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Structuralism vs. Monetarism: Inflation in Chile

1. INTRODUCTION

Inflation has plagued much of Latin America since the 1930s and Chile since the late nineteenth century. Two competing schools of thought have developed in Latin America to explain this chronic inflation. Latin American monetarism suggests that the factors causing inflation in Latin America are similar to those causing inflation elsewhere and are primarily a matter of excessive aggregate demand. The classic empirical study embodying monetarist assumptions is Arnold Harberger's analysis of Chilean inflation.[1] The second theory, structuralism, stresses that there are factors peculiar to Latin America's institutional structure that explain the region's predisposition to inflation.

One important argument of the structuralist school is that the roots of inflation can be found in bottlenecks of "inelastic supply" in the agricultural sector. This argument has been cited as particularly applicable to the Chilean economy. It is examined here and tested using Chilean data.

As might be expected, a consensus position exists in the literature that grants both structural and monetarist factors a role in the Latin American inflationary process: "Structural problems are considered

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to be at the root of inflation, but demand problems are clearly related to the propagation and persistence of the phenomenon."[2] However, although several econometric studies of inflation in Latin America have tested the significance of monetarist factors using Harberger's basic approach, little attempt has been made either to formulate rigorously or to test the structuralist theory based on a weak agricultural sector. The structuralist approach has lacked the theoretical underpinnings needed to compete with the monetarist hypothesis.

This chapter develops a statement of the structuralist hypothesis of the role of agricultural difficulties in inflation. The innovation of this model is that it does not rely on the assumption that prices adjust more slowly downward than upward, an assumption that is commonly felt to be necessary for the structuralist conclusions. The reformulated structuralist theory is incorporated into the Harberger model of inflation and is tested using quarterly Chilean data over the years 1940-1970.

The plan of the chapter is as follows. Section 1 summarizes salient aspects of the structuralist-monetarist dispute relevant to the agricultural weakness argument. In Section 2 this structuralist theory is critically examined. Section 3 develops an alternative formulation of the argument. In Section 4 the tests are performed, the empirical results analyzed, and the policy implications of the findings discussed.

1. SUMMARY OF THE STRUCTURALIST AND MONETARIST DISPUTE

The Latin American monetarist position is rooted in the belief that increases in money income occur in response to increases in aggregate demand. Inflation is the result of continued expansion of aggregate demand after real income approaches the capacity or supply constraints of the economy. According to Latin American monetarists, this inflation is generated by unjustified expansion both in government deficits (financed for the most part by increases in the money supply) and in central bank loans to the public and to commercial banks.[3] The policy prescription offered by monetarists is monetary and fiscal restraint since it it the lack of such restraint that leads to rising prices. If inflation is not contained, it is argued that a second best solution is to end or avoid price controls, although the result may be greater price level instability.

Harberger's "The Dynamics of Inflation in Chile," the best-known empirical study of Latin American inflation, provides and tests a

monetarist model of inflation.[4] The Harberger model uses the traditional liquidity preference function to express the demand for money. In this view, the demand for money is a function of the price level, the level of real income, and the cost of holding money. The supply of money is assumed to be determined exogenously. In equilibrium, given the level of real income and the cost of holding money, the price level will adjust to equate the demand for money to an existing supply. The price level then is expressed as a function of the quantity of money, the level of real income, and the cost of holding cash. The effects of increases in the money supply on the price level are assumed to occur over time, and thus money supply enters the equation in the form of a distributed lag. Since Harberger is interested in analyzing the inflation rate rather than the price level, he takes percentage first differences of the above-described function and arrives at the following inflation equation to be tested with quarterly data:

$$P'_t = S'_t + \beta_1 Y'_t + \beta_2 M'_t + \beta_3 D'_t + \beta_4 A'_t \qquad (8\text{-}1)$$

where P'_t equals the percentage change in price level within each quarter; Y'_t, the percentage change in real income from the past to the current quarter; M'_t the percentage change in the money supply in the six months ending with the end of quarter t, and D'_t, a distributed-lag weighted average of the three past values of M'_t. A'_t equals the percentage change in the general price level in the year ending at the beginning of the current quarter minus the percentage change in the general price level in the year before that. This variable does not include the change in the market rate of return realizable from investment in nonmonetary assets because it is argued that past changes in the inflation rate have the greatest impact on the change in the expected costs of holding real cash. Finally, S'_t equals a seasonal constant. (A discussion of the results, broadly supportive of the monetarist hypothesis, is postponed to Part IV.) Thus, in Harberger's model, given full employment income and the predetermined cost of holding cash, government-induced expansion in aggregate demand, assumed to be the result of money supply growth, is responsible for higher price levels.

Latin American structuralists will grant that the money supply may increase along with the price level. Unlike monetarists, however, they believe that the money stock is responding to inflation rather than initiating it. The initiating or underlying factors, it is hypothesized, are not to be found in monetary and fiscal policies but rather in the more basic weaknesses characteristic of the Latin American

economies. In general terms the source of rising prices is thought to be the pressure of economic growth on an underdeveloped social and economic structure. Specifically, the agriculture, foreign trade, and government sectors are regarded as suffering from institutional rigidities that cause prices to rise with economic development.[5] The structuralist factor that is cited as particularly applicable to the Chilean economy is a weak agricultural sector.[6] It is argued that, with economic growth and consequent industrialization, there is increased demand for food and raw material deliveries to the industrial sector; but agricultural output is sluggish and cannot keep pace with the demand at constant prices. The rural socioeconomic structure is most often held responsible for this.

Specifically, structuralists cite the land-tenure arrangement as the primary cause for low investment and for the relatively backward production techniques of Latin American agriculture. The land is divided predominantly into minifundia and latifundia; that is, small peasant plots and large estates. Both are seen as contributing to the problem of a relatively backward traditional agricultural sector. It is argued that large estates are inefficient because their owners are not "economic men" and thus are uninterested in maximizing their money profits. On the other hand, minifundia are not productive because they are too small to be efficiently cultivated and because their peasant owners lack the time and human resources to learn better techniques.[7]

A relatively backward agricultural sector is almost always one of the problems of developing economies. The distinguishing feature of the structuralist approach is the argument that this problem can lead to inflation. It is clear, however, that the absolute price level does not have to rise for the relative price of food to increase. A rise in the relative price of food can be accomplished through a decline in prices of other commodities with food prices constant. One additional and crucial assumption made by structuralists that turns relative price increases into overall inflationary pressure is the following: prices in the nonfood sectors of the economy are inflexible downward. It is the rise in the relative price of food combined with the rigidity of nonfood prices that results in an increase in the overall level of prices. In general, downward inflexibility of prices is ascribed to the pervasiveness of imperfect competition in those Latin American economies suffering from inflation. The existence of downward price inflexibility due to market power is accepted as an institutional constraint and is not given much attention. Yet it is as crucial to the structural analysis as is the assumption of bottlenecks in agriculture.

To summarize, there are two elements traditionally specified as necessary for structural inflation: first, excess demand in the agricultural sector due to the lack of sufficient technological change, bidding up relative prices in this sector; second, price and wage floors in the nonfarm sector.

If such factors are at the root of inflationary pressures, monetary and fiscal policies can slow inflation but only at a cost to economic development. With a stagnant agricultural sector, for example, growth elsewhere in the economy will increase the demand for agricultural products (due to an increase in income) while reducing the supply (by drawing away labor resources). This leads to an increase in prices that cannot be offset because prices are rigid elsewhere in the economy. Hence, the only way to prevent prices from rising is to curtail the increase in excess demand for agricultural goods. Without extensive structural change, this means stopping economic growth. Thus the structuralists argue that the preferred way to stop inflation is through structural reforms:

> The second sort of action, with a greater chance of success in Latin America than over-all restrictions upon demand, is the loosening of bottlenecks —that is, of particular insufficiencies in supply that are possible causes of inflationary spiral. Herein lies the role of investments bearing a rapid maturity, of food imports in the event of poor harvest, and of agrarian reforms, doubtless difficult to manage but the effect of which should eventually be the increase of food production and the simultaneous disappearance of both the largest landholdings, where there is no incentive to rational production, and the smallest whose lack of means restrains development.[8]

2. A CRITIQUE OF THE STRUCTURALIST MODEL

There are a number of problematical parts to the theory of structuralism. The structuralist explanation of inflation is criticized here on empirical and then on theoretical grounds. First, in the inflationary process that Chile has undergone, prices in the nonfarm sectors of the economy have not been merely rigid downward in the face of excess supply but rather they have continued to rise. The assumption of a floor to price changes is clearly inadequate to explain this.

Second, it is simply a matter of arithmetic that a rise in relative prices in agriculture, given a floor to prices in other sectors, requires a rise in the general price level. If prices advance due to excess demand in one sector and are not cut in response to excess supply, on the average prices increase. This combination of events offers an explanation for a once-and-for-all increase in the price level. A constant

inflation rate, however, can only be explained within the structuralist framework if relative prices continue to advance.

Moreover, in Chile there has been a tendency for the rate of inflation itself to rise. For structuralist factors alone to lead to this result, relative food prices would not only need to rise, they would need to rise at an increasing rate. In Chile relative food prices have increased over the period 1940–1970. However, there has been no positive trend in the rate of change in relative food prices as required.

Third, structuralism does not provide a theoretical justification for the assumed downward rigidity of nonfood prices. Downward price rigidity and upward flexibility are attributed to the presence of oligopoly power in the manufacturing and service sectors; but theoretical doubts can be raised about ascribing this asymmetrical pricing response to oligopolistic factors. In particular the pricing behavior described by this assumption is not consistent with the maximization of an oligopolistic industry's long-run profits.

To see this point, assume that an oligopolistic industry is in equilibrium at its profit-maximizing price. Now assume that demand increases for just a short period and that this causes the short-run profit-maximizing price to rise. If oligopolies respond readily to the temporarily increased demand by raising prices, then when demand falls they have the wrong price. The original price now maximizes profits but by the assumption under question oligopolies hesitate to lower their prices again. It is quite likely that downward price changes do threaten industrywide pricing discipline. They may be interpreted as an attempt by one firm to increase its market share and so may spark a price war. To avoid this, firms may hesitate to cut prices. However, if firms are slow to lower prices, maximization of profits requires them to hesitate before raising prices as well. Since prices cannot be adjusted downward without cost, they should be raised only when conditions that call for a price rise clearly persist. Otherwise, firms may be committed to a pricing structure that is too high to maximize current profits. Hence, oligopolies may be slow to raise or lower prices in response to change in demand in order to preserve industrywide cooperation on pricing structure. If firms pursue this strategy the assumption that prices are more likely to move up readily but down slowly in organized sectors must be questioned.[9] However the assumption of asymmetrical price responsiveness is not necessary to a structuralist theory of inflation. In Section III below, where the structuralist model is reformulated, it is replaced with the assumption that, on average, firms in manufacturing and service markets are slower to adjust prices in either direction to changed market conditions than those in the agriculture sector.

Thus, the structuralist argument as it stands can be criticized on several specific grounds. More generally, the structuralist model is stated in an intuitive form. Consequently, it is unclear how one would go about testing it. Related to this is the fact that structuralism specifies no role either for inflationary expectations[10] or for aggregate demand elements, and so is incomplete as a model of inflation. The reformulated structuralist model, derived in Section III below, attempts to deal with this problem as well as to answer the specific criticisms of the traditional structuralist model raised in this section. Far from invalidating the basic point of the structuralist approach, once inflationary expectations and aggregate demand elements are included, it is possible to avoid the problems outlined above. In particular, structuralist factors can be linked to an ongoing inflation process without the need to assume a floor to price changes in the nonunionized, oligopolistic sector.

3. THE STRUCTURALIST MODEL REFORMULATED

The purpose of this section is to derive the structuralist hypothesis that relative prices affect the inflation rate from a clearly specified theoretical framework that provides refutable hypotheses and that answers the specific criticisms of the traditional structuralist approach raised in the previous section. The model is first briefly outlined and is then derived and stated in a more rigorous form.

In inflationary economies such as Chile's, where the annual rate of price change averaged 30 percent over the years 1940–1970, it is reasonable to assume that a positive future rate of inflation is anticipated. Thus it is likely that individuals use some model to formulate their expectations of future rates of price change. Now assume that in some way the government is able to increase monetary aggregate demand to validate the expected price increases (as discussed further below). Then in equilibrium real demand and supply of goods are in balance and prices increase at the expected rate of inflation. Monetarists would attribute a rise in the overall inflation rate to an increased rate of growth of aggregate demand. It would seem that if the expansion in money aggregate demand is kept equal to the real growth in output plus the expected growth in prices, inflation would continue at the equilibrium expected rate. This, however, is not necessarily the case. Overall demand may be kept in balance with an increase in demand in one sector balancing a decrease in another. Different sectors then may adjust their prices to changes in the level of demand at different speeds. Specifically, as was indicated above,

competitive sectors may adjust their prices and wages in reaction to changed demand conditions faster than noncompetitive sectors. The rapidity with which prices adjust is also determined by the nature of the product. Those products with long- and fixed-contract periods for their inputs or outputs will have prices that adjust relatively slowly.

The assumption maintained here is that, for whatever reason, prices in agriculture react more rapidly to changed market conditions than do prices elsewhere. Then, if aggregate demand equals aggregate supply but the composition of excess aggregate demand is such that there is an exogenous increase in excess demand in agriculture and a corresponding decrease in excess demand elsewhere, the inflation rate in the short run will rise.

But this is just what the structuralists argue is occurring. The basic assumption of the structuralist view is that with industrialization and continued agricultural backwardness, the increasing demand for agricultural products overruns supply increases in that sector. The matching excess supply occurring in the nonfood sectors may not lead to a balancing decline in the rate of change in nonfood prices. Demand would be less than supply but prices would not fall elsewhere in the economy at the same rate that they are rising in the agricultural sector. The overall result in the short run is an increase in the inflation rate.

Furthermore, developing economies such as those of Latin America, to the extent that they are often subject to upward relative price pressure in the more traditional agricultural sector, would be more prone to inflationary pressures than developed countries where excess demand might not be expected to occur systematically in agriculture.

The Model Derived

To derive the model in a form suitable for hypothesis testing,[11] a linear price reaction equation is adopted such that:

$$\frac{\dot{P}_i}{P_i} = \frac{K_i X_i}{q_i^S} = \frac{K_i(q_i^D - q_i^S)}{q_i^S} \qquad (8\text{-}2)$$

where $\dot{P}_i$ is the first derivative of the price of good i with respect to time, K_i, a positive constant, X_i, the level of excess demand, q_i^D, the quantity demanded, and q_i^S, the quantity supplied. The equation states that the relative rate of change in a price is directly proportional to the excess demand for the good expressed as a fraction of

the quantity supplied. Excess demand equations take the following form:

$$X_i = X_i(P_1, \ldots, P_n; P_1^e, \ldots, P_n^e; A) \tag{8-3}$$

where P_i^e indicates the expected price and A is a term representing the initial level and distribution of assets.[12]

The Laspeyres price index is then utilized to measure the inflation rate, $\dot{P}/P$. In a two-sector economy,

$$\frac{\dot{P}}{P} = \frac{\bar{q}_1 \dot{P}_1 + \bar{q}_2 \dot{P}_2}{\bar{q}_1 P_1 + \bar{q}_2 P_2} \tag{8-4}$$

where $\bar{q}_1$ and $\bar{q}_2$ are base period quantities, and P_1 and P_2 and $\dot{P}_1$ and $\dot{P}_2$ are current prices and current changes in prices, respectively, the agricultural sector is indicated by subscript 1 and the rest of the economy by subscript 2. Substituting the price reaction Equation (8-2) into Equation (8-4) results in:

$$\frac{\dot{P}}{P} = \left(\frac{\bar{q}_1 P_1 K_1 X_1}{q_1^S} + \frac{\bar{q}_2 P_2 K_2 X_2}{q_2^S} \right) / (\bar{q}_1 P_1 + \bar{q}_2 P_2) \tag{8-5}$$

$$\approx \frac{\sum_{i=1}^{2} P_i K_i X_i}{\sum_{i=1}^{2} \bar{q}_i P_i}$$

which holds precisely for the case where the quantity weights, $\bar{q}_i$, equal the quantities supplied, q_i^S.[13]

To interpret this result, use is made of Walras' law, which states that the total net monetary value of excess demand for goods is equivalent to the excess supply of money. In symbols,

$$\sum_{i=1}^{n} P_i X_i = -X_{n+1} \tag{8-6}$$

where P_i is the price and X_i, the excess demand of the i^{th} good. The

$n + 1$ commodity is money, and $P_{n+1} = 1$. When there is excess aggregate demand, by definition,

$$\sum_{i=1}^{n} P_i X_i > 0 \tag{8-7}$$

Equation (8-5) can then be rewritten, as follows,

$$\frac{\dot{P}}{P} = \frac{K_2 \sum_{i=1}^{2} P_i X_i}{\sum_{i=1}^{2} P_i \bar{q}_i} + (K_1 - K_2) \frac{P_1 X_1}{\sum_{i=1}^{2} P_i \bar{q}_i} \tag{8-8}$$

to indicate that the inflation rate is positively related, first, to the current level of excess aggregate demand relative to output, and second, assuming $K_1 > K_2$, to excess demand in agriculture relative to overall output. This is so unless prices adjust quickly to clear markets. For example, if price reaction coefficients are sufficiently large, the entire price adjustment process could occur within the quarter. Then, even with $K_1 > K_2$, sectoral imbalances would not have any impact on the quarterly inflation rate since excess demand in each sector would return to zero within the quarter.

Equation (8-8) implies that inflation may occur in the short run, despite an absence of excess aggregate demand, if excess demand exists in agriculture. This follows because prices react more quickly in agriculture than elsewhere. Equation (8-8) also implies, *mutatis mutandis*, that when excess supply exists in agriculture, $P_1 X_1 < 0$, with $\sum_{i=1}^{2} P_i X_i = 0$, the price level should fall in the short run, and the larger the excess supply in absolute value, the greater the decline in the price level.

Excess demand in agriculture, X_1, is not directly observable. Thus, the rate of change in the relative price of food, ψ, is substituted into equation (8-8) as follows: By definition

$$\psi = \frac{\dot{P}_1}{P_1} - \frac{\dot{P}_2}{P_2} \tag{8-9}$$

Substituting (8-2) into (8-9),

$$\psi = \frac{K_1 X_1}{q_1^S} - \frac{K_2 X_2}{q_2^S} \tag{8-10}$$

Using the identity $P_1X_1 + P_2X_2 = \Sigma\, P_iX_i$[14] to substitute for X_2 in (8-10) results in:

$$\psi = \left(\frac{K_1}{q_1^S} + \frac{K_2}{q_2^S}\frac{P_1}{P_2}\right) X_1 - \frac{K_2 \Sigma P_i X_i}{q_2^S P_2} \tag{8-11}$$

Then,

$$X_1 = \frac{1}{\dfrac{K_1}{q_1^S} + \dfrac{K_2}{q_2^S}\dfrac{P_1}{P_2}}\,\psi + \frac{K_2/q_2^S P_2}{\dfrac{K_1}{q_1^S} + \dfrac{K_2}{q_2^S}\dfrac{P_1}{P_2}}\,\Sigma P_i X_i \tag{8-12}$$

Substituting (8-12) into (8-8) results in:

$$\frac{\dot{P}}{P} = h\frac{\Sigma P_i X_i}{\Sigma P_i \bar{q}_i} + g\psi \tag{8-13}$$

where

$$h = \frac{K_2 q_1 P_1}{K_1 q_2 P_2 + K_2 q_1 P_1} K_1 + \left(1 - \frac{K_2 q_1 P_1}{K_1 q_2 P_2 + K_2 q_1 P_1}\right) K_2 > 0 \tag{8-14}$$

which is a weighted average of each sector's price reaction coefficients with weights essentially made up of each sector's share of output; and where

$$g = (K_1 - K_2)\frac{P_1 q_1 P_2 q_2}{K_2(P_1 q_1)^2 + (K_1 + K_2)P_1 q_1 P_2 q_2 + K_1(P_2 q_2)^2} \gtrless 0 \tag{8-15}$$

Whether g, the coefficient of ψ, is positive or negative depends only on the size of K_1 relative to K_2. The absolute size of the coefficient of ψ approaches in the limit the share of sector 1 in the price index as K_2 approaches zero. Thus, Equation (8-13) indicates that the rate of change in the price level varies directly with the level of excess

aggregate demand and, assuming $K_1 > K_2$ with ψ, the rate of change in the relative price of food.

In the estimation of an inflation equation, the coefficient of ψ may overestimate the impact of structural imbalances on inflation and may reflect to some extent the influence of excess aggregate demand variables since ψ, as indicated by Equation (8-11), is influenced by excess aggregate demand. This is discussed further below.[15] However, here it can be noted that this occurs only if price reaction coefficients are larger in agriculture than elsewhere. Only if K_1 is greater than K_2, which is all that is required for structuralist factors to have an impact on the short-run inflation rate, will the inflation rate vary directly with the rate of change in the relative price of food.

If X_1 is a sector in which prices adjust more slowly than elsewhere, K_2 will be greater than K_1 and the coefficient for ψ will be negative in an estimated inflation equation.[16]

Maintaining the assumption that $K_1 > K_2$, at a given level of excess aggregate demand relative to output, the inflation rate rises if excess demand increases in agriculture and falls elsewhere. The higher rate of change in prices in agriculture is not immediately matched by a decline in the rate of change in prices in the rest of the economy, and thus, when the relative price of food rises, the inflation rate is greater than if excess aggregate demand factors alone were considered. For this to be the case, in the short run the income velocity of money must rise. If the structural inflationary pressures persist, real output and the rate of employment will drop in the absence of expansionary monetary and fiscal policy.

Equations (8-8) and (8-13) state that the inflation rate varies directly with excess aggregate demand relative to output. Harberger's inflation equation indicates the potential extent of the excess supply of money or excess demand for goods and thus can be used to reflect $\Sigma P_i X_i$ in Equations (8-8) and (8-13).[17] However, it is implicitly assumed in the Harberger model that real income is always equal to full employment real income. This assumption, which implies that markets are always in equilibrium, is not required for the Latin American monetarist model, which argues only for the primacy of excess aggregate demand forces in inflation. If Harberger's assumption does hold, that is, if prices react quickly to clear markets in all sectors, no structural inflation is possible, as discussed above.

To use Harberger's variables in a test for structural inflation, Harberger's equation needs to be interpreted as representing the monetarist causes of inflation—that is, the growth in the money supply (since changes in fiscal policy are assumed to have relatively little

impact) given the growth in full employment real income. More specifically, the real income term included in the Harberger equation must measure full employment income, Y_f, not actual income, Y. If prices do not clear markets continuously, actual quarterly income, Y, will often vary from full employment income, Y_f. Indeed, because of data limitations the income variable used by Harberger and also used here may well be closer to Y_f than to Y. Quarterly income data are not available and, therefore, annual data are interpolated to provide quarterly statistics.

To summarize the workings of a model of inflation that includes both structuralist and monetarist factors, assume that excess aggregate demand, as well as excess demand and excess supply in each sector and inflationary expectations, equal zero. The inflation rate then equals zero according to Equations (8-8) and (8-13). If monetary authorities increase the money supply so that there is an excess demand for goods, inflation results. The inflation rate varies with the amount of excess aggregate demand relative to output. Starting over again from a position of zero excess aggregate demand, structural imbalances may also provoke inflation in the short run. If $K_1 > K_2$ and if excess demand occurs in agriculture, balanced by equal excess supply elsewhere, in the short run inflation results. For this to be possible a temporary rise in the velocity of money is required. The greater the value of excess demand in agriculture, relative to overall output, and the greater $K_1 - K_2$, the greater is the short-run structural inflation. Thus both aggregate demand and structural factors can influence the short-run inflation rate.

An ongoing long-run inflation at a constant rate is also possible. This is the result if the government, through monetary and fiscal policy, maintains excessive aggregate demand. Eventually, expectations of a continuing inflation are likely to develop. If the government fulfills these expectations by expansionary monetary and fiscal policy, the inflation continues at the equilibrium expected rate.[18] A spurt (or decline) in the inflation rate is then possible if structural imbalances develop. However, structural factors alone will not lead to a permanently changed inflation rate unless fiscal and monetary policies respond in the appropriate direction. If structural pressures persist, then real output and the rate of employment may drop temporarily in the absence of an accommodating monetary and fiscal policy. To see this assume $\Sigma P_i X_i = 0$; then according to inflation equation (8-13), inflation occurs if excess demand arises in agriculture such that $P_1 X_1 > P_2 X_2$. Because $K_1 > K_2$, the price level rises. But since $K_2 > 0$, with $X_2 < 0$, eventually prices will fall in the nonfood sector bringing the overall price level down. Furthermore, there

is a wealth effect, since the rise in prices lowers real balances, a component of assets. With the fall in assets, excess demand in the i^{th} sector, as (8-3) indicates, will decline. Then $\Sigma P_i X_i$ will be negative until the price level drops back to its initial position.

Structuralists usually grant that growth in aggregate demand plays some part in the process of inflation. Their essential differences with Latin American monetarists is their belief that monetary and fiscal authorities are reacting to a prior price increase.[19] Once the inflation rate increases due to structural factors, it is argued, monetary and fiscal authorities are disposed to raise the rate of growth of money supply to avoid cuts in government purchasing power and disruptions to the economy, such as increases in the unemployment rate and declines in output.

The monetarist hypothesis is that monetary and fiscal policies are active, or exogenous. Clearly, the potential for these policies to respond to inflation exists. The structuralist hypothesis that the relative price of food has an impact on the long-run inflation rate requires as a necessary condition that the monetary and fiscal policy implemented by the government be a passive variable. Although this is a crucial component of the structuralist theory, whether stated explicitly or left implicit, statistical tests to determine the hypothesis' validity for Latin American inflations have not yet been performed. Here, the Sims test[20] for the presence of a passive or active money supply is used to determine which of these hypotheses is tenable for the case of Chile. The test will be described and the results analyzed in Section IV.

4. THE TESTING OF LATIN AMERICAN STRUCTURALIST AND MONETARIST THEORIES

4.1 Results Using Harberger's Inflation Equation

In the Latin American monetarist model the inflationary process is ascribed to demand-pull factors. The Latin American structuralist hypothesis stresses the role of the relatively backward agricultural sector in inflation. In the structuralist model reformulated above, it is suggested that inflation may be related both to the level and distribution of excess aggregate demand, with inflation increasing, *ceteris paribus*, with the concentration of excess demand in agriculture. Thus, according to the price change equation derived from the reformulated structuralist theory,

$$\frac{\dot{P}}{P} = K_2 \frac{\Sigma P_i X_i}{\Sigma P_i \bar{q}_i} + (K_1 - K_2) \frac{P_1 X_1}{\Sigma P_i \bar{q}_i} \qquad (8\text{-}16)$$

As indicated above, monetarist pressures on prices are measured by Harberger's variables, and if Harberger's assumptions are correct, these variables should appear with the coefficients his model predicts and the coefficient of ψ should be insignificantly different from zero. On the other hand, if the reformulated structuralist hypothesis is correct, the coefficients of both the demand-pull variables and of ψ should be significant with the anticipated signs. Hence, to test for the existence of demand-pull and structural elements in the inflation process the Harberger equation is run without and then with the rate of change of the relative price of food, ψ.[21]

The results employing quarterly data[22] follow for the period 1940-1970 using only Harberger's variables. (Standard errors appear in parentheses; $m_{b_2 b_3}$ indicates the covariance of the coefficients M'_t and D'_t.)

$$P'_t = S'_t - \underset{(0.24)}{0.92 Y'_t} + \underset{(0.06)}{0.26 M'_t} + \underset{(0.06)}{0.12 D'_t} \qquad (8\text{-}17)$$

$$\bar{R}^2 = 0.30$$

$$DW = 1.42$$

$$m_{b_2 b_3} = -0.00815$$

$$P'_t = S'_t - \underset{(0.23)}{0.39 Y'_t} + \underset{(0.05)}{0.25 M'_t} + \underset{(0.06)}{0.16 D'_t} + \underset{(0.03)}{0.18 A'_t} \qquad (8\text{-}18)$$

$$\bar{R}^2 = 0.47$$

$$DW = 1.66$$

$$m_{b_2 b_3} = -0.000580$$

These results broadly parallel those Harberger arrives at for the period 1940-1958. The demand-pull variables—current and lagged money supply, real income, and the change in the inflation rate—are significant with the expected signs in each equation, although the significance of the coefficient of the A'_t may represent the impact of omitted variables or additional lags on included variables as well as inflationary expectations. The sums of the coefficients of M'_t and D'_t in each equation are not significantly different from 0.5 as the theory predicts. The coefficient of the cost-of-holding-cash variable, A'_t, is significant with the anticipated position sign.[23]

4.2 The Importance of the Structuralist Variable

Harberger's equations are then augmented to include the rate of change of the relative prices of food with the following results:

$$P'_t = \underset{(0.22)}{S'_t} - \underset{(0.05)}{0.90Y'_t} + \underset{(0.06)}{0.24M'_t} + \underset{(0.07)}{0.16D'_t} + 0.14\psi_t \qquad (8\text{-}19)$$

$$\bar{R}^2 = 0.40$$

$$DW = 1.40$$

$$m_{b_2b_3} = -0.000734$$

$$P'_t = \underset{(0.22)}{S'_t} - \underset{(0.08)}{0.45Y'_t} + \underset{(0.05)}{0.23M'_t} + \underset{(0.06)}{0.18D'_t} + \underset{(0.03)}{0.13\psi_t} + 0.16A'_t \qquad (8\text{-}20)$$

$$\bar{R}^2 = 0.53$$

$$DW = 1.58$$

$$m_{b_2b_3} = -0.00631^{24}$$

The coefficients of the variables of Equations (8-17) and (8-18) remain substantially unchanged in the Equations (8-19) and (8-20) when the structuralist variable ψ is included. However, this variable is also significant and positive as predicted in the structuralist model.[25]

The Durbin-Watson statistics for Equations (8-17) to (8-20) are in the indeterminate range. This suggests the possibility that positive first-order linear correlation of the residuals exists. The equations can be reestimated making use of the Cochrane-Orcutt procedure to adjust for this possible problem. The results follow (ρ indicates the autocorrelation coefficient; $\bar{R}^2_u$, the variance explained by the independent variables not including ρ):

$$P'_t = \underset{(0.28)}{S'_t} - \underset{(0.06)}{0.79Y'_t} + \underset{(0.08)}{0.22M'_t} + \underset{(0.08)}{0.11D'_t} \qquad (8\text{-}21)$$

$$\bar{R}^2 = 0.36 \qquad \bar{R}^2_u = 0.30$$

$$DW = 2.01 \qquad \rho = 0.30$$

$$m_{b_2b_3} = 0.0000004$$

$$P'_t = \underset{(0.25)}{S'_t} - \underset{(0.05)}{0.36Y'_t} + \underset{(0.07)}{0.23M'_t} + \underset{(0.03)}{0.15D'_t} + 0.19A'_t \qquad (8\text{-}22)$$

$$\bar{R}^2 = 0.48 \qquad \bar{R}^2_u = 0.47$$

$$DW = 1.93 \qquad \rho = 0.17$$

$$m_{b_2b_3} = -0.000413$$

$$P'_t = \underset{}{S'_t} - \underset{(0.26)}{0.69Y'_t} + \underset{(0.06)}{0.21M'_t} + \underset{(0.07)}{0.13\psi_t} \qquad (8\text{-}23)$$

$$\bar{R}^2 = 0.46 \qquad \bar{R}^2_u = 0.39$$
$$DW = 2.06 \qquad \rho = 0.34$$
$$m_{b_2 b_3} = 0.000168$$

$$P'_t = \underset{}{S'_t} - \underset{(0.24)}{0.38Y'_t} + \underset{(0.05)}{0.22M'_t} + \underset{(0.07)}{0.17D'_t} + \underset{(0.06)}{0.13\psi_t} + \underset{(0.03)}{0.17A'_t} \qquad (8\text{-}24)$$

$$\bar{R}^2 = 0.55 \qquad \bar{R}^2_u = 0.53$$
$$DW = 1.95 \qquad \rho = 0.21$$
$$m_{b_2 b_3} = -0.000275$$

These results differ from those above in two respects: First, the coefficient of the real income variable becomes insignificant in the Equations (8-22) and (8-24), where the A'_t variable is included. Second, in Equations (8-21) and (8-23) the coefficient of the lagged money supply variables are no longer significant. At least one money supply variable remains significant in each equation and the sum of the money supply variable's coefficients in each equation is insignificantly different from 0.5. The coefficient of ψ also remains significant with the positive sign predicted by the structuralist hypothesis.[26]

In sum, these regression results imply that the null hypothesis that excess aggregate demand variables as here constructed do not affect the inflation rate can be rejected. The rate of change of the relative price of food also enters significantly with the expected sign in each of the above equations so that the null hypothesis that the structuralist variable does not influence the inflation can also be rejected.

4.3 The Direction of Causality Between Money Supply and Prices in Chile

In the Latin American monetarist framework inflation is the result of overly expansive fiscal and monetary policy. This implies that money supply increases lead to inflation. Structuralists do not necessarily deny that the supply of money grows along with the price level. However, they argue that the price level is exogenously determined by other factors such as excess demand conditions in agriculture and that the money supply responds. Sims offers a procedure to test for the direction of causality between two variables where the possibility of feedback in either direction exists. To derive this test, Sims shows that: "If and only if causality runs one way from current and past

values of some list of exogenous variables to a given endogenous variable, then in a regression of the endogenous variable on past, current, and future values of the exogenous variables, the future values of the exogenous variables should have zero coefficients."[27] That is, if causality runs from money supply to prices only, future values of money supply in a regression of prices on money should have zero coefficients. Similarly, if causality runs from prices to money supply only, future values of prices should have zero coefficients in a regression of money on prices.

Thus there are two null hypotheses to be tested. The first null hypothesis, $H_0{}^1$, is that future values of prices as a group have coefficients insignificantly different from zero in a regression of money on prices, past, current, and future. The second null hypothesis, $H_0{}^2$, is that future values of money supply as a group have coefficients insignificantly different from zero in a regression of prices on money, past, current, and future. These hypotheses are tested with an F-test on the coefficients of the future independent variables in regressions that include the past, current, and future independent variables along with a constant term and a linear trend term. Sims's testing procedure is followed. To avoid serial correlation in the residuals, all variables were prefiltered with the filter Sims uses. Thus, each variable in its log form $x(t)$ was replaced by $x(t) - 1.5\,x(t-1) + 0.5625\,x(t-2)$.

Regressions were run for the period 1940 through 1970 and for the subperiod 1960 through 1970. Table 8-1 shows the results of the regressions of money on prices and prices on money for the period 1940 through 1970, both with past and with past and future independent variables. Table 8-2 shows the results of these regressions for the subperiod 1960-1970.

The F-tests for the coefficients on the four future independent variables only, in the regressions including leading and lagging variables, are shown in Table 8-3. For the overall period, 1940-1970, and for the subperiod, 1960-1970, the strict monetarist hypothesis of one-way causality from money supply to prices can be rejected and the strict structuralist hypothesis of one-way causality from prices to money supply can be rejected. Passive money supply may exist. Therefore, the structuralist hypothesis, that is, that excess demand in agriculture has influenced the long-run inflation rate in Chile, cannot be rejected. These results also support the monetarist conclusion that money influences prices and thus that control over money can have an impact on prices.

In sum, the empirical results of this section support a broad model of inflation. The findings of significant coefficients with the anticipated signs for the demand-pull and expectational variables in the

Table 8-1. Chile: Regressions Between Past and Future Money Supply and Prices for the Period 1940-1970

	Coefficient on Lag of:									$\bar{R}^2$	*DW*
	-4	*-3*	*-2*	*-1*	*0*	*1*	*2*	*3*	*4*		
P on *M*: Past Only	0.194	0.038	0.189	0.258	0.225					0.9377	01.97
	(2.20)	(0.477)	(2.49)	(3.327)	(2.84)						
P on *M*: With Future	0.132	-0.042	0.160	0.248	0.215	0.168	0.041	-0.105	0.075	0.9415	1.93
	1.450	(-0.470)	(1.822)	(2.801)	(2.458)	(1.969)	(0.497)	(-1.272)	(.929)		
M on *P*: Past Only	0.146	0.005	0.218	0.351	0.406					0.9318	1.79
	(1.285)	(0.044)	(2.020)	(3.421)	(3.964)						
M on *P*: With Future	0.229	-0.031	0.047	0.122	0.097	0.181	0.099	0.074	0.272	0.9495	2.10
	(2.172)	(-0.297)	(0.444)	(1.133)	(0.845)	(1.90)	(1.046)	(0.805)	(3.88)		

Values of *t*-statistics appear in parentheses.

Table 8-2. Chile: Regressions between Past and Future Money Supply and Prices for the Period 1960–1970

	Coefficient on Lag of:									$\bar{R}^2$	*DW*
	-4	*-3*	*-2*	*-1*	*0*	*1*	*2*	*3*	*4*		
P on *M*: Past Only	0.337	0.173	-0.100	0.280	0.448					0.7927	1.82
	(2.256)	(1.021)	(-.605)	(1.814)	(3.487)						
P on *M*: With Future	0.171	0.082	-0.231	0.106	0.346	0.292	-0.041	0.005	0.171	0.8344	1.81
	(1.092)	(0.455)	(-1.278)	(0.596)	(2.477)	(2.043)	(-0.302)	(0.034)	(1.256)		
M on *P*: Past Only	0.261	0.016	0.195	0.485	0.345					0.8801	2.06
	(1.233)	(0.086)	(1.007)	(3.196)	(2.569)						
M on *P*: With Future	0.396	0.019	0.128	0.239	-0.002	0.091	-0.086	0.181	0.210	0.9095	2.21
	1.741	0.104	0.699	1.416	-0.014	0.750	-0.743	1.473	2.206		

Values of *t*-statistics appear in parentheses.

Table 8-3. *F*-Tests on Future Quarters' Coefficients

Regression Equation		*F*	*Degrees of Freedom*
1960-1970	*M* on *P*	3.89*	4,35
1960-1970	*P* on *M*	3.02*	4,35
1940-1970	*M* on *P*	4.45*	4,115
1940-1970	*P* on *M*	1.90**	4,115

F-tests are for the null hypothesis that all four future independent variables have zero coefficients.
*Significant at the 0.05 level.
**Significant at the 0.10 line.

Harberger inflation equations are consistent with the Latin American monetarist argument that excessive aggregate demand is responsible for inflation. Also, the Sims test for active and/or passive money supply does not refute the monetarist hypothesis that expansion of the money supply contributes to higher prices. However, the reformulated structuralist model is also substantially supported by the results here. First, the finding of the significant and positive coefficient for ψ (along with the significant coefficients with appropriate signs for the aggregate demand variables) in the estimation of the Harberger inflation equations is consistent with the reformulated structuralist model. Second, according to this model, if the concentration of excess demand in agriculture is to have an impact over the long run, the rate of monetary expansion must respond to the changed inflation rate. The null hypothesis that this in fact has occurred in the Chilean economy cannot be rejected by the Sims test for the existence of a passive and/or active money supply.

Thus there is evidence that inflation varies with excess demand in agriculture or with ψ, the rate of change in the relative price of food, as well as with overall excess aggregate demand. Since the relative price of food in Chile has increased over time (see Figure 8-1), this implies that ψ has been positive more often than negative and, therefore, that the inflation rate in Chile has been higher than would have been the case if purely excess aggregate demand variables were at work. In this sense the structuralist position on the predisposition of Latin American economies to inflation is supported by the evidence for Chile. The structuralist policy prescription of the need for land reform that increases agriculture's productivity is also validated by the evidence for this model. But the monetarist argument that the structuralist factors need not inevitably lead to increased inflation is

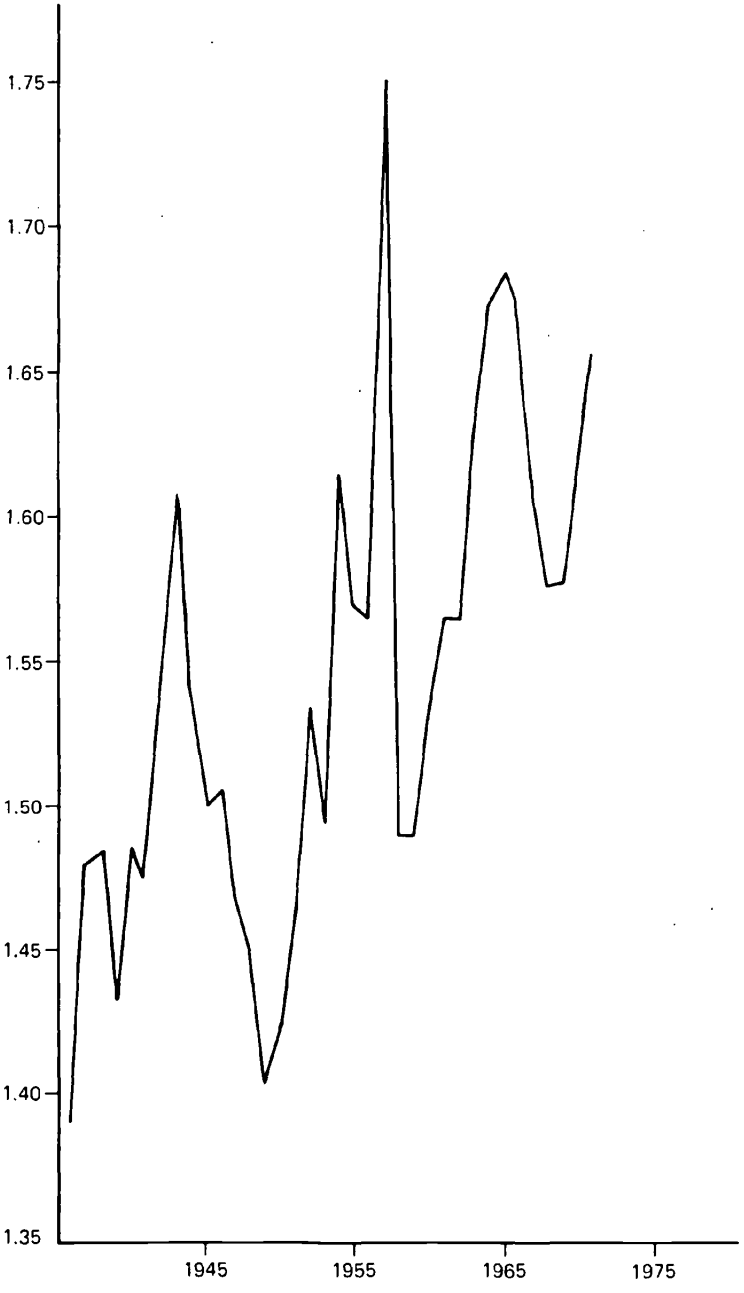

FIGURE 8-1. Chile-Food Price/CPI (1941-1975)

also supported. Money supply may, in fact, have been passive in Chile as the structuralists suggest. However, the importance of inflationary expectations suggests that if monetary and fiscal restraint is implemented, unemployment and a slowing of growth will ensue before inflation is brought completely under control. Furthermore, the results imply that the less flexible prices outside the agricultural sector are, the more agricultural difficulties will contribute to inflationary pressures. And, in spite of monetary and fiscal policies that keep aggregate demand in bounds, excess demand in agriculture can raise the short-run inflation rate. Thus policies that control inflationary expectations and that improve agricultural productivity will have an impact, along with the traditional policies of monetary and fiscal restraint, in limiting the inflationary process.

NOTES

1. Arnold Harberger. "The Dynamics of Inflation in Chile," in Carl Christ, ed., *Measurement in Economics: Studies in Mathematical Economics in Memory of Yehuda Grunfeld* (Palo Alto, Calif.: Stanford University Press, 1963), pp. 219-250.

2. Jorge Cauas, "Stabilization Policy—The Chilean Case," *Journal of Political Economy* (July-Aug 1970) p. 816.

3. Due to the weakness of government bond markets, in Latin America little expansion in aggregate demand occurs without concomitant growth in the money supply. Thus, increases in the money supply accompany expansionary fiscal policy as well as expansionary monetary policy. This may explain the origin of the use of the term "monetarist" in Latin America to refer to those who see excess aggregate demand as the cause of inflation. It should be noted that Latin American monetarists, unlike those identified as monetarists in the United States, do not take a position on the question of whether money supply growth to finance government spending has a greater impact on nominal income than money supply growth to finance central bank loans to the public. Hence, Latin American monetarists do not take a position in the debate over whether, in theory, only money matters. In this respect they can be distinguished from U.S. monetarists. Since the Latin American monetarist viewpoint stresses the role of aggregate demand, U.S. monetarist theory is a subcategory of this broader approach.

4. Op. cit., Harberger.

5. See W. Baer, "The Inflation Controversy in Latin America: A Survey," *Latin American Research Review* (Spring 1967) for a summary of the structuralist theory and D. Seers, "A Theory of Inflation and Growth in Underdeveloped Economies," *Oxford Economic Papers*, No. 1, 1964, for a discussion of its historical development.

6. D. Seers, "A Theory of Inflation and Growth in Underdeveloped Economies," p. 195.

7. Thus, according to David Felix (1965), Julio Olivera (1967), and Dudley Seers (1962) among others, it is the deficient institutional structure in the countryside that limits food production and renders it rigid and unresponsive to demand pressures. In their broad use of the term, supply is "inelastic." However, as shown in "Aggregate Market Responses in Developing Agriculture: The Postwar Chilean Experience" by Jere Behrman, Chapter 2 in *Analysis of Development Problems: Studies of the Chilean Economy*, edited by R. Eckaus (New York: Elsevier, 1973), the agriculture sector in Chile is not unresponsive to economic signals. The explanation for low land productivity is, therefore, obviously more complicated. Theordore Schultz, *Transforming Traditional Agriculture* (New Haven: Yale University Press, 1964), argues that the missing factor is public infrastructure investment. It may be that the holders of land in Chile do not demand such an infrastructure and the increase in taxes that would go with it. The desire for bringing the government into the promotion of agricultural growth in this way may be correlated with the rural class structure so that, for example, the Mexican Revolution brought a new class of landowners who sought and obtained more growth and more government involvement in agriculture. Not all structuralists hold government policy blameless for agriculture's backwardness in Latin America. See, for example, Geoffrey Maynard, *Economic Development and the Price Level* (London: Macmillan, 1962).

8. Pierre Uri with Nicholas Kaldor, Richard Ruggles, and Robert Triffin, *A Monetary Policy for Latin America* (New York: Praeger, 1968), p. 85.

9. There is another explanation for a lagged adjustment of prices to excess demand conditions in organized and, to a lesser extent, in competitive industries. In unionized firms and even in many nonunion firms, wages of employees are altered only at discrete intervals—generally once a year, but occasionally longer. The explanation for this wage-setting process in unionized firms is related to the fixed-term wage contract. Even where escalator clauses are present, the wage rate is adjusted with a time lag, again at regular time intervals fixed by the contract. One reason for this behavior is that it is costly for employers to inform employees of pay changes and to make such changes at short intervals. This involves the direct pecuniary costs of setting the wage and notifying workers of the changes and the indirect or nonpecuniary costs related to the inevitable morale problems that arise whenever wages are changed. Prices may then be set to some extent as a markup on wages. In many nonunionized firms the same process may be observed. One might expect, however, that wages and prices are set more frequently in competitive firms, and thus also on these grounds prices are more flexible in competitive than in organized sectors. The existence of unions may explain wages and prices that move upward easily, but are rigid downward. However, union power has not been pervasive in the Chilean economy over the years 1940-1970.

10. It has been suggested by some structuralists (see Mueller [1965, p. 153], Uri [1968, p. 83], and Seers [1962, p. 189]) that the fact that when monetary authorities restrict growth in credit, the decline in inflation that occurs is accompanied by a decline in economic growth disproves the neoclassical monetarist theory. Once expectations and discrete price changes are included in an inflation

model, it is clear that prices would not adjust immediately to a decline in aggregate demand and that output would fall as well.

11. The framework used here is similar to one evolved originally by A. Enthoven in his "Monetary Disequilibria and the Dynamics of Inflation," *Economic Journal* (June 1956), which derived necessary and sufficient conditions for a price rise under a variety of price reaction assumptions.

12. Hence, X_i depends on expected prices as well as actual prices and assets. It is possible to separate out the influence of expected prices and have $\dot{P}_i/P_i$ be a function of the expected inflation rate, $\dot{P}_e/P$, and a redefined excess demand variable, Z_i, which excludes the impact of expectational elements. Thus each sector's prices will vary with excess demand and the expected inflation rate; and, aggregating, it can be shown that the overall inflation rate varies with the anticipated rate of inflation and excess aggregate demand. To see this, the definition of X_i is rewritten to isolate the influence of expectations so that,

$$\text{(i)} \quad X_i = f_1^i(P_1, \ldots, P_n; A) + f_2^i(P_1^e, \ldots, P_n^e)$$

substituting (i) into the price reaction Equation (8-2), the result is

$$\text{(ii)} \quad \frac{\dot{P}_i}{P_i} = \frac{K_i f_1^i(P_1, \ldots, P_n; A)}{q_i^S} + \frac{K_i f_2^i(P_1^e, \ldots, P_n^e)}{q_i^S}$$

Let

$$\text{(iii)} \quad Z_i = f_1^i(P_1, \ldots, P_n; A)$$

Then, since it will be assumed that when $Z_i = 0, \frac{\dot{P}_i}{P_i} = \frac{\dot{P}_e}{P}$,

$$\text{(iv)} \quad \frac{\dot{P}_i}{P_i} = \frac{K_i Z_i}{q_i^S} + \frac{\dot{P}_e}{P}$$

For now, however, the expected inflation rate is assumed to be zero.

13. This assumption, which essentially requires the quantity weights to equal the current quantities supplied, is maintained throughout. The assumption simplifies the exposition but is not necessary for the testing of the model.

14. Hereafter the range of indexation is suppressed. It should be assumed to be 2 unless otherwise indicated.

15. The circumstances under which the coefficient of ψ overestimates the influence of structural imbalances on the inflation rate are discussed in footnote 24.

16. The results of estimating an inflation equation with X_1 chosen as a sector with relatively sticky prices are described below.

17. Harberger's equation can be seen as giving the inflation rate as a function of $\dot{M}_S/M - \dot{M}_D/M = (\dot{M}_S - \dot{M}_D)/M = \Sigma P_i X_i/M$. That is, for Harberger, the excess

supply of money in the current period is determined by the rate of change in the money supply in the current and preceding periods minus the rate of change in the variables determining the demand for money in the current period. (Current excess supply of money does not depend on rates of change in money demand and supply lagged additional periods because of the assumed rapid adjustment of prices.) The variables that Harberger uses are included in one test of (8-13) along with ψ. So the regression performed is:

$$\frac{\dot{P}}{P} = \alpha \frac{\Sigma P_i X_i}{M} + \beta \psi + u$$

Then, in terms of Equation (8-13), α measures $hM/\Sigma P_i q_i$ and β measures g. In the case when $K_1 = K_2 = K$, α equals $KM/\Sigma P_i \bar{q}_i$ and $\beta = 0$. In this case, the price reaction coefficient, K, indicates according to (8-8) and (8-13) to what extent excess aggregate demand relative to output gives rise to inflation. The inflation equation (8-13) developed here is meant to be consistent with Harberger's model when it is assumed that the income variable used reflects full employment income and that monetary policy is the important determinant of excess aggregate demand. Therefore, $K = V = \Sigma P_i \bar{q}_i/M$, so that $\alpha = \Sigma P_i \bar{q}_i/M \; M/\Sigma P_i \bar{q}_i = 1$, and in testing (8-13), one would expect the same coefficients that Harberger finds. However, to the extent annual real income is an endogenous variable, the Harberger prediction of a negative (and insignificantly different from minus one) coefficient for this variable would not be found.

18. In the case of inflationary expectations, market conditions of excess aggregate demand are not necessary for inflation. As indicated in note 12, the impact of inflationary expectations on price changes can be separately added to the sectoral or aggregate price change equations to reflect this.

19. Although Harberger's study, "The Dynamics of Inflation in Chile," focuses on and supports the impact of money supply on pricing, he suggests the possibility in the conclusion of the study that monetary authorities are adjusting the money supply in response to inflation.

20. Chris Sims, "Money, Income, and Causality," *American Economic Review* (September 1972).

21. The rate of change in the price of food relative to other prices will move with the rate of change in the price of food relative to *all* prices. In the estimation of an inflation equation this latter variable is used to measure ψ. That is, *FPI/CPI* is found by dividing the food price component, *FPI*, of the *CPI* by the *CPI*. $\psi(t)$ is then proxied by taking the quarterly rate of change in the price of food relative to all prices; that is,

$$\psi(t) = \frac{\frac{FPI}{CPI}(t) - \frac{FPI}{CPI}(t-1)}{\frac{FPI}{CPI}(t)}$$

22. Data on prices, money supply, and income are obtained from the Boletin Mensual of the Banco Central de Chile. Data on prices are derived from the consumer price index for Santiago. The food price component of the *CPI* is used to derive the relative price of food. The series used for money supply is that for the "total del dinero circulante." Since 1948 this series includes currency outside of banks, demand deposits in commercial banks (including float and government deposits and excluding interbank deposits), and deposits of the government and semifiscal agencies in the central bank. The definition of the money supply differed slightly before 1948. In periods of overlap the latest data is used. Data on prices and money supply are provided in monthly form. An averaging procedure is used to calculate a quarterly series. Quarterly real national income statistics are found through linear interpolation of the annual data in a manner suggested by Adolofo Diz in his study, "Money and Prices in Argentina," in *Varieties of Monetary Experience*, David Meiselman, ed. (Chicago: University of Chicago Press, 1970).

23. For purposes of comparison, the results Harberger arrives at when estimating these equations for 1940 through 1958 are reproduced here:

$$\text{(i)}\quad P'_t = \underset{}{S'_t} - \underset{(0.22)}{0.63Y'_t} + \underset{(0.09)}{0.32M'_t} + \underset{(0.10)}{0.27D'_t} \qquad R^2 = 0.52$$

$$\text{(ii)}\quad P'_t = \underset{}{S'_t} - \underset{(0.24)}{0.49Y'_t} + \underset{(0.09)}{0.33M'_t} + \underset{(0.10)}{0.26D'_t} + \underset{(0.03)}{0.05A'_t} \qquad R^2 = 0.54$$

The results obtained for the longer period, 1940-1970, differ in that the cost-of-holding variable, A'_t, is significant. As in Harberger's estimation of these equations when A'_t is included, the coefficient of real income is smaller than unity and so does not conform in this respect to the model's predictions. Harberger attributes this to the possibility that the level of real income affects the inflation rate over time as does the rate of monetary expansion. He does not attempt to correct for this by including income in the form of a distributed lag because the quarterly real income data is a constructed series, arrived at, in the first place, by interpolating the annual data. An alternative explanation for the size of the coefficient of Y and for its lack of significance at even the 10 percent level in several of the estimated equations reported below is that, as suggested above, this variable does not reflect full employment real income but actual real income that is not exogenous but rather is determined simultaneously with the inflation rate.

24. The seasonal constants are insignificant in all these equations estimated over 1940-1970 except for a positive coefficient for the second quarter of the year in Equations (8-17) and (8-18), which include only the money supply variables and real income.

25. There is a difficulty in interpreting the size of the coefficient of ψ, the rate of change in the relative price of food. Since, as indicated by Equation (8-11), ψ is itself a function of excess aggregate demand, its coefficient may, to some extent, reflect the influence of excess aggregate demand variables. If, as is assumed, agriculture prices adjust more rapidly than other prices, ψ will be a

leading indicator. That is, in an excess aggregate demand-caused spurt in inflation, food prices will go up first. The relative price of food will then rise, and there will be a positive correlation between the rate of change in relative food prices and the inflation rate. However, if excess aggregate demand continues at the same level, the inflation rate will persist at the new level, but the relative price of food will drop to its original level. The higher level of inflation will then be correlated with a negative rate of change in the relative price of food. Thus, on balance, no positive correlation results between ψ and the inflation rate because agriculture is a leading sector unless increases in aggregate demand and the inflation rate are reversed *before* relative food prices can adjust back to their original level. Under this circumstance of a gyrating excess aggregate demand and inflation rate, the size of the independent influence of the distribution of excess aggregate demand on inflation will be overstated by the coefficient of ψ in the inflation equation. But agriculture can be a leading sector only if prices adjust more rapidly in agriculture than elsewhere. The attribution of a positive coefficient of ψ to the influence of excess aggregate demand on both the inflation rate and the rate of change in the relative price of food is based on the assumption that prices in agriculture are more flexible than other prices. If this assumption is correct, the distribution of excess aggregate demand will have an impact on the inflation rate, as the structuralists claim, although the impact will be overstated by the coefficient of ψ.

26. The equations described above also were estimated with ψ defined as the rate of change in the relative price of housing. To construct ψ, the consumer price index housing (*vivienda*) component available since 1958 was used. Following the comments made above, a negative coefficient should be found for this term. The equations were estimated for the period 1958-1970 with results similar to those updated above except that the coefficients of ψ are all negative and significant as predicted. The results are available from the author.

27. Chris Sims, op. cit., p. 541.

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