{t+2}} \tag{8}$$

(marginal productivity of capital equal to depreciation rate plus the marginal cost of credit)

7' Period t+1 is still "short run," i.e., its capital stock is predeterminate because period t investment was decided in period t-1 according to assumption A.

$$(9) \quad (1-a)\,\frac{Q_{t+2}}{L_{t+2}} = \frac{W^{ee}_{t+2}}{P^{ee}_{t+2}}\,[1 + \mu(\rho^{b,ee}_{t+2} + 2s^{ee}_{t+2}\,\frac{ED_{t+2}}{NW_{t+2}})]$$

(marginal productivity of labor equal to real wage inaluding the financial costs of working capital computed at the marginal cost of credit)

Plugging (8) and (9) into the production function, we get:

$$(10) \quad \left(\frac{d + \rho^{b,ee}_{t+2} + 2s^{ee}_{t+2}\,\frac{ED_{t+2}}{NW_{t+2}}}{a}\right)^{a} \left\{\frac{W^{ee}_{t+2}\,[1 + \mu(\rho^{b,ee}_{t+2} + 2s^{ee}_{t+2}\,\frac{ED_{t+2}}{NW_{t+2}})]}{P^{ee}_{t+2}}\right\}^{1-a} = 1.$$

Note that for expected values of ρ^{b}_{t+2}, s_{t+2}, and $\frac{W_{t+2}}{P_{t+2}}$ equation (10) determines the optimum $\ell^*_{t+2} = (\frac{ED_{t+2}}{NW_{t+2}})^*$. It is easy to see that

$$\frac{\partial \ell^*_{t+2}}{\partial \ell^{b}_{t+2}} < 0, \qquad \frac{\partial \ell_{t+2}}{\partial s_{t+2}} < 0, \text{ and } \frac{\partial \ell^*_{t+2}}{\partial \frac{W^{ee}_{t+2}}{P^{ee}_{t+2}}} < 0.$$

In words, the optimum leverage ratio decreases as credit conditions deteriorate (either ρ^{b}_{t+2} or s_{t+2}, or both, increase) and as real wage rate increases.

Once ℓ^*_{t+2} has been determined, euqations (8) and (9) determine the optimum capital-labor ratio:

$$k^* = \left(\frac{K_{t+2}}{L_{t+2}}\right)^*$$

$$= \frac{[d + \rho^{b,ee}_{t+2} + 2s^{ee}_{t+2}(\frac{ED_{t+2}}{NW_{t+2}})^*]\ (1-a)}{\frac{W^{ee}_{t+2}}{P^{ee}_{t+2}}\ [1 + \mu(\rho^{b,ee}_{t+2} + 2s^{ee}_{t+2}(\frac{ED_{t+2}}{NW_{t+2}})^*)]\ a}$$

and finally, taking into account the definitions of ED_{t+2} and NW_{t+2} given by (2) and (3) we get:

$$(11)\quad K^*_{t+2} = \emptyset^*_{t+2}\ [\sum_{i=0}^{t} \frac{\Pi_i}{P_i} + \frac{\Pi^e_{t+1}}{P^e_{t+1}}]$$

where
$$\emptyset^*_{t+2} = \frac{\ell^*_{t+2} + 1}{1 + \frac{\mu W^{ee}_{t+2}}{k^*_{t+2} P^{ee}_{t+2}}}$$

$$= \frac{\ell^*_{t+2} + 1}{1 + \mu\left(\frac{1 + \rho^{b,ee}_{t+2} + 2s^{ee}_{t+2}\ \ell^*_{t+2}}{1-a}\right)^{\frac{1}{a}} \left(\frac{W^{ee}_{t+2}}{P^{ee}_{t+2}}\right)^{\frac{1+a}{a}}}$$

is a function of $\rho^{b,ee}_{t+2}$, s^{ee}_{t+2}, and $\frac{W^{ee}_{t+2}}{P^{ee}_{t+2}}$ such that

$$\frac{\partial \emptyset^*_{t+2}}{\partial \rho^{b,ee}_{t+2}} < 0, \qquad \frac{\partial \emptyset^*_{t+2}}{\partial s^{ee}_{t+2}} < 0, \text{ and } \qquad \frac{\partial \emptyset^*_{t+2}}{\partial \frac{W^{ee}_{t+2}}{P^{ee}_{t+2}}} < 0.$$

Note that the desired stock of capital for period t+2 depends on: the credit conditions ($\rho^{b,ee}_{t+2}$ and s^{ee}_{t+2}) and the real wage rate $(\frac{W^{ee}_{t+2}}{P^{ee}_{t+2}})$ that are expected to prevail during period t+2; the accumulated profits up to period t; and expected profits for period t+1.

To be more specific about investment behavior, it is necessary to make some assumptions on formation of expectations. If we assume that the firm has sticky long-run expectations and extrapolative short-run expectations, then the desired level of capital for period t+2 is

$$K^*_{t+2} = \emptyset^* \ [\sum_{i=0}^{t} \frac{\Pi_i}{P_i} + \frac{\Pi_t}{P_t}\ ]$$

and the desired level of capital for period t+1, in period t-1, was:

$$K^*_{t+1} = \emptyset^* \ [\sum_{i=0}^{t-1} \frac{\Pi_i}{P_i} + \frac{\Pi_{t-1}}{P_{t-1}}].$$

Therefore, periot t+1 investment will be:

$$I_{t+1} = K^*_{t+2} - K^*_{t+1}(1-d).$$

$$(12) \quad I_{t+1} = \emptyset^* \ [\frac{\Pi_t}{P_t} + \Delta \frac{\Pi_t}{P_t}] + dK^*_{t+1},$$

i.e., net investment is a constant proportion of period t profits, adjusted by change in profits from period t-1 to period t. If we keep the sticky-long-run-expectations assumption but adopt a more general adaptive-expectations scheme for the short run we get:

$$K^*_{t+2} = \emptyset^*[\sum_{i=0}^{t} \frac{\Pi_i}{P_i} + \sum^{t} \frac{\Pi_i}{P_i} \gamma(1-\gamma)^{t-i}]$$

and

$$K^*_{t+1} = \emptyset^*[\sum_{i=0}^{t-1} \frac{\Pi_i}{P_i} + \sum_{i=0}^{t-1} \frac{\Pi_i}{P_i} \gamma(1-\gamma)^{t-1-i}]$$

Therefore, I_{t+1} is

$$(13) \quad I_{t+1} = \emptyset^*[\frac{\Pi_t}{P_t} (1+\gamma) - \gamma \sum_{i=0}^{t-1} \frac{\Pi_i}{P_i} \gamma(1-\gamma)^{t-1-i}] + dK^*_{t+1}$$

or

$$I_{t+1} = \emptyset^*[\frac{\Pi_t}{P_t} + \gamma(\frac{\Pi_t}{P_t} \sum_{i=0}^{t-1} \frac{\Pi_i}{P_i} \gamma(1-\gamma)^{t-1-i})] + dK^*_{t+1}$$

i.e., net investment in period t+1 is a constant proportion of period t profits, plus a proportion γ of the expectation error of period t. In other words, firms will try to keep a constant proportion between accumulated profits and the stock of fixed capital.

If we wanted to adopt the same adaptive expectation scheme for both the short and the long run, $\emptyset^*$ would not be a constant any more and investment would be a rather complicated function of distributed lags in credit conditions (ρ_i^b and s_i), real wage rate $(\frac{W_i}{P_i})$ and real profits $(\frac{\Pi_i}{P_i})$.

From the point of view of our main points, the previous discussion gives the following insights:

a) With imperfect credit markets and lacking an active capital market, investment in fixed capital will not only be a function a credit conditions, but also a function of the expected real wage rate and observed and expected real profits.

b) In case of a perverse supply-side effect of anti-inflationary monetary policy, even though credit conditions are becoming tighter, the real wage rate may deteriorate and real profits increase (especially when the tighter credit conditions show up as an increase in s_t). These changes in real wage rate and real profits may offset the negative effect of the increased cost of credit on investment. Therefore investment in fixed capital may fall less than it would in a perfect credit and capital market situation.

c) Our previous analysis gives a rationale for a financial "rule of thumb" very common in economies that lack an active capital market. In such economies firms tend to associate fixed investment with profit financing (or, what is the same, fixed assets with equity capital) and working capital with debt financing. This rule of thumb also has its consequences in relation to supply-side effect of credit tightening: working capital may be more sensitive to the increased costs of credit than investment in fixed capital is, unless the credit tightening situation produces a significant fall in profits. Our analysis suggests that the rationale for such a "rule of thumb" may be the presence of sticky long-run expectations.

D. Interest rate ceilings on bank loans and bank credit rationing[8]

In this section, we introduce another institutional characteristic very common in economies with persistent inflation: the setting by the government of interest rate ceiling on bank loans and the corresponding quantitative rationing of bank credit. Again, this is not a necessary consequence of persistent inflation, but it is a very common policy applied by the government in such economies.

In order to simplify the analysis, we adopt again assumptions A, B, C.2 and D.2. That is, we consider that investment of period t cannot be modified and all the adjustment to the new credit conditions must necessarily come from changes in working capital.

The maximum interest rate on bank loans will generally be below the basic interest rate in free financial markets. Therefore, the marginal firm will face a supply of credit like the one in graph 3.2. We are assuming that the total interest rate charged by lenders increases with the "net" leverage ratio where debt is computed net of indebtedness to the banking system.[9] Both ρ_t^M (maximum interest rate on

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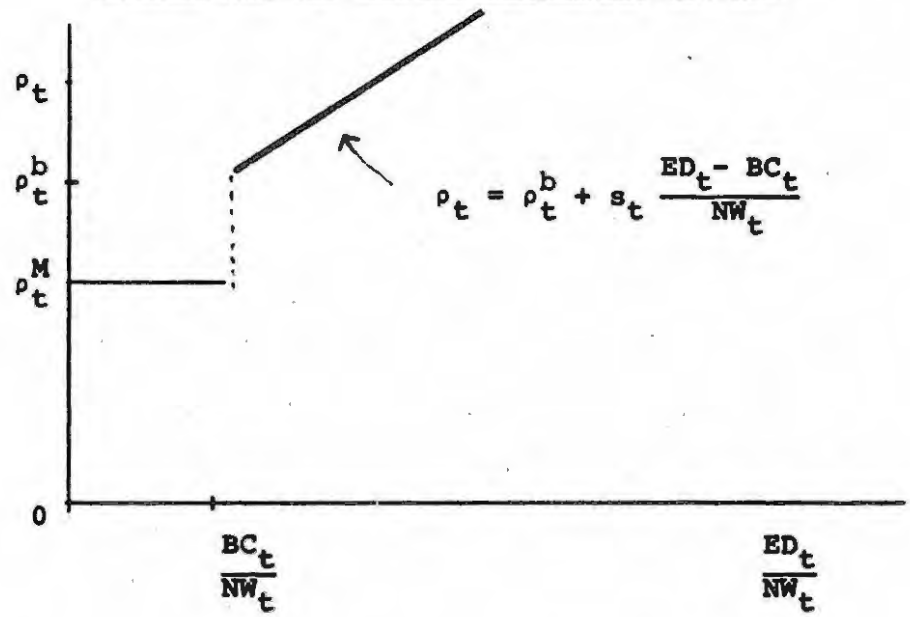
[8] This section discusses more formally the issues introduced under "Bank credit rationing" in Section E of Chapter I.

[9] This seems to us more realistic than assuming it increases with the total leverage ratio. See Chapter I, section E.

bank loans) and BC_t (bank credit) are exogenously fixed.

Graph 3.2

Supply of credit faced by the marginal firm under maximum bank rate and credit rationing



In general, the level of activity of the firm will be such that the total amount of credit used is above BC_t.

Let us write down the marginal firm's maximization problem under the new circumstances:

$$(14)\quad \text{Max } \Pi = P_tQ_t - dP_tK_t - L_tW_t - \rho_t^M BC_t - \rho_t^b(P_tK_t + \mu L_tW_t - NW_t - BC_t) - s_t\left(\frac{P_tK_t + \mu L_tW_t - NW_t - BC_t)^2}{NW_t}\right.$$

The first order condition for profit maximization is:

$$(15) \quad (1-a)\,\frac{P_tQ_t}{L_t} = W_t\,\{1 + \mu[\rho_t^b + 2s_t\,\frac{(P_tK_t+\mu L_tW_t-NW_t-BC_t)}{NW_t}]\}$$

Note that ρ_t^M does not eneter directly into the determination of short-run Q_t, although it may indirectly affect Q_t through its probable influence on ρ_t^b and s_t.[10] Something different happens with a change in BC_t. In addition to its probable influence on ρ_t^b and s_t, it has a direct effect on Q_t due to its role in determining the "net" leverage of the firm. This effect can be put in elasticity terms as follows:

$$(16) \quad \varepsilon(Q_t, BC_t) = (1-a)\,\frac{1}{1+\mu v_t}\,2s_t\,\frac{BC_t}{NW_t}\,(a + \frac{\mu v_t^w}{1+\mu v_t})^{-1}$$

As a rough approximation, for $a=\frac{1}{3}$ and $\mu=1$, we have:

$$\frac{\Delta Q_t}{Q_t} = 4\;s_t\,\frac{\Delta BC_t}{NW_t}$$

and the effect on prices (assuming unitary-elastic aggregate demand and zero-demand effect of the increased cost of credit) will be

$$\frac{\Delta P_t}{P_t} = -\frac{4}{3}\,s_t\,\frac{\Delta BC_t}{NW_t}\;.$$

That is, in a situation in which the marginal cost of credit for a ℓ^* x 100 percent leveraged firm is twice the

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[10] The effect of changes in ρ_t^m upon ρ_t^b and s_t depend on what assumptions are made about the behavior of bank credit recipients. If they were ready to re-lend it in the free credit market (that is, if they assign to credit its financial opportunity cost, whatever its cost) changes in ρ_t^m will not affect ρ_t^b or s_t.

basic rate (let us say $2s_t\ \ell^* \approx \rho_t^b = 0.05$) and bank credit is approximately equal to the outside banking system debt,

i.e, $\frac{BC_t}{ED_t - BC_t} \approx 1$, we can write:

$$\frac{\Delta Q_t}{Q_t} = 2 \times 2s_t \frac{ED_t - BC_t}{NW_t} \frac{BC_t}{ED_t - BC_t} \frac{\Delta BC_t}{BC_t} \doteq 0.1 \frac{\Delta BC_t}{BC_t} ,$$

i.e., a 10 percent cut in bank credit would reduce real growth by 1 percent.

$$\frac{\Delta P_t}{P_t} \quad -0.033 \frac{\Delta BC_t}{BC_t}$$

and prices would increase by 1/3 of 1 percent.

Two things should be noted:

a) This effect adds to the effect on quantity supplied and market prices originated in the increase in ρ_t^b and s_t that the cut in bank credit will product.

b) This additional effect would be zero if the leverage charge were a function of total leverage instead of outside banking system leverage.

Note also that bank credit at an interest rate below the basic free rate constitutes a subsidy to firms. Therefore, an increase in ρ_t^M and a cut in BC_t will necessarily reduce the profits of the firm. This fact will reduce period t+2 investment in fixed capital. If investment of period t were variable, this profit effect would help in reducing the perverse supply-side effect of an increased cost of credit.

Let us finally consider a situation which may be of some importance for economies with a low degree of factor mobility. Under such circumstances, it is possible to have some sectors of the economy where price structure is such that only bank credit is used (the basic rate in the free financial markets exceeds the rate of return of capital gross of interest payments). For the firms in these sectors, total bank credit is a crucial variable for the determination of the level of production. If investment of period t is predetermined, a cut in BC_t has to be accompanied by a sufficient cut in L_t. More precisely:

$$\mu dL_t W_t = dBC_t.$$

This means that the elasticity of Q_t with respect to BC_t is:

$$(17) \quad \varepsilon(Q_t, BC_t) = \frac{1 + \mu v_t}{\mu} \frac{BC_t}{Q_t P_t}$$

For usual values of the parameters this elasticity is around the proportion of bank credit to total output. It is obvious that the supply-side effect of a cut in bank credit will be very important in these sectors. But, as was stated before, the situation described can occur only in economies with low degree of factor mobility. Otherwise it is impossible to imagine the existence of sectors that have, permanently, a much lower rate of return on capital than the rest of the economy.

The main findings of this section can be summarized in the following proposition:

> When there exists maximum interest rate on bank loans and the correspondent quantitative bank credit rationing, a change in credit conditions due to a cut in the amount of bank credit to marginal firms has an additional effect on supply of commodities and market prices. This is so because the cut in bank credit not only increases the basic interest rate and/or the leverage charge, but also changes exogenously the leverage of the firm in terms of credit from outside the banking system. The change in maximum bank rate has no other effects than those that come from its influences on ρ_t^b and s_t.
>
> The cut in bank credit may have a very important effect on supply and prices in sectors of the economy that can only use bank credit because the basic rate of the free financial markets exceeds their gross rate of return on capital. This phenomenon cannot occur unless the economy has a low degree of factor mobility. Both an increase in the maximum bank rate and in the amount of bank credit reduce profits, and therefore will tend to reduce next period's investment.

E. The role of leading firms[11]

In order to incorporate leading firms into the analysis let us add assumption C.2 bis:

> C.2 bis: There are two kinds of firms: leaders and marginal. Leading firms have access to the stock market and are able to get all the credit they need at the basic interest rate of the market. They face a demand for the commodity which is less than infinitely price-elastic. These firms compute demand by subtracting from the demand of the whole market the aggregate supply of the marginal firms. The objective of the leading firms

[11] Section E of Chapter I includes an informal presentation of this discussion.

is to maximize the present value of the stream of future profits. Marginal firms behave as indicated in assumption C.3.

We keep our previous assumptions A, B, C.3, D.2 and now we add C.3 bis.

It is still possible to talk of the aggregate supply of commodities by the marginal firms, but there is no such thing for the whole set of firms. We have to look instead at the price setting behavior of the leading firm under some assumption about aggregate demand for the whole market.

The behavior of the marginal firms has already been described in the previous sections of this chapter. In order to distinguish in our notation between the two kinds of firms we use the superscript m for "marginal" and ℓ for "leaders."

Since the leading firm knows the total demand of the market $Q_t(p_t)$ and also the aggregate supply of the marginal firms $Q_t^m(P_t, W_t, \rho_t^b, s_t)$ it is able to compute the excess demand $Q_i^\ell = Q_t - Q_t^m$ relevant for its pricing (or production) and investment decisions. All these are obtained from the following maximization problem:

$$\text{Max } PV_t = \sum_t^\infty [P_i Q_i^\ell - I_i P_i - L_i W_i - \rho_i^b \mu L_i W_i] \cdot$$

$$\cdot \frac{1}{\prod_{j=t}^{i} (1+\rho_j^b)}$$

subject to all the corespondent constraints.

From the first order condition $\frac{\partial PV_t}{\partial P_t} = 0$, we get the following price setting rule:

(18) $$P_t = \frac{W_t(1 + \mu\rho_t^b) L_t}{(1-a)Q_t^{\ell}} M$$

(19) where $M = (1 + \frac{1}{\eta(Q_t^{\ell}, P_t)})^{-1}$ is the mark-up factor;

$\eta(Q_t, P_t)$ is the price elasticity of the demand faced by the leader firm, which can be computed from:

(20) $$\eta(Q_t, P_t) = \frac{1}{\theta} \eta(Q_t, P_t) - \frac{1-\theta}{\theta} \varepsilon(Q_t^m, P_t)$$

where $\theta = \frac{Q_t - Q_t^m}{Q_t}$ is the share of the market which corresponds to the leading firm and $\eta(Q_t, P_t)$ is the price elasticity of the total demand for the market. Before looking at the effect on P_t of a change in credit conditions, let us look at how M changes when P_t and ρ_t^b change.[12] From (19) and (20) it is possible to get:

(21) $$\varepsilon(M, P_t) = -M \{1 - \frac{1}{\theta}[\frac{\eta(Q_t, P_t)}{\eta(Q_t^{\ell}, P_t)}]^2 - \frac{1-\theta}{\theta} [\frac{\eta(Q_t^m, P_t)}{\eta(Q_t^{\ell}, P_t)}]^2$$

$$\times [1 + \frac{\mu v_t^w (1 + \mu v_t - \mu v_t^w}{(1-a)[\mu v_t^w + a(1+\mu v_t)](1+\mu v_t)}]\} < 0.$$

[12] For simplicity we assume that only ρ_t^b changes, i.e., s_t remains constant.

$$(22)\quad \varepsilon(M,\ \rho_t^b) = -\frac{\varepsilon(Q_t^m\rho_t^b)}{1+\varepsilon(Q_t^m P_t)}\ \left[1 + \frac{\frac{1+a}{1-a}\ \frac{\mu v^w}{\mu v_t + a(1+\mu v_t)}}{\eta(Q_t,P_t)}\right]$$

The elasticity of P_t with respect to ρ_t^b can be obtained from (18). If for simplicity we assume $\eta(Q_t,\ P_t) = -1$, i.e., we work with (18) transformed into:

$$P_tQ_t = \bar{G}_t = P_tQ_t^m + \frac{W_t(1+\mu\rho_t^b)L_t}{1-a}\ M$$

where $\bar{G}_t$ is expenditure by consumers, it can be easily shown that:

$$(23)\quad \varepsilon(P_t,\ \rho_t^b) = \frac{(1-a)\ \frac{\mu\rho_t^b}{1+\mu\rho_t^b} - a\ \frac{1-\theta}{\theta}\ \varepsilon(Q_t^m\rho_t^b) + (1-a)\,\varepsilon(M,\rho_t^b)}{1+a\frac{1-\theta}{\theta}[1+\varepsilon(Q_t^m,P_t)] - (1-a)\,\varepsilon(M_1P_t)} > 0.$$

It can be shown[13] that for $0<\theta<1$ (0 and 1 excluded):

$$\frac{\partial|\varepsilon(M,P_t)|}{\partial\theta} < 0,\quad \frac{\partial|\varepsilon(M,P_t^b)|}{\partial\theta} > 0,\ \text{and}\ \frac{\partial|\varepsilon(P_t,\rho_t^b)|}{\partial\theta} > 0.$$

In words, we have shown the following proposition:

> The higher the market share of the leading firm, the higher the effect of an increased cost of credit on prices.

The intuitive explanation of this result is the following: in addition to the effect on prices due to the

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[13] The computationof these derivatives is a bit tedious. The easiest way to to it is by showing that

$$\frac{\partial|\eta(Q_t^e,P_t)|}{\partial\theta} < 0,\quad \frac{\partial|\varepsilon(M,P_t)|}{\partial|\eta(Q_t^e,P_t)|} > 0,\quad \frac{\partial|\varepsilon(M,P_t)|}{\partial|\eta(Q_t^e,P_t)|} < 0,\quad \frac{\partial|\varepsilon(P_t,\rho_t)|}{\partial|\eta(Q_t^e,P_t)|} < 0.$$

It is necessary to use:

increased cost of working capital that we would expect in a competitive situation, we now have an increase in the mark-up applied by the leading firm because the supply of its competitors shifts down, and, as a consequence, the price elasticity of the demand it faces decreases in absolute value.

In order to have a quantitative idea of these results, we can use a numerical example. Let's take the following numerical values: $a=1/3$, $\mu=1$, $\rho_t^b=0.05$, $v=0.10$ and $v^w=0.025$, which agree with our previous examples.

Table 5.1 shows the value of the elasticities involved for different values of θ. Note that for $\theta=0.10$ we have

$$\frac{\Delta P_t}{P_t} \approx 0.032 \frac{\Delta\rho_t^b}{0.050} \approx \frac{2}{3} \Delta\rho_t^b$$

and for $\theta=0.90$ the percentage increase in prices is

$$\frac{\Delta P_t}{P_t} \approx 0.05 \frac{\Delta\rho_t^b}{0.05} \approx \Delta\rho_t^b .$$

A comment on the investment behavior of the leading firm

The interest-elasticity of the leading firm's investment is relevant for a discussion of the effect of changes

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$$\frac{1}{\theta} = \frac{\varepsilon(Q_t^m,P_t)-\eta(Q_t^\ell,P_t)}{1+\varepsilon(Q_t^m,P_t)} \quad \text{and} \quad \frac{1-\theta}{\theta} = -\frac{\eta(Q_t^\ell,P_t)+1}{1+\varepsilon(Q_t^m,P_t)} .$$

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The model we are using can give some useful insights on this subject.

From the first order conditions of the maximization problem we get the desired level of capital stock for period t+2, which is

$$(24) \quad K_{t+2} = a \frac{Q^{\ell}_{t+2}}{\rho_{t+2} + d}$$

When the expected value of ρ_{t+2} increases, K_{t+2} will decrease as in the competitive case. But now we know that Q_t can be higher due to the deterrent effect of the increased cost of credit on the supply by marginal firms (and the consequent increase in the market share of the leading firm). Therefore, in the same was as it may correct upward its expectations on the real rate of interest, it may also change in the same direction the expected output. If this happens to be the case, the net effect on the desired stock of capital for period t+2 (and on period t+1 investment) will be smaller than otherwise. In other words, we have reasons to expect an interest-rate-elasticity of investment in fixed capital lower than for the competitive case.

Chapter V.

THE SHORT-RUN EFFECTS OF MONETARY POLICY ON COMMODITY MARKETS: THE CASE OF ARGENTINA.

A. Introduction

In chapter I we showed that in the Argentinian economy, the dynamic behavior of the rate of inflation, the rate of growth of real output and the rate of expansion of money supply called for an explanation along lines somewhat different from the conventional ones. In an informal way, we advanced a possible explanation of such behavior. Chapters II, III and IV offer a theoretical framework that can be used for a more formal testing of our main hypothesis. We undertake this testing in the present chapter.

We shall first discuss the sectoral structure and some institutional arrangements of the Argentinian economy that must be taken into account in chosing the level of aggregation and the variables that are to be considered exogenous. Next we present the basic structure of the econometric model and discuss our main assumptions, especially those related to the way economic agents form their expectations about the future course of inflation. The next task is to do the estimating and to interpret the results. Finally the implications for the design of stabilization policy will be discussed.

The testing of our main hypothesis would require, ideally, the construction of a macroeconometric model more complex than the one used in this section. Resource limitations have prevented us from undertaking such a task. Our present approach is limited in that it only focuses on the market for manufactured commodities, and it does not analyze the response of factor prices in future quarters to the current and past monetary and fiscal policies of the government. Nevertheless, it strongly suggests that the perverse effects of monetarist stabilization policies described in chapter I are explained by the response of the supply of commodities to credit conditions. While the evidence about how long these perverse affects persist is severely limited by the lack of estimates for the dynamic response of factor prices to fiscal and monetary macro-policies, the empirical conclusions do permit us to draw some practical implications relevant to the task of designing a stabilization policy.

B. Financial markets and the relevant real rate of interest

In Chapter I we described some special features of the financial sector of the Argentinian economy that can be considered to be the result of persistent inflation itself, or of institutional arrangements that have been historically associated with persistent inflation.

The effects of some of these special features on the behavior of suppliers of commodities have been discussed formally in Chapter IV. It was shown there, in general, that these special features make for a stronger response of the aggregate supply of commodities to changes in credit conditions. It was argued -- also in Chapter IV -- that with imperfect credit markets and government controlled interest rates on bank loans, the interest rate relevant to production and investment decisions would be the one charged in the free markets where the firms procure their marginal funds, that is, the interest rate which the firms take as the marginal cost of credit.

We have discussed the possibility of treating the recorded nominal interest rate charged on bank acceptances as the relevant interest rate. Our attempts to explain the behavior of this rate persuaded us that it is not a good proxy for the "marginal cost of credit". There are many evidences that even in the bank acceptance market, which is supposed to be a free market for loans, banks have changed the effective rate charged to borrowers by using indirect methods (including compensatory balances, administrative charges, shorter terms to maturity of the supplementary guaranty than the term of the loan, etc.), rather than by adjusting nominal rates. It also seems that the bank acceptance market was not free of credit rationing. Unfortunately, the <u>effective</u> rate charged to borrowers in the bank acceptance markets, or the rate charged in order free markets for loans (like those based upon acceptance by "financieras", where probably credit rationing was less frequent) have not been recorded on a regular basis.

For these reasons we have to be content with testing our main hypothesis by using aggregate demand and supply equations in which the real rate of interest is replaced by a function of its main argument - the measure of ex-ante disequilibrium in the money market. In other words, instead of using adapted versions of equations (1) and (2) of Chapter III, we shall use adapted versions of equations (1a) and (1b) of the same chapter. The required adaptation refers to features discussed in Chapter IV and to other special characteristics of the Argentinian economy that necessarily have to be taken into account in the empirical testing of our main hypothesis. We shall now turn to the description of these characteristics.

C. Sectoral structure and institutional arrangements in the Argentinian economy

The input-output table for Argentina shows several peculiarities in the structure of its economy which are important in deciding upon the level of aggregation for the econometric analysis. Some comments about this are in order, and also about other technological and institutional characteristics which are relevant to the specification of the relationships we wish to estimate.

Table 1. Input-output table for the Argentine Economy-1963

(in billions of pesos)**

	Agric.	Manuf.	Const.	Serv.	Total inter. demand	Private Consump.	Gov. Cons.	Inv.	Exp.	Total final demand
Agric.		1.0			1.0	1.3		0.1	1.7	3.1
Manuf.	0.3		0.5	2.0	2.8	7.3	0.3	1.2	0.2	9.0
Const.									1.4	1.4
Serv.	0.9	3.6	0.1		4.6	4.5	1.4		0.2	4.7
Subtotal domestic inputs	1.2	4.6	0.6	2.0	8.4	13.1	1.7	2.7	2.1	19.6
Imports		0.8	0.1		0.9	0.2		0.6		0.8
Total inputs	1.2	5.4	0.7	2.0	9.3	13.3	1.7	3.3	2.1	20.4
Wages	0.6	1.7	0.5	3.9	6.7					
Non-wages*	2.3	4.7	0.2	4.8	12.0					
Total Value Added[1]	2.9	6.4	0.7	8.7	18.7					
Total Produccion	4.1	11.8	1.4	10.7	28.0					

* includes indirect taxes and depreciation

** figures smaller than 0.1 billions have been omitted

1) Agriculture, as a productive sector, represents around 16 percent of total GDP. It produces approximately 80 percent of total exports and approximately 10 percent of private consumption. Agricultural prices in the domestic markets basically depend on world prices and on the exchange rate and export taxes fixed by the government. Costs in agriculture depend on the prices of manufactures and services as well as the wage rate. Changes in these prices will surely affect the farmer's production and investment decisions, but, in the short run, they can only affect agricultural prices to the extent that the government decides to take them into account in setting the exchange rate and the export taxes. In any given quarter, agricultural output depends on decisions that the farmers had adopted one or more quarters before, and on weather conditions.

2) Construction industry represents approximately 4 percent of total GDP. The whole of its output is absorbed by domestic investment demand. In this sector, suppliers and demanders usually engage in long term contracts with specific price adjustment clauses (generally linked to changes in input prices and nominal wages). Manufacturing industry (which in the input-output table also includes mining) is the main source of inputs for construction. The output of construction sector is highly dependent upon both government expenditures and the amount of bank credit which the Central

Bank allocates to mortgages. It also depends on private sector investment decisions.

3) All the services together constitute a very important sector of the economy They represent approximately 46 percent of total GDP. Expenditure in services accounts for more than 80 percent of government consumption demand and approximately a third of consumption demand by the private sector. (The services provided by the government are valued at their wage costs and computed as government consumption on the expenditure side of the budget). Approximately a third of total service output (mainly energy, transportation and gas) is sold to the manufacturing industry to be used as an input. Self-employment and Public Enterprises are two very pervasive organizational forms in the service sectors. There is a large share of services (especially those that are inputs of the manufacturing industry) for which prices are set by the government. In the short run, costs and demand conditions affect the prices of these services only to the extent that the government allows them to do so. Prices of other services (such as housing rents) are either fixed by the government or subject to long-term contracts with pre-established indexing clauses. Prices

of personal services depend mainly on demand conditions and nominal wages. Real output in all these service sectors taken together is strongly dependent upon the level of activity in the sectors that produce goods, upon government expenditure decisions, and upon consumption demand by the private sector.

4) Manufacturing (including the very small mining sector) represents approximately 34 percent of total GDP. Manufactured goods account for more than half of private consumption demand and approximately one-third of total investment demand. It also provides inputs used by agriculture and by construction and the services sector. Sales to the government and exports are of relatively minor importance. Prices of manufactures are generally determined in free markets: consequently, costs and demand conditions play a much more relevant role here than in the short run determination of other sectoral prices. Manufacturing industry uses inputs provided by agriculture and the service sectors. It also uses an important amount of imported inputs. Therefore, agricultural, service and import prices, together with the wage rate, are arguments of the cost of production function for manufacturing. In this sector real output reflects production decisions of private entrepreneurs, which in turn depend upon entrepreneurs' current perception of costs and demand conditions, and upon the long run expectations that, in the past, have determined their fixed capital investments.

5) Imports are not only an important input for manufacturing industry, but also provide for approximately 20 percent of the final demand for investment goods. Imports of consumer goods are largely restricted by very high tariff barriers or bans. Therefore, they are practically insignificant. Import prices depend upon world prices and the exchange rate and import duties set by the government. Quantitative restrictions have not generally been used for intermediate imports, except for very short periods of time. (Even during these periods, intermediate imports must not have constituted a bottleneck for manufacturing production, because bans or quantitative import restrictions have usually followed periods of speculative accumulation of stocks of imported goods.)

6) Almost all nominal wages are set either in collective bargaining between very strong trade unions and business syndicates, or by agreement between the trade unions and the government, or by the government alone. But no wages, perhaps with the sole exception of those of business executives, are the result of individual bargaining between worker and employer. Past and expected inflation, unemployment, political and social climate, and many other economic and non-economic variables are taken into account by each contestant in selecting a strategy. Yet, except for

the influence the government can exercise during the bargaining process, other current and future macroeconomic policies of the government are generally irrelevant in determining nominal wages during the current quarter. In other words, nominal wages are largely an exogenous variable in any individual quarter. Current and future inflation, unemployment, fiscal and monetary policies and many other economic and social variables will affect, conceivably, the level of nominal wages in future quarters. One of the most important variables taken into account in deciding the adjustment in nominal wages is the recent history of consumer goods inflation. This, in turn, is some weighted average of the rate of inflation as measured by the price of manufactures, services and agricultural goods.

The preceding description tells us that any anti-inflationary effect of government macro-policies has to show up first in the market for manufactures and services with freely determined prices. If the government has some effective capability of reducing the rate of inflation of agricultural and import prices, energy, transportation and gas prices, or labor costs, that capability will transpire in the guise of administrative determination of the exchange rate, export and import taxes, public utilities and public enterprise prices or of the level of nominal wages. Government

ability to affect these prices in the short run depends upon the effectiveness of its regulatory and pricing policies related to each particular market, but has little to do with its ability to change fiscal and monetary macropolicies. Prices in the construction sector are not directly set by the government, but due to the institutional arrangements commented in 2), they basically follow the price of manufactures and nominal wages.

The previous description tells us also that any short-run contractionary or expansionary effect of macropolicies on real output will show up in construction, manufacturing industry and government services.

We are especially interested in looking at the effects of monetary policy on output and prices through the supply of commodities. On a priori grounds, it is in agriculture and manufacturing industry that one can expect this kind of effect to be relevant. Services usually have a very short period of production, and, therefore, working capital is generally unimportant. In the construction industry, working capital is important, but given the kind of contracts under which construction projects are carried out, output is basically demand-determined and prices move in strict response to some long-run cost formula.

Taking into account the special role of manufacturing prices and output, we decided to select this sector as the main focus of our empirical analysis. The empirical testing of our main hypotheses would require, ideally, the estimation of a complete structural macro model of the Argentinian economy. But that is totally beyond our present possibilities. Therefore, we shall focus on what we consider to be the one commodity market (actually, the market of a very broadly defined, composite commodity) that plays the most important role as receiver and transmitter of the short run effects of anti-inflationary monetary policy.

Before leaving this section we want to comment on some of our assumptions. We believe them to be justified by structural and institutional characteristics of the Argentinian economy which we have discussed herein.

For specification and estimation purposes, we shall assume initially that nominal wages, agricultural and import prices, and the prices of services such as utilities (power and gas) and transportation, are either predetermined or exogenous policy variables. Estimates based on the method of instrumental variables (which are consistent even if some simultaneity exists between those factor prices and the endogenous variables) will, nevertheless, be reported. We shall also assume that real output of agriculture and construction are exogenous. Real output of the service sectors will be considered to be a function of the output of the three commodity sectors. Therefore, once the real output of manufacturing is determined, total output follows as a consequence. These assumptions mean that there are only two endogenous variables to be explained by the model: real output and prices in the manufacturing industry.

Any assumption about exogeneity is, at best, but a rough approximation. There is always some broader sense in which the assumed exogenous variables can be considered to be endogenous. But for our present purposes - and taking into account that we use quarterly information - all the variables we assume to be exogenous can realistically be considered as being, in a "causal" sense, independent from the observed values for the quarter of manufacturing prices and output. As we show in section G, there are strong similarities between the ordinary least-squares estimates (which are consistent only if the exogeneity assumption is valid) and the instrumental-variables estimates (appropriate to generate consistent estimators even if there is simultaneity between the factor prices and the endogenous variables of our model). Such similarities suggest that factor prices in the current quarter are not significantly correlated with the random shocks of current quarter manufacturing prices and output.

The exogeneity of the money supply is a subject that deserves some comments. There are at least three reasons why, in actual economies, money supply might be endogenous.

First, in open economies with less than flexible exchange rates and some freedom of movement for commodities and capital, one of the sources of changes in money supply (namely, the balance of payments) is intrinsically endogeneous, in the sense that it is generally affected by current domestic inflation, real output, interest rates and other relevant macroeconomic variables. Moreover, the Central Bank cannot control the balance of payments with the same degree of effectivity as it can control the expansion of domestic credit. While this kind of endogeneity of the money supply is not as important in Argentina as it is in other small, open economies that have adhered more closely to the rules of fixed exchange rate and free trade, we have explicitely taken it into account by excluding from the changes in our monetary aggregate that portion that originated in the balance of payments.[1]

Second, the expansion of domestic credit is in part determined by the behavior of households and firms, in terms of preference for currency versus deposits in the banks, and by the behavior of the banks in relation to the demand for excess reserves. We have not made any attempt to deal with this problem because it would have implied a level of disaggregation in the modeling of the economy

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1 Actually we include only the endogenous part of the balance of payments, which we estimate by subtracting from the overall balance of payments the movement of capital induced by the Central bank through subsidised sales of future foreign exchange. See Section C.

that largely exceeded our present possibilities. On the other hand it would not have introduced any kind of substantive modification to our analysis.

Third, domestic credit expansion may respond to changes in current inflation and real growth because the Central Government follows a rule of accomodating the money supply to "external shocks" or any other kind of current events. There is no way of directly testing the direction of the causality among such variables as credit expansion, inflation and real output growth within the shortest period of time for which the data are available (in our case, the quarter). Yet, this within-the-quarter causality is the one that could introduce inconsistency into the estimating process. Moreover, if there is no causality from money to prices or real output (i.e. if money has been managed in a completely passive fashion) the whole exercise of looking at the effects of changes in money supply on the commodity markets would make no sense. We shall therefore, examine some indirect evidence.

In section C of chapter I, after describing the way in which monetary policy was used in Argentina from the early forties to the present, we concluded that on several occasions money supply was actively used to try to fight inflation or to help the economy emerge from a recession. That monetary policy was not totally passive can be documented statistically by using the Granger-Sims analysis of causality[2]. In graph 5.1 we show the correlation coefficient of the rate of growth of money supply[3] (from eight previous quarters to eight posterior quarters) and the rate of growth of nominal income, the rate of inflation and the rate of real growth. Each one of these series have been "prewhitened" using ARIMA processes estimated by R. Fernandez (1975)[4]. The correlation coefficients are compared with twice their standard

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2 See Granger (1969) and Sims (1972). Our implementation of the test is similar to that of Feige and Pearce (1976).

3 After the adjustments introduced to take care of the endogeneity of part of the balance of payments.

4 R. Fernandez [1975] ,Table 9, App. c. For Money Supply (ms) we used the following ARIMA(3,2):

$$ms_t(1-1.066L-0.282L^2+0.481L^3)=0.008+(1-0.647L-0.421L^2)u_t$$

For the rate of inglation (π) we used:

$$\pi_t(1-0.546L+0.679L^2-0.374L^3)=0.005+(1+0.029L+0.963L^2)v_t$$

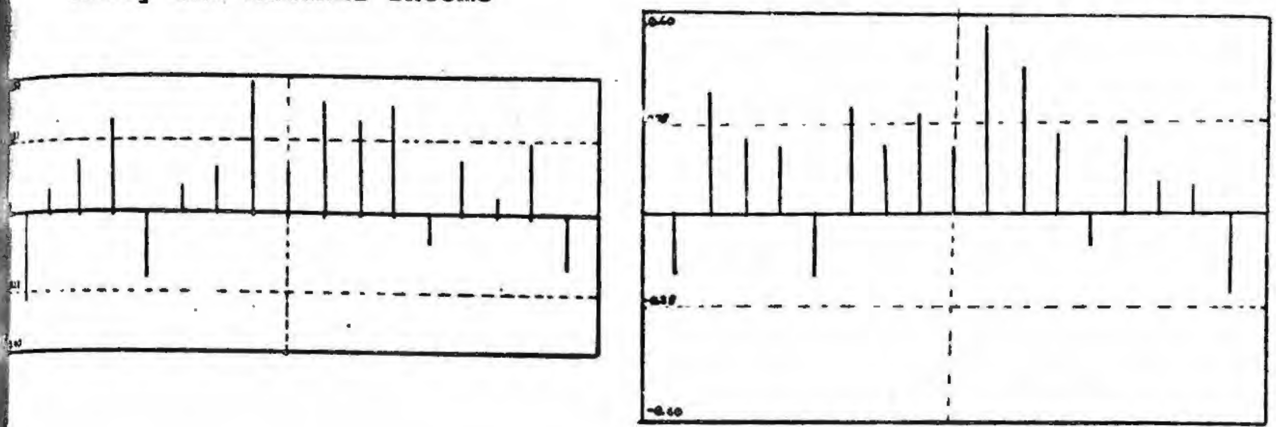
And for real output (ry_t) we used:

$$ry_t(1-0.276)=w_t$$

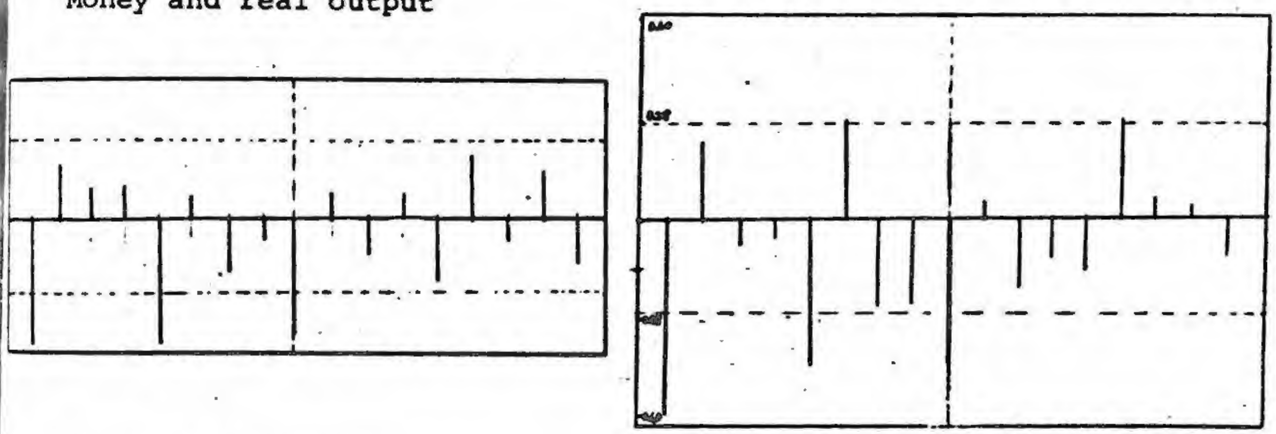
where L is the lag operator and u_t, v_t and w_t are white noises.

Graph 5.1

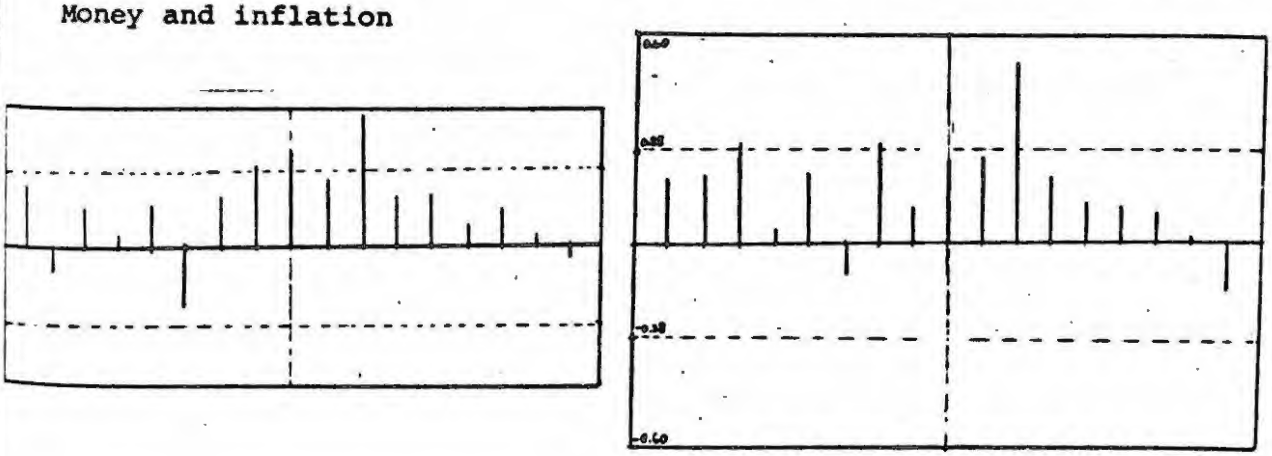
Money and Nominal Income



Money and real output

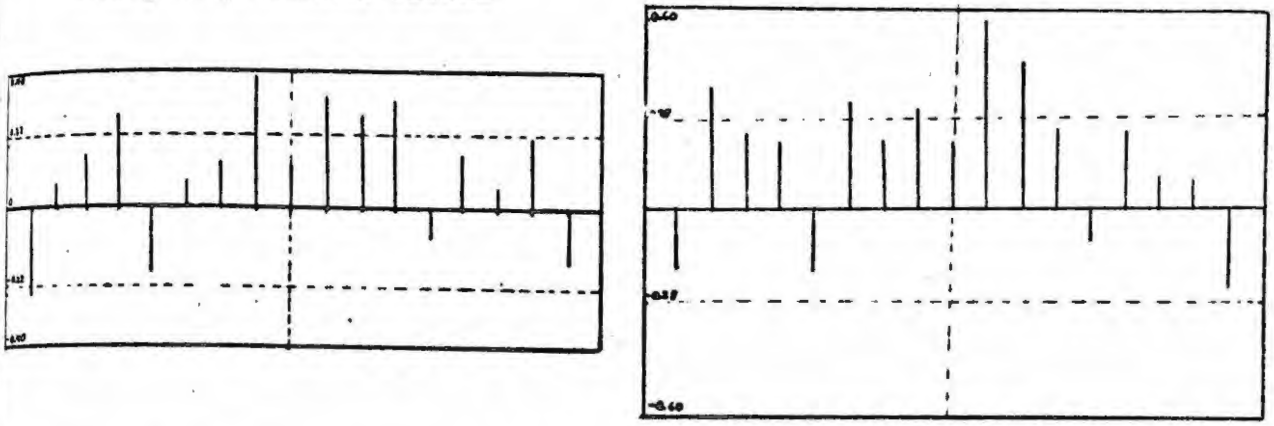


Money and inflation

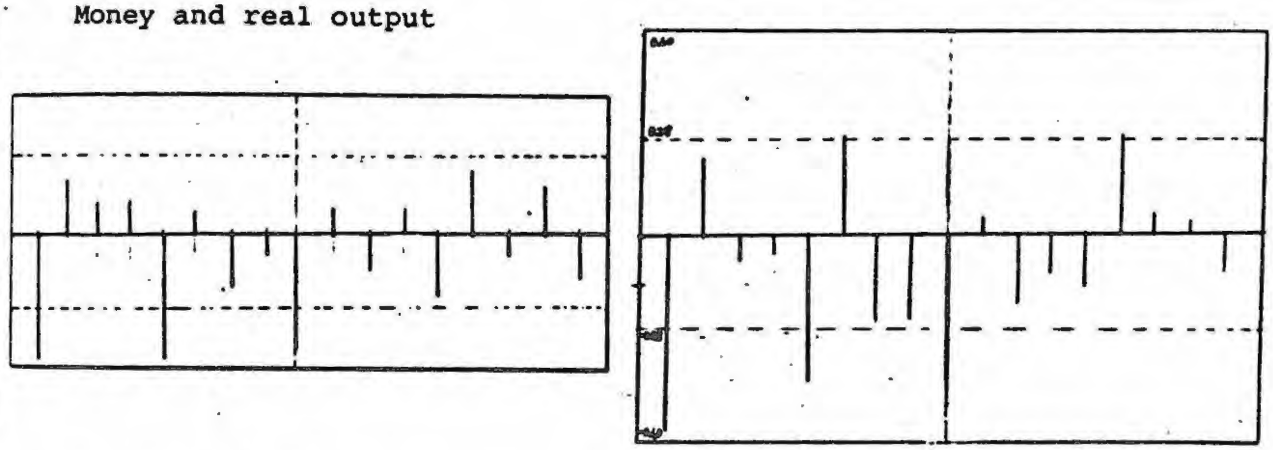


Graph 5.1

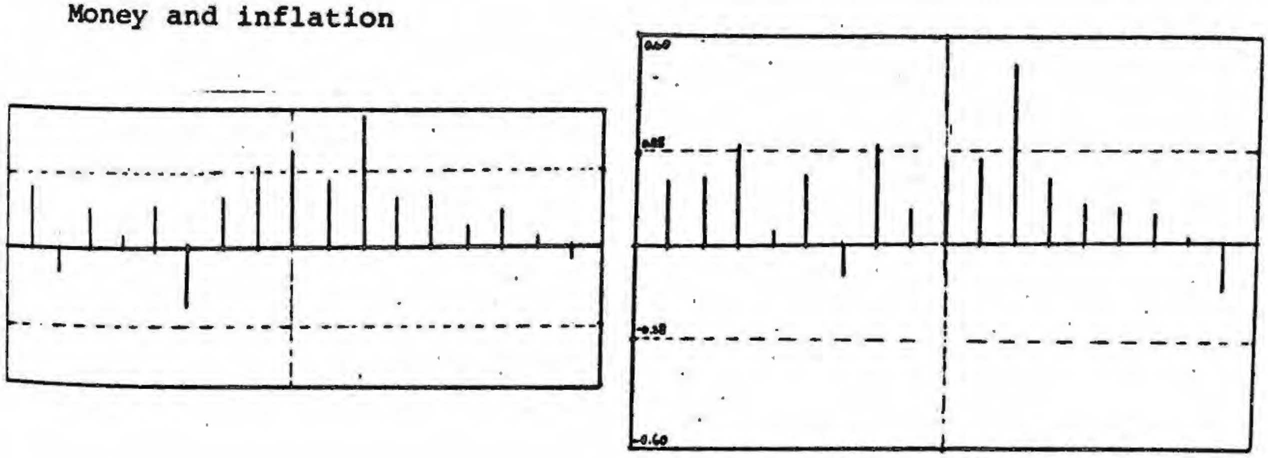
Money and Nominal Income



Money and real output



Money and inflation



errors[5]. Significant correlation coefficients between lagged money supply and each one of the other variables indicate causality from money to the latter. Significant coefficients of money supply in posterior quarters and the other variables indicate causality from the latter to money supply.

Let us first look at the correlation between money supply and nominal income. Taking the period 1955I-1976I there are three significant correlation coefficients indicating causality from money to nominal income, and three from nominal income to money. Taking the period 1963I-1976I (which is our basic sample period) there are still three indications of causality from money to nominal income but the number of significant coefficients indicating feedback from nominal income to money is only two.

The correlation between money supply and real income during the period 55I-76I shows two significant coefficients implying causality from money to real income and none from the latter to the former. Taking the period 69I-76I, the indications of causality from money increase to three, and, similarly the indications of feedbacks from real income to money increase to one.

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5 The standard error is taken to be $n^{-1/2}$ where n is the number of observations. This corresponds to the assumption of a joint-normal distribution.

Looking at money supply and prices we find only one indication of causality in each direction during the period 1955I-1976I, while taking the shorter period 1963I-1976I, we find two significant correlation coefficients indicating causality from prices to money supply and only one indicating that the causality runs from money to prices.

Altogether there are clear indications that money was not merely passive, but on the other hand there are also clear evidences of feedbacks from prices and output to money. It is therefore justified to look at the effects of changes in money supply on prices and output, but on the other hand, the existance of significant correlation between money in future quarters and current rates of inflation and real outputs suggests that in the current quarter money may be correlated with the random shocks that affect nominal income. If this is the case, the estimated coefficients of money supply (when taken as endogenous) may be affected by a simultaneity bias. We deal with this problem by examining, after the estimation process, the direction in which our conclusion would be affected if the simultaneity has existed.

D. The basic structure of the econometric model

Before going into details about specification, we must discuss the structure of the model that we endeavor to test and estimate.

Basically, we work with an adapted version of the model developed in Chapter III. It includes an aggregate demand for, and aggregate supply of manufacturers.

Supply and demand for other goods, services and factors of production are not included because their prices are considered to be exogenous.

Each commodity is purchased and sold several times before it reaches the household that will consume it or the firm that will use it as capital equipment. We have to decide at which stage of the commercialization process we shall draw the line that separates demand from supply. It has been observed very often that retail prices follow, with some lag, the behavior of wholesale prices. In addition, there are some practical advantages in choosing the wholesale stage as the object of our analysis. Although quantities transacted are neither recorded at the wholesale nor at the retail levels, in wholesale markets it is possible to identify supply with output and to transfer to the demand side of the market any change in inventories of finished goods which is not strictly proportional to changes in output. This allows for a simple statistical differentiation between "working capital" and "surplus or speculative" inventories. (A manufacturing firm that choses to keep some portion of its current production in the form of surplus inventories instead of selling all its production at the market wholesale price, will be considered - to the extent of that inventory decision - to be a demander rather than a supplier in the market for manufactures.) That means that the quantity transacted will be taken to be equal to current quarter production of manufactures. Therefore, the two endogenous variables we shall try to explain are wholesale prices and current-quarter production of manufactures.

Aggregate demand for manufactures.

Aggregate demand for manufactures in real terms is simply assumed to be dependent upon present and past levels of real income and upon the measure of disequilibrium in the money market as shown by equation (1) in Table 5.2.

The distinction between demand for consumption and for investment is dropped because there is no information on the proportions of expenditure on manufactures that can be attributed to those two categories. But the distributed lag on real income should capture both the dependence of consumption demand upon permanent income and the dependence of investment demand upon current and past levels of output.

The monetary disequilibrium variable is also entered as a distributed lag, in order to capture the usual lagged response of investment expenditures (both fixed and in the form of surplus inventories) to credit conditions.

Table 5.2. THE BASIC ECONOMETRIC MODEL

(1) $\log Q^{d}_{ma} = c \;.\; PDL(\log Y) + c_m \;.\; PDL(\log MS' - \log MD')$

(2) $\log p_{ma} - \log p^{e}_{ma} = f \;.\; (\log Q^{d}_{ma} - \log Q_{ma})$

(3) $\log p_{ma} = \log p^{e}_{ma} + f \;.\; c_y \;.\; PDL(\log Y) + f \;.\; c_m .$
$PDL(\log MS' - \log MD') - f . \log Q_{ma}$

(4) $\log Q_{ma} = b_k . PDL(\log K) + b_{vf}\, PDL\left(\log \dfrac{W^{0.35} \,.\, P_a^{0.20} \,.\, P_{im}^{0.16} \,.\, P_{es}^{0.29}}{P_{ma}}\right) + b_m . PDL(\log MS' - \log MD') +$

$b_{\sigma} \; .PDL\,(\sigma^2_{\pi}) + b_{bc} . \; PDL\left(\log \dfrac{BC}{W^{0.35} \cdot P_a^{0.20} \cdot P_{im}^{0.16} \cdot P_{es}^{0.29}}\right)$

(5) $p_{ma} = a_{\pi}\, \pi^{e} + a_y PDL(y) + a_m PDL(ms' - md') + a_q q_{ma}$

(6) $q_{ma} = b_k\, PDL(k) + b_{vf} PDL(p_{vf} - p_{ma}) + b_m\, PDL(ms' - md') +$

$b_{\sigma} \cdot PDL(D\, \sigma^2_{\pi}) + b_{bc}\, PDL(bc - p_{vf})$

Where:

the a's, b's, c's, and f are parameters to be estimated low case letters are continuously compounded rates of growth of the variables denominated with the respective capital letters, e.g.,: $q_{ma} = \log Q_{ma} - \log Q_{ma_{-1}}$;

PDL means polinominal distributed lags;

Q^{d}_{ma} is the quantity demanded of manufacturing commodities;

Y is real income in terms of manufacturing prices, which is computed as $Q_a \frac{P_a}{P_{ma}} + Q_{ma} + Q_c \frac{P_c}{P_{ma}} +$ $(Q_a+Q_{ma}+Q_c) \cdot 0.70 \frac{P_s}{P_{ma}}$ where Q_a, Q_{ma} and Q_c are agricultural, manufacturing and construction GDP respectively, and GDP in the service sectors is estimated in 0.70 times the GDP in the sectors that produce goods. P_{ma}, P_a, P_c and P_s are price indices for manufacturing, agriculture, construction and services respectively.

MS' is money supply in an ex-ante sense discussed later on;

MD' is money demand. Its specification is discussed in the next section;

Q_{ma} is the quantity produced by manufacturing industry;

K is the stock of capital at the beginning of the quarter, obtained by accumulation of investments using a rate of depreciation of 1% a quarter and a benchmark of capital stock for the end of 1960;

W is an index of nominal wages;

P_{im} is an index of domestic prices of imported goods;

P_{es} is a price index for economic services (energy, transportation and gas);

is the variance of predicted inflation;

BC is Bank Credit to manufacturing firms;

π^e is expected inflation;

P^e_{ma} is the index of the expected price of manufactured goods computed as $P_{ma_{-1}} . \exp(\pi^e)$;

P_{vf} is the rate of change of variable cost of production which is computed as $0.35w+0.20p_a+0.16P_{im}+0.29p_{es}$.

Sectoral prices, especially for agriculture, services and imports, relative to manufacturing prices, should be introduced because we are now working with a sectoral component of total aggregate demand and there may be substitution effects. However, in preliminary regressions we found these effects to be insignificant, so that we decided to eliminate relative prices from equation (1).

In the theoretical discussion of Chapter III, it was assumed that the commodity market reached equilibrium within each individual period and that the demand for commodities had unitary price elasticity. These two assumptions greatly simplified the exposition in Chapter III, but it does not seem convenient to impose them as a priori restrictions in a quarterly model for an actual economy. Instead we shall assume the price adjustment mechanism of equation (2). Equation (2) tells us that the actual price level differs from the expected price level as a function of the difference between the quantity demanded and the quantity supplied at the expected level of prices. The value of the coefficient is not specified a priori, but subject to estimation.[6]

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[6] The assumptions used in Chapter III are equivalent to make f equal to 1.

Combining the demand equation with the price adjustment mechanism, we obtain equation (3) in which the unobservable quantity demanded at the expected price level is replaced by a function of its arguments. Therefore, equation (3) is the specification suited for estimation.

Note that the measure of monetary disequilibrium enters into equation (1) for two reasons. First, because there can be direct spillover effects of monetary disequilibrium on the commodity market[7], and second, because the relevant real rate of interest - which should be an argument of the demand equation - is not observable, but is assumed to be a function of current and past monetary disequilibrium.

Equation (5) results from taking first differences in equation (3), and for reasons that will be explained below, this is the version finally used in the estimation.

Aggregate supply of manufactures.

As can be seen in equation (4) of Table 5.2, aggregate supply of manufactures is specified as a function of the stock of fixed capital, the cost of the variable factors of production relative to the prices of manufactures, the measure of monetary disequilibrium, the variance of expected inflation, and total bank credit in terms of variable factor costs.

7 The specification of this spillover effects, taking into account the restriction imposed by Walras' Law, that was discussed in Section , of Chapter I, are entirely applicable here.

This aggregate supply equation differs from (2) in Chapter III in three main respects. First, the variable factor of production is taken to be a composite factor which includes labor, agricultural and imported goods, and economic services. Second, the real rate of interest has been replaced by the measure of monetary disequilibrium. Third, real bank credit has been introduced as an additional argument, taking into account the discussion of Chapter IV, section D. In addition, all the arguments are entered as polynomial distributed lags to capture partial adjustments and differences in the length of the process of production of the variety of goods that have been aggregated.

Equation (6) results from taking first differences in (4). Again, this is the version used in the estimation.

<u>The demand for money and the measure of monetary disequilibrium</u>

Defining money as an aggregate which includes not only currency and demand deposits but also interest-bearing financial assets is very inappropriate in economies with persistent inflation. In these economies the difference between a demand deposit and a savings or time deposit (or any other interest-bearing financial asset) is measured by nominal interest rates that are in the order of "several times 10 percent." Furthermore, once one begins including interest-bearing financial assets in the money aggregate, it becomes very difficult to decide where to stop the aggregation process.

Moreover, in Argentina savings and time deposits have become gradually less important due to the setting of interest rates by the Central Government. Thus the balances that remained since the mid fifties reflect the behavior of some groups of the population which behave more traditionally than rationally; and therefore one should not expect for our sample period strong substitution effects between this kind of financial asset and others available in the portions of the financial market where free interest rates prevail. The demand for the more liquid assets, such as currency and demand deposits, is motivated by transactions purposes and has surely closer connections with the demand for commodities and the supply of and demand for short-term loans in free financial markets. Firms and households whose liquidity levels fall short from the desired level according to the planned level of transactions and the opportunity cost of money will tend to decrease transactions or to demand more loans (if they are net demanders in the loan market) or supply less loans (if they are net suppliers) in order to rebuild their liquidity levels. If situations of deficit of liquidity predominate, transactions will be adjusted downward and the net demand for loans will increased. The opposite will happen if situations of excess of liquidity predominate.[8]

For these reasons we shall define money in the most conventional and restrictive sense, i.e., including only currency outside the banking system and demand deposits in the commercial banks.

The conventional determinants of the transactions demand for money are expenditures in nominal terms and some measure of the opportunity cost of holding money. For this reason, the real rate of interest and the expected rate of inflation should both enter as arguments. We want also to test the hypothesis (which has very often been

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8 We prefer to tell the story of the relationship between money and the loan and commodity markets in this fashion rather than describing it as a problem of allocation of wealth among alternative assets, because in economies with persistent inflation the "speculative" or "asset" motive for holding money tends to dissappear. In Chapter I, we showed that the increase in the demand for currency between 1946 and 1955 can be explained by using an "asset" demand argument, but such phenomenon took place only during that period, and disappeared once banks became involved again in the promotion of more convenient financial assets. During the sample period we use in this chapter, that phenomenon had completely disappeared.

advanced) of dependence of the demand for money upon the variance of predicted inflation. The main reason for introducing the variance of predicted inflation is that uncertainity about the level of prices may induce higher precautionary blances. Therefore, we should expect a positive coefficient for this variable.

The specification adopted is shown in equation (7) of Table 5.3.

As in the case of the commodity market, we do not want to impose a priori that monetary equilibrium has to be achieved within the quarter.

We shall try three alternative assumptions for modeling the disequilibrium situation. Two of them are introduced because together they characterize the conventional assumption in empirical estimation of demand for money. It is the third one, however, that conceptually fits better into our present model. We decided, neverthless, to keep the other two in order to be able to discern whether our final results depended upon our unusual aggregate supply function, or upon our unusual demand for money. Let us begin with the two alternative partial adjustment assumptions most often used in practice. One of them is taken up in equation (8a), which implies that in each quarter people adjust a fixed proportion of the difference between the log of the desired amount of real cash balances, and the log of the initial stock of real cash balances.

Table 5.3

Demand for money and the measure of monetary disequilibrium.

(7) $\log \frac{MD}{E} = \ell_\rho \rho + \ell_\pi \pi^e + \ell_\sigma \sigma_\pi^2$ $\quad \ell_\rho<0;\ \ell_\pi<0;\ \ell_\sigma>0$

(8a) $\log \frac{M}{P} - \log (\frac{M}{P})_{-1} = \gamma_1 [\log \frac{MD}{P} - \log (\frac{M}{P})_{-1}]$ $\quad 0<\gamma_1<1$

(8b) $\log M - \log M_{-1} = \gamma_2 [\log MD - \log M_{-1}]$ $\quad 0<\gamma_2<1$

(9a) $\log \frac{M}{E} = (1-\gamma_1) \log (\frac{M}{E})_{-1} + \gamma_1 \ell_\pi \pi^e - \gamma_1 \ell_\sigma \sigma_\pi^2 .$

(9b) $\log \frac{M}{E} = (1-\gamma_2) \log \frac{M_{-1}}{E} + \gamma_2 \ell_\pi \pi^e - \gamma_2 \ell_\sigma \sigma_\pi^2 .$

(10) $MS' = M_{-1} + \Delta DC + NSFE$

(11) $\log MD' = \log E' + \ell_\pi \pi^e + \ell_\sigma \sigma_\pi^2 .$

(12) $\rho = \bar{\rho} + \theta(\log MD' - \log MS')$ $\quad \theta>0$

(13) $\log M - \log MD = \alpha(\log MS' - \log MD")$ $\quad 0<\alpha<1$

(14) $\log MD - \log M_{-1} = \gamma(\log MD^* - \log M_{-1})$ $\quad 0<\gamma<1$

(15) $\log MD'^* = \log E' + \ell_\rho \bar{\rho} + \ell_\pi \pi^e + \ell_\sigma \sigma_\pi^2$

(16) $\log MD"^* = \log E' + \ell_\rho \rho + \ell_\pi \pi^e + \ell_\sigma \sigma_\pi^2$

(17) $\log \frac{M}{E} = (1-\gamma) \log \frac{M_{-1}}{E} + [\alpha - \gamma(1-\alpha) \ell_\rho \theta] \log \frac{MS'}{E'}$

$+ [\gamma(1-\alpha) \ell_\rho \theta - \alpha](1-\gamma) \log \frac{M_{-1}}{E'} + \gamma(1-\alpha)$

$(1+\gamma \ell_\rho \theta) \ell_\pi \pi^e + \gamma(1-\alpha)(1+\gamma \ell_\rho \theta) \ell_\sigma \sigma_\pi^2 .$

(18) $\log MD' = (1-\gamma) \log M_{-1} + \gamma \log E' + \gamma \ell_\pi \pi^e + \gamma \ell_\sigma \sigma_\pi^2 .$

where:

MD is money demand, a non-observable variable;

E is expenditure at current prices computed as $Q_aP_a + Q_{ma}P_{ma} + Q_cP_c + (Q_a+Q_{ma}+Q_c)\cdot 0.70\cdot P_s - X\cdot P_a + M\cdot P_{im}$, being X and M exports and imports respectively;

M is the actual amount of currency outside the banks plus demand deposits;

P is an index of the general level of prices;

MS' is money supply exogenously controlled by the Monetary Authority;

ΔDC is the increment in domestic credit by the Banking System in excess of saving and time deposits and other non-monetary liabilities;

NSFE is the net sale of future foreign exchange by the Central Bank;

E' is computed as $Q_aP_a + Q_{ma_{-1}}P^e_{ma} + Q_cP_c + (Q_a+Q_{ma_{-1}}+Q_c)\cdot 0.70\cdot P_s - X_{-1}\cdot P_a + M_{-1}\cdot P_{im}$.

Alternatively, Equation (8b) implies that people adjust in each quarter a constant proportion of the discrepancy between the logs of the desired and initial stocks of nominal money.

The functions suited for estimation that result from applying assumptions (8a) and (8b) into equation (7) are shown in Table 5.3 under numbers (9a) and (9b). Since we do not have data on the relevant real rate of interest we have just omitted it from equations (9a) and (9b).[9]

For the specification of the spillover effects of monetary disequilibrium using the information provided by the estimated coefficients of (9a) and (9b), we adopt a modified version of the specification discussed in Chapter III. The modifications have been introduced to take into account the openness of the economy and some restrictions imposed by our present model's failure to include all the markets that actually exist.

9 For the purpose of implementing our measure of monetary disequilibrium we do not need the numerical value of the coefficient of the real rate of interest. Of course, it is recognized that to the extent that the real rate of interest during the sample period had been correlated with some of the other arguments, the coefficient of the latter will be biased.

We assume that there is a certain quantity of money that would just satisfy people's demand for money given the expected inflation and its variance for the current quarter, and assuming that the level of nominal expenditure will equal current production of the exogenous sections valued at their actual prices, plus net imports in the previous quarter valued at their exogenous current prices, plus previous quarter production of manufactures valued at the expected price level. We call this demand for money MD' and it is computed as shown in Equation (11).

In an open economy, the Central Bank lacks complete control over all the components of Money Supply. This is taken into account in defining MS'. MS' is an exogenous (policy) variable even when ex-post MS is endogenous due to the endogeneity of several components of the balance of payments. It is computed by adding to the previous quarter's stock of money the actual change in domestic credit, and the net sale by the Central Bank of future foreign exchange, as shown in equation (10). The latter is taken to be an exogenous inflow (or outflow) of foreign capital. It exists, and it is considered exogenous because Central Banks decide how much foreign exchange to sell at a future exchange rate that is usually well below what would be the market-clearing rate.

The difference between MS' and MD' constitutes a monetary disequilibrium which is "ex-ante" with respect to the working of the commodity on loan markets within the current quarter. We measure this disequilibrium by the difference between log MS - log MD' and, as it was stated previously, it affects both the demand for and supply of commodities.

Other variables, the behavior of which is not explained by the model (such as net movement of foreign capital other than NSFE, domestic consumption of exportable goods, and imports) are assumed to adjust as to make compatible the ex-post monetary disequilibrium registered by equations (8a) or (8b) and the actual values of Q and P explained by equations (3) and (4).

The partial adjustment assumption of equations (8a) and (8b) is taken to describe the overall process of adjustment in the money market and not simply the behavior of demanders. For this reason we should expect that under those specifications the adjustment coefficients will be dependent upon the kind of policy applied by the monetary authority. In order to overcome this weakness of the conventional assumptions on which empirical money demands are usually based, we shall try a third specification of the disequilibrium process in the money market. Moreover, this last specification has the advantage of allowing a more appropriate treatment of the real interest rate than the one it accorded to it in the previous specifications.

Equation (12) is the same assumption about the behavior of the real rate of interest that was postulated in Section E of Chapter III. The money demand used for computing the relevant measure of monetary disequilibrium is evaluated at the expected level of expenditures (E') and the long run real rate of interest ($\bar{\rho}$), as indicated in (15). The stated MD' in (15) is a "desired" level which demanders will strive to reach only in part during the current quarter. This partial adjustment (which now refers exclusively to the behavior of demanders) is represented in equation (14) which applies indistinctly to money demand whatever the moment at which it is computed (i.e., it applies to MD as well as MD' and MD"). It is further assumed that the monetary disequilibrium that still remains once ρ has adjusted according to (12), will be partially closed during the quarter by adjustment either of expenditures (away from the expected level) or of the balance of payment, or of both. It should be noted that adjustment in expenditures will induce further changes in money demand, and the change in the balance of payment will induce a level of money supply different from that initially engineered by the Central Bank. The total effect of these changes is to decrease the disequilibrium that remains after the real interest rate has adjusted to a proportion of its initial level. This is specified in equation (13). Using (16) and (14) to substitute for MD" in (13), and then using (12), (14) and (16) to substitute for ρ, we obtain equation (17) which is appropriate for estimation. The main difference between (17) and the previous specification (9b), is that we have two additional explanatory variables, log $\frac{MS'}{E'}$ and log $\frac{MS}{E'}_{-1}$. These variables introduce explicitely the policy of the Central Bank as argument of the demand for money actually observed in the economy.

Once the coefficients of (17) have been estimated, it is possible to identify γ (the adjustment coefficient of demanders), and ℓ_π and ℓ_σ (the coefficients of the expected rate of inflation and its variance in the long-run demand for money). Coefficient α, the proportion of the disequilibrium that is eliminated within a quarter through adjustments in expenditures and the balance of payments, ℓ_ρ, the coefficient of the real interest rate in the long-run demand for money, and θ, the coefficient of adjustment of the real interest rate in response to monetary disequilibrium cannot be identified.

Since now γ represents strictly demanders' willingness to materialize within the quarter only a portion of their excess demand (as computed from the long run demand for money function), we have to construct our measure of effective monetary disequilibrium as indicated in (18). The money demand which is compared with money supply is the one that will effectively show up in the market, taking into account demanders' partial stock adjustment.

E. Expected Inflation.

The model formed by equations (3) and (4) or, for that matter, (5) and (6) involves three non-observable variables. One of them is money demand before the working of the commodity markets (MD'), the determination of which we have discussed in the previous section. The other two unobservables are expected inflation (π^e) and the variance of expected inflation (σ_π^e). They enter into the three basic equations of the model and in the estimation of money demand. Thus, we have to make some assumption about how economic agents form their expectations.

Before going into details about specification, a practical issue must be taken up. What precise price index should expected inflation refer to? In the aggregate-demand and supply equations for manufactures, there is no doubt that it should refer to the wholesale price index for domestic manufactures. In the demand for money equations, other price aggregates may be relevant. For simplicity, our basic expected inflation variable will be the same one used for the aggregate supply and demand equations, but we shall check how inclusion of other versions of the rate of inflation affects the estimation of the involved parameters.

Having chosen the aggregate price index, we next have to choose an assumption about what information, and what procedure do economic agents use to make their predictions.

Cagan's "adaptive" expectations and Muth-Sargent-Lucas' "rational" expectations have been previously used in demand for money equations for the Argentinian economy. Adaptive expectations have been found to lead to some "suspicious" results in that context[10]. Fernandez [1975] found evidence favorable to "rational" expectations, but that is not very conclusive either. Independently of empirical evidence we think that neither adaptive expectations a-la-Cagan, nor rational expectations a-la-Muth-Sargent-Lucas are appropriate to the Argentine economy. On the one hand, inflation being in the order of "several" ten percents a year and subject to strong fluctations, prediction errors are very costly to the decision maker. Therefore, it is difficult to accept that people will not

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[10] See Diz (1970), Mallon and Sourrouille (1975).

try to use whatever other information (additional to the past rates of inflation) can be obtained at a cost, so far as the latter is less than the gains to be had from predictive accuracy. On the other hand, the Muth-Sargent-Lucas type of rational expectations specified by Fernandez (namely the rates of inflation predicted by the researcher's model, estimated by using information for the whole sample period) involves the use of information that the economic agent could not have used simply because it belonged to the future.

Another specification of "rational expectations", which will be referred to as Muth-Friedman "best one can do" expectations, is much more appealing than the previous ones. Economic agents are assumed to use all relevant information available at the moment they are making the prediction. They are supposed not to know the true value of the parameters in the relevant relationships of the economy, but they rather estimate them using the least squares method. Once this has been done, they use the estimated equation to predict the future value of the desired variable. This prediction, under certain assumptions, is known to be optimal in the minimum quadratic effor sense. B. Friedman has recently shown that this kind of expectations is also adaptive in form, but with "coefficient of adaptation" not necessarily constant (as in the Cagan scheme) but dependent on the past values of the exogenous variables. This expectations assumption is very interesting because it implies that economic agents are neither irrational nor seer. In addition, it allows for computation for each period, not only of a predicted (or expected) value but also of the variance of the prediction error, which is precisely what we need in order to replace the two unobservable variables which remain in our model.

In Chapter III we showed that in the rational expectations framework a-la-Muth-Sargent-Lucas, every kind of real effects of monetary policy will vanish, and (except for random shocks) the economy will always be in long run equilibrium. This is not obviously the case with the "best one can do" expectations. Therefore, under this assumption, it is still meaningful to try to test the empirical relevance of the supply side effects we are interested in.

For the reasons given in the preceding paragraphs, we decided to use a "best one can do" expectations framework. In order to implement it we have to find out, within the limits of our structural model, what are the relevant variables people are supposed to use in predicting inflation. Our first step will be to estimate a reduced form equation for the quarterly rate of inflation, in terms of the current and lagged values of the observable exogenous variables and the lagged values of the endogenous variables of our model.

We begin by running a regression with the current and first lagged value of all the exogenous variables and the first lagged value of the endogenous variables. Then we proceed to eliminate those variables having a t statistic smaller than one. For the two variables that remained in lagged form (rate of increase in wages and rate of growth of money supply) additional lags were introduced. The wage rate lagged more than one-quarter failed to satisfy the above significance requirement. Therefore, values lagged by two and more quarters were kept only for the rate of growth of money supply. In order to reduce the number of parameters to be estimated, we decided to adopt a second degree polynomial distributed lag assumption. As a result of these steps, we achieved, for the period 63I to 76II, the estimated equation shown under number (19) in Table 5.4

Table 5.5 shows the plots of actual and fitted values and of the lag structure of the rate of growth of money supply.

The following characteristics of this equation are worth noting:

1) The sum of the coefficients of w, w_{-1}, p_a, p_m, p_{es} is 1.071 and the standard error is 0.064. This means that the sum is not significantly different from 1.

Table 5.4. **ESTIMATED REDUCED FORM EQUATION FOR THE RATE OF INFLATION.**

(19)
$$\pi = \underset{(1.320)}{0.126}\, w + \underset{(1.112)}{0.064}\, w_{-1} + \underset{(5.346)}{0.436}\, p_a + \underset{(3.246)}{0.202}\, p_m + \underset{(3.421)}{0.154}\, p_{im} -$$
$$- \underset{(-1.794)}{0.154}\, ms - \underset{(-1.763)}{0.071}\, ms_{-1} - \underset{(-0.507)}{0.009}\, ms_{-2} + \underset{(1.156)}{0.033}\, ms_{-3} +$$
$$+ \underset{(1.444)}{0.055}\, ms_{-4} + \underset{(1.535)}{0.057}\, ms_{-5} + \underset{(1.577)}{0.039}\, ms_{-6}$$

$R^2 = .945$
D.W.=2.059
h=*
S.E.=0.037

(20)
$$\frac{\pi_{+1} + \pi}{2} = \underset{(2.930)}{0.233}\, w - \underset{(-3.082)}{0.207}\, w_{-1} + \underset{(4.260)}{0.346}\, p_a - \underset{(-3.396)}{0.432}\, p_{a_{-1}} +$$
$$+ \underset{(4.003)}{0.396}\, p_{im} + \underset{(4.391)}{0.643}\, \pi_{-1} + \sum_{i=1}^{20} \gamma_{-i}\, ms_{-i}$$

$R^2 = 0.032$
D.W.=2.065
h=*
S.E.=0.036

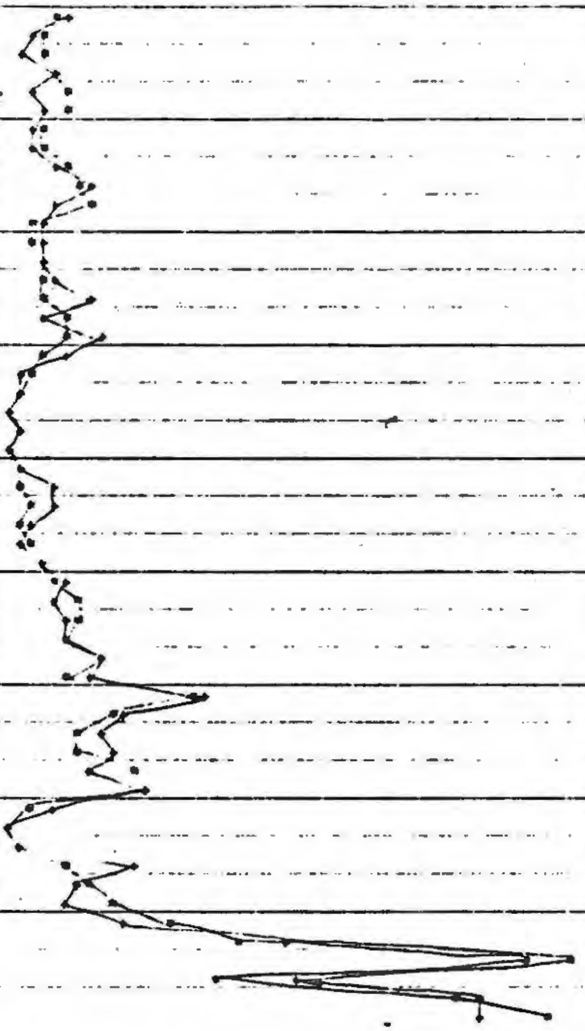
$\gamma_1 = -0.008\ (-0.125)$	$\gamma_{11} = 0.019\ (0.877)$
$\gamma_2 = 0.024\ (0.590)$	$\gamma_{12} = 0.003\ (0.159)$
$\gamma_3 = 0.047\ (1.812)$	$\gamma_{13} = -0.012\ (-0.653)$
$\gamma_4 = 0.062\ (2.997)$	$\gamma_{14} = -0.026\ (-1.323)$
$\gamma_5 = 0.070\ (3.084)$	$\gamma_{15} = -0.037\ (-1.738)$
$\gamma_6 = 0.071\ (2.746)$	$\gamma_{16} = -0.045\ (-1.956)$
$\gamma_7 = 0.068\ (2.414)$	$\gamma_{17} = -0.049\ (-2.065)$
$\gamma_8 = 0.059\ (2.111)$	$\gamma_{18} = -0.047\ (-2.118)$
$\gamma_9 = 0.048\ (1.795)$	$\gamma_{19} = -0.039\ (-2.141)$
$\gamma_{10} = 0.034\ (1.407)$	$\gamma_{20} = -0.024\ (-2.149)$

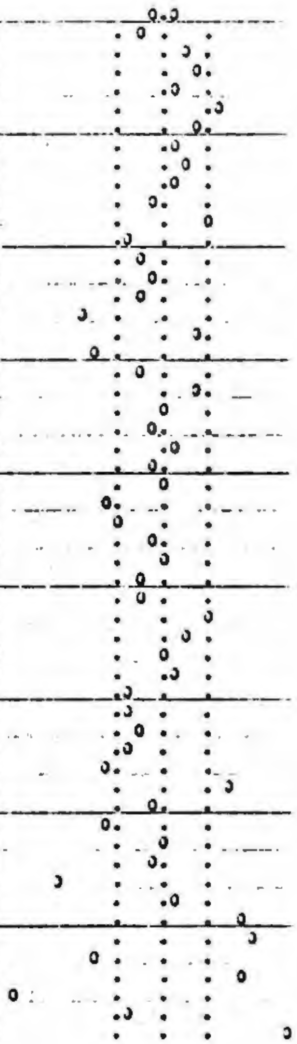
The number in parentheses is the observed value of t.
* not applicable because no lagged variable is used as regressor.
** not applicable because TxV'(b')>1 (the number of observations times the estimated varianace of the estimator for the coefficient of the first lag of the endogenous variable is greater than 1).

TABLE 5.5 ACTUAL AND FITTED VALUES OF QUARTERLY RATE OF INFLATION

PLOT OF ACTUAL(*) AND FITTED(+) VALUES — PLOT OF RESIDUALS(O)

ID	ACTUAL	FITTED	RESIDUAL
6301	.5661E-01	.6715E-01	-.105E-01
6302	.4201E-01	.2177E-01	.202E-01
6303	.4081E-01	.1780E-01	.230E-01
6304	.6077E-01	.5319E-01	.758E-02
6401	.7202E-01	.2673E-01	.453E-01
6402	.6599E-01	.3789E-01	.281E-01
6403	.4034E-01	.3445E-01	.589E-02
6404	.4773E-01	.3233E-01	.153E-01
6501	.7492E-01	.6315E-01	.118E-01
6502	.8456E-01	.9370E-01	-.914E-02
6503	.9483E-01	.6028E-01	.346E-01
6504	.2293E-01	.4207E-01	-.191E-01
6601	.2854E-01	.4312E-01	-.146E-01
6602	.4082E-01	.4764E-01	-.682E-02
6603	.4658E-01	.5775E-01	-.112E-01
6604	.4709E-01	.9966E-01	-.523E-01
6701	.6614E-01	.3963E-01	.263E-01
6702	.6932E-01	.1196	-.503E-01
6703	.4914E-01	.6667E-01	-.177E-01
6704	.3491E-01	.6998E-02	.279E-01
6801	.1436E-01	.1626E-01	-.190E-02
6802	.7674E-03	.6429E-02	-.566E-02
6803	.1810E-01	.1078E-01	.732E-02
6804	.2303E-02	.5399E-02	-.260E-02
6901	.1061E-01	.1186E-01	-.125E-02
6902	.1628E-01	.5150E-01	-.352E-01
6903	.2226E-01	.4966E-01	-.274E-01
6904	.1207E-01	.2162E-01	-.955E-02
7001	.2245E-01	.1721E-01	.524E-02
7002	.3645E-01	.4744E-01	-.110E-01
7003	.5206E-01	.6557E-01	-.135E-01
7004	.8719E-01	.5050E-01	.367E-01
7101	.6382E-01	.4491E-01	.189E-01
7102	.6972E-01	.6747E-01	.225E-02
7103	.1133	.1067	.655E-02
7104	.6659E-01	.9215E-01	-.256E-01
7201	.2221	.2474	-.253E-01
7202	.1311	.1459	-.148E-01
7203	.9203E-01	.1166	-.246E-01
7204	.8038E-01	.1215	-.411E-01
7301	.1517	.1055	.462E-01
7302	.1697	.1731	-.335E-02
7303	.2273E-01	.5835E-01	-.356E-01
7304	.3801E-02	-.3927E-03	.419E-02
7401	.1336E-01	.1608E-01	-.272E-02
7402	.7699E-01	.1508	-.738E-01
7403	.1012	.8824E-01	.130E-01
7404	.1292	.7141E-01	.579E-01
7501	.2062	.1411	.651E-01
7502	.2900	.3378	-.478E-01
7503	.6993	.6423	.570E-01
7504	.2586	.3617	-.103
7601	.5560	.5802	-.242E-01
7602	.6763	.5859	.903E-01





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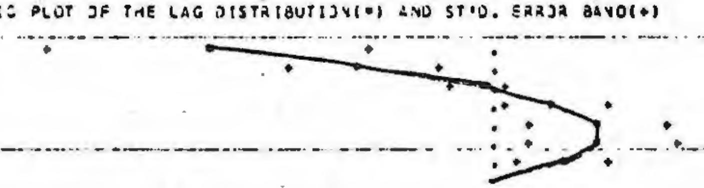
DISTRIBUTED LAG INTERPRETATION

COEFFICIENT	STD. ERROR	T-STATISTIC
-.1539	.8576E-01	-1.794
-.7135E-01	.4048E-01	-1.763
-.9004E-02	.1777E-01	-.5068
.3216E-01	.2809E-01	1.156
.5514E-01	.3818E-01	1.444
.5694E-01	.3711E-01	1.535
.3856E-01	.2446E-01	1.577

PLOT OF THE LAG DISTRIBUTION(*) AND STD. ERROR BAND(+)



MEAN LAG = -14.8100
STANDARD ERROR = 44.6959
SUM OF LAG COEFFICIENTS = -.504216E-01
STANDARD ERROR = .994974E-01

2) The sum of the coefficients of the current and lagged rates of growth of money supply is -0.050 with a standard error of 0.099, i.e., it is not significantly different from 0.

3) Current and previous quarter rate of growth of money supply have negative coefficients. The two quarters lag has a coefficient still negative but very close to zero, and for the three and more quarters lags the coefficients become positive.

Since w, p_a, p_{im}, and p_{es} are precisely the prices of the main inputs used by manufacturing industry, one is tempted to interpret their coefficients as the shares of each input on total costs of production. But this is not strictly so. The effects of changes in these input prices on manufacturing prices come from the supply and demand sides. The comparison of the estimated coefficients with the input shares as obtained from the input-output table suggests that agricultural prices may have stronger demand effect for manufactures than wages and the prices of services (energy, transportation and gas).

In the same way, monetary expansion comes to the reduced form equation for the rate of inflation from both the demand and supply equations. The signs of the coefficients seems to suggest that supply side effects predominate during two quarters. But it is too early to draw such a conclusion. Only structural equations can really tell us what is the economic mechanism which brings about the observed relationship between the variables.

Table 56 reports other regressions of the rate of inflation on exogenous or predetermined variables.

Regression (19.a) differs from (19) in that the money supply variable has been disaggregated into two components: Bank credit to the Government, and the rest. The coefficients of input prices are not very different from those of equation (19); neither is the sum of the coefficients of all the money supply variables; but the difference in the lag structure of the two components of money supply is very interesting. Public sector credit has negative (and large) coefficients for the current and previous quarter. Then they become positive. Private sector credit has always negative (but small) coefficients. This result seems to contradict, at least partially, the conclusions of those authors who regard the fall in bank credit to the private sector as the reason for the stagflationary initial effects of restrictive monetary policy. We prefer equation (19) to regression (19.a) because the standard errors are about the same, while the Durbin-Watson statistic is favorable to (19)[11].

---

11 We compare the Durbin-Watson statistic rather than Durbin's h because the latter is not applicable when lags of the endogenous variables are not among the regressors, or where

$h = \rho' \sqrt{\frac{T}{1-TV'(b_1')}}$ does not exist because TV'(b') is greater

than 1 (ρ' is the estimated autocorrelation coefficient, T is the number of observation and V'(b') is the estimated variance of the coefficient of the first lagged endogenous regressor). See Durbin [1970].

Table 6. ALTERNATIVE REGRESSIONS FOR THE QUARTERLY RATE OF INFLATION.

Regression (19.a)

lags	w	p_a	p_m	p_{es}	ms_{gov}	ms_{rest}
0	0.26(3.50)	0.36(4.62)	0.25(3.26)	0.10(2.48)	-0.17(-2.55)	-0.02(-1.17)
1	0.10(1.17)				-0.08(-2.32)	-0.02(-1.88)
2					-0.01(-0.28)	-0.02(-1.72)
3					0.04(2.14)	-0.02(-1.14)
4					0.07(2.47)	-0.01(-0.83)
5					0.07(2.57)	-0.01(-0.64)
6					0.05(2.58)	-0.00(-0.54)

$R^2=0.94$, D.W.=2.54, S.E.=0.035.

lags	Regression (19.b)	Regression (19.c)	Regression (19.d)	
	π	$\Delta\pi = \pi - \pi_{-1}$	π	ms
1	0.51(5.91)	-0.58(-4.00)	0.34(2.91)	0.08(0.29)
2	0.27(5.71)	-0.24(-1.98)	0.22(2.58)	0.31(1.25)
3	0.11(2.13)	-0.03(-0.20)	0.09(0.80)	0.44(1.70)
4	0.15(0.24)	0.08(0.48)	-0.04(-0.32)	0.50(1.89)
5	-0.04(-0.58)	0.12(0.48)	-0.16(-1.12)	0.50(2.02)
6	-0.05(-0.93)	0.11(0.51)	-0.25(-1.68)	0.47(2.16)
7	-0.04(-0.88)	0.07(0.30)	-0.33(-1.99)	0.40(2.25)
8	-0.01(-0.35)	0.02(0.07)	-0.37(-2.10)	0.32(2.16)
9	0.02(0.44)	-0.03(-0.13)	-0.40(-2.08)	0.22(1.69)
10	0.05(1.09)	-0.07(-0.28)	-0.40(-2.00)	0.13(0.96)
11	0.08(1.52)	-0.09(-0.36)	-0.36(-1.88)	0.04(0.29)
12	0.09(1.81)	-0.09(-0.35)	-0.32(-1.73)	-0.03(-0.24)
13	0.10(2.02)	-0.06(-0.26)	-0.23(-1.52)	-0.09(-0.67)
14	0.10(2.11)	-0.01(-0.06)	-0.15(-1.19)	-0.13(-1.06)
15	0.08(1.96)	0.05(0.22)	-0.06(-0.58)	-0.16(-1.43)
16	0.06(1.42)	0.12(0.57)	0.03(0.33)	-0.16(-1.45)
17	0.03(0.68)	0.18(0.92)	0.10(1.09)	-0.14(-1.51)
18	0.01(0.05)	0.22(1.22)	0.15(1.41)	-0.12(-1.14)
19	-0.01(-0.39)	0.23(1.46)	0.16(1.52)	-0.08(-0.78)
20	-0.02(-0.69)	0.15(1.64)	0.11(1.55)	-0.04(-0.52)
R^2	0.56	0.28	0.61	
D.W.	2.44	2.02	2.28	
S.E.	0.089	0.089	0.084	
h	2.03	*	1.87	

The numbers in parentheses are the observed t's.
*not applicable because $TxV'(b_1') > 1$.

(19.b) is a regression of the rate of inflation on its past values according to a polynomial-lag structure of degree four and length 20; (19.c) is the same regression but is performed on the first differences of the rate of inflation. The standard errors of these two equations are around 2.5 times that of equation (19). The Durbin-Watson statistic suggests that the specification in the first differences is superior to the other one. (19.c) also shows that only the first and second lagged values of the first differences are significant in explaining current inflation.

Finally, regression (19.d) adds the specification of regression (19.b) plus 20 quarters polynomial lags of the 4th degree on the past rates of growth of money supply. It can be seen that the standard error reduces from 0.089 to 0.084 and the Durbin-Watson statistic improves from 2.44 to 2.28. This suggests that past rates of growth of money supply convey information about future inflation additional to that provided by past rates of inflation. Comparing the standard error of (19.d) with that of equation (19) it is possible to get an idea of how important the additional information (with respect to that provided by past rates of inflation) that is conveyed by the current quarter rates of change of input prices.

Summing up: equation (19) - which can be taken to be a simplified reduced form equation for the rate of inflation within the context of our model - could be re-estimated with all the information available in every quarter, and then, used to predict inflation one quarter ahead. But in order to do that, economic agents should have not only the historical information needed to estimate the parameters of (19), but also the value of input prices and monetary expansion one period ahead.

In Argentina, monetary policy has never been announced in advance; therefore, it is not realistic to assume that economic agents knew in advance the rate of growth of money supply for the next quarter.

The exchange rate and export and import taxes (which are the main determinants of agricultural and import prices) have usually been kept constant for rather long periods, and devaluations and drastic changes in taxes have always been preceded by balance of payments crises and strong speculation in the black market for foreign exchange. In the same way, the prices for services like electricity, transportation and gas were not continuously modified but kept constant for a while and then adjusted upward according to actual increases in costs since the last adjustment. Nominal wages have been modified either in pre-established dates and by proportions decided in long run negotiations, or by government decisions following periods of social unrest due to deterioration of real wages. In both circumstances a reasonable guess of the final outcome is usually possible several months before the adjustment. All this is telling us that at every moment of time, economic agents surely know more than what one can mechanically ascribe to them from some average of past values.

As a compromise assumption we shall postulate that economic agents are able to predict without error the future price of inputs one quarter ahead, and that using that information and the past values of all relevant economic variables, they predict the quarterly rate of inflation that will prevail on average over the next two quarters. There are several reasons that render this assumption appropriate. On the one hand, the 180-days loan is the typical operation in free credit markets. Therefore, in the aggregate supply equation where the variance of expected inflation enters via the uncertain real cost of credit, the variance of expected inflation should refer to the same 180-days period. On the other hand, even when the relevant expected inflation refers to one quarter ahead, as in the aggregate demand equation, it seems more likely that economic agents will assign to the next quarter the average inflation they expect over the somewhat longer time span for which they have to predict inflation in order to make financial decisions[12]. Finally, the trick of selecting two quarters as the time span of the prediction, combined with the assumption that input prices are known with certainty only for one quarter ahead, sets a framework of imperfect information on which the prediction has to be made, which probably resembles reality closer than the alternative assumptions of absolute lack of information or perfect certainty about the future course of input prices.

Summing up: we assume that economic agents predict inflation with all relevant past information available and knowing, in addition, the price of inputs that will prevail one-quarter ahead. With all this information they do "the best they can" to predict the average quarterly rate of inflation during the next half-year period.

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12 In the preliminary regression we found that the quarterly average expected inflation over the next two quarters performed as well in the demand equation, as the one-quarter future expected inflation. As in the supply equation, the former was more adequate. We decided to use the quarterly average expected inflation over the next <u>two</u> quarters in both contexts.

With this availability of information, equation (19) can not be directly used. Instead we have to try to get a representation of how average inflation during the two quarters ahead relates to one-quarter ahead rates of change of input prices and past values of whatever variable may prove to be relevant. Our model does not offer an explanation of behavior over time of the wage rate and agricultural, service and import prices. Neither does it tell anything about the determinants of changes in money supply through time. Therefore, we cannot draw from our model precise indications of what variables should replace the unknown future values of input prices and monetary expansion in equation (19). Instead, we have tried to get such kinds of indications from a statistical analysis of the historical data.

We began with a regression like (19) but where the dependent variable is the arithmetic average of the rates of inflation in quarters t and t+1 and the explanatory variables are the rates of input price inflation in quarter t, the rate of wage inflation in quarter t, and six lagged values of the rate of growth on money supply (t-1 to t-6). We then tried adding additional lags for the input price rates of inflation and all other exogenous and endogenous variables in the model (5) and (6).

The variables that failed to have a t statistic higher than 1 were discarded, and when several lags appeared to be significant, we tried polynomial distributed lags of different degrees and lengths. Finally we chose the regression for the period 63I - 76I which is reported under number (20) in Table 4.

The main differences between (20) and (17) are as follows:

1) Agricultural and manufacturing price inflation lagged one period, enter as explanatory variables in (20), but not in (19), while service price inflation - which appears in (19) - was not significant in (20).

2) Twenty, instead of seven lagged rates of growth of money supply enter as explanatory variables in (20).

These differences are not surprising: agricultural and manufacturing price inflation in the immediate past are probably the main determinants of future nominal wage increases and adjustments in the exchange rate. The adjustment in the price of services (energy, transportation and gas) within a two-quarter span must be closely related to past changes in other prices (which enter into the costs of services) and there the rate of increase in the price of services one-quarter ahead becomes uninformative once current and past increases on other prices are introduced. Finally, in the absence of information about the rate of growth of money supply in the next two quarters, a longer history of past changes in money supply is used to learn about Central Bank behavior on that subject.

Table 7 reports other regressions that one could conceivably adopt as alternatives to (20) in specifying people's formation of expectations about future inflation. (20a) is a regression of $\frac{\pi_{t+1} + \pi_t}{2}$ on twenty lagged rates of inflation (π_{-1} to π_{-20}) with coefficients constrained to a polynomial of degree four. Note that the standard error is 0.071 - twice that of (20). (20.c) is similar to (20.a) but twenty lagged rates of growth of money supply are added. The standard error decreases to 0.065 showing that past rates of growth of money supply convey information additional to that provided by past rates of inflation. Finally, regression (20.b) could be seen as a simple quantity theory specification. If MV=PQ, we can write π = ms + q + v where q is the rate of growth of GDP at constant price and v the rate of growth of velocity. If we assume v is a function of expected inflation, which in turn in a function of current and past rates of growth of money supply and real output, we discover that can be seen as a function of past rates of monetary expansion and past rates of real growth. (20.b) uses twenty lagged values of the rates of growth

Table 7. ALTERNATIVE REGRESSIONS TO PREDICT FUTURE INFLATION

lags	Regression (20a)	Regression (20b)		Regression (20c)	
1	0.60 (8.27)	0.43 (6.67)	0.33 (1.46)	0.15 (0.52)	0.65 (3.82)
2	0.30 (7.49)	0.20 (3.08)	0.35 (2.15)	0.26 (0.95)	0.46 (4.59)
3	0.10 (2.31)	0.02 (0.24)	0.36 (3.09)	0.33 (1.17)	0.32 (5.99)
4	-0.01 (-0.39)	-0.12 (-1.42)	0.34 (4.20)	0.36 (1.22)	0.22 (5.50)
5	-0.07 (-1.39)	-0.22 (-2.41)	0.32 (4.86)	0.36 (1.17)	0.15 (2.94)
6	-0.08 (-1.81)	-0.28 (-3.05)	0.29 (4.55)	0.34 (1.06)	0.12 (1.88)
7	-0.06 (-1.63)	-0.31 (-3.48)	0.25 (3.73)	0.29 (0.90)	0.12 (1.64)
8	-0.02 (-0.68)	-0.31 (-0.74)	0.20 (2.90)	0.23 (0.71)	0.13 (1.85)
9	0.02 (0.67)	-0.29 (-3.85)	0.15 (2.16)	0.15 (0.48)	0.17 (2.41)
10	0.07 (1.73)	-0.26 (-3.73)	0.10 (1.46)	0.07 (0.22)	0.21 (3.22)
11	0.10 (2.41)	-0.21 (-3.32)	0.05 (0.76)	-0.02 (-0.07)	0.27 (4.09)
12	0.12 (2.86)	-0.16 (-2.57)	0.00 (0.03)	-0.11 (-0.37)	0.32 (4.67)
13	0.13 (3.14)	-0.09 (-1.58)	-0.04 (-0.71)	-0.18 (-0.66)	0.37 (4.86)
14	0.12 (3.23)	-0.03 (-0.56)	-0.08 (-1.42)	-0.25 (-0.93)	0.41 (4.79)
15	0.10 (2.90	0.02 (0.32)	-0.11 (-2.00)	-0.30 (-1.16)	0.43 (4.63)
16	0.07 (1.98)	0.07 (1.02)	-0.13 (-2.42)	-0.33 (-1.35)	0.44 (4.45)
17	0.03 (0.79)	0.10 (1.56)	-0.14 (-2.69)	-0.34 (-1.51)	0.42 (4.29)
18	-0.01 (-0.19)	0.11 (1.97)	-0.13 (-2.83)	-0.31 (-1.63)	0.37 (4.15)
19	-0.03 (-0.87)	0.10 (2.29)	-0.11 (-2.90)	-0.25 (-1.73)	0.29 (4.03)
20	-0.03 (-1.32)	0.08 (2.54)	-0.06 (-2.91)	-0.15 (-1.81)	0.17 (3.94)
R	0.70	0.76		0.67	
D.W.	1.51	1.38		0.54	
h	2.03	2.12		*	
S.E.	0.071	0.065		0.078	

The numbers in parenthesis are the observed t's.
*not applicable because no lagged endogenous variables are used as regressor.

of money supply and real GDP with coefficients constrained to a polynomial of the fourth degree. The standard error is 0.078 and the Durbin-Watson statistic is 0.54. The latter shows a misspecification problem and the former shows that the explanatory power of this regression is even lower than that involving only past rates of inflation (20.a). A regression including past values of money supply, real output and past rates of inflation (which could be seen as a quantity theory version involving autoregressive inflationary expectations) is very similar to (20.b) with insignificant coefficients for the past rates of real GDP growth.

The comparison with (20) of all these alternative regressions shows that input prices for one-quarter ahead and for some past periods constitute an important piece of information in predicting the average rate of inflation which will prevail in the next two quarters.

We can now generate the values of expected inflation and its variance for our basic sample period 1963I, 1976I. The following steps are involved in the computation:

1) Estimating the parameters of equation (20) using information for the preceding 48 quarters (12 years)[13].

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[13] Note that we are still giving people too much information in letting them know in advance the right specification.

The length of the sample period is kept constant. Therefore, every time an additional observation (referring to a more recent quarter) is added, the oldest observation is simultaneously dropped. The 48 quarters length for the "moving" sample period is the longest one that the availability of published information permits. The size of the sample used in estimating (20) for more recent quarters is not increased because there is no reason to assume that economic agents in recent quarters were actually exposed to a longer "learning" period than that of the economic agents in previous quarters.

2) After having estimated equation (20) based on information from quarters t-1 to t-48, we use it to predict $\frac{\pi_{t+1}+\pi_t}{2}$ using the actual values of the explanatory variables (w_t, w_{t-1}, p_{a_t}, $p_{a_{t-1}}$, p_{im_t}, π_{t-1}, ms_{t-i}, i=1,...,20). This predicted value is taken to be expected inflation in period t (π^e_t).

3) The variance of predicted inflation is computed as:

$\sigma^2_\pi = s^2[1 + \underline{x}'_p\ (X'X)\underline{x}_p\ ]$ where $\underline{x}_p$ is the vector of actual values of the explanatory variables used to compute expected inflation in step 2); X is a matrix with the historic information on the explanatory variables used to estimate equation (20) in step 1); and s^2 is the standard error of the estimated equation.

Steps 1), 2) and 3) were undertaken for periods t= 62IV to t= 75IV. The estimated π^e and σ^2_π appear in Table 5.8. Table 5.9 shows a plot of π^e_t, $\pi^e_t \pm \sigma_{\pi t}$ and the actual values of $\frac{\pi_{t+1}+\pi_t}{2}$.

TABLE 5.8 EXPECTED INFLATION AND ITS VARIANCE

		π^e	σ_π^2	σ_π	$\pi^e - \sigma_\pi$	$\pi^e + \sigma_\pi$
6301	.	.466151E-01	.139697E-02	.373761E-01	.923893E-02	.839912E-01
6302	.	.355592E-01	.142780E-02	.377863E-01	.221288E-02	.777955E-01
6303	.	.433354E-01	.144190E-02	.379724E-01	.536300E-02	.813077E-01
6304	.	.758842E-01	.143822E-02	.379239E-01	.379643E-01	.113812
6401	.	.552552E-01	.125250E-02	.353907E-01	.198645E-01	.906458E-01
6402	.	.691366E-01	.135323E-02	.367870E-01	.323495E-01	.105924
6403	.	.549618E-01	.131578E-02	.362737E-01	.186881E-01	.912355E-01
6404	.	.364795E-01	.126253E-02	.355322E-01	.947300E-03	.720116E-01
6501	.	.490675E-01	.121212E-02	.348155E-01	.142720E-01	.839030E-01
6502	.	.898942E-01	.121047E-02	.347918E-01	.551023E-01	.124686
6503	.	.330376E-01	.119609E-02	.345845E-01	-.154695E-02	.676221E-01
6504	.	.575835E-01	.117820E-02	.343250E-01	.232586E-01	.919085E-01
6601	.	.275949E-01	.117772E-02	.343180E-01	-.672308E-02	.619129E-01
6602	.	.521201E-01	.121748E-02	.348925E-01	.172277E-01	.870126E-01
6603	.	.641928E-01	.120403E-02	.346992E-01	.294937E-01	.988920E-01
6604	.	.678594E-01	.118793E-02	.344664E-01	.333930E-01	.102326
6701	.	.471198E-01	.119632E-02	.345880E-01	.125318E-01	.817077E-01
6702	.	.109309	.121184E-02	.348115E-01	.744973E-01	.144120
6703	.	.427207E-01	.123653E-02	.351643E-01	.755635E-02	.778850E-01
6704	.	.315964E-01	.126041E-02	.355023E-01	-.390593E-02	.670987E-01
6801	.	.229179E-01	.149783E-02	.387019E-01	-.157840E-01	.616197E-01
6802	.	.352673E-01	.122341E-02	.349773E-01	.290040E-03	.702446E-01
6803	.	.322571E-01	.919720E-03	.303269E-01	.193013E-02	.625839E-01
6804	.	.261564E-01	.893730E-03	.298953E-01	-.373893E-02	.560518E-01
6901	.	.327897E-01	.892127E-03	.298685E-01	.292117E-02	.626582E-01
6902	.	.373668E-01	.864034E-03	.293945E-01	.797234E-02	.667613E-01
6903	.	.283183E-01	.843792E-03	.290481E-01	-.729666E-03	.573664E-01
6904	.	.356851E-01	.775502E-03	.278479E-01	.783721E-02	.635329E-01
7001	.	.249777E-01	.759070E-03	.275513E-01	-.257355E-02	.525290E-01
7002	.	.421567E-01	.108701E-02	.329699E-01	.919679E-02	.751266E-01
7003	.	.710891E-01	.107270E-02	.327521E-01	.383370E-01	.103841
7004	.	.420367E-01	.847917E-03	.291191E-01	.129176E-01	.711557E-01
7101	.	.406642E-01	.710325E-03	.266520E-01	.140122E-01	.673161E-01
7102	.	.950444E-01	.515501E-03	.227047E-01	.723397E-01	.117749
7103	.	.938599E-01	.385647E-03	.196379E-01	.742220E-01	.113498
7104	.	.863371E-01	.383758E-03	.195898E-01	.667473E-01	.105927
7201	.	.120683	.377015E-03	.194169E-01	.101266	.140100
7202	.	.152957	.426523E-03	.206526E-01	.132305	.173610
7203	.	.871981E-01	.458047E-03	.214020E-01	.657961E-01	.108600
7204	.	.933340E-01	.448589E-03	.211799E-01	.721540E-01	.114514
7301	.	.119163	.465894E-03	.215846E-01	.975763E-01	.140748
7302	.	.117340	.470495E-03	.216909E-01	.956494E-01	.139031
7303	.	.855513E-01	.507375E-03	.225250E-01	.630262E-01	.108076
7304	.	.176789E-02	.599497E-03	.244847E-01	-.227168E-01	.262525E-01
7401	.	.603204E-02	.583270E-03	.241510E-01	-.181190E-01	.301830E-01
7402	.	.767192E-01	.606715E-03	.246316E-01	.520876E-01	.101351
7403	.	.499044E-01	.609498E-03	.246880E-01	.252164E-01	.745924E-01
7404	.	.706586E-01	.624468E-03	.249894E-01	.456692E-01	.956480E-01
7501	.	.136064	.779274E-03	.279155E-01	.108148	.163979
7502	.	.340040	.103814E-02	.322201E-01	.307820	.372260
7503	.	.650466	.128694E-02	.358740E-01	.614592	.686340
7504	.	.374677	.159169E-02	.398960E-01	.334781	.414573
7601	.	.522995	.149707E-02	.386920E-01	.484303	.561687

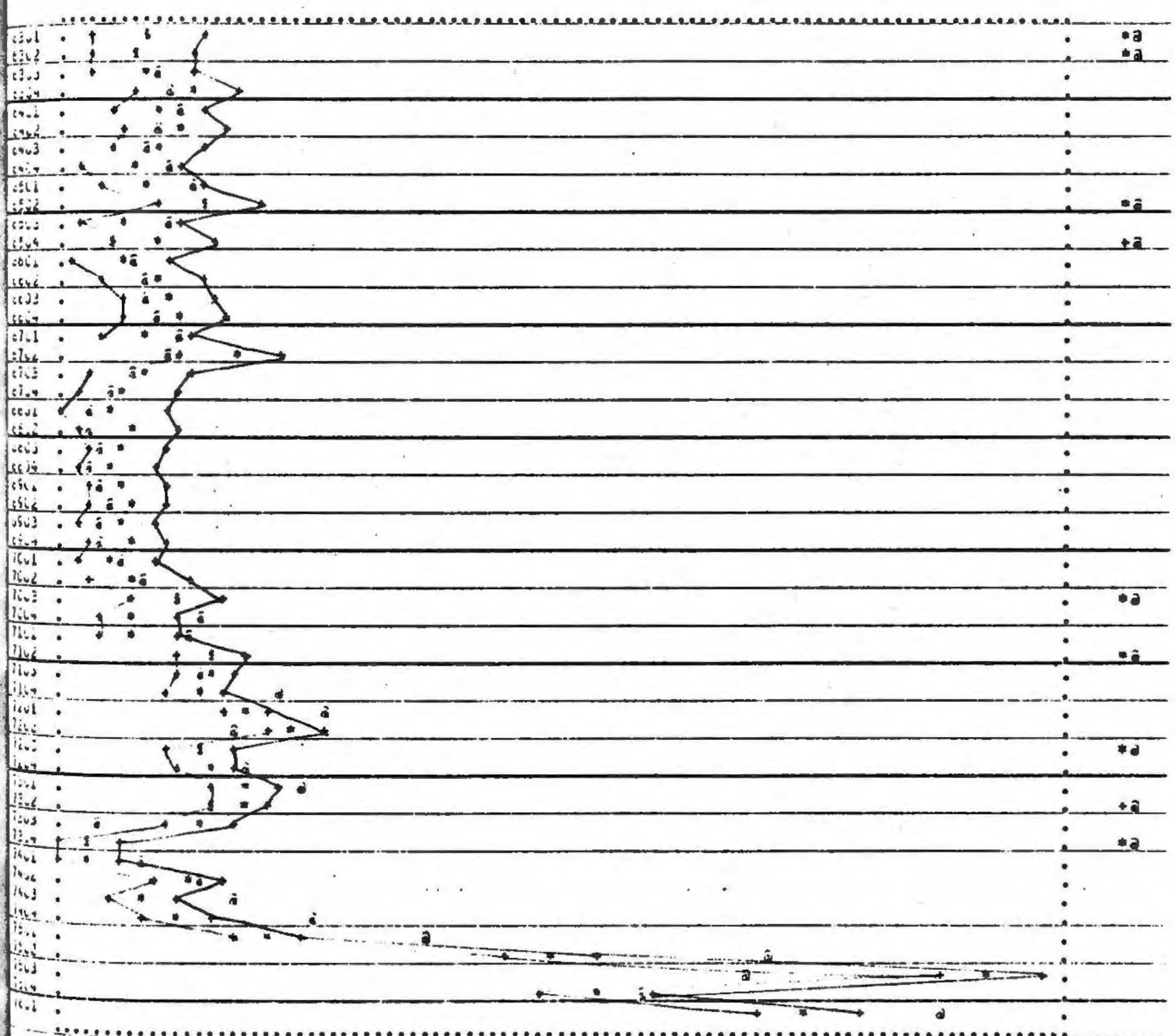
ABLE 5.9

ECTED INFLATION AND ITS VARIANCE

π PLOTTED WITH (@)
π^e PLOTTED WITH (*)
$\pi^e - \sigma_\pi$ PLOTTED WITH (+)
$\pi^e + \sigma_\pi$ PLOTTED WITH (+)

POINTS EXCEEDING THE SCALE OF THE GRAPH AND POINTS WHERE TWO OR MORE VARIABLES HAVE THE SAME VALUE WILL BE PLOTTED WITH (@). THE VARIABLE CONCERNED WILL BE INDICATED ON THE FAR RIGHT HAND SIDE OF THE GRAPH.

MINIMUM= -0.022717 MAXIMUM= 0.086440



F. Estimation of the demand for money

Having obtained estimated values for expected inflation and its variance, the next step is to estimate the equation for the demand for money.

The parameters of equations (9a) and (9b) of Table 5.4 were estimated by Ordinary Least Squares based on information for the period 1963I to 1976I. Those of equation (17) were estimated by Non-Linear Least Squares, taking into account the restrictions on the coefficients.[13]

The results are reported in Table 5.10. Note that in the three regressions, a dummy was introduced to represent periods during which price controls were effective.[14] Expected inflation does not appear in (22) and (23) because it was excluded from the regression.

The main difference between (22) and (23) on the one hand, and (21) on the other is, precisely, the role of

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[13] Note that in (17) the coefficient of log $\frac{M_{-1}}{E'}$ is equal to the product of the coefficients of log $\frac{M_{-1}}{E}$ and log $\frac{MS'}{E'}$, times minus one.

[14] The dummy assumes value 1 from 67II to 70IV when wage controls and price agreements were being applied. Since 71I the value of the dummy is decreased by 0.25 each quarter and becomes zero in 71IV. This way we try to capture the gradual elimination of the wage and price control system during 1971. In 1973III wages and price controls were again imposed. The dummy is set equal to 1 from 73III to 74II. Since 71III the system began to be relaxed and it was practially inoperative by 75III. Again, the dummy is decreased by 0.25 each quarter beginning in 74III.

Table 5.10

ESTIMATED DEMAND FOR MONEY EQUATION.

$$\text{(21)} \quad \log \frac{M}{E} = \underset{(13.67)}{0.62} \log \left(\frac{M}{E}\right)_{-1} - \underset{(-12.53)}{0.80}\ \pi^{e} + \underset{(5.04)}{92.57}\ \sigma_{\pi}^{2} + \underset{(2.33)}{0.03}\ DPC - \underset{(-8.72)}{0.78}$$

$R^2=0.95$
S.E.=0.041
D.W.=1.624
h=1.460

$$\text{(22)} \quad \log \frac{M}{E} = \underset{(34.55)}{0.74} \log \frac{M_{-1}}{E} + \underset{(3.70)}{59.65}\ \sigma_{\pi}^{2} + \underset{(2.05)}{0.04}\ DPC - \underset{(10.95)}{0.52}$$

$R^2=0.963$
S.W.=0.038
D.W.=1.662
h=1.152

$$\text{(23)} \quad \log \frac{M}{E} = \underset{(8.32)}{0.39} \log \left(\frac{M}{E}\right)_{-1} + 0.87 \log \frac{MS'}{E'} - 0.34 \log \frac{M_{-1}}{E'} + \underset{(4.32)}{56.72}\ \sigma_{\pi}^{2} + \underset{(2.62)}{0.05}\ DPC - \underset{(-3.48)}{3.28}$$

$R^2=0.982$
S.E.=0.028
D.W.=1.893
h=*

where:

DPC is a dummy variable that assumes value 1 from 67II to 70IV and then declines by 0.25 each quarter beginning at 0 again in 71IV. It is also 1 from 73III to 74II and then declines by 0.25 each quarter until it reaches zero in 75III.

The numbers in parentheses are observed t's.

* not applicable because $TxV'(b_1') > 1$.

expected inflation. While in (21) (which corresponds to the partial adjustment in terms of real money) expected inflation is a crucial explanatory variable (the t statistic is -12,53), in (22) and (23) (which correspond to the partial adjustment assumption in terms of nominal money) its coefficient is zero.

The statistical results are largely favorable to (23) on all scores. This is not surprising since specification (17) includes MS' on the right-hand side; MS' differes from M on the left-hand side only in that M includes the effects of the endogenous part of the balance of payments.

The comparison of (21) and (22) shows that from the point of view of the statistical results, the latter, i.e., the regression that implies a partial adjustment assumption in terms of nominal money has a standard error smaller than the former, and a Durbin-Watson statistic closer to 2. In spite of these statistical results, the choice between (21) and (22) or (23) is still difficult because it implies deciding between values of the elasticity of demand for money with respect to expected inflation of approximately 0.35 or of zero.

So far, all the previous estimations of the demand for money done by other researchers showed a significant effect of expected inflation (whatever the form in which this expectation was specified).[15] Why do our results differ from theirs in equation (15)? Simply because all

[15] See, for example, Diz [1962], and Mallon and Sourrouille [1975].

previous estimations used a partial adjustment assumption in terms of real money. If the true adjustment takes place in nominal terms, but the explanatory variable is $\log\left(\frac{M}{E}\right)_{-1}$ as in (21), instead of $\log\frac{M_{-1}}{E}$ as in (22) and (23), a term $\log\frac{E_{-1}}{E}$ is left out of the regression and, as a consequence, expected inflation, which is highly correlated with $\log\frac{E}{E_{-1}}$ turns out to show statistical significance. Once $\log\frac{M_{-1}}{M}$ is substituted for $\log\left(\frac{M}{E}\right)_{-1}$, expected inflation is no longer significant.[16]

The choice between (22) and (23) is not so crucial, for both imply very similar values for the coefficient of the demand for money. While the coefficient of adjustment by demanders in (23) is more than twice the coefficient of adjustment in (22), this discrepancy does not generate large differences in the extent of the monetary disequilibria that emerge from the two estimated money demands. This is so becuase in the case of (22) the small coefficient of adjustment is not taken into consideration in computing the monetary disequilibrium.[17] In fact, equation (23) confirms that such omission is reasonable since the slow adjustment in (22) cannot be interpreted as due to the behavior of demanders.

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[16] The same results were obtained for the U.S. by Modigliani. See Modigliani, Rasche and Cooper [1970].

[17] See equation (11) in Table 5.3.

Only after checking through preliminary regressions and finding that the choice did not significantly affect the estimation of the parameters of the aggregate demand and supply euqations, did we decide to use (22) as our demand for money.

Note that (22) implies that, except for the influence of the variance of expected inflation and the effect of price controls, "desired" velocity is a constant. The variance of expected inflation, which turns out to be highly significant, has a positive effect on the demand for money, i.e., desired velocity of money decreases when people's prediction of future inflation becomes more uncertain. Price controls also increase the demand for money. (23) is both conceptually and statistically superior in some respects, yet we chose (22) to report the estimation of aggregate demand and supply equations because, while in preliminary regressions we found that the estimated coefficients of aggregate demand and supply were fairly similar regardless of which equation is used for the demand for money, the significance of the monetary disequilibrium variable in both aggregate demand and aggregate supply was higher where we used (22).

G. Estimation of aggregate demand for and supply of commodities

Having estimated the coefficients of the demand for money, we have all that we need to undertake the estimation of the aggregate demand and supply equations.

Preliminary regressions

The results of preliminary regression by Ordinary Least Squares (OLS) showed that residuals in equations (3) and (4) were highly autocorrelated, with estimated autocorrelation coefficient very close to 1. For this reason, we decided to work with first differences in (3) and (4), that is, with specifications (5) and (6). After this change in the specification, autocorrelation disappeared.

The results of these preliminary regressions were also used to choose the lag structure for the different explanatory variables. The following were the main findings:

1) The capital stock variable in the aggregate supply equation showed completely insignificant coefficients up to the third lag, and then they became insignificant after the ninth lag. A polynomial lag structure of the second degree was chosen and the estimated temporal "weights" for the capital stock variable were 0.11; 0.18; 0.21; 0.21; 0.18 and 0.11 for lags fourth to ninth respectively.

2) The real wage rate in the same quarter was completely insignificant and it had the wrong sign in the aggregate supply equation. But from the first until the sixth lag it was significant and it had the right sign. A second degree polynomial lag structure was used and the estimated "weights" turned out to be: 0.32; 0.25; 0.18;

0.13; 0.08 and 0.04 for lags first to sixth, respectively.

3) The variables, "real Bank credit to manufacturing" and "variance of expected inflation" proved to be significant only for the same quarter. Therefore, no lagged values were included for these two variables in the aggregate supply equation.

4) In the aggregate demand equation, real income in the same quarter appeared to be insignificant, but all the lagged values from the first to the sixth turned out to have significant coefficients. The estimated "weights" were: 0.42; 0.28; 0.17; 0.09; 0.03 and 0.01 for lags first to sixth respectively.

5) The monetary disequilibrium variable appeared to be significantly positive in the aggregate supply equation for the contemporaneous quarter and the first and second lags. In the aggregate demand, the coefficients of the monetary disequilibrium variable were in general insignificant and with alternate signs.

If the real wage rate of the same quarter in the aggregate supply equation, and the real income of the same quarter in the aggregate demand equation (both of which turned out to be insignificant in the preliminary regressions) were eliminated, equations (5) and (6) would become a recursive system and the use of OLS estimation would be justified. But the coefficients of these two variables may have come up insignificant simply because there is a simultaneity problem that biases the OLS estimation. For this reason, we decided to estimate the whole model using Full Information Maximum Likelihood (FIML).

To simplify the estimation problem we decided to keep the previously estimated weights for the lagged capital stock, real wage rate and real income variables. But the real wage rate and the real income of the current quarter were kept in the supply and demand equations, respectively. For the monetary disequilibrium variables, no results from the previous regression were used, so that for these variables, not only the sum but also each one of the coefficients came out from the FIML run.

Main results

The estimated equations are reported in Table 5.11 under numbers (24) and (25). Both current quarter real income in the demand equation, and current quarter real wage rate in the supply equation, are still insignificant; thus the model was finally reestimated without these variables. The final results are reported under numbers (26) and (27).

Beginning with aggregate supply, the following aspects of the estimation results are worth noting:

1) The coefficient of the capital stock variable (weighted average of lags fourth to ninth) is 1.06 with t statistic of 6.77. According to the theory of Chapter II,

Table 5.11

FIML ESTIMATION

OF THE STRUCTURAL MODEL OF THE COMMODITY MARKET.

$$(24)\quad q_{ma} = \underset{(6.86)}{1.07}(k)_{-4\text{ to }-10} + \underset{(0.46)}{0.04}\,(p_{vf}-p_{ma})$$

$$- \underset{(-2.41)}{0.54}\,(p_{vf}-p_{ma})_{-1\text{ to }-7} + \underset{(2.92)}{0.01}(bc-p_{vf})$$

$$- \underset{(-1.44)}{0.99}D\sigma^2_{\pi} + \underset{(3.45)}{0.13}(ms-md) + \underset{(2.37)}{0.07}(ms-md)_{-1} + \underset{(1.10)}{0.02}(ms-md)_{-2}$$

$$(25)\quad p_{ma} = \underset{(24.32)}{1.03}\pi^{e} - \underset{(-3.41)}{0.20}q_{ma} + \underset{(.145)}{0.12}y + \underset{(1.87)}{0.28}(y)_{-1\text{ to }-6}$$

$$- \underset{(-1.02)}{0.01}(ms-md) + \underset{(1.98)}{0.03}(ms-md)_{-1} + \underset{(1.46)}{0.02}(ms-md)_{-2}$$

$$- \underset{(-1.62)}{0.04}\Delta DPC$$

$$(26)\quad q_{ma} = \underset{(6.77)}{1.06}(k)_{-4\text{ to }-10} - \underset{(-2.57)}{0.57}(p_{vf}-p_{ma})_{-1\text{ to }-6}$$

$$+ \underset{(2.90)}{0.01}(bc-p_{vf}) - \underset{(-1.36)}{0.93}\,D\sigma^2_{\pi} + \underset{(3.40)}{0.12}(ms-md)$$

$$+ \underset{(2.40)}{0.07}(ms-md)_{-1} + \underset{(1.38)}{0.02}(ms-md)_{-2}$$

$$(27)\quad p_{ma} = \underset{(26.07)}{1.05}\pi^{e} - \underset{(-3.33)}{0.15}q_{ma} + \underset{(1.79)}{0.25}(y)_{01\text{ to }-6} - \underset{(-1.07)}{0.02}(ms-md)$$

$$+ \underset{(2.02)}{0.04}(ms-md)_{-1} + \underset{(1.98)}{0.04}(ms-md)_{-2} - \underset{(-1.07)}{0.04}\,\Delta DPC$$

The numbers in parentheses are observed t's.
The weights for k are: 0.11; 0.18; 0.12; 0.21; 0.18; 0.11
The weights for p_{vf} are: 0.32; 0.18; 0.13; 0.08; 0.04.

The weights for y are: 0.42; 0.28; 0.17; 0.09; 0.03; 0.01.

under constant returns to scale that coefficient should be 1. Note that our estimation does not significantly differ from that *a priori* value.

2) The coefficient of the real wage rate variable (weighted average of lags first to sixth) is -0.57, with a t statistic of -2.57. This implies an elasticity of manufacturing output with respect to the variable factors of production of 0.35, which although a bit low, does not seem completely implausible especially of one takes into account that in Argentina the possibility of firing workers is rather limited.

3) The coefficient of real bank credit to manufacturing firms is very small (0.01) but still significant with a t statistic of 2.90.

4) The variance of expected inflation came out with the expected sign, but the t statistic is realtively low (-1.36). We decided to keep that variable in the estimated equation because in all preliminary regressions we found its coefficient to be almost insensitive to inclusion and exclusion of other variables, and, on several occasions, it had a higher t statistic.

5) The sum of the coefficients for the monetary disequilibrium variable was estimated at 0.21 with a t statistic of 3.13. The estimated coefficient for monetary disequilibrium in the current quarter is 0.12 with a t statistic of 3.40; for the first lag, the coefficient is 0.07 with a t statistic 2.40; and for the second lag, the

the coefficient is 0.02 with t statistic 1.38.

In relation to the aggregate demand equation, the main results are the following:

6) The estimated coefficient for expected inflation is 1.05 with a t statistic of 26.07. It is not possible to reject the hypothesis of its being equal to 1 that is implied in the price-adjustment scheme specified in equation (2) of Table 2.

7) The coefficient of current quarter production (9a) is -0.15 with a t statistic of -3.33, and that of permanent income is 0.25 with a t statistic of 1.79. This implies a long-run elasticity of the demand for manufactures with respect to permanent income of 1.67.

8) The sum of the coefficients for the monetary disequilibrium variable is 0.06 with a t statistic of 1.45. Therefore, it is not significantly different from zero at the 5 percent level. Individually considered, the coefficient of the monetary disequilibrium in the same quarter is completely insignificant (and negative) but the coefficients become positive and more significant for the first and second lags. Further lags proved to be totally insignificant.

The overall performance of the model is fairly satisfactory. The R^2 of the aggregate supply function is 0.931 with a standard error of 0.025 and a Durbin-Watson statistic of 2.17. For the aggregate demand function the R^2 is 0.944 with a standard error of 0.031 and a Durbin-

Watson statistic of 2.14. Note that while the reduced form equation (19) predicted inflation with a standard error of 0.037, the structural system permits a reduction of the standard error for the same variable to 0.031.

Implications for our theory

Regarding the monetary influence of our aggregate supply, our main thesis is confirmed by the statistical results. Not only are the coefficients of the monetary disequilibrium variable in the supply equation statistically significant, but if this variable is omitted, the sign of the real wage rate variable reverses and its coefficient becomes insignificant. In other words, it is only after introducing the monetary disequilibrium variable that the supply equation comes close to resembling the conventional short-run supply of the theory of the firm.

Monetary influences on the demand equation are weaker, but in relation to this point it is necessary to remember that the expected inflation already accounts for the effects of monetary expansion, especially of that expansion which took place one and more quarters earlier.

The demand side effect of monetary disequilibrium is insignificant within the initial quarter, while the supply side effect is strong. This means that the first effect of monetary contraction is to depress manufacturing output, which in turn increases the rate of inflation within the same quarter. In other words, "stagflation" is the initial effect of monetary restriction on the market for manufacturing commodities. Setting aside the effects of this initial acceleration of inflation on factor price inflation over the next quarters, the direct supply-side effect will still be strong one quarter ahead and will tend to peter out from there on. The deflationary demand-side effects begin to operate with a lag of one-quarter; and, taking into consideration the role that such effects play in the regression used for generating expected inflation, they increase in importance from there on.

Implications in relation to other authors' views

In Chapter I, we described other authors' views about the supply-side effects of credit restriction. We saw that most of them regarded bank credit to the private sector (or to the sector relevant for their analysis) as an argument of the production function. (This is true in particular of the work of Almonacid and Pastore, and McKinnon.) In terms of the specification of aggregate supply, that means that the log of real bank credit should be the relevant financial variable used as explanatory variable. We entered such a variable in (4) and (6) together with our monetary disequilibrium variable. Therefore, our results enable us to tell

something about the views of the authors. Note that the real bank credit variable for the current quarter had a statistically significant coefficient in (24) and (26), but its lagged values were insignificant. This means that we may not reject the hypothesis that real bank credit helps to explain aggregate supply. But note that the coefficient of real bank credit is less than one tenth that of the measure of monetary disequilibrium, even when the order of magnitude of both variables is approximately the same.[17']
This means that the overall liquidity situation of the economy is a much more important determinant of supply than the specific amount of bank credit received by manufacturing industry.

Other authors, particularly in the United States, have argued that real cash balances is an argument of the production function because they render "commercial services". They have not suggested that this fact could play a relevant role in the course of stabilization plans, but the point has been made mainly in the context of the "optimum quantity of money" discussion. Our money disequilibrium variable is, for all practical purposes, almost colinear with the amount of real cash balances. Therefore, without having observations

[17'] Note that the real bank credit variable that enters in (24) and (26) is the percentage change in nominal bank credit to manufacturing industry, minus the percentage change in the price of the variable factors of production. The monetary disequilibrium variable is, practically speaking, the percentage change in nominal money supply minus the percentage change in expected expenditure.

on the relevant real interest rate, there is no way to discriminate between the specification of those authors and our own specification presented in Chapter II. Evaluating the relative merits of either becomes one of those questions that can be answered only by comparing the quality of the respective theoretical underpinnings rather than by looking at the statistical results.

Sensitivity to the exogeneity assumptions

The estimates reported in Table 5.11 may be affected by a simultaneity bias if some of the variables that have been assumed to be exogenous are actually correlated with the stochastic error of the aggregate demand and supply equations. As we have noted in section C of this chapter[18] this may be the case for the factor prices and the money supply.

Factor price in the current quarter enter in the aggregate demand equation via expected inflation. In the aggregate supply function they do not enter as argument because in going from (24) to (26) the "real wage" rate variable for the current quarter was dropped; but one could argue that the lack of significance of the latter in (24) is in fact due to a simultaneity bias. Therefore, it is convenient to analyse the possible effects of eliminating the assumption of exogenous factor prices on the estimate for both the aggregate demand and the aggre-

[18] See page 202.

gate supply equations. Even if factor prices responded within the current quarter to the actual rate of inflation or to the rate of real growth, Instrumental Variables estimators are still consistent if the instruments used are uncorrelated with the random errors of the equations. In Table 5.12 we compare our previous FIML estimates of Table 5.11 with Instrumental Variables estimates. We used as instruments: four-lagged values of the rate of inflation π and of the rate of growth of nominal wages; two-lagged values of the rates of growth of the other three factor prices (prices of agricultural goods, imports and services), and four-lagged rates of growth of the real output of manufacturing industry. All of them may be though of as arguments of reduced-form equations for each one of the factor prices. Being lagged values, they must be uncorrelated with the random shocks of the current quarter. Note that the FIML and Instrumental Variables estimates reported in Table 5.12 are very close. This means that our estimates of Table 5.11 must not be affected by any significant simultaneity problem originated in the behavior of factor prices. It is also possible to get some insight about the possible simultaneity bias that results from assuming that the money supply is endogenous. Suppose that a random shock occurred that increased the rate of inflation during the current quarter, and that the monetary authority responded in accomodating fashion (probably a realistic case for Argentina at several points

Table 5.12 Instrumental Variable Estimates of Aggregate Demand and Supply

Aggregate Supply	(k) -4 to -10	$P_{vf}-P_{ma}$	$(P_{vf}-P_{ma})$ -1 to -7	(b_c-P_{vf})	$D\sigma_{\pi}^2$	ms-md	ms-md_{-1}	$(\text{ms-md})_{-2}$	R^2	S.E.
FIML	1.07	0.04	-0.54	0.01	-0.99	0.13	0.07	0.02	0.931	0.025
	(6.86)	(0.46)	(-2.41)	(2.91)	(-1.44)	(3.45)	(2.37)	(1.10)		
IV	1.10	0.12	-0.50	0.01	-1.16	0.12	0.06	0.02	0.933	0.025
	(6.46)	(1.38)	(-2.02)	(2.52)	(-1.55)	(3.30)	(2.30)	(0.89)		

Aggregate Demand	π^e	q_{ma}	y	y -1 to -6	ms-md	$(\text{ms-md})_{-1}$	$(\text{ms-md})_{-2}$	DPC	R^2	S.E.
FIML	1.03	-0.20	0.12	0.28	-0.01	0.03	0.02	-0.04	0.944	0.031
	(24.32)	(-3.21)	(0.15)	(1.87)	(-1.02)	(1.98)	(1.46)	(-1.62)		
IV	1.04	-0.18	0.07	0.27	-0.01	0.02	0.02	-0.04	0.944	0.031
	(24.47)	(-3.05)	(0.73)	(1.75)	(-0.04)	(1.67)	(1.91)	(-1.40)		

throughout our sample period). That kind of Central Bank behavior would create a positive covariance between the random error in the aggregate demand equation, on the one hand, and the money supply, on the other. This would bias upwards our estimates of the coefficient of the monetary disequilibrium variable in the aggregate-demand equation, making for effects of monetary disequilibrium on the demand-side that are weaker than those estimated in (27). Suppose further that the Monetary Authority reacted to a random shock that tended to diminish real output by trying to shorten the fall through a compensatory expansion of money supply (more often than not, this is the realistic possibility for Argentina[19]). Such behavior would register in the form of a negative covariance between the random shock of aggregate supply and the money supply. That in turn would bias downward the estimates of the monetary disequilibrium variable in equation (26). In other words, the supply-side effects of monetary disequilibrium would be underestimated by the results reported in Table 5.11. Summing up, the kind of simultaneity bias that might arise from money supply being endogenous would reinforce, rather than weaken, our substantive findins. For this reason, we conclude that our main results are acceptably robust with respect to the possibility that the main arguments of the structural equations may be endogenous.

[19] See the description of monetary policy in Section C, Chapter I, and the correlation coefficient for money supply of real output for the current quarter reported in Graph 5.1.

H. Policy Implications

It is more or less evident that with the money supply growing say, at 30 percent per year, there will be persistent inflation of around 25 percent a year. It is also more or less clear that if some day the state of persistent inflation is successfully eliminated, the monetary expansion necessary to preserve price stability will have to average the expansion of real GNP. But for an economy in a state of persistent inflation neither of these two propositions is useful. What is needed is a way, socially permissible, of moving from one state to the other.

The perverse stagflationary effects that we have showed to be the initial result of stabilization plans based on monetary restrictions greatly reduce the social acceptability of such plans. During the period in which real growth is falling and inflation continues at its previous rate or even accelerates, the government faces strong pressures against the restrictive policy and must give it up before the (presumably positive) "second run effects" begin to flourish. That governments behave this way is not surprising in a "pluralistic-conflict-society" in which, as Mallon and Sourrouille put it, "the feasibility of economic measures is largely determined by the need of regimes to mobilize and retain shifting coalition support."[20]

[20] See Mallon and Sourrouille [1975] preface.

Numerous reasons have been advanced to explain why workers oppose monetarist stabilization policies; they usually refer to trade union attempts to maintain excessive levels of real wages. Our analysis shows that even with real wages at their full-employment, steady-state equilibrium levels, a stabilization plan based on monetary restriction must, to be successful, improve capital returns at least temporarily and deteriorate the real wage rate. In other words, even if the inflationary economy is in a full-employment steady-state equilibrium path and the real wage rate and the real interest rate are at the "right" levels, the path to a non-inflationary state requires a redistribution of income against wage earners. This bias in the distribution of the burden of stabilization efforts inherent to monetarist stabilization policies, greatly reduces their political feasibility.

The weight of these disadvantages of stabilization policies based on monetary restrictions is closely related to the duration of the perverse effects analysed in this paper. If the stagflationary effects persist only for one or two quarters, it would be easy to argue that the benefits of eliminating inflation will more than compensate for the social costs incurred during the transition period. But if the perverse effects persist for one or more years, the judgment becomes more difficult. Unfortunately, our analysys does not formally answer this crucial quandry. We have found that the supply-side effects of monetary restriction in a given quarter are strong within the same quarter and also during the next one, but the effects seem to vanish after that. This does not mean that inflation will begin to decelerate and output to recover two quarters after the stabilization policy has been inaugurated. It all depends on the response of factor prices (a) to the initial acceleration of inflation, and (b) to the fall in real output. Apparently, in the case of Argenina, it is easier for accelerated inflation to result in increased factor prices than for a fall in output to translate into factor price reductions. Thus, in the second quarter the rate of monetary expansion will again fall short from the rate of growth of money demand, and this additional monetary restriction will replicate the effects of that of the initial quarter. The same will happen with monetary restriction in the third quarter, and so on. By this process, the perverse stagflationary effects may continue for several quarters.

In trying to find a way out of the dilemma posed by the perverse effects of monetarist stabilization policy, the possibility that naturally arises is that of controlling the rate of growth of factor prices. In turn this means control of the rate of devaluation (which larely determines the rate of growth of agriculture prices and import prices), the rate of change of prices for services such as transportation, electricity, and gas (which in fact are produced, or at least priced by the government), and the rate of change of nominal wages. According to the discussion of the preceding sections it is mainly the behavior of these prices that charts the course of expected inflation. On the other hand, cuts in the rate of growth of money supply produce the perverse effects here described <u>only</u> to the extent that there is no simultaneous decrease in the growth of money demand, which in turn largely depends on expected inflation.

A set of policies which includes compulsive decreases in the rates of growth of factor prices together with <u>accomodating</u> decreases in money supply will obviously diminish the risk of stagflationary effects. Still, the solution is not as easy as it sounds because (a) expected inflation will not automatically fall in the same proportion as the rate of growth of factor prices due to the influence of past rates of inflation and monetary expansion, and (b) the government may find that it is easier to cut the rate of growth of prices for certain factors than for others. In letting these considerations influence its decisions, the government may create serious distortions in relative prices. Moral suasion, guidelines, and even direct price controls of manufacturing prices may be necessary complements to the control of factor prices and money supply. Consistency of the whole set of these measures in order to avoid undesired changes in relative prices and over- or under-expansion of money supply will be crucial for the success of the stabilization plan.

Coordinating monetary policy with pricing and income policies is no simple task. One way of ensuring that monetary policy is accomodating is by trying to keep the real rate of interest at its long-run equilibrium level. The practical way for the Monetary Authority to do this would be to issue an indexed bond with real return $\bar{\rho}$ and to keep its market value growing exactly at the pace of price inflation. The Monetary Authority can do this by supplying any amount of bonds demanded by the public at that price. With reasonably efficient financial markets, the nominal rate fo interest will be equal to $\bar{\rho}$ plus the economy-wide expected rate of inflation. Interesting enough, interest rates will behave exactly the same as in a monetarist rational-expectations world, but in the course of reaching this result the policymaker will have lost his basic anti-inflationary instrument: money supply will become completely endogenous!

Having done this, monetary policy is busy enough trying to keep at its long-run equilibrium level. Wage-price controls and/or guidelines have to be used to try to reduce inflationary expectations, otherwise the rate of inflation will perpetuate itself around its initial level. The interesting aspects of combining wage-price controls and/or guidelines with a monetary policy based on a fixed real rate of interst is that, should the former be successful in reducing inflationary expectations, money supply will automatically be accommodating. In other words, such a combination of policy instruments deliberately avoids the kind of inconsistent monetary policies that have been observed in periods of price controls (for example, a large monetary expansion devised to keep an artifically low nominal interest rate).

Once the economy has reached a rate of inflation (actual and expected) that is considered tolerable and suitable to be maintained as a ceiling, the adequate mix of policy instruments will probably be different. It does not seem practical to base the maintenance of the ceiling upon permanent wage and price controls. On the other hand, a fixed <u>real</u> interest rate may not be appropriate for longer periods. The economy will surely be affected by real shocks and the real rate of interest will have to be variable if the burden of adjustment is to be shared by workers and capital owners. Once the economy is on a non-inflationary path, a more active monetary policy oriented to <u>preserve</u> stability is called for.

Managing price controls so as to maintain relative prices reasonably close to their long-run equilibrium levels is probably a more difficult task than that of achieving an accomodating monetary policy. The economic history of Argentina is full of examples of short-run decerlation of inflation based on the expedient measure of allowing some crucial relative price to deteriorate extremely. Invariably, such experiences ended in a revival of inflation originating in the real effects of that distortion. Extremely low agricultural prices end up producing falls in supply and the consequent balance of payments crises. Overvaluation of the currency depresses exports, expands imports and induces outflow of foreign capital. The natural outcome is, again, a balance of payments crisis. Below-cost pricing of public services gives rise to increasing deficits (usually financed by excessive monetary expansion) with the consequent inflationary effects after some time. Excessively low real wages create social tensions which end up defeating governments and producing radical changes in policies. So far, each one of these "extremist" incomes policies has been applied for a while, creating conditions for its replacement by another "extremist" policy, and so on. The ability of the government to apply income policies compatible with overall equilibrium has yet to be proved.

The analysis of this paper, however, suggests that achieving such a difficult combination of price-management and monetary policy may be the only way out of the perverse stagflationary marsh in which stabilization plans are usually mired in their initial stages.

APPENDIX

A note on McKinnon's book: Money and Capital in Economic Development.

In the introduction to his book, Ronald McKinnon characterizes his discussion as a monetary model alternative to both "short-run Keynesian theory or the long-run monetary growth models now in vogue." Next, he asserts that the basic assumptions of his model "are better suited to explaining the relationship between monetary processes and capital accumulation in the underdeveloped world" (pag. 3). The basic message of his analysis is that the rates of interest paid on bank deposits and charged on bank loans should be drastically increased. In his words, "optimal real rates of interest on deposits and loans, for which capital-scarce economies should strive, are surprisingly high." This strategy is seen on the one hand as the key to rapid growth, and, on the other hand, as a way of stabilizing an economy without losses of real output.

There are two main analytical novelties in his analysis. The first is a demand for "money" which is positively related to both the real return on holding money (which is computed as the difference between the average interest rate paid on money holdings and the expected rate of inflation) and the average real return on physical capital. This "complementarity" between "money" and physical capital is used to demonstrate that an increase in the real return on money holding will raise the demand for money and will raise investment in physical capital. As a result, the rate of growth of the economy will be higher.

The second analytical novelty is the strict dependence in the short run of aggregate supply of commodities with respect to the amount of real bank credit to firms. The increase in the real return on money holdings would increase the demand for "money" and decrease the demand for commodities. Therefore, relying on such a property in devising a strategy for stabilization purposes, instead of curbing the expansion of money supply, has the advantage that real bank credit to producers will still be abundant and supply of commodities will not be curtailed. The dependence of aggregate supply upon real bank credit is also a reason for expecting a more rapid growth during the period along which the demand for money rises as a consequence of the increased real rate of interest.

The comparison of McKinnon's analysis and conclusions with those of conventional monetary theory, as well as the evaluation of the former's adequacy to the reality of semi-industrialized economies to which that author refers, is made difficult by the use of unusual terminology and certain ambiguities in assumptions which play a fundamental role in his analysis. The purpose of this note is to help in clarifying these aspects.

The first difficulty relates to McKinnon's definition of money and the menu of assets that he considers in his formal analysis. He refers to "money" as including currency, and all kinds of bank deposits. It is conceivable to imagine banks paying an interest rate even on demand deposits, but how could interest be paid on currency holding? Therefore, to be able to make "money" a stable function of its real return, currency should be excluded from it. Neither should Demand Deposits be included if they do not bear interest, as is usually the case. Therefore, McKinnon's demand for "money" could be better named "demand for interest bearing bank deposits." This being the case, the proposition "the demand for interest-bearing bank deposits can be increased by increasing the interest rate paid on them" would be more easily understood than McKinnon's not quite equivalent proposition ("the demand for money can be raised by raising interest rates").

Next, McKinnon considers that people hold either "money" or physical assets. This means that if any other kind of financial asset or claim exists in an actual economy (such as bills of exchange, I.O.U.'s, receivables, etc.) they are either included within the concept of "money," or left out of the analysis. It is fair to say that, although in describing the actual economies he recognizes the existence of loan markets(or at least of individual lenders) outside the banking system (see, v.g., page 71), in his formal analysis he assumes them away. This assumption is not at all innocuous. If non-bank sources of credit for firms do exist and practially all firms use them (as seems to be the case in the actual economies McKinnon has in mind), then this fact by itself demonstrates that actual rates of return on the assets invested in firms are at least as high as the effective interest rate charged by the non-bank lenders. This being the case, the interest rate charged on rationed bank loans will not play the fundamental role that McKinnon assigns to it as setting a minimum floor to the level of rates of return on real assets held by firms. McKinnon's argument about the lack of uniformity of the marginal rates of return on real assets will still be warranted because it is likely that non-bank rates differ greatly due to the segmentation of those non-institutional markets. But the argument that many resources are invested in assets with a very low (or even negative) marginal rate of return reduces its force. Of course we concede that some households may be investing in physical assets with very low returns because they do not have available the alternative of buying financial assets with a reasonable return. Yet in the economies McKinnon has in mind, households that are not linked to firms usually have low incomes and cannot save much at any rate.

The existence of important non-bank sources of credit for firms, even when coming from segmented markets, does damage also to McKinnon's assumption about a close relationship between supply of commodities and bank credit received by the firm. If the change in bank credit reflects merely a shift between bank and non-bank market for loans, the effect on production will be much smaller than if that change reflects an absolute decrease of total credit (bank and non-bank) in the economy. Moreover, if credit in non-bank markets is rationed by interest rates (as it probably is), then it will be those rates (and not the quantity of credit) that will be related in a stable fashion to production and supply of commodities.

McKinnon's argument about the "complementarity" between "money" (interest bearing bank deposits) and physical capital also deserves some comments. Part of the argument is that an increase in the demand for "money" (produced by higher interest rates paid on it) would increase the average rate of return on physical assets because some investments with low rate of return will not be undertaken and there will be more credit available for investments with high rates of return. Rather than a stable functional relationship between money demand and real return on physical assets, this is a description of a process of reallocation of resources that presumably would be put in operation by the increase in bank rates. The second part of the argument is that "invested-oriented" firms will have higher transactions demand for money due to the "greater lag between income and disbursements associated with 'lumpiness' in investment" (page 58). Therefore a higher ratio of investment to income, derived from an exogenous increase in the real return on physical assets, will increase the demand for "money." The substitution between "money" and physical capital as alternative ways of allocating wealth is considered by McKinnon to be unimportant, at least, up to a point of very high rates of return on "money."

McKinnon uses this "complementarity" between "money" and real assets in order to argue that rising interest rates (and the demand for money) would raise investment in fixed capital because it will make investment opportunities possible that previously found no external sources of financing. He seems to argue that the scarcity of external sources of <u>debt</u> financing, rather than the availability of equity capital, is keeping the rate of investment below its potential level. Empirical evidence suggests that the latter is still a more important restraint and that the leverage ratio of firms — at least in some of the economies that McKinnon analyses — is already much higher than in developed, price-stable economies.* If this is so, McKinnon's argument for explaining how higher interest rates would increase investment loses its force.

His main policy recommendation is to increase interest rates on bank deposits and bank loans. To the extent that the rise

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* See Chapter I, Section B.

in bank deposits' interest rates (that McKinnon recommends) means the elimination of relaxation of maximum interest rates provisions that prevented the banks from paying the market clearing rate, one can expect that there will be imporvements in the allocation of resources. Clearing market interest rates will promote a higher degree of financial intermediation and stronger forces toward the equalization of the marginal rates of return in different economic activities. Such a measure may also induce an increase in total savings, because some households discouraged by the artificially low interest rates paid on bank deposits may have been consuming more than they would have in a free market interest rate situation. And, in addition, there is also the possible allocative gain associated with a larger use of real cash balances in transactions (the optimum quantity of money argument). But all of these are once-and-for-all allocation improvements that should be welcome, but that have very little to do with stabilization policy because one cannot expect that the effects will occur very soon after the elimination of the interest rates limitations on bank deposits and loans. Moreover, big gains in terms of resource allocation would require the rebuilding of — or creation of — active capital markets (for long-term bonds and equities) which experience shows to be a very slow process. And, in any case, such a set of policy recommendations can be easily drawn from a very conventional resource allocation kind of analysis. The whole story of complementarity between "money" and physical assets, and the introduction of bank credit in the production function is unnecessary. It is for this reason that we think that McKinnon's proposition must be interpreted in a much more strict and literal way. He thinks that the <u>availability of real bank credit</u> (apparently at whatever interest rate) is one of the crucial determinants of production; and, therefore, whatever the policy-maker can do to increase that availability (including the enforcement of an interest rate higher than that which would otherwise be dictated by a free market of loans), will help to increase output and, consequently, reduce inflation. The questions which naturally arise are the following: Once the interest rate is a market clearing rate, are increasing interest rates and reducing money supply <u>really</u> two <u>different</u> alternative policy choices? Once the interest rate becomes a clearing market rate, won't the interest rate (rather than the availability of real bank credit) be the financial piece of information that firms will consider in deciding how much to produce? In such a situation, wouldn't very high interest rates induce a reduction of production and therefore jeopardize the stabilization plan?

We have posed these questions because we think they show that this whole story of financial influences through the supply side of the commodity markets is still a largely unsettled issue in spite of McKinnon's claim of having made it an alternative theory of money and growth.

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