



10)

Conference on Planning and Short-Term
Macro-economic Policy in Latin America,
jointly sponsored by the Latin American
Institute for Economic and Social Planning,
Ministerio de Planificación y Política
Económica de Panamá, and the National
Bureau of Economic Research.

Isla Contadora, Panamá, 31 October to 2 November 1975.



THE MONETARY APPROACH TO THE BALANCE OF PAYMENTS
WITH EMPIRICAL APPLICATION TO THE CASE OF
PANAMA

G. H. Borts

&

J. A. Hanson */

*/ Department of Economics, Brown University, Providence, R.I.
and Latin American Institute for Economic and Social Planning.

The opinions expressed in this study are the exclusive responsibility
of the authors and may not coincide with those of the sponsoring
organizations. This document should not be reprinted or quoted without
his permission.

1944

1. The first part of the report deals with the general situation of the country and the progress of the war. It mentions the fact that the war has been going on for a long time and that the situation is becoming more and more difficult for the Axis powers. It also mentions the fact that the Allies are making progress in the Pacific and in the Middle East.

2. The second part of the report deals with the situation in the Pacific. It mentions the fact that the Allies have taken the Philippines and that they are now moving on to the Japanese home islands. It also mentions the fact that the Japanese are still holding out in the Pacific.

3. The third part of the report deals with the situation in the Middle East. It mentions the fact that the Allies have taken the Suez Canal and that they are now moving on to the Persian Gulf. It also mentions the fact that the Japanese are still holding out in the Middle East.

Resumen

THE MONETARY APPROACH TO THE BALANCE OF PAYMENTS WITH EMPIRICAL APPLICATION TO THE CASE OF PANAMA

La versión más sencilla de la teoría monetaria de balanza de pagos se basa en la idea de una tasa de cambio fijado y un movimiento estrictamente proporcional entre precios locales e internacionales. Por estas razones la política monetaria no tiene efecto, porque no puede influir en los precios locales y la expansión del crédito doméstico se transforma inmediatamente en una pérdida igual de reservas.

Este trabajo se basa en la hipótesis de que los precios locales no fluctúan en proporción estrictamente igual a los precios internacionales.

Primero, el dinero actúa como un amortiguador a todas las variaciones en los precios e ingresos. Por ejemplo, si se aumentan los precios de exportaciones la gente no gasta todo el ingreso adicional, por lo cual no sube en proporción los precios y bienes que no entran en comercio internacional (bienes domésticos). Segundo, variaciones en la emisión del dinero puede afectar los precios de bienes domésticos, y a través de este efecto real, la demanda real por dinero cambia. La demanda real por dinero aumenta (baja) cuando el crédito doméstico aumenta (baja) porque las familias consumen bienes domésticos en menor grado que los producen y por eso las familias perciben un ingreso real más alto (baja) cuando los precios de dichos bienes aumentan (bajan). Por estas dos razones, los precios domésticos no cambian proporcionalmente a los internacionales, y la expansión de crédito doméstico no resulta en una baja igual de reservas internacionales.

En base a estas dos ideas se desarrolla un modelo en que los precios domésticos y los cambios en las reservas se determinan simultáneamente por la interpretación convencional de los factores que influyen en la balanza de pagos - las elasticidades de demanda y oferta y el stock de dinero - y por una relación que expresa el equilibrio entre el flujo de emisión y los cambios en la demanda por dinero, que es la base del modelo sencillo de la teoría monetaria de la balanza de pagos.

/Se prueba

Se prueba el comportamiento del modelo sencillo de la teoría monetaria de la balanza de pagos en el caso de Panamá. Los resultados empíricos sugieren que solamente 50 por ciento de los aumentos en los precios internacionales se refleja en los precios locales.

La relación entre precios locales y cambios en crédito doméstico es mucho más significativa, y tomando en cuenta esta relación, el efecto de los precios internacionales sobre los precios locales no es significativo.

Después se estima el modelo en que se determinan simultáneamente los precios domésticos y los flujos de las reservas. En dicho modelo los flujos de reservas y crédito doméstico producen el mismo efecto sobre los precios domésticos, que predice la teoría, y en general el modelo ofrece una buena explicación de las variaciones de precios domésticos y reservas que ocurre en Panamá.

THE MONETARY APPROACH TO THE BALANCE OF PAYMENTS
WITH EMPIRICAL APPLICATION TO THE CASE OF
PANAMA ★/

G. H. Borts and J. A. Hanson

The monetary approach to the balance of payments explains the elimination of payments disequilibrium in terms of factors bringing the demand and supply of money into equality. It treats the supply of money as endogenous by assuming a feedback from the balance of payment through changes in international reserves to changes in the monetary liabilities of the central bank and government.

One of the important questions in monetary theory is the extent to which the monetary authority of an open economy can affect the price level, or the other arguments of the demand for money, such as the level of real output and the interest rate. If it were the case that any increase in monetary liabilities of the authority were met by an equal and offsetting outflow of international reserves (or an equiproportionate rise in the price of home goods and foreign exchange) then one would have to argue that monetary policy had no influence on the real responses of the system.

We argue below that monetary policy will have real effects if it produces changes in relative prices. An example of such a change would be a rise or fall of prices of non traded or home goods relative to world prices in a regime of either fixed or flexible exchange rates. Thus the effectiveness of monetary policy in an open economy depends on the existence of a group of commodities whose relative prices can be influenced by domestic conditions of demand and supply. The simple monetarist models do not allow such commodities, but focus on a world in which prices are given to each trading country. One of the purposes of this paper is to widen these assumptions, to allow for nontraded goods, and implicitly to bring monetary policy back into the monetarist model.

★/ Department of Economics, Brown University, Providence, R.I. and ILPES. This work was partially supported under Contract N9 1005-4000726, U.S. Department of State and U.S. Treasury Department. The authors are grateful to the Electronic Data Processing Unit of CEPAL for their assistance.

A second purpose of the paper is to clarify the effects of external shocks to the balance of payments. The simple monetarist model will very likely provide an incorrect answer to the question: "What is the impact effect of an increase in particular world prices on the balance of payments of a small country"? The simple model tells us that the balance of payments will temporarily improve, as the higher prices produce an increase in the demand for the stock of money. But we shall see that the answer is far more complex. Indeed the effects on the balance of payments depend on whether it is import or export prices that have risen, and depend, in part, on a more traditional consideration of elasticities of demand.

The present paper is organized into three sections. Section I will discuss the small country model in which the price level and other determinants of the demand for money are exogenous. Section II will develop a small-country model in which the price level is endogenous. Section III will discuss some of the issues involved in empirical testing of the model, and an Appendix treats more complicated version of the model. Finally, Section IV discusses preliminary empirical estimates for the case of Panamá.

I. SMALL-COUNTRY MODEL - EXOGENOUS PRICE LEVEL

One of the first methodological approaches in the area of monetary models of the balance of payments is the specification and testing of the simple, small-country model. It is assumed that the price level in the country is determined in the world market: all goods are transportable, markets are perfect, and the country is too small for its quantities purchased and sold to have an effect on world prices, or for its balance of payments deficits and surpluses to have an effect on the world money stock. A model is derived in which the balance of the payments of the country is shown to be positively related to the arguments of the demand for money, and negatively related to the domestic sources of the supply of money.

Assume that the country is in equilibrium in the sense that the demand for the money stock, M_d , is equal to the supply of the money stock, M_s . Assume the existence of fixed exchange rates and note that the supply of the money stock consists of two sets of liabilities, those of the local government, D , and those of foreign governments, R . The two types of money circulate side by side as perfect substitutes. The condition of equilibrium may then be written

$$(1) \quad M_d = R + D$$

Noting that the three terms are subject to change over time, the theory implies that ΔR the endogenous variable may be written as follows:

$$(2) \quad \Delta R = \Delta M_d - \Delta D$$

Note that ΔR is the balance of payments. The empirical implications of this relationship are that factors increasing the demand for the money stock (increased prices or output) will yield a surplus in the balance of payments, while increases in the supply of local government monetary liabilities will yield a deficit. In a statistical regression using ΔR as the dependent variable, the theory would lead one to expect a coefficient on ΔD of minus unity, and positive coefficients on changes in the price level and real output.

Empirical tests of the small-country model have been carried out by fitting the balance of payments function, equation (2), to the right-hand variables (ΔD , and the arguments of ΔM_d), on the assumption that they are all exogenous. The results have been mixed. Some investigators have reported a coefficient on ΔD of minus unity; others obtain a smaller absolute coefficient. Almost all investigators obtain positive coefficients for real income and the price level (which increase M_d), but the coefficients are occasionally different, suggesting that the price level may play a different role from real output in affecting the demand for money. Many of the tests are statistically significant, and the goodness of fit is taken as confirmation of the empirical validity of the model ^{1/}.

This methodology does not permit a definitive test of the proposition that under fixed exchange rates domestic prices are unaffected by monetary policy (most of the tests were carried out for countries with fixed rates). While the data apparently do not reject the implications of the small country assumptions, the tests are insensitive to the possibility that the assumptions are false. There is nothing in equation (2) which allows for the possibility that home prices are endogenous, and consequently no way for the data to refute this possibility. What is needed then is a model which is so specified that home prices may be either endogenous, depending on the values of certain empirically estimable parameters, or depending on certain statistical relationships which hold in one case and not the other.

Before such a model is presented, however, it is useful to look more carefully at the assumptions underlying equation (2). Some of these assumptions may be retained in the later model. Others require considerable exploration and change, particularly if the model is to be applied to a wider variety of country experiences.

^{1/} In an unpublished paper written in April 1974, Hans Genberg has noted 25 studies of the empirical aspects of the monetary approach to balance of payments. There are more.

1. An obvious question relating to equation 2 is the appropriate time period over which it holds. Actual money holdings may differ substantially from desired stocks over long periods of partial adjustment implying expansions in domestic credit do not immediately "leak out" the exterior. However there are greater difficulties with the simple model than the appropriate lag structure.
2. Perhaps the strangest assumption underlying equation (2) is that the determinants of the demand for money are exogenous, and therefore unaffected by the supply of money. To see how extreme this assumption is, consider what it implies for the price level. While foreign prices may be independent of the money supply, can the same be true of nontraded goods? To make a case for such a proposition, one would have to argue that the price of nontraded goods is determined in the long run by export and imported input prices. To satisfy equilibrium conditions in the factor markets these prices must bear a determinate relation to each other. The exact nature of such a relation would depend on the shape of the production transformation function. But at best this is a long run relationship. In the short run (and possibly the long run as well), the price of the nontraded good will depend on the state of demand. Thus the assumption of independence is broken once nontraded goods are allowed into the picture.

It is less puzzling to note that investigators applying this small-country model have assumed that the level of output and employment are exogenous, i.e., independent of monetary influences. While this may have been adopted as a statistical convenience, it is virtually implied by the assumption that prices are fixed in the world market. Why should anyone close down a factory or lay off workers if he can see all his output at a fixed price in the world market? One would have to assume institutionally fixed wages to have unemployment in such an economy; and even then the output level would be exogenous in the sense that it could not be influenced by aggregate demand.

/While the

While the assumption of exogenous output is thus consistent with the small country hypothesis, it nevertheless is unsatisfactory as a maintained hypothesis. Even small countries have experienced periods of unemployment, and less than equilibrium output. Moreover, imports appear to have a positive statistical association with short-run variations in real output in a manner contrary to that assumed in equation (2). Thus more theoretical structure is needed to understand why the overall balance of payments appears explainable in a model which does not attempt to explain variations in output. This will be explored below.

3. A second problem with equation (2) is that there are other possible structural relationships between the variables which are consistent with the condition that changes in the demand for money equal changes in the supply of money.

a) If for example the central bank has decided to fix the country's overall money supply and sterilize the movement of international reserves, then the negative relation between ΔR and ΔD automatically follows. This possibility becomes plausible once we see that the demand for money stock could adjust to the fixed supply in the manner described by monetary theory in a closed economy.

b) There are other linkages between ΔR and ΔD implied by the operations of the central bank, at least in some short-run periods. Before these can be described it is necessary to take a closer look at D to see what is included in the monetary liabilities of government. The issue arises for three reasons: in a monetary system with a central bank, the authority issues high powered money H , so that the identity must read $H = R + D$; secondly, the relevant measure of D comes only after an examination of the combined financial operations of the central bank and the Treasury; and finally R consists not simply of gold reserves, SDR's and deposits of foreign exchange, but must be corrected for official holdings of the short-term liabilities and assets. There are a number of possible institutional settings in which correct measurement of ΔH , ΔR , and ΔD will not occur by looking only at the balance sheet of the central bank. A few of these are; International

/reserves are

reserves are held by more than a single government department, or held by the Treasury alone; high powered money is issued by both Treasury and central bank; the government's short-term liabilities are held by foreign governments and central banks. For these reasons we would submit that the correct way to measure changes in D is through the flows over time in the government-central bank budget constraint. In this definition the sources of government funds consist of tax revenues t , the issuance of debt i_g , and the issuance of high powered money h . The uses of government funds are the net acquisition of international reserves r , and the purchase of goods and services Y_g . This definition may then be used to express the components of $\Delta H = \Delta D$ as

$$(3) \quad h = r + (Y_g - t - i_g)$$

The last three terms thus constitute the ΔD which must be measured.

Having defined the components of ΔD , we can return to the question of alternative relations between ΔH , ΔR , and ΔD . Suppose that the central bank feeds reserves into the banking system when money market interest rates are rising, and withdraws reserves when money market interest rates are falling ^{1/}. Further, assume that interest rates vary because of variations in the issuance of debt by the business sector. During periods of rising interest rates one would observe the simultaneous occurrence of increased bank reserves, increased central bank holdings of money market paper, and increased foreign purchases of securities. During periods of falling interest rates, the three would decrease together. Thus one would observe a positive relation (in the short-run) between the balance on capital account and the issuance of high powered

^{1/} It has been claimed that such a policy is followed in the U.S. The evidence is that the Federal Reserve System sets a target range for the Federal Funds rate, and then manipulates reserves in order to keep the Federal Funds rate within the target. When money market rates are falling the target range is likely to remain too high too long; and conversely when money market rates are rising.

money, and a positive relation between the balance on capital account and ΔD . The latter term would show an increase when the central bank purchased short-term government debt or other money market paper. A numerical example will illustrate. Suppose when money market rates are rising (due to an expansion in private issuance of debt) the central bank purchases fifty worth of debt in the market at the same time foreigners purchase fifty of debt. The $\Delta H = 100$, $\Delta R = 50$, $\Delta D = 50$. The debt from the public. Thus equation (2) could remain satisfied, but the underlying causal relations may not always be the same.

II. A SMALL COUNTRY WITH ENDOGENOUS PRICE LEVEL

To keep the presentation simple, we will assume that the government issues money, there are no banks, and no market in securities. Later in the paper these institutions will be introduced, but the logic of the model may be seen by abstracting from them.

It is assumed that the household earns income from the production of an export good, x , and a home good, Y . Income is disbursed on the home good, Y_h , an imported good, v , on the flow accumulation of cash balances, m , and on the payment of taxes, t . All the symbols are in nominal money units. Thus we have

$$(4) \quad x + Y \equiv Y_h + v + m + t$$

It is assumed that government finances its expenditure through taxation t , and the issuance of money, m^S . These funds are spent on the net purchase of international financial assets, r , and on the purchase of the home good $\frac{1}{\lambda}$. We have

$$(5) \quad \begin{aligned} t + m^S &\equiv r + Y_g && \text{or} \\ m^S &\equiv r + Y_g - t \equiv r + d \end{aligned}$$

1/ For the results of the model it is not necessary that the government buys only the nontraded good, though this may be a reasonable approximation.

The excess demand for home goods may then be written

$$E(Y) \equiv Y_h + Y_g - Y = x - v - m - t + Y_g$$

When the definitions of the balance of payments ($r = x - v$) and of the government budget constraint are introduced, we have

$$E(Y) \equiv m^s - m$$

We shall assume that the home good market is cleared by the movement of its price, and look behind the definitions to the economic determinant of m^s and m . We shall demonstrate that excess demand for home goods is a function of the level of, P_y , the price of home goods and of the money stock M_s .

In the short run with the money stock fixed, a determinate price of Y brings $E(Y)$ to zero in a stable fashion. However, in the short-run the flow of reserves, r , will adjust the rate of increase in the money supply toward money demand. Thus in the short run, the model has two endogenous variables, r and P_y .

In the long run, M_s constitutes a third endogenous variable. In the long run, the money stock changing due to government budget activities, and reserve increments, both the money stock, r and P_y come to a stable equilibrium point.

This model stands in contrast with the simple one-country model presented earlier, where the only endogenous variable is r , and the only structural equation is (2). As we saw earlier, that relation implied a positive relation between r and P_y . Now with P_y endogenous in the present model, we derive a second structural relation between r and P_y . It will be seen that the second relation between r and P_y is the "conventional wisdom" on the subject, and underlies the usual micro approach to balance of payments equilibrium.

1. The Determinants of m^S . As shown in the government budget constraint (5), the growth of the money supply consists of two terms: r , the net growth of international financial assets, and a composite term $Y_g - t$, which in the simplified institutional setting assumed here, is the growth of domestic liabilities of the government, d . We shall assume that d is exogenous, but that r depends on the factors influencing exports and imports. Two factors stand out: P_y and M_s . It is assumed the prices of exports and imports are exogenous. When P_y rises, there will be two effects: a substitution of consumer spending away from Y and toward imports; and a substitution of production away from exports and toward Y . Both effects will lead to an excess supply of Y .^{1/} The two effects, also by assumption, lead to a reduction in the excess of exports over imports.

The balance of payments also depends on M^S , the money stock. Holding everything else constant, a higher level of M^S leads to an increase of household expenditures and thus an increase of imports, and a decline in the balance of payments position. To summarize, the determinants of m^S may be written

$$(6) \quad m^S \equiv r(P_y, M^S) + d, \quad \text{where } r_1, r_2 < 0$$

The $r(\)$ function which constitutes the traditional wisdom about the balance of payments implies a negatively sloped relation between r and P_y for a given money stock, as shown in Figure 1. The function shifts downward for larger values of M_s .

^{1/} Rudiger Dornbusch analyzes a micro-model of devaluation in which the excess demand for the home good is offset by fiscal policy. The present paper assumes instead that excess demand for the home good is corrected in the short run by changes in its price and in the balance of trade (P_y and r); and in the long run corrected by changes in its price and in the money stock (P_y and M).

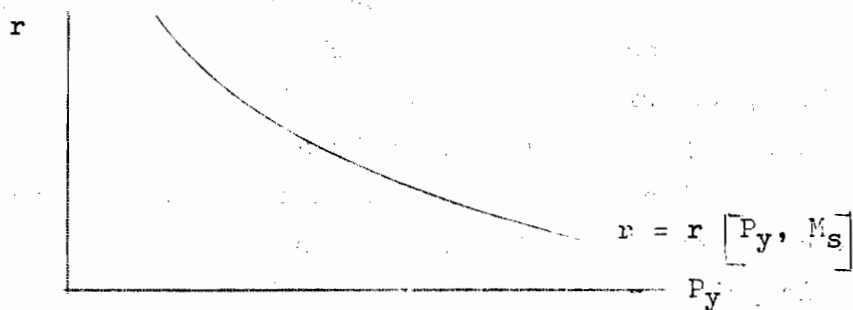


Figure 1

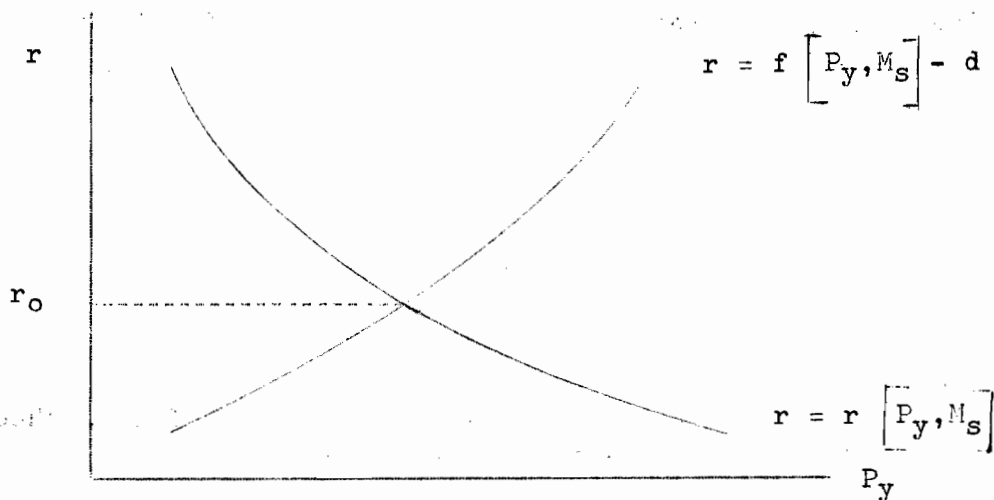


Figure 2

2. The Determinants of m. We shall assume that the desired flow rate of cash hoarding responds to the stock disequilibrium. If households wish to hold more cash than they have at present, then they will hoard, and conversely, if they wish to hold less. Thus it is immediately evident that the flow rate of hoarding is negatively related to M, the stock of cash. But what determines the desired level of money stock; and will households move immediately to the desired level, or will they adjust fractionally and with a lag? The approach we shall adopt is that households use cash as a shock absorber which acts to even out the flow of real consumption in the face of short-run variations in prices ^{1/}. This role of cash may be seen by rewriting the consumer budget constraint:

$$(4') \quad m \equiv x + Y - Y_h - v - t$$

An increase the price of exports would raise the household's income. So would a rise in the price of the domestic goods, since $Y > Y_h$. Assume that the household expects such increased income to be temporary and holds real consumption constant. This assumption implies that households engage in short-run hoarding or savings of cash, in the face of the expectation that real income will fall to its original level at a later date. Thus the holding of cash as a shock absorber will be positively related to the price of Y and price of exports. Import prices may also affect hoarding, through the direction of the relation

^{1/} See Michael Darby's paper for a statement of this theory applied to demand for consumer durables.

may be ambiguous $\frac{1}{2}$. It is also reasonable to assume that the demand for cash as a shock absorber is negatively related to the amount of cash so held.

Cash is also used by the household to store wealth. This part of the demand dominates in the long-run but presumably changes more slowly and will not be discussed in detail in the theoretical model. However, in any econometric estimation involving changes over time one would expect long-run demands for wealth to play a role.

We shall then write m in terms of its determinants:

$$(7) \quad m = f(P_y, M_s) \quad f_1 > 0, f_2 < 0$$

The market clearing of the price of domestic goods is then a single equation

$$(8) \quad P_y = (E(Y)) = (m^S - m) = (r(P_y, M_s) + d - f(P_y, M_s))$$

For a given level of the money stock and of d , equation (8) implies a stable market clearing process, since $r_1 < 0$ and $f_1 > 0$

1/ A change in import prices which was known to be permanent would have no effect on long-run money holdings, since it does not cause a change in the division of expenditures, between present and future. A permanent rise (fall) in import prices would lower (raise) the real value (in terms of utility) of present consumption and saving-wealth-future consumption in exactly the same proportion. Therefore there would be no incentive to vary hoarding.

A change in import prices which is not known to be permanent could affect hoarding either positively or negatively. When import prices fall, temporarily, there is a tendency to spread the potentially higher level of consumption over the future by using cash balances as a shock absorber. On the other hand, if imports are durables, which may be an important case in developing countries, then there will be some tendency to take advantage of abnormally low prices, by substituting holdings of goods for cash. Notice that both the income and speculative effects work in the same direction in the case of home goods, as $Y < Y_h$.

/Over time

Over time the money supply will also change, as a consequence of the government budget and balance of payments flows, and a second equation is added:

$$(9) \quad M_s = m^s = r(P_y, M_s) + d$$

For a given level of d , the money stock and price level reach equilibrium through a stable process, at which $m^s = 0$; $m = 0$, $r = -d$. ^{1/}

3. Equilibrium with fixed and variable money supply. The approach to short-run equilibrium may be depicted graphically by imposing on Figure 1 the representation of the flow equilibrium condition $m^s = m$. Writing this as $r = -d + f(P_y, M_s)$ we may plot the relation as an upward sloping function in the r, P_y plane. This is shown in Figure 2, together with the negatively sloped "micro" relation $r = r(P_y, M_s)$:

As mentioned earlier, the upward sloping relation is an implication of the simple, small-country approach discussed at the beginning of the paper. If P_y were exogenous, as claimed in that model, then there would be no need for the graph. The flow of reserves would be determinate, as only one r satisfies the flow equilibrium relation, $r = f(P_y, M_s) - d$, for given values of P_y and M_s . However in the present model P_y is endogenous, and the short-run, flow equilibrium pair, P_y, r , are found at the point on the $r(P_y, M_s)$ function which implies equilibrium in the home goods, and therefore the money market.

The approach to equilibrium with a variable money supply may also be described in Figure 2. Suppose for the sake of example that the intersection, r_0 , is a positive balance of payments, and $d = 0$. Then the money supply will increase. The negatively sloped $r ()$ function

^{1/} It is assumed that P_y reaches an equilibrium for a given level of M_s , and then is displaced by changes in the level of M_s . The stability of this process thus depends on $M_s/dM_s = r_1(\frac{P_y}{M_s}) + r_2 = (r_1 f_2 - r_2 f_1)/(r_1 - f_1)$. Under the sign assumptions in the text this derivative is negative.

will shift back to the left, and the positively sloped $m = m^S$ function will shift down to the right. The net effect is to eliminate the balance of payments surplus and change the money supply at full long-run equilibrium, when stock as well as flow demands equal supplies.

We can now see the short-run and long-run effects of changing d . Begin at full equilibrium, with $d = 0$, but now raise it to some positive number. In the short run, holding M^S constant, yields an increase of P_y equal to $-1/(r_1 - f_1)$, and a reduction of r equal to $-r_1/(r_1 - f_1)$. This increase of d will yield a growth of the money supply because $\frac{\Delta r}{\Delta d} + 1 > 0$.

In the new full equilibrium, when the money supply stops growing, the flow value of r declines an amount equal to the negative of d , while P_y has risen (from the original $d = 0$ equilibrium) by $-f_2/(\Delta)$. Whether P_y rises more in the long run than the short-run depends on the difference $r_2 - f_2$. Note that this long-run does not imply homogeneity of degree zero; i.e., the equilibrium real money stock is not necessarily invariant to changes in the flow rate of domestic credit creation, d . That is, unlike the result of the simple model, all domestic credit creation does not leak out through corresponding losses in reserves. The reason for this result is that the creation of domestic credit raises the demand for home goods and household's perception of their long-run incomes, since $Y < Y_h$. Households, by assumption, are unaffected by the falling relation of reserves to domestic credit, within the equilibrium money stock which this credit creation implies.

In a more realistic world, where international reserves are limited, households might use the change in the composition of the money stock in forming their expectations about the future course of relative prices and react accordingly. That is, the composition of the money stock would enter the behavioral functions. However, in such a world governments would also act to stem the reserve loss by either reducing credit expansion or varying the effective exchange rate. Of course the latter policy might include variations in tariffs and other limitations on international commerce and finance, as well as straightfoward

/variations in

variations in the exchange rate. The discussion of these reactions by households and governments goes far beyond the scope of this paper and will be treated in the authors' future work.

4. The Shock Absorber Hypothesis. The shock absorber hypothesis is derived from the permanent income theory of consumption. It underlies the preceding discussion of the hypothesis that cash hoarding and dishoarding are used to maintain a constant level of utility in the face of expected but temporary variations in real income. Deeper examination of this hypothesis reveals more clearly the nature of the $r(P_y, M_s)$ and $f(P_y, M_s)$ functions discussed earlier, and permits a closer identification of the exogenous elements of the government budget constraint. Look again at the household budget constraint, and rewrite it in terms of prices and quantities.

$$m \equiv X \cdot P_x + Y \cdot P_y - Y_h \cdot P_y - V \cdot P_v - t$$

Now assume that t , P_x , and P_v are fixed, and derive $f_1 = m / P_y$.

$$(10) \quad m / P_y = \left[P_x \cdot \frac{X}{P_y} + P_y \cdot \frac{Y}{P_y} \right] - \left[P_y \cdot \frac{Y_h}{P_y} + P_v \cdot \frac{V}{P_y} \right] + Y - Y_h$$

Assuming competitive equilibrium in the production of X and Y the first bracketed term is zero. Assuming consumer utility maximization and a fixed level of utility, the second bracketed term is zero. Thus the effect on boarding of a change in P_Y is

$$(10') \quad \frac{\partial m}{\partial P_Y} = X - Y_h > 0$$

Now look at the balance of payments relation implied by the shock absorber demand for boarding. Rewrite the budget constraint, and derive $r_1 \equiv \partial x / \partial P_Y$.

$$(11) \quad \frac{\partial x}{\partial P_Y} = \frac{\partial m}{\partial P_Y} = X + \left(\frac{\partial Y}{\partial P_Y} \right) P_Y + \left(\frac{\partial Y_h}{\partial P_Y} \right) P_Y + \left(\frac{\partial Y}{\partial P_Y} \right) P_Y + \left(\frac{\partial Y_h}{\partial P_Y} \right) P_Y$$

Substituting from above, we see

$$(11') \quad \frac{\partial x}{\partial P_Y} = - \left(\frac{\partial Y}{\partial P_Y} \right) P_Y + \left(\frac{\partial Y_h}{\partial P_Y} \right) P_Y < 0$$

Note that $\partial Y / \partial P_Y$ is defined for a constant level of utility. Thus the negative term $\partial Y / \partial P_Y$ represents only pure substitution effects in the production and consumption of Y.

It may also be seen that x and r depend negatively on the actual amount of boarding, m . Assume that the consumption levels Y_h and Y depend on each holding. Then

$$(12') \quad \frac{\partial x}{\partial m} = - \left(\frac{\partial Y}{\partial m} \right) P_Y + \left(\frac{\partial Y_h}{\partial m} \right) P_Y$$

and

$$(13) \quad \frac{\partial r}{\partial m} = - \left(\frac{\partial Y}{\partial m} \right) P_Y + \left(\frac{\partial Y_h}{\partial m} \right) P_Y$$

There relations may also be used to identify the effect of an exogenous increase in P_Y , the price of imports. Using the same arguments as above we see that $\partial m / \partial P_Y = X - V$, while $\partial r / \partial P_Y = r_3 = -V - \partial Y / \partial P_Y$. Thus, both of the curves shift in Figure 2 as a consequence of the increase in the price of imports. The upward sloping $f[1] - d$ function shifts downward, while the downward sloping $r[1]$ function may shift in either direction, depending on the (utility constant) price elasticity of demand for imports. The impact on P_Y is unambiguously positive, since $\partial P_Y / \partial P_Y = (f_3 - r_3) / (f_1 - f_1) > 0$. The impact on r the balance of payments is ambiguous, since $\partial r / \partial P_Y = (r_1 f_3 - r_3 f_1) / (f_1 - f_1)$. Note, however, that even if expenditures on imports are unchanged ($r_3 = 0$), the balance of payments effect is negative since the higher P_Y draws resources out of export production.

We may now see more clearly the $r(P_y, M_s)$ and $f(P_y, M_s)$ functions underlying the equilibrium depicted in Figure 2. The $f(\)$ function depicts the behavior described in (10) and (12), the $r(\)$ function depicts that described in (11) and (13). The condition of equilibrium which implies $m^s = m$ may again be written as the upward sloping function.

$$(14) \quad r = m - d = f(P_y, M_s) - d$$

While the downward sloping r function may be written

$$(15) \quad r(P_y, M_s) = m - YP_y + Y_h P_y + Y_g P_y + t = f(P_y, M_s) - E(Y) - d$$

Exogenous shifts in the two functions may be seen by rewriting them with the d term made explicit:

$$(14') \quad r = (XP_x + YP_y - Y_h P_y - VP_v - t) - (Y_g P_y - t)$$

$$(15') \quad r = (XP_x + YP_y - Y_h P_y - VP_v - t) - (YP_y - Y_h P_y - Y_g P_y) - (Y_g P_y - t)$$

It may be seen that a shift of d which occurred through a rise of government demand for Y , holding t constant would shift (14') but not (15'). On the other hand, a change in d which occurred because of an exogenous change in the level of tax collections would have no effect on either function, because it would change the demand for hoarding by an equivalent amount. This rather extreme result is due to the shock absorber assumption that the household views changes in the determinants of its cash flow as temporary, maintaining a consumption level which yields a constant level of utility. There is no question that if a change in t were expected to be permanent, there would be a smaller effect on m , because the household would change its consumption level.

5. An Expanded Model. It is now possible to increase the range of the model by introducing some of the aspects of a large open economy. It will now be assumed that there is a commercial banking system and a central bank. The government-central bank will issue high powered money to be used exclusively as a reserve by the commercial banks. There will be a securities market in the liabilities of government, business, and households, all assumed to pay the same interest rate n . Securities will be purchased by foreigners, by households, and by banks. Security sales by businesses will be used to purchase the domestic good for capital construction.

The new assumptions lead to a new set of budget constraints, an additional market, and an additional dependent variable, the interest rate n . Whereas the simpler model was solved by finding an equilibrium price level and money stock, this expanded system must also have an equilibrium interest rate.

Budget Constraints

a) Government - Central Bank

Sources of Funds are: $h + t + i_g$, respectively the issuance of high powered money, tax receipts, and net sales of debt. Uses of Funds are: $r + Y_g$, as before the net acquisition of international reserves and the purchase of goods and services. This implies that $h = r + (Y_g - t - i_g)$. We shall now denote the parenthesized term as d .

b) Commercial Banks

Sources of Funds are m^s the net issuance of new deposit liabilities. Uses of Funds are $h + i_B$, respectively the acquisition of high powered money and the acquisition of securities.

c) Households

As before, sources of funds are $x + Y$, the income generated from production of exports and home goods. Uses of funds are $Y_h + v + m + t + s$, the same as before, but with the addition of s , the net purchase of securities.

The Securities Market

It will be assumed that the interest rate equilibrates the flow demand and supply of securities. The demand for securi-

ties consists of foreign demand b_k , plus the sum of household and bank demand, $s + i_B$. The supply consists of the sum of security issuance by government and businesses, $i_g + y_B$. When the securities market is thus in equilibrium, the balance on capital account is the net foreign purchase of securities.

$$(16) \quad b_k = i_g + y_B - i_B - s$$

Additional Behavior Assumptions

The cash hoarding demand m will now depend on P_y , M^S , n , and W . The last variable is nonmonetary wealth, consisting of the sum of securities owned by households. It will be assumed that cash hoarding will depend positively on W , and negatively on n . It will also be assumed that the level of business investment depends negatively on n , and that foreign purchases of securities depend positively on n .

Solution for P_y , M^S , and n

The new budget constraints again lead to the definition of excess demand for Y equal to $m^S - m$.¹

$$(17) \quad y_h + y_g + y_m - y = m^S - m$$

Assuming that P_y brings the excess demand for y to zero, we may write:

$$m^S = f(P_y, M, n, W)$$

A series of substitutions lead to this result:

$$E(y) = y_h + y_g + y_B - y = x - v - m - s - t + y_B + y_g$$

$$\text{Substitute } b_k = i_g + y_B - s - i_B$$

$$E(y) = x - v - m - t + y_g + b_k - i_g + i_B$$

$$\text{Substitute } m^S = h + i_B$$

$$E(y) = x - v - m - t + y_g + b_k - i_g + m^S - h$$

Note the definition of the balance of payments

$$r = x - v + b_k$$

and substitute the government budget constraint.

Further, assume that the growth of the money supply bears a fixed ratio δ to the growth of the real money:

$$\frac{\dot{M}}{M} = \delta + \frac{\dot{P}}{P} \quad (17)$$

Then equilibrium in the market for bonds implies the relation

$$(18) \quad \frac{r}{P} + \delta = \frac{1}{P} \left(\frac{d}{dt} \left(\frac{B}{P} \right) \right) \quad n.s.$$

For fixed levels of δ , $\frac{d}{dt} \left(\frac{B}{P} \right)$ and $\frac{B}{P}$, this may again be represented as a positive relation between r and $\frac{B}{P}$.

When we consider the possibility of a shift in the definition in (17) again, we find a shift in the relation between r and $\frac{B}{P}$. This may be seen by differentiating (18)

$$(19) \quad \frac{dr}{r} + \frac{d\delta}{\delta} = \frac{1}{P} \left(\frac{d}{dt} \left(\frac{B}{P} \right) \right) \frac{P}{B} - \frac{1}{P} \left(\frac{d}{dt} \left(\frac{B}{P} \right) \right) \frac{P}{B} \quad n.s.$$

thus (19')

The argument given above implies that $\frac{dr}{r} < 0$, since $\frac{dr}{r}$ depends on the change in the growth rate of the household and firms. It is seen that in (19) r depends on δ and $\frac{B}{P}$. It is seen that r declines if δ increases.

As in the case of a change in δ , the two functions (18) and (19) shift when δ changes. This may be seen by rewriting (18) explicitly

$$(18') \quad \frac{r}{P} + \delta = \frac{1}{P} \left(\frac{d}{dt} \left(\frac{B}{P} \right) \right) \frac{P}{B} = \frac{1}{P} \left(\frac{d}{dt} \left(\frac{B}{P} \right) \right) \frac{P}{B} \quad n.s.$$

$$(19') \quad \frac{dr}{r} + \frac{d\delta}{\delta} = \frac{1}{P} \left(\frac{d}{dt} \left(\frac{B}{P} \right) \right) \frac{P}{B} - \frac{1}{P} \left(\frac{d}{dt} \left(\frac{B}{P} \right) \right) \frac{P}{B} \quad n.s.$$

A number of variations of δ are possible. If t and i_g are constant and y_g varies, then

$$(18) \quad \frac{dr}{r} = -1; \quad (19) \quad \frac{dr}{r} = \frac{(1-\delta)}{\delta} < 0$$

If y_g and i_g are constant and t varies,

$$(18) \quad \frac{dr}{r} = (1-\delta) \frac{dt}{t}; \quad (19) \quad \frac{dr}{r} = -1$$

If y_g and t are constant and i_g varies,

$$(18) \quad \frac{dr}{r} = -1; \quad (19) \quad \frac{dr}{r} = -1$$

These differences will play a role in identifying the econometric counterparts of (18) and (19).

The system is closed by noting that equilibrium in the securities market determines a relation between n and h ; and therefore there is a second relation between n and r . This may be seen by rewriting (16) noting that b_k and Y_B depend on n , s depends on W , and i_B depends on h .

Thus we have

$$b_k(n) = i_g + Y_B(n) - s(W) - i_B$$

Substituting the identity

$$i_B = m^s - h = h(\phi - 1)$$

we have

$$\begin{aligned} b_k(n) &= i_g + Y_B(n) - s(W) + h(1 - \phi) \\ &= i_g + Y_B(n) - s(W) + r(1 - \phi) + d(1 - \phi) \end{aligned}$$

So we may write

$$(20) \quad r = b(n, W,)$$

To recapitulate, with a fixed level of the money stock M^s , and wealth W , equations (18), (19) and (20) determine equilibrium levels of P_y , n , and r . When we allow the money supply to change as a result of the solution for r , a long run equilibrium will be reached at which an equilibrium money stock is found. This implies $r + d = 0$. Thus in the long run, we have a solution for P_y , n , and M^s .

6. Floating Exchange Rates

Up to now the model has been applied to a fixed exchange environment in which the government purchased all the foreign exchange presented to it. It is possible to weaken this assumption, so that one may simultaneously determine the price of home goods, the money supply, and the exchange rate. A free exchange rate system is usually conceived to be an environment in which the government fixes the money supply independently of the state of the balance of payments, and allows the exchange market to set the price of foreign exchange. If the government allowed the money supply to be influenced directly by the state of the balance of payments, there could be no variation in the price of foreign exchange.

/One can

One can see the impossibility of simultaneous determination of the price of home goods, money supply, and exchange rate by writing the following market clearing system. Note that p is the price of foreign exchange. For the sake of simplicity, the discussion of this section ignores the capital market and returns to the endogenous price level model of section 1.

$$(21) \quad \dot{P}_y = r(P_y, p, M_s) + d - f(P_y, p, M_s)$$

$$(22) \quad \dot{M}_s = r(P_y, p, M_s) + d$$

$$(23) \quad \dot{p} = -O(r(P_y, p, M_s))$$

The determinant of this system would be zero. However, it is possible to model the three variables, if one imagines government intervention in the exchange market which leans against movements in the exchange rate, but does not attempt to fix the rate. If, for example, the government purchased foreign exchange when the price fell and sold foreign exchange when the price rose, then an additional functional relation would be added to the model. It would link changes in the money supply to changes in the exchange rate. Moreover, the exchange rate would now bring the net sum of all international financial transactions to zero. Those transactions which the government chose not to clear through its own foreign exchange stabilizing operation would be brought to equality with those transactions carried out for stabilization purposes. An important result of this section is that the government demand for foreign exchange must be price elastic. That is, the government must increase the domestic currency value of foreign exchange purchases when the price of foreign exchange falls. An inelastic demand for foreign exchange would destabilize the model.

The assumed type of reaction function is not unrealistic. Most governments intervene in the exchange market even when there is no stated par value for foreign exchange. The problem with modelling such an assumption, however, is that the target level of \bar{p} which triggers

/off such

off such intervention will itself change from one period to another. In the conceptual model, this issue will be ignored, and the target level will be assumed a constant. The problem will surface, however, when an econometric specification is considered.

Government intervention in the exchange market requires a redefinition of variables. In particular, r will now denote the net excess supply of foreign exchange, consisting of the sum of two elements, r^0 the private supply, and r^1 the government demand ^{1/}. Note that both r^0 and r^1 are measured in the domestic currency. The term r^1 denotes government purchase (or sale) of foreign exchange. It will be assumed that

$$r^1 = j(p) \quad j' < 0$$

Government buys foreign exchange when its price falls, and sells foreign exchange when its price rises. The government budget constraint is then $m^s = r^1 + d$.

The new model is now written as follows: ^{2/}

$$(21') \quad \dot{P}_y = r^0(P_y, p, M_s) + d - f(P_y, M_s)$$

^{1/} The net private supply of foreign exchange $r^0 = r^0(P_y, p, M^s)$ is derived from the function $r = r(P_y, M^s)$ described earlier in equation (6). It is assumed that $r_1^0 < 0$, $r_2^0 > 0$, and $r_3^0 < 0$.

^{2/} The function f would depend on the exchange rate if the demand for hoarding rises when foreign prices rise. In fact under the shock absorber hypothesis, m is independent of p , since a change in traded goods prices changes the money value of exports and imports equiproportionately. Starting the analysis at a current account equal to zero, the change in p leaves m unchanged.

$$/(22') \quad \dot{p} = -0$$

$$(22') \quad \dot{p} = -\theta (r^0(P_y, p, M_s) - j(p))$$

$$(23') \quad \dot{M}_s = j(p) + d$$

It is assumed that P_y and p quickly reach equilibrium for a fixed level of the money supply. The determinant of the system in P_y and p is positive if $j' < 0$, as assumed. The value of this determinant is $j' (r_1^0 - f_1) + f_1 r_2^0$. Also note that a higher level of the money stock implies a higher price of foreign exchange. Over time the money stock will change if $j + d \neq 0$, and the money stock will reach a stable equilibrium if $\dot{M}_s / M_s = j' (p / M) < 0$. This is assured if $j' < 0$. It is clear then how important the assumption of exchange rate intervention ($j' < 0$) is to determine this hybrid system. Note that both the exchange rate and money supply are determinate, and that the exchange rate brings r^0 (the portion of the excess demand for foreign exchange which the government does not accommodate) into equality with $-r^1$.

III. SOME ASPECTS OF ECONOMETRIC ESTIMATION: A MODEL INVOLVING HOME GOODS, NO SECURITIES, NO BANKS, FIXED EXCHANGE RATES

We shall derive reduced form estimating equations for the preceding models on the assumption that the data satisfy short-run but not long-run equilibrium. Thus it is assumed that $m = m^s$ (the demand for hoarding equals the flow of new cash), but that the money stock continues to change as a result of new shocks to its exogenous component d . The statistical implications of this hypothesis will be contrasted with rival hypotheses about the determinants of the money supply.

The model may be written as a set of linear equations and put into the reduced form. It is also possible to include M as an endogenous variable, changing over time in response to the identity $m^s = r + d$. In that case the final reduced forms involve distributed lags of exogenous variables: the government deficit, d , and the export and import prices, P_x and P_v .

/The hoarding

The hoarding function $f(P_y, M_s)$ can be written

$$(24) \quad m = a_0 + a_1 P_y - a_2 M + a_3 P_x - a_4 P_v$$

The equality of m^s and m may then be written

$$(25) \quad r = -d + a_0 + a_1 P_y - a_2 M + a_3 P_x - a_4 P_v. \frac{1}{}$$

The balance of payments equation $r = r(P_y, M_s)$ will be written

$$(26) \quad r = u_0 - u_1 P_y - u_2 M + u_3 P_x + u_4 P_v$$

The coefficients of P_x and P_v reflect the assumptions that a rise of P_x will increase m and r , a fall of P_v will increase m , and has an ambiguous effect on r .

Equations (25) and (26) can be solved for r by eliminating P_y .

$$(27) \quad r_T = B_0 - B_1 d_T - B_2 M_T + B_3 P_x - B_4 P_v$$

where the B 's are functions of the a 's and u 's. Unfortunately this system is unidentified, i.e. if equation 27 is estimated we cannot obtain the original values of the a 's and u 's. However if we assume that P_v does not affect the demand for money, as discussed earlier, the system is just identified.

If it seems desirable to incorporate M as an endogenous variable we note that $M_T = M_0 + \frac{T}{0} (r_t + d_t)$.

1/ Notice that Equation 25 precludes a long-run demand function for money which is homogeneous of degree zero. While we have previously hypothesized that this is the case, it would be useful to test the hypothesis. Unfortunately this would require a flow money demand equation which is non linear in P_y , yielding inconsistent estimators in the reduced forms. This problem might be solved through an iterative, estimating procedure, but at present we have decided to use the linear forms.

When this definition is substituted in (27) a difference equation may be formed:

$$(28) \quad r_T = \gamma_1 r_{T-1} - \gamma_2 d_T + \gamma_3 d_{T-1} + \gamma_4 P_{xT} - \gamma_4 P_{xT-1} - \gamma_5 P_{vT} + \gamma_5 P_{vT-1}$$

This difference equation may be expressed as r_T equal to a sum of weighted lagged terms in d_T , P_{xT} and P_{vT} where the weights decline to zero. That is

$$(29) \quad r_T = \sum_{t=0}^T \phi_t d_t + \sum_{t=0}^T \xi_t P_{xt} + \sum_{t=0}^T \theta_t P_{vt}$$

Where the coefficients of the lagged exogenous variables represent weights which decline to zero. A least squares estimation procedure may be used by truncating the length of the lags. Once an estimate of r_T is obtained, it can be used to estimate M_T ; and P may be estimated in the second stage, from either (25) or (26). The discussion of the shock absorber hypothesis suggests that d might be replaced by Y_g in (25).

IV. SOME EMPIRICAL RESULTS: THE CASE OF PANAMA

Panamá represents an interesting test case for the monetary model of the balance of payments. In addition to being physically small, which should tend to reduce the relative size of the home goods sector, it is one of the few countries in which foreign and domestic currency circulate side by side. The rate of exchange has been maintained at par with the dollar and is unlikely to change, although there may have been some variations in the effective rate of exchange ^{1/}. Thus it seems that the simple monetary theory should be quite appropriate in the case of Panamá.

The simple model yields two testable hypotheses: that local prices move in proportion to international prices and that domestic credit expansion has no effect on the rate of change of local prices. To test the first hypothesis the growth rate of local prices, as measured by the consumer price index, was regressed on the growth rate of import prices yielding the following equation: ^{2/}

^{1/} Tariffs for purposes of import substitution have risen. The physical growth of the Free Zone of Colon also tends to act as an effective devaluation.

^{2/} All data have been taken from IMF International Financial Statistics (IFS) Monetary data for June were taken directly from the monetary survey for the following years: 1953-54 Dec. 1955, 1955-56 Dec. 1957 1957-62 IFS Summary, 1963-64, 1967, 1965-66, 1968 1967-68 1970 1969-71 January 1973, 1972-73 July 1975. Reserves = Foreign Assets (net) - Foreign Deposits. Domestic Credit = Money - Reserves. Money includes quasi money but excludes currency.

Consumer prices were used to represent home goods prices, as they contain a larger element of service prices than wholesale prices. The GNP deflator was not used, owing to the problem of a variable base. Import prices shown in IFS are U.S. export prices; import unit values, shown in various issues of Ingreso Nacional yield similar results. Presuming that the effective exchange rate including transport costs, which is applicable to imports has risen more rapidly than U.S. export prices, the responsiveness of consumer prices to import prices would be even lower.

Growth of consumer prices = .19 + .47 Growth of import prices
(.10)

$R^2 = .97$ SEE = 1.33 D.W. = 1.55
(no serial correlation)

That is a ten percent growth in import prices causes a growth in consumer prices of between 2.7 and 6.7 percent, but not a ten percent growth as the simple model predicts. Regressions of the logs of consumer prices on import prices or import and export prices yield similar results ^{1/}.

To test the second hypothesis, domestic prices were regressed on domestic credit creation, changes in reserves, real growth and import prices. The influence of domestic credit was significantly positive, though smaller than might be expected. Import prices had an insignificant effect on the growth of domestic prices when domestic credit was included.

Thus the simple model is again rejected.

The effect of reserve growth was insignificant. Since there is a high inverse correlation (-81) between reserves and import prices one might imagine that reserves act as a buffer

^{1/} Log consumer prices = 1.88 + .59 log import prices
(.03)

$R^2 = .98$ SEE = .02 D.W. = .72

Log consumer prices = 1.43 + .58 log import prices + .11 log
(.02) (.03) export
prices

$R^2 = .99$ SEE = .01 D.W. = 1.09

Part of the difference in coefficients is attributable to the use of logarithms rather than percentage growth rates.

to import price changes and at the same time buffer the effect of import prices on the domestic price index ^{1/}.

As a preliminary test of the model of the balance of payments described in Section II we linearize equations 6 and 8, shown in Figure 2, and add an error term ^{2/}.

1/ The relevant regressions are:

Growth rate of domestic prices = $-92 + .13$ Growth rate of money
(.04) due to domestic credit

+ $-.01$ Growth rate of money + $.09$ Growth rate of
(.04) due to reserves (.12) import prices
 -7.8 Growth rate of income
(9.4) $R^2 = .90$ SEE = .99 D.W. = 1.75

Growth rate of domestic prices = $-.61 + .03$ Change Domestic Credit
(.01)

$-.03$ Change in reserves $-.11$ Growth of
(.01) (.08) Import prices
+ 11.5 Growth rate of income
(5.7) $R^2 = .96$ SEE = .59 D.W. = 1.49

Growth rate of domestic prices = $.02 + .04$ Change Domestic Credit
(.01)

$-.11$ Growth import prices
(.10) $R^2 = .94$ SEE = .70 D.W. = 1.85

2/ Recall the linearization implies that the flow money demand function cannot be homogeneous of degree zero.

There is also a question of the appropriate point at which to measure prices and money, for flows over a period. In this preliminary work the money stock is measured at the beginning of the year June to June, prices at the end. It could be argued that the appropriate measure of prices over the period and money stock would be centered at the middle of the period, that is December from the year June to June. However this presents certain problems due to seasonality and because the mid period money stock is not completely independent of the flows. These problems will be investigated in later work.

$$/ r = A_0 + a_1 P_y$$

(+)

$$r = a_0 + a_1 P_y + a_2 P_x + a_3 M - d + u_1$$

(+)(+)(-)

$$r = b_0 + b_1 P_y + b_2 P_x + b_3 M + b_4 P_v + u_{II}$$

(-)(+)(-)

where the expected signs of the coefficients are shown in parentheses. These structural equations are just identified,^{1/} but were estimated with two stage least squares to facilitate hypothesis testing.

The estimated structural equations, using the estimated values of r and P respectively, are:

$$P_y = 91. + .06 d + .04 \hat{r} + .06 M + .04 P_x$$

(.02) (.03) (.01) (.02) x

$$R^2 = .99 \quad SEE.68 \quad D.W.=1.03$$

$$r = 2199 - 29.9 \hat{P}_y + 1.51 M + 1.69 P_x + 4.9 P_y$$

(7.0) (.44) (.50) x (1.51) y

$$R^2 = .91 \quad SEE 10.7 \quad D.W.=2.6$$

All variables are significant at the 95% level and of the correct sign, except r which is significantly at 90% level in the first equation and M which is significantly positive in the second. As the hypothesis suggests, the coefficients of d and r are essentially the same (actually .056 and .042) ^{2/}.

^{1/} Recall this depends upon our assumption that import prices do not enter the money demand function. However we have just seen that import prices do not significantly influence domestic prices when domestic credit is included.

^{2/} In the direct regression of r on d , allowing for non linearities in the demand for money, the coefficient of d was not significantly different from zero, as opposed to one predicted by the monetary theory.

$$r = -7.6 \text{ Old} + .96 (\text{growth of income} \times M) - 3.83 (\text{growth of price} \times M)$$

(.22) (.58) (1.26) x M

$$R^2 = .94 \quad SEE.8.1 \quad D.W. 2.34.$$

/Imports appear

Imports appear to be highly elastic i.e. a rise in import prices reduces import quantity and expenditure on imports substantially. Exports also appear to be in elastic supply ^{1/}.

Though these empirical results are only preliminary, and require additional testing, they do suggest that the simple monetary model of the balance of payments should be rejected in favor of a model with endogenous prices, one in which monetary policy plays a role.

^{1/} It might be useful to add a variable allowing for income growth and changes in permanent income in the two structural equations. Only non permanent holdings of money would then affect local prices in the first equation.

Appendix

SOME ADDITIONAL ASPECTS OF ECONOMETRIC ESTIMATION IN:
MORE COMPLICATED MODELS

Add securities, banks, and the rate of interest to the Model of Section III, but keep the exchange rate fixed. The reduced form of this system may be derived by looking back at equations (18) - (20), and changing the specifications slightly. We shall split the balance of payments r into its components b , the balance on current account, and b_k , the balance on capital account. The actual solutions will not be presented because of their length, but the solution will be described heuristically. There are now five equations in this system ^{1/}:

Equilibrium in the market for home goods

$$(30) \quad \phi(r + d) = f(P_y, M, n, P_x, P_v, W)$$

The balance on current account

$$(31) \quad b_c = r(P_y, M, P_x, P_v)$$

The balance on capital account

$$(32) \quad b_k = i_g + Y_B(n) - s(W) + r(1 - \phi) + d(1 - \phi)$$

$$(33) \quad \text{where } b_k = b(n), \text{ and } (34) \quad r = b_c + b_k$$

The endogenous variables in this system are r , b_c , b_k , P_y , and n .

The procedure followed is to note that we may transform (3) into

$$(30') \quad b_c = f(P_y, n, E_o)$$

by substitution from (33) and (34). The term E_o denotes the exogenous variables. In addition, (32) may be transformed into

$$(32') \quad b_k = h(n, E_2),$$

by substitution from (33) and (34).

^{1/} Equations (30), and (32) are derived in the text as (18) and (20). Equation (31) goes back to equation (6).

We may then solve (32') for n as a function of b_c ; solve (33) for P_y as a function of b_c , and substitute into (30'), deriving a reduced form for b_c as a function of the exogenous variables.

$$(35) \quad b_c = j(E_0, E_1, E_2)$$

This reduced form may be estimated. The estimates b_c will be employed to derive a second stage estimate of r as a function of b_c and the other exogenous variables. The vehicle for this procedure is equation (32) which may be written as follows:

$$(36) \quad r(1 - \phi) = b(n(b_c, E), Y_B(n(b_c, E) - i_g - s(W) - d(1 - \phi))$$

All of the right hand side variables are now exogenous, and we may estimate (36). It should therefore be possible to find the effects of exogenous variables on the current account as well as on the capital account.

Ad Hoc Assumptions about Central Bank Behavior

At the beginning of the paper, it was suggested that h may not be an endogenous variable. The Central Bank may fix the level of the increase in high-powered money h , or it may vary h in response to variations in the interest rate.

If the Central Bank fixes the level of h independently of the other variables in the system, then h will be independent of r the predicted level of the balance of payments. This hypothesis may be tested once r is estimated.

If h is a function of the interest rate, then equation (32) could be estimated directly, with n as a function of W and the other exogenous variables in that equation. Then \hat{h} could be estimated from \hat{n} , and \hat{M} could be estimated from \hat{h} . These estimates could be compared with h and M derived from the earlier procedures. An additional test would be available from alternative estimates of (30). If h is a function of n , then P_y can be estimated as a function of present and past values of n , and values of P_x , P_v , and W . These estimates of P_y could be compared with those derived above, for if h is independent of r , then P_y should be independent of r .

Add floating exchange rates.

Now assume that government transactions in foreign exchange are a function of the exchange rate, as described earlier in Section II.5. Again we shall write government purchases of foreign exchange as $r^1 = j(p, \bar{p})$, $j_1 > 0$. We shall also assume that the government has a target value of the exchange rate in mind. This target value is not a rate which they wish to achieve, but a benchmark which serves to define the further range of government exchange operations. When this benchmark changes, as it is likely to do from time to time, the whole function will shift. The exchange rate brings the total volume of exchange market transactions into equilibrium, i.e., $j = b_c + b_k$. Thus floating exchange rates may be introduced into the preceding model, by expanding the system to six equations. As before we have:

Equilibrium in the market for home goods

$$(37) \quad o(r^1 + d) = f(P_y, n, E_o)$$

As before we assume that the exchange rate does not affect the demand for cash hoarding. E_o denotes the exogenous variables.

The balance on current account:

$$(38) \quad b_c = r(P_y, p, E_1)$$

The exchange rate does affect the current account.

The balance on capital account

$$(39) \quad b_k = i_g + Y_B(n) - s(W) + r^1(1 - o) + d(1 - o)$$

Foreign purchases of domestic securities ^{1/}

$$(40) \quad b_k = b(n)$$

The government's decision function for purchasing foreign exchange:

^{1/} Foreign purchases of domestic securities may also depend on the exchange rate for two reasons: Because of speculative anticipations of future changes in the exchange rate. Secondly foreign demand perhaps should be measured in the foreign unit of currency and then converted to domestic currency at the going exchange rate.

$$/(41) \quad r^1 = j(p, \bar{p})$$

$$(41) \quad r^1 = j(p, \bar{p})$$

Finally the exchange market equilibrium condition

$$(42) \quad r^1 = b_c + b_k$$

Conceptually, this system can be reduced to four equations, and then solved for b_c as a function of the exogenous variables. By substituting from (42) and (40), equation (37) may be written as

$$(37') \quad b_c = f(P_y, n, E_o)$$

By substituting from (40) and (42), equation (39) may be written as

$$(39') \quad b_c = g(n, E_1)$$

By substituting (38), (39) and (41) into (42) we have

$$(42') \quad p = p(P_y, n, E, \bar{p})$$

This system of four equations may then be solved for b_c as a function of the exogenous variables. The econometric procedures would then follow those described for the fixed exchange rate case. Note that the measurement of \bar{p} is not possible, so that it may be necessary to use dummies for specific periods when it is known from other information that \bar{p} has changed.

REFERENCES

- M. Darby, "The Allocation of Transitory Income Among Consumers' Assets", American Economic Review, 62, Dec. 1972.
- R. Dornbusch, "Exchange Rates and Fiscal Policy in a Popular Model of International Trade", American Economic Review, 65, Dec. 1975.
- H. Genberg, "A Summary of Some Recent Research on the Monetary Approach to Balance of Payments Theory", unpublished manuscript, Geneva, April, 1974.

1946

1947

1948

1949

1950

1951

1952

1953

1954