1979

Long-Run Inflation in Open Economies

Geoffrey S. Kingston

20/20

ISSN: 0318-725X

ISBN: 0-7714-0149-3

RESEARCH REPORT 7931

LONG-RUN INFLATION IN OPEN ECONOMIES

by

Geoffrey Kingston

December, 1979

LONG-RUN INFLATION IN OPEN ECONOMIES*

Geoffrey Kingston
The University of Western Ontario
London Canada

November 1979

*I wish to thank J. M. Parkin and participants in seminars at the University of Western Ontario and the Australian National University for helpful comments on an earlier version of this paper. I also wish to thank A. Serletis for research assistance.

This paper outlines some models that seek to explain postwar inflation trends. The emphasis is on open-economy aspects of the topic. The main tool of analysis is simple geometry.[1]

The paper is organized as follows. Section I exposits a version of the traditional Cagan (1956)-Bailey (1956) model of secular inflation under exogenous monetary growth. That analysis applies to what may be termed <u>independent</u> economies: a national economy is said to be independent insofar as the attempts of its central bank to peg or stabilize the exchange rate are sporadic and non-systematic.[2] This term embraces the "n^{th}" country in a reserve-currency fixed-rate system as well as floating-rate countries. Section II considers such an economy under the alternative assumption that monetary expansion is endogenous and the fiscal deficit, net of debt interest, is exogenous. Here it is shown that an increase in the fiscal deficit will generally induce a <u>magnified</u> increase in domestic price and monetary growth. This result is compared to the "overshooting proposition".[3] Section III addresses the question of whether floating-rate countries are liable to import inflation. It briefly restates the assumptions and arguments underlying the standard negative answer to such a question. It also shows that higher inflation abroad can <u>reduce</u> long-run inflation at home; the key assumptions required for this non-standard result are an exogenous fiscal deficit, and substitution between foreign and domestic currencies. Section IV considers dependent economies under exogenous international reserve ratios. It exposits the Mundell (1972) extension of the Cagan-Bailey analysis to a multi-country reserve-currency system, and incorporates useful amendments suggested by, for example, Claassen (1972) and McKinnon (1972). Section V reconsiders dependent economies under the alternative policy of exogenous fiscal deficits. Section VI argues that the response of international liquidity to higher world-wide inflation is a test of whether the postwar behaviour of dependent economies is better explained by the Section IV model or by our Section V alternative. Section VII concludes the paper.

I. INDEPENDENT ECONOMIES UNDER EXOGENOUS MONETARY GROWTH

Independent economies were defined as being either n^{th} countries or as nations under flexible exchange rates. The leading postwar example of the first kind of independent economy has been the United States; specific discussion of her postwar experience is usefully deferred. Postwar examples of the second kind are less numerous than might be supposed. For example Canada's postwar dollar has obviously fluctuated in price against the United States dollar, yet has done so within a band of less than 20 per cent around parity; "approximate" parity has been an important long-run policy norm in Canada. Similarly,

> "Even though we have had nearly five years of floating rates, it is my impression that the monetary authorities of the major countries have behaved with far less independence than the theorists of floating rates are prone to assume. Consequently, in terms of the way the international monetary system has worked since 1973, I would characterize it as a hybrid, functioning if anything more like a fixed-exchange-rate system than like a textbook case of floating rates." (Harberger (1978), p. 511.)

Yet a few countries have unambiguously foregone the option of systematic intervention in their foreign exchange markets (typically as an unavoidable consequence of their chronic internal price and monetary growth), thereby furnishing unambiguous examples of independent economies. Table 1 draws attention to three such cases.

The inflation rates set out in Table 1 can be explained by what might be termed the "naive" quantity theory. I shall spell out that theory rather pedantically, in order to introduce assumptions, notations and definitions required subsequently. The assumptions are as follows: individuals hold a quantity of money balances equal to some constant fraction of their money income, real intensive output (output per effective labour unit) is constant, the growth rates of population and labour-augmenting technical progress are constant, and the growth rate of money is exogenous. The first

TABLE 1

Country	Period	Inflation Rate (π)	Monetary Growth(μ)	Output Growth(ρ)
		Percent	per	annum
Argentina	1949-74	27	29	3.0
Chile	1952-70	32	38	4.3
Uruguay	1958-65	26	34	1.7

Sources and Methods: Harberger (1978) for μ and π; International Financial Statistics (various issues) for ρ. Estimate of ρ for Chile is from a series beginning in 1961 (rather than 1952).

TABLE 2

Country	Period	Inflation Rate	Monetary Growth	Output Growth
		Percent	per	annum
Argentina	1974-76	293	262	0.4
Chile	1971-76	273	231	2.0
Uruguay	1965-68	95	66	2.7

Sources: See foot of Table 1.

two assumptions may be formalized by:

$$m \equiv M/Py = \varkappa$$

where M = stock of money in nominal terms, P = price of domestic output, m = stock of money in real intensive terms, y = volume of real output, and $\varkappa$ is a positive constant.

Next, take percentage changes of the above equation, bring the third and fourth assumptions into the analysis, and denote the long-run equilibrium and pegged states of variables by asterisks and bars respectively, yielding:

$$\pi^* = \bar{\mu} - \rho$$

That is, the long-run rate of inflation (π^*) is explained as the difference between the policy-determined growth rate of money ($\bar{\mu}$) and the exogenously-given growth rate of real output (ρ).[4]

The facts laid out in Table 1 are in line with this relationship. On the other hand, they do not establish that monetary growth is exogenous. Moreover, the statistics of <u>transitions</u> to much higher rates of price and monetary growth tell a different story; see Table 2.

These figures clearly illustrate the overshooting phenomenon. Cagan (1956) and Bailey (1956) are the landmark contributions to a modified quantity theory which, inter alia, explains overshoots. That analysis is usefully exposited by considering the standard model of a monopolistic facing zero marginal costs. For example, following Friedman (1971) one might envisage a privately-owned mineral spring.

Assume the monopolist in question faces a linear demand curve.[5] Figure 1 shows that curve as DD, cutting the quantity and price axes at b and b/a respectively. The marginal revenue curve, MR, cuts the abscissa

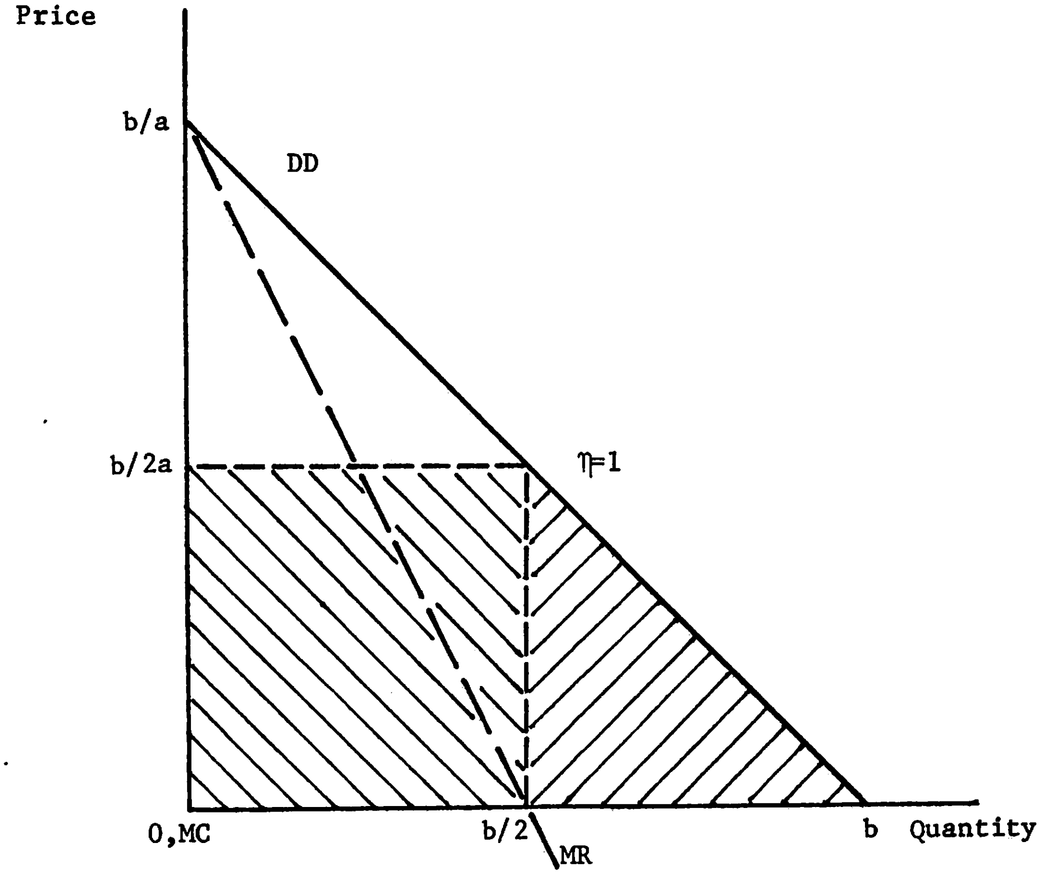


Figure 1

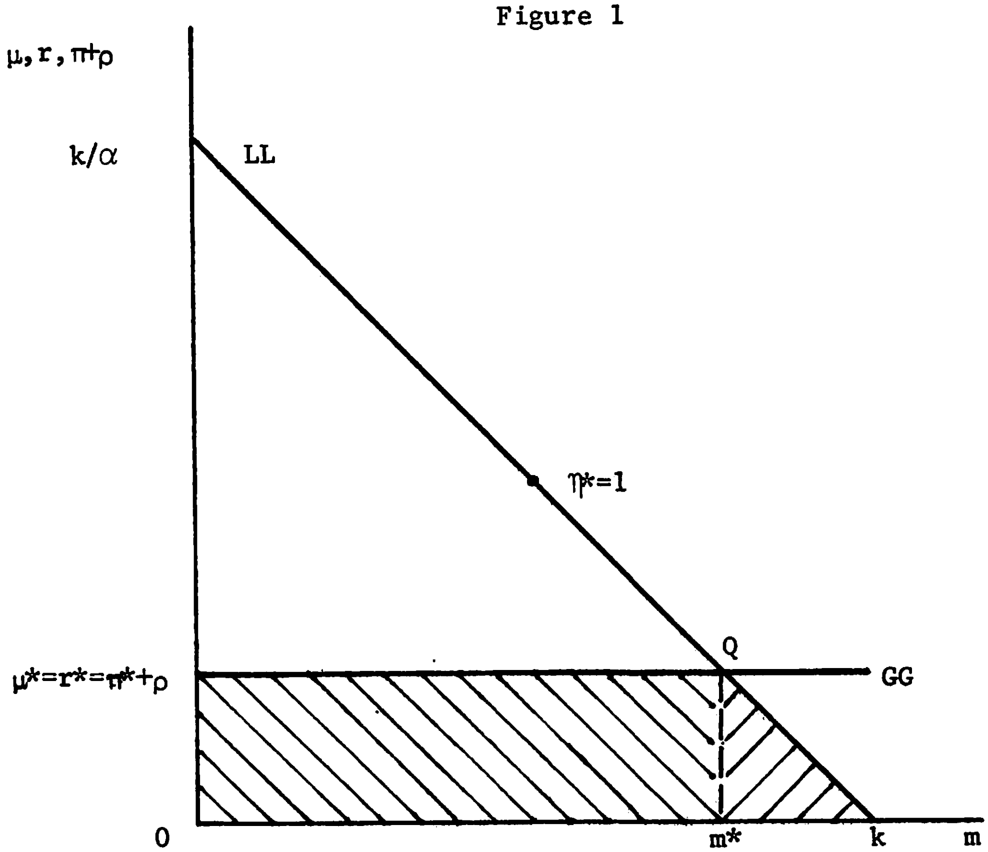


Figure 2

and ordinate at b and b/a respectively. By assumption the firm's marginal cost curve, MC, coincides with the abscissa. Profit maximization calls for price to be set at b/2a, requiring output to be b/2, at which point revenue (see shaded rectangle) is also maximized, and the absolute value of the price elasticity of demand, η, is unity (see midpoint of DD). But Pareto optimality and the fact of zero marginal costs together require reduction of price to zero. In that event the deadweight efficiency loss (see shaded rectangle), revenue, and the price elasticity of demand, are all reduced to zero.

One can draw parallels between such a monopolist and the public sector of an independent economy. Consider first the demand for money. Suppose that the financial instruments in the economy, apart from domestic money, are equity and government bonds. Suppose further that those two assets are imperfect substitutes for money and perfect substitutes for one another. Now Sidrauski's (1967) positive optimizing model of a growing monetary economy with standard utility and production functions describing the private sector and a Friedman (1969)-style helicopter to characterize the public sector shows that the long-run marginal product of capital is tied to the sum of the exogenously-given rates of effective labour-force growth, time discount, and depreciation--a modified golden rule. This suggests that if the public sector were also to purchase output, raise conventional taxes, and issue bonds, yet on a "small" scale, then the modified golden rule would continue to hold in steady state. If, in addition, the rates of discount and depreciation were both zero, then equity (and government bonds) would yield a real rate of return equal to ρ, the long-run rate of real output growth--the so-called simple golden rule.[6] Since this rule dramatically simplifies the subsequent analysis, and in the light of the foregoing argument, it is assumed henceforth. One resulting simplification is that the long-run nominal interest rate, growth rate of nominal income, and growth rate of money, will equal one another:

$$r = \rho + \pi = \mu$$

so that the long-run opportunity cost of holding money (assumed until further notice to be noninterest-bearing and not a substitute for foreign currency) can be denoted by any of these three variables. A simple explanation, then, of the long-run demand for money in real intensive terms, is[7]

(1) $m = k - \alpha\mu$

where k and α are positive constants.

Consider next the supply of money. Let G and $g\,(\equiv G/Py)$ stand for government purchases in nominal and real intensive terms respectively. Similarly, let T and t denote nominal and real intensive tax revenues, net of transfers. It makes no difference here whether domestic public spending (taxes) falls on domestic or foreign goods (factors). The difference $g - t$ measures the real intensive fiscal deficit, net of debt interest. Define $g - t \equiv \delta$. This deficit, together with debt interest, must be financed by selling bonds to the private sector or by creating money. Now in the long run, and under the simplifying golden-rule assumption, revenue from ongoing bond sales is precisely equal to outlay on debt interest: bonds are purely self-financing items and can be ignored. The long-run government budget constraint reduces to[8]

(2) $\delta = \mu m$

where real intensive revenue from money creation, μm, could also have been written as rm or as $(\rho + \pi)m$.

The foregoing money demand function and government budget constraint together comprise a system of two equations in three unknowns: μ, m, and δ. Analogy with the monopolist's problem suggests that the extra equation required might be furnished by assuming deficit-maximizing behaviour by government, that is, $\mu^* = k/2\alpha$.[9] But the evidence suggests that the analogy is not exact in this respect. For if public sectors were deficit maximizers then we would observe a long-run interest elasticity of money demand, η^*, in the neighbourhood of unity. Yet the post-1950 data have generally yielded $\eta^* \leq 1/2$,[10] implying that deficits have been less than maximal.[11] On the other hand, postwar inflation rates have been positive. At this stage, therefore, we close the system by assuming a pegged growth rate of money, $\bar{\mu}$, bounded above and below by $k/2\alpha$ and ρ respectively.

The analysis thus far is portrayed by Figure 2. The LL schedule shows the demand for money in real intensive terms. The GG schedule shows our provisional assumption regarding public-sector behaviour. The schedules intersect at Q, thereby determining equilibrium inflation π^* $(=\bar{\mu} - \rho)$, equilibrium real intensive money holdings m*, the equilibrium real intensive fiscal deficit net of debt service δ^*(see shaded rectangle), and the waste made by a positive growth rate of money (see shaded triangle).[12] Pareto optimality calls for a zero growth rate of money to eliminate the efficiency loss--the so-called full-liquidity rule (Friedman (1969)).

Finally, how does this model account for the overshooting phenomenon illustrated by Table 2? The reason is apparent from Figure 2. During a transition from low to high monetary growth, the private sector economizes on its money holdings in real intensive terms. Such a once-over reduction can be effected only if the sum of price and real output growth temporarily outstrips monetary growth.

II. INDEPENDENT ECONOMIES UNDER EXOGENOUS FISCAL DEFICITS

One difficulty with the story so far is the assumed exogeneity of monetary growth. In the first place, that assumption is contrary to standard fiscal theory. For the long-run money demand schedule and government budget constraint of the preceding section together imply that monetary growth can be exogenous only if the fiscal deficit is endogenous. Yet macroeconomic analysis conventionally postulates exogeneity with respect to real intensive public purchases and taxes (at least in the long run), implying that the difference between these two variables must also be exogenous. Second, the natural interpretation of economic developments in independent economies is that central banks have accommodated fiscal authorities rather than the other way round. Consider for example Table 3, which shows recent average values of selected fiscal and monetary variables in the United States.

These figures are in line with the long-run government budget constraint (2)[13] (and clearly show the importance of netting out debt service). The historically high value of μ is more plausibly seen as a consequence of historically high fiscal deficits than as an independent shift in Federal Reserve Board policy.[14]

Motivated by these considerations, this section respecifies the Section I model by postulating that δ (rather than μ) is pegged. The resulting explanation of monetary growth and inflation can be summarized by a single implicit equation:

$$(3) \qquad \bar{\delta} = \mu^*(k-\alpha\mu^*)$$

so that μ^* and π^* ($=\mu^*-\rho$) are increasing functions of $\bar{\delta}$, providing μ^* is less than its revenue-maximizing value $k/2\alpha$. Overall, then, the present model is not vastly different from its Section I counterpart.

TABLE 3

United States, 1972-78

Monetary Growth	Fiscal Deficit Incl.Debt Interest	Fiscal Deficit Excl. Debt Interest (δ)	Revenue from Money Creation (μm)
Percent per annum	Percentage of gross national product, per annum		
7.62	3.00	0.59	0.58

Sources and methods: Money is defined by the end-year Line 14 figures in International Financial Statistics, various issues. Fiscal deficits incl. debt interest refers to Federal fiscal-year figures including off-budget Federal entities, from The Budget of the United States Government (1979). Debt interest: Federal fiscal-year figures from the Statistical Abstract of the United States (1978) and the Federal Reserve Bulletin. Revenue from money creation: $\mu m \equiv 100\ (M - M_{-1})/Py$, where Py (also used to normalize the deficit variables) is end-year current price gross national product, as reported in International Financial Statistics.

The model is portrayed by Figure 3, which is similar to the diagram in Turnovsky (1978). The LL schedule is the same as in Figure 2. The GG schedule, a rectangular hyperbola, depicts our new assumption concerning government policy. GG is drawn on the assumption that the fiscal deficit $\bar{\delta}$ is positive yet less than maximal. It follows that GG must cut LL twice, once above and once below the point at which money demand is unit elastic. Earlier it was pointed out that observed elasticities since 1950 have been one-half or less. This suggests that the lower intersection Q is the relevant one for that period. Moreover, it will soon become apparent that the comparative-static properties of the upper intersection R are "Lafferesque", and therefore anomalous. Accordingly, attention is henceforth confined to lower intersections. (This constitutes a departure from Turnovsky (1978).) The size of the fiscal deficit net of debt interest is shown by the shaded rectangle. The efficiency loss induced by departure from a balanced-budget policy (viz. $\bar{\delta} = 0$) is shown by the shaded triangle.

Consider now the effects of an increased fiscal deficit. This disturbance can be analyzed by algebra[15] or by a diagram. The relevant geometry is shown by Figure 4. The initial government policy schedule GG_o intersects with LL at point Q to determine initial equilibrium monetary growth, μ_o^*, and initial equilibrium real intensive money balances, m_o^*. The initial fiscal deficit (net of debt interest) is shown by the rectangle $Om_o^* Q\mu_o^*$.

Next, suppose the fiscal deficit increases by the proportion QQ'/Qm_o^*. It is irrelevant here whether an increase is the consequence of increased public purchases, or reduced net taxes or some combination of the two.[16] The new government policy schedule, GG_1, must pass through Q', that being the northeast corner of one of the revenue rectangles determining long-run budgetary equilibrium after the increase in the deficit. However, Q' is to the right of LL, and

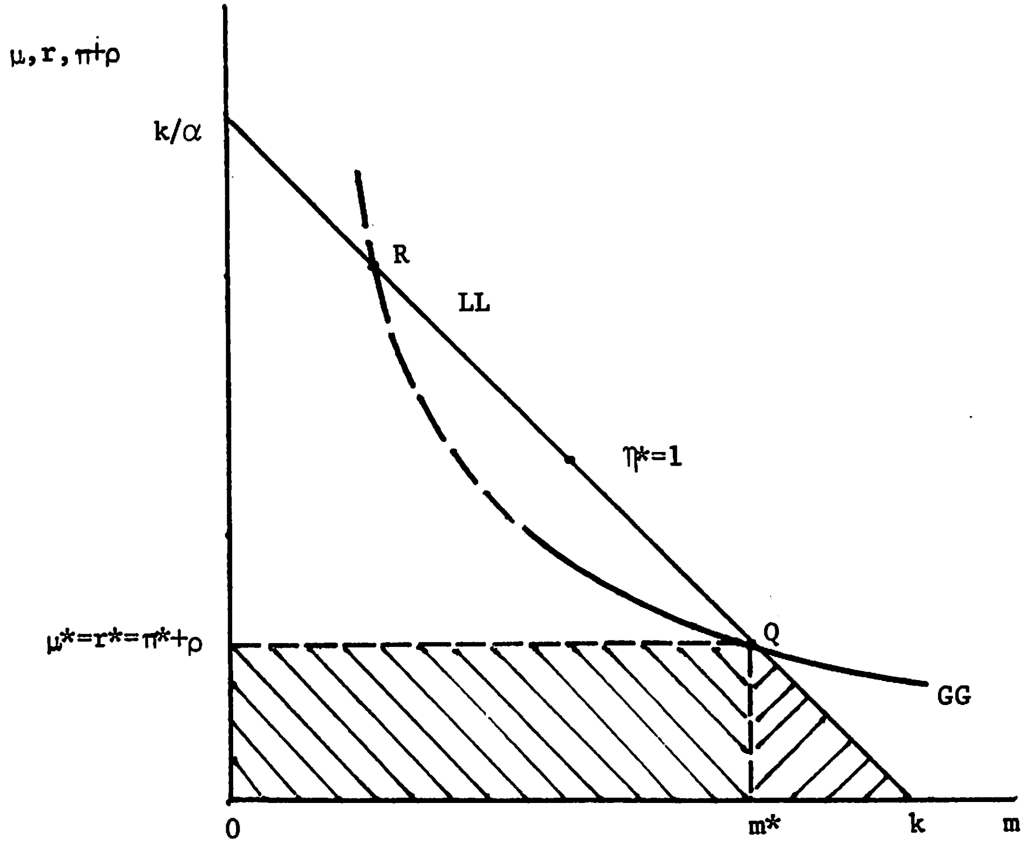


Figure 3

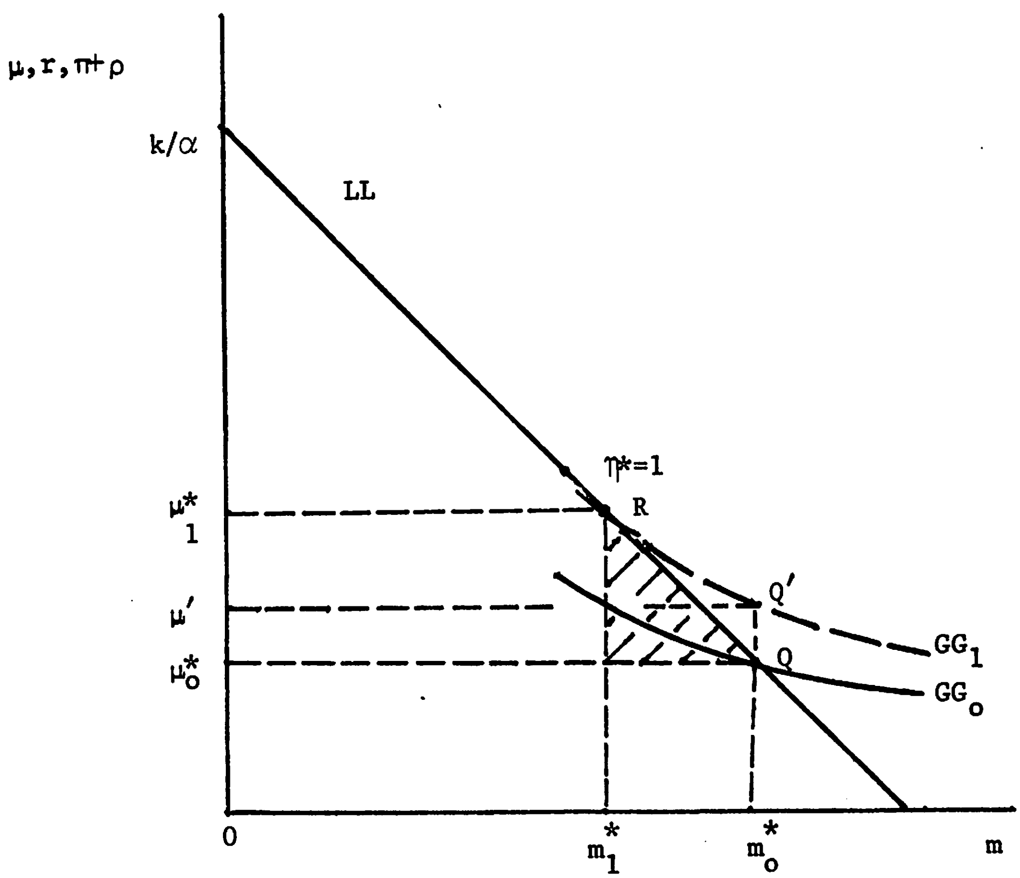


Figure 4

therefore lies in the region of an excess supply of money. Thus the price-quantity pair (μ', m_o^*) is not an equilibrium pair. This paper is silent on the question of short-run adjustment mechanisms. But it is clear from Figure 4 that simultaneous budgetary and monetary equilibrium, on the inelastic segment of the money demand schedule, will occur at R, at which point the new growth rate of money, μ_1^*, exceeds μ_o^* by <u>more</u> than the proportion QQ'/Qm_o^*. Such an increase is necessary to generate enough revenue from money creation to offset the reduction in equilibrium real intensive money balances. The increased welfare cost is shown by the shaded triangle.

The new equilibrium rate of inflation $\pi_1^* (= \mu_1^* - \rho)$ must also rise disproportionately, provided that real output growth is non-negative. To see this, for $\rho \geq 0$ we have

$$\frac{\pi_1^* - \pi_o^*}{\pi_o^*} = \frac{\mu_1^* - \mu_o^*}{\mu_o^* - \rho} \geq \frac{\mu_1^* - \mu_o^*}{\mu_o} > \frac{\bar{\delta}_1 - \bar{\delta}_o}{\bar{\delta}_o},$$

as required.

These disproportionate effects are reminiscent of the traditional overshooting effect (see Section I). In both cases the key ingredient is money demand that is responsive rather than completely inelastic. For if the money demand schedule of Figure 4 were vertical in the relevant range, then the new equilibrium would be at Q′ (rather than R), corresponding to an equiproportionate increase in monetary growth. But the analogy is not exact: the present overshooting proposition refers to a permanent effect, whereas its traditional counterpart refers to a temporary phenomenon.

III. INDEPENDENT ECONOMIES AND IMPORTED INFLATION

This section investigates whether increased inflation in the rest of the world can affect long-run inflation in an independent economy. It assumes throughout that there is a freely floating exchange rate between the "domestic" economy (which could consist of a group of countries linked by fixed exchange rates; see Section IV) and the "foreign" economy that is a potential inflation transmitter.

Standard long-run theory predicts that under a floating exchange rate, an increase in price and monetary growth abroad will induce a completely offsetting appreciation of the exchange rate, thereby insulating home price and monetary growth from the shock. Formally, recall that P stands for the domestic-currency price of domestic output, and use P_f and E to denote the foreign-currency price of foreign output and the price of foreign currency respectively.[17] The theory of international trade predicts long-run relative purchasing power parity (PPP), that is, the equilibrium domestic terms of trade $(P/EP_f)^*$ are predicted to be stationary at least in the absence of ongoing changes in tariffs, international transfers, etc. In terms of percentage changes:

$$(4) \qquad \pi^* = \pi_f^* + \epsilon^*$$

where π, π_f and ϵ stand for the growth rates of P, P_f and E respectively. This equation may be recast in terms of domestic and foreign monetary growth, by adding ρ to both sides:[18]

$$(5) \qquad \mu^* = \mu_f^* + \epsilon^* .$$

Use a tilda to denote variables that may or may not be exogenous globally but are definitely exogenous to the country under consideration. Assuming μ_f^* is such a variable, (4) may be restated either as

$$\varepsilon^* = \bar{\mu} - \tilde{\mu}_f ,$$

if domestic monetary growth is exogenous (recall Section I), or as

$$\varepsilon^* = \mu(\bar{\delta}) - \tilde{\mu}_f ,$$

if the domestic fiscal deficit is exogenous (recall Section II). In either event, an increase of 1 percentage point in foreign monetary and price growth will reduce the growth of the price of foreign currency by the same amount, thereby leaving domestic monetary and price growth undisturbed.

It might be thought that the orthodox theory is incorrect insofar as it abstracts from a tendency for long-run national inflation rates to become synchronized even under freely flexible exchange rates. The remainder of this section argues a contrary view: a richer analysis of the international transmission of inflation under fully flexible rates leads to the prediction that higher inflation abroad will <u>reduce</u> long-run inflation at home.[19]

The argument in question has two main elements. The first is that agents are not necessarily specialized in their holdings of national currencies (as we have assumed thus far), but substitute between domestic and foreign monies, as their rates of return change. Formally, respecify the domestic money demand function (1) as

(6) $$m = k - \alpha\mu + \alpha_f\mu_f$$

where $m \equiv M/Py$ = real intensive demand for domestic currency by domestic and foreign residents, and α_f is a positive constant.[20] The second element is a fixed-deficit explanation of monetary growth, as outlined in Section II:

(7) $$\bar{\delta} = \mu m.$$

Upon setting $\mu_f = \tilde{\mu}_f$ we have a system of two equations, (6) and (7), to solve for μ^* and m^*.

The domestic effects of increased foreign inflation and monetary growth are shown by Figure 5. The initial money demand schedule LL_o intersects with the government policy schedule GG at Q to determine initial equilibrium domestic monetary growth, μ_o^*, and the initial equilibrium domestic money stock in real intensive terms, m_o^*. The fiscal deficit (held constant during this experiment) is shown by either of the rectangles $Om_o^*Q\mu_o^*$ or $Om_1^*R\mu_1^*$.

Now suppose there is an increase in the growth rates of foreign prices and money. This constitutes an increase in the price of a substitute for domestic money and therefore shifts its demand schedule to the right. With the linear functional form assumed here, the new domestic money demand schedule, LL_1, is parallel to its initial counterpart LL_o. At the new equilibrium R, corresponding to the price-quantity pair (μ_1^*, m_1^*), agents are holding more domestic money, and the deficit is financed by a reduced percentage growth rate of the domestic money supply. The new domestic inflation rate, $\mu_1^*-\rho$, is lower.

Under the present assumptions of freely flexible exchange rates, and currency substitution, the fixed money growth hypothesis yields quite different predictions: an increase in foreign inflation will have no effect on domestic inflation, and will increase the domestic fiscal deficit net of debt interest. These differences suggest a potential test of the fixed money growth hypothesis vis a vis our fixed-deficit alternative.

IV. DEPENDENT ECONOMIES UNDER EXOGENOUS INTERNATIONAL RESERVE RATIOS

Monetary dependence has been a long-run policy norm of most countries. There is considerable agreement nowadays that postwar dependence is better explained by a dollar-standard model than by the more familiar gold-standard model.

A leading contribution to dollar-standard theory is Mundell (1972). That analysis proceeds by extending the traditional model of an independent

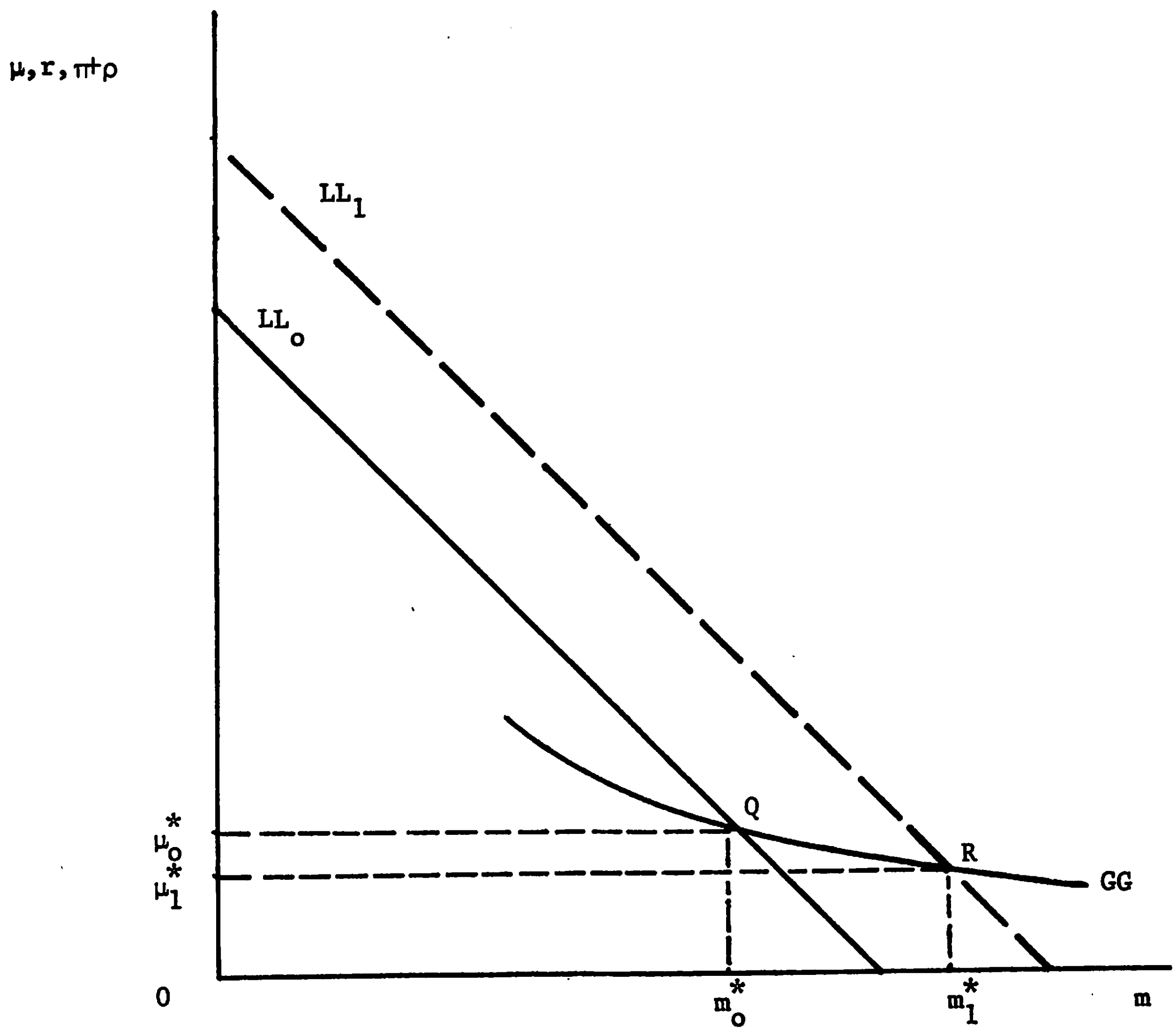


Figure 5

national economy under exogenous monetary growth (see Section I).to a world model consisting of one "nth" or "centre" country together with n-1 dependent or "peripheral" countries. In a world of n currencies, the n-1 central banks of dependent economies would systematically intervene in the market for the centre's currency, in order to fix (or at least stabilize) the n-1 independent exchange rates. For simplicity, however, Mundell (1972) assumes that there is only one currency--the money issued by the centre (more on this below).

Another building block of the Mundell model is the "law of one price", which may be defined as the relationship asserted by equation (4) in the special case $e^* = 0$. It predicts that long-run national rates of inflation will be equal within a fixed-exchange-rate system. Table 4 sets out post-1950 inflation data on some countries that have maintained fairly stable rates of exchange against the United States dollar. There are irregularities, whose explanation requires recourse to the more-general PPP theory. In particular, deviations from the law of one price tend to be associated with episodes of revaluation (cf. Germany) or devaluation (cf. the United Kingdom). But the main lesson of Table 4--at least in comparison with Tables 1 and 2--is the overall similarity of these national inflation rates within each of the three periods, especially the first two.

What is the explanation of the increased rates of inflation in the second or third column of Table 4, as opposed to the first column? Mundell (1972) is generally understood as being addressed to this question. It suggests that in the mid-1960s the authorities controlling the United States began to behave something like the zero-marginal-cost monopolist of Section I. The United States public sector had a special incentive to do so (so the argument runs) owing to the fact of a strong foreign official

TABLE 4

Postwar Inflation in the United States and in Selected Countries

With Fairly Stable Dollar Parities

	1952-67	1967-72	1972-78
United States	1.5	4.6	9.5
Australia	2.5	4.3	13.2
Canada	1.7	3.9	9.2
Germany	1.9	3.5	6.1
Japan	4.3	5.9	13.9
United Kingdom	2.8	6.6	16.4

Source: Harberger (1978).

demand for United States dollars (as well as the usual domestic private demand). This circumstance enabled a potentially larger fiscal deficit at less cost to domestic moneyholders.

Four objections may be raised against such an explanation. First, foreign official holdings of United States official liabilities typically earn interest, as pointed out by, for example, McKinnon (1972). Second, whereas Mundell assumes in effect that peripheral national money bases have 100 percent international reserve backing, the actual reserve backing is typically much less than that. On the relevant theory and evidence, see, for example, Claassen (1972) and Section VI, respectively. Third, the evidence on post-1950 money demand elasticities for the United States and elsewhere, is inconsistent with the hypothesis that public sectors are seignorage maximizers (recall Section I). Fourth, there are arguments for postulating that an independent economy's fiscal deficit is exogenous with respect to the growth rate of money, rather than vice versa (recall Section II).

The remainder of this section formally exposits a version of the Mundell (1972) model that takes these objections into account.[21] Following Claassen (1972) and others, the international reserve ratios of peripheral economies are assumed exogenous. On the other hand, peripheral economies are <u>not</u> assumed small, in contrast to Harberger (1978), Kingston and Turnovsky (1978), and others.

For expository convenience, assume n=2. Let A stand for the centre country, with a lower-case subscript on A variables. Similarly, let B stand for the peripheral country. For simplicity we revert to the assumption of no currency substitution. Monetary growth in A is assumed to be exogenous: it turns out to be irrelevant for B whether monetary growth in A is generated by a Section I process or by our Section II alternative. Equilibrium real intensive money demand, by A's private sector, under exogenous growth in A, may be described by:

$$(8) \qquad m_a^* = k_a - \alpha_a \bar{\mu}_a \; .$$

Assume that international reserves are held in the form of A's government bonds, and earn a golden-rule rate of interest. Then A does not derive seignorage from foreign official holdings of its public debt; revenue from money creation is raised from domestic residents only:

$$(9) \qquad \delta_a^* = \bar{\mu}_a m_a^* \quad [= \bar{\mu}_a (k_a - \alpha_a \bar{\mu}_a)] \; .$$

Hence A's fiscal deficit is an increasing function of monetary growth, assuming $0 < \bar{\mu}_a < k_a/2\alpha_a$. Thus far, the analysis is formally identical to the Section I analysis of an independent economy.

The situation in the dependent economy is quite different. Under the law of one price, and with equal real growth rates internationally, B must accept the inflation, interest, and money growth rates determined within A. Equilibrium real intensive money demand by B's private sector may be described by:

$$(10) \qquad m_b^* = k_b - \alpha_b \bar{\mu}_a \; .$$

Thus B's money stock, too, is governed by A's monetary growth.

This is not the end of the story concerning B's lack of policy autonomy. Apart from conventional taxes, B's public sector has two revenue earners. The first is the real intensive domestic source component of B's monetary base, c. In equilibrium this yields a flow of revenue equal to $\mu_b^* c*$. The second is the real intensive foreign source component of B's monetary base, f. Assuming that holdings of B's base money do not earn interest, B's public sector gets revenue by receiving a flow of interest payments on its reserves, with equilibrium value $r_a^* f^*$, and then not remitting the proceeds directly to the members of B's private sector who hold base money of foreign source (as would be required in a world of superneutral money). In consequence, and noting that $\mu_b^* = r_a^* = \bar{\mu}_a$, and that $c+f \equiv m_b$, B's long-run government budget constraint is described by:

$$(11) \qquad \delta_b = \bar{\mu}_a m_b^* \quad [= \bar{\mu}_a (k_b - \alpha_b \bar{\mu}_a)].$$

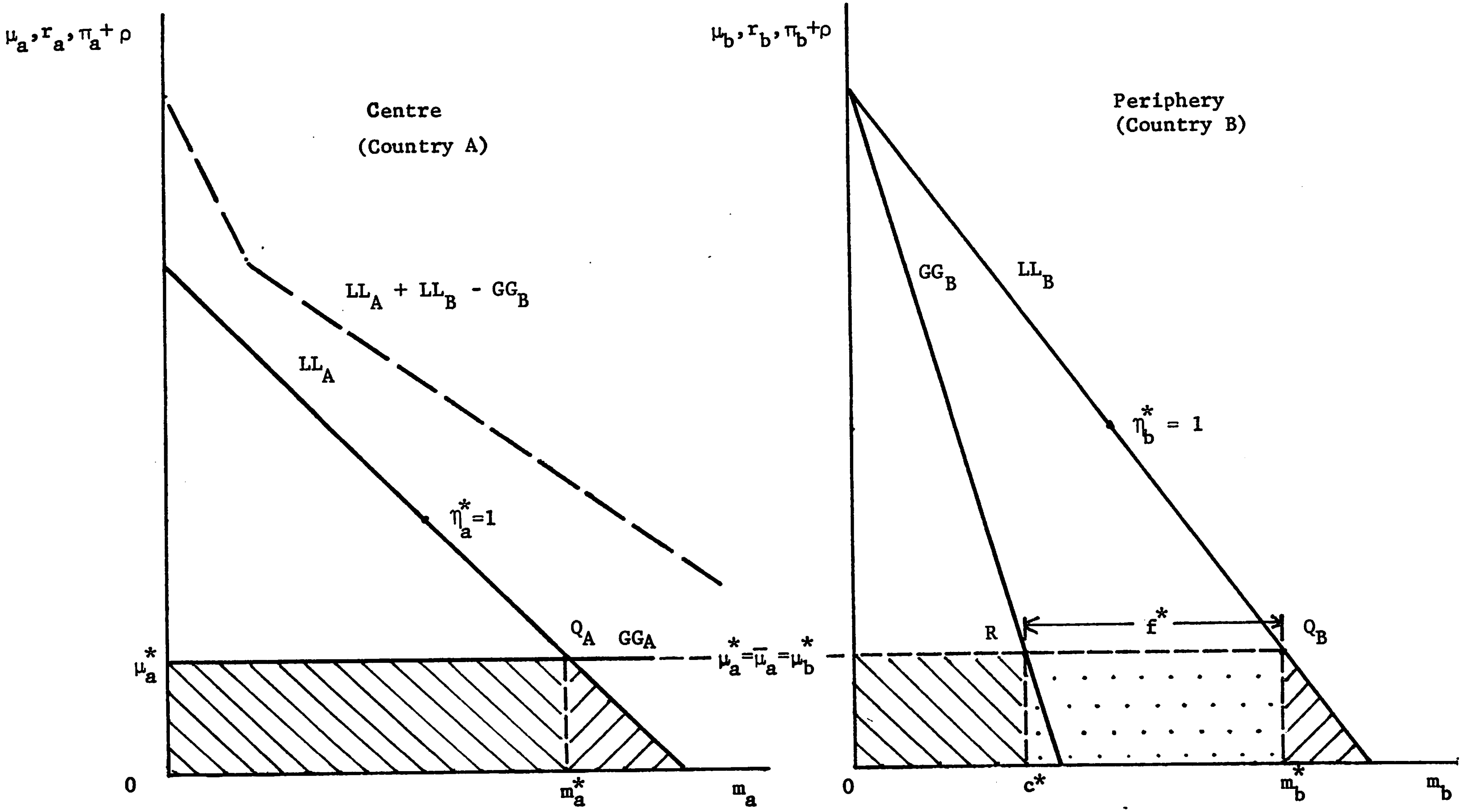
Equation (11) implies that in the long run, and indirectly, the fiscal deficit of a peripheral country, net of debt interest, is wholly determined by the growth rate of money in the centre. In particular, the peripheral fiscal deficit is an increasing function of the centre's money growth rate, provided that $0 < \bar{\mu}_a < k_b/2\alpha_b$. The notion that monetary dependence entails such a well-defined degree of fiscal dependence--regardless of the dependent economy's relative size--is unorthodox. On the other hand, Brunner (1976) obtains a similar implication from an analysis that abstracts from interest payments and steady inflation but is richer than ours in several other respects.

Consider finally the division of B's monetary base into domestic and foreign source components. Define B's international reserve ratio by $\phi \equiv f/m_b$, and assume this ratio is pegged by B's public sector to some fraction between zero and unity:

$$(12) \qquad f^* = \bar{\phi} m_b^* \quad [= \bar{\phi}(k_b - \alpha_b \bar{\mu}_a)] \ , \ 0 < \bar{\phi} < 1 \ .$$

Thus, real intensive international reserves are an increasing function of B's international reserve ratio and, indirectly, a decreasing function of A's growth rate of money.

This model is portrayed by Figure 6. Real intensive money demand by A's private sector is shown by the LL_A schedule. A's government policy schedule, GG_A, determines the world growth rate of money and, therefore, the



$\mu_a, r_a, \pi_a + \rho$
Centre
(Country A)
$LL_A + LL_B - GG_B$
LL_A
$\eta_a^* = 1$
Q_A
GG_A
μ_a^*
0
m_a^*
m_a
$\mu_a^* = \bar{\mu}_a = \mu_b^*$
$\mu_b, r_b, \pi_b + \rho$
Periphery
(Country B)
GG_B
LL_B
$\eta_b^* = 1$
R
f^*
Q_B
0
c^*
m_b^*
m_b

Figure 6

world growth rate of prices: $\pi_a^* = \pi_b^* = \bar{\mu}_a - \rho$. These schedules intersect at Q_A to determine the equilibrium real intensive money balances held by A's private sector, m_a^*; A's equilibrium fiscal deficit net of debt interest, δ_a^* (see left-hand shaded rectangle); and the welfare cost from the standpoint of A residents (see left-hand shaded rectangle). It is a simple matter to redraw the left-hand panel for the case of an exogenous fiscal deficit rather than an exogenous growth rate of money.

In the periphery the private sector's demand for money is shown by LL_B. The schedules LL_B and GG_A (horizontally extended) intersect at Q_B to determine the equilibrium real intensive money balances held by B's private sector, m_b^*; B's equilibrium fiscal deficit net of debt interest, δ_b^* (see right-hand shaded rectangle plus right-hand dotted rectangle); and the welfare cost from the standpoint of B residents (see right-hand shaded triangle). The public sector's demand for international reserves is shown by GG_B, which intersects with GG_A (horizontally extended) at R to determine the division of B's monetary base into its equilibrium real intensive domestic source component, c*, and equilibrium real intensive international reserves, f*.

According to the foregoing account, there is no "seignorage problem". On the Mundell-Claassen view, by contrast, international reserves do not earn interest, and therefore generate an ongoing transfer from the periphery to the centre. Put another way, the periphery must run a sustained balance-of-payments surplus, equal to the area of the dotted rectangle, to prevent reserves from dwindling in real intensive terms. In this case the aggregate demand for the centre's currency is described by $LL_A + LL_B - GG_B$; Figure 6 refers. In contrast to the case of interest-bearing reserves, a shift in the periphery's international reserve ratio will now affect the variables determined by the left-hand panel of Figure 6. For example, a reduction in that ratio will now reduce the centre's real intensive monetary base, thereby causing a temporary overshoot of the world rate of inflation.

V. DEPENDENT ECONOMIES UNDER EXOGENOUS FISCAL DEFICITS

This section considers dependent economies under pegged fiscal deficits net of debt interest, rather than pegged international reserve ratios. It is necessary at the outset to modify the Section IV assumptions in at least one other respect, for a key implication of those assumptions is that a dependent economy ultimately must relinquish control over its fiscal deficit net of debt interest regardless of whether its international reserve ratio is pegged or not.

One possibility is that international reserves do not earn interest (see last paragraph of Section V), in which event we may respecify B's long-run government budget constraint (11) as

$$\text{(13)} \qquad \bar{\delta}_b = \tilde{\mu}_a c^* \; [= \tilde{\mu}_a (k_b - \alpha_b \tilde{\mu}_a - f^*)] \; .$$

It follows that equilibrium real intensive international reserves, f^*, are a decreasing function of B's fiscal deficit and an ambiguously-signed function of A's growth rate of money.[22] The tilda superscript has the same meaning as in Section III, and reflects a point made in Section IV: an analysis of inflation in dependent economies can proceed without having first to explain the cause of monetary growth in the centre. The ambiguous sign of $\partial f^*/\partial \tilde{\mu}_a$ is investigated in Section VI.

Alternatively, the required respecification of equation (11) follows from the assumption that reserves do earn interest, but public-sector behaviour is such that a revenue flow $\bar{\mu}_a f^*$ is retained and disbursed within B's central-banking system ("Christmas bonuses to bank employees") rather than turned over to Treasury's consolidated revenue. Such an arrangement could also be represented by equation (13), with the caveat that the left-hand side of (13) would then measure a more narrowly defined fiscal deficit.

In either event the relevant diagram is Figure 7. The extended horizontal line shows the exogenously-determined world rate of growth of nominal variables, $\tilde{\mu}_a$, intersecting with B's private money demand schedule LL_B at Q to determine B's equilibrium money stock, m_b^*, and B's welfare cost (see shaded triangle). The rectangular hyperbola GG_B shows B's policy schedule in the present case. The extended horizontal line and GG_B intersect at R to divide B's monetary base into an equilibrium domestic source component, c*, and equilibrium international reserves, f*. The shaded rectangle shows B's fiscal deficit (or, alternatively, the exogenous part thereof; see above), and the dotted rectangle shows the revenue generated by B's international reserves. Discussion of points S and T, and the associated construction lines CC_S and CC_T, is deferred to Section VI.

An increased fiscal deficit will shift GG_B to the right, thereby increasing c* and reducing f* by identical amounts, with no effect on B's overall monetary base m_b^*. This is essentially a simple "monetary" explanation of reserve losses in a dependent economy, together with an explanation of the concurrent increase in domestic credit. By contrast, the monetary approach to the balance of payments typically assumes that such increases are exogenous.

VI. DEPENDENT ECONOMIES, IMPORTED INFLATION, AND INTERNATIONAL LIQUIDITY

Both our models of a dependent economy yield the standard prediction that in the long run, an increase of 1 percentage point in foreign price and monetary growth will raise domestic price and monetary growth by the same amount. But there is no standard answer to the question: what is the effect of an increase in foreign price and monetary growth on a dependent economy's equilibrium real international liquidity, as measured either by long-run real intensive international reserves, f*, or by the long-run

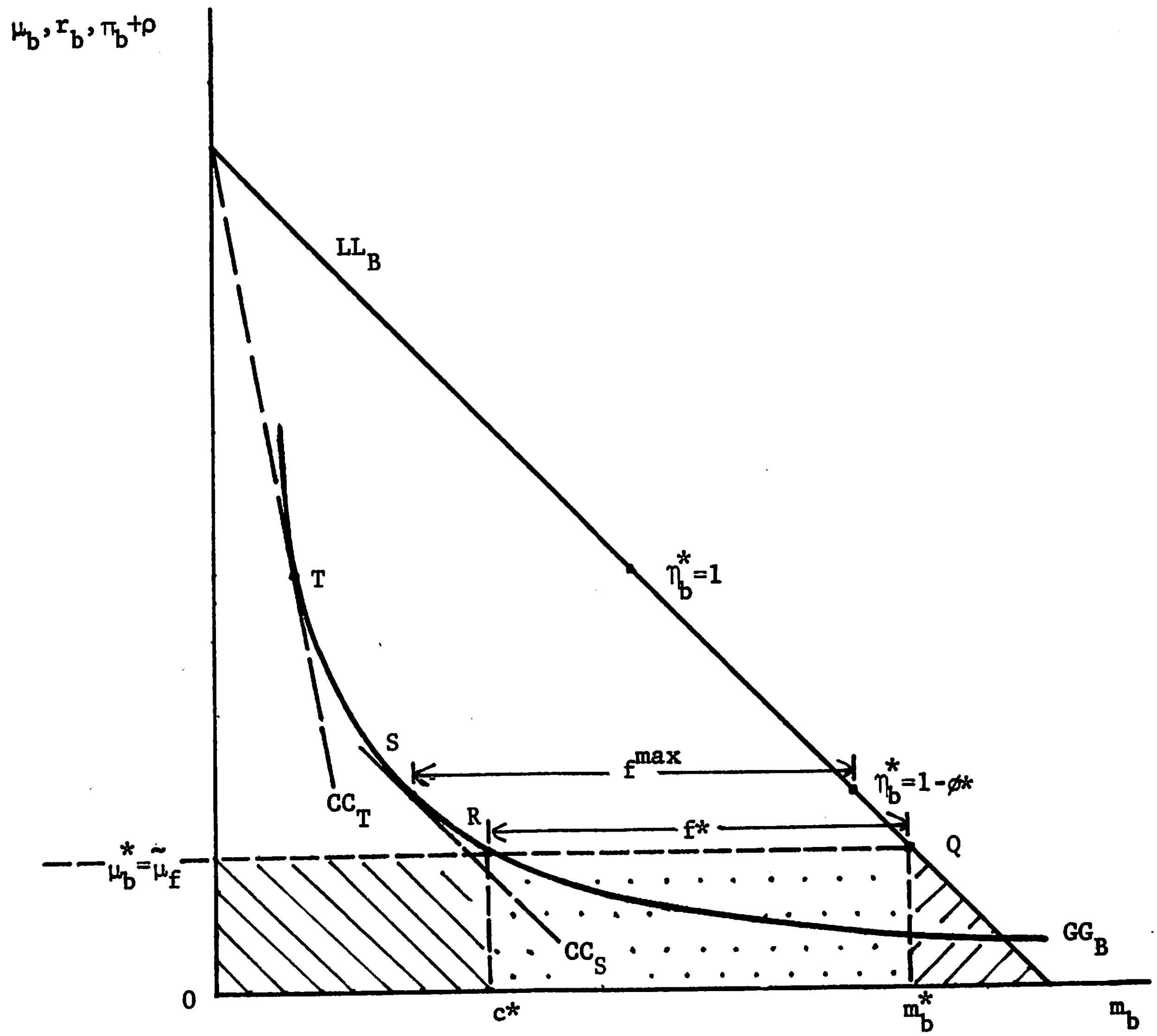

$\mu_b, r_b, \pi_b+\rho$
LL_B
$\eta_b^*=1$
T
S
f^{max}
$\eta_b^*=1-\phi^*$
CC_T
R
f^*
Q
$\mu_b^*=\tilde{\mu}_f$
CC_S
GG_B
0
c*
m_b^*
m_b

Figure 7

international reserve ratio, ϕ^*? This section derives the theoretical answers to such a question that are implied by the fixed international reserve ratio hypothesis of Section IV and by the fixed fiscal deficit hypothesis of Section V. It also investigates the actual postwar association between worldwide inflation and the international reserve ratios of each of the non-U.S. countries in Table 4. This enables us to make some progress towards discriminating between the two alternative hypotheses on the public-sector behaviour of dependent economies.

The relevant theoretical implications of the Section IV model are obvious. Inspection of the right-hand panel of Figure 6 reveals that an increase in foreign price and monetary growth will reduce long-run real intensive international reserves, and, by assumption, have no effect on the long-run international reserve ratio.

The theoretical issue is more interesting in a Section V setting. Refer again to Figure 6. Point S there is located by drawing a line CC_S that is parallel to the money demand schedule LL_B and tangent to the government policy schedule GG_B. Now if foreign monetary growth $\tilde{\mu}_f$ were equal to the height of S above the horizontal axis, then f^* would be maximized (for any given value of $\bar{\delta}_b$). Such a growth rate of money would also render the long-run interest elasticity of B's money demand, η_b^*, equal to $1 - \phi^*$, the ratio of B's domestic credit to her overall monetary base.[23] It follows that if $\tilde{\mu}_f$ were always sufficiently low to ensure that $\eta_b^* < 1 - \phi^*$, then an increase in $\tilde{\mu}_f$ within such a range would <u>increase</u> f^* (but vice versa if the relevant range were characterized by $\eta_b^* > 1 - \phi^*$). The Section IV model, on the other hand, predicts (without any condition on η_b^*) that an increase in $\tilde{\mu}_f$ will <u>reduce</u> f^*.

These opposed predictions do not lead to a usable test, however. For it turns out that postwar values of $1 - \phi^*$ have an ambiguous relationship to post-war values of η_b^*, at least in the case of the non-U.S. countries set out in Table 4. (Values of $1 - \phi^*$ are easily deduced from Table 5 below.)

Fortunately there is another, usable test; again Figure 6 refers. Point T is located by drawing a line CC_T that passes through the point of intersection of LL_B with the vertical axis and is tangent to GG_B. If $\tilde{\mu}_f$ were equal to the height of T above the horizontal axis, then ϕ^* would be maximized (for any given value of $\bar{\delta}_b$). Such a $\tilde{\mu}_f$ would also render η_b^* equal to unity.[24] It follows that if $\tilde{\mu}_f$ were always sufficiently low to ensure that $\eta_b^* < 1$, then an increase in $\tilde{\mu}_f$ within such a range would <u>increase</u> ϕ^*.

Now we have already made considerable use of the "stylized fact" that $\eta^* < 1$ since 1950. This inequality almost certainly holds for the non-U.S. countries of Table 4, and we also have the required increases in moving averages of $\tilde{\mu}_f$; again Table 4 refers. In short we now have useful opposed predictions. All that remains is to consider corresponding moving averages of ϕ^* ratios; Table 5 refers.

Table 5 does not show increases in ϕ^* as we move from the first column to the third column. Indeed, ϕ^* would seem to be roughly trendless in most cases. Thus the evidence is more consistent with the fixed reserve ratio hypothesis than the fixed deficit hypothesis. That is not altogether surprising in view of the relatively artificial assumptions on public-sector behaviour that were required for motivating the Section V model.[25]

TABLE 5

Postwar International Reserve Ratios in Selected Countries

With Fairly Stable Dollar Parities

	1952-67	1967-72	1972-78
Australia	.59	.70	.60
Canada	.79	.79	.51
Germany	.77	.73	.78
Japan	.71	.37	.32
United Kingdom	.38	.40	.37

Source and Method: *International Financial Statistics*, various issues; international reserve ratio of country i ≡ i's Line 11 ÷ i's Line 14.

VII. CONCLUDING COMMENTS

Harberger (1978) raises the following issue:

> "But while we can assert with great confidence that monetary expansion is in a sense the proximate cause of inflation, we should not be too smug about it, for it only pushes the explanation one step back. The car rolls down the hill when somebody takes the brake off, but who does that, and why?"
> (Harberger, 1978, p. 511)

Citing postwar episodes, Harberger proceeds to argue that fiscal deficits should be regarded as the next step back towards an explanation of inflation. By contrast, traditional long-run theory postulates that the rate of monetary expansion is exogenous, unless the country under consideration is "peripheral" in a fixed-exchange-rate system. Accordingly, this paper extended the traditional theory by analyzing the case of endogenous monetary growth together with an exogenous fiscal deficit (net of debt interest). One interesting finding for this case is that unless the country under consideration is peripheral, a given percentage increase in its fiscal deficit will generally induce a magnified increase in the growth rates of domestic money and prices. The logic of this result turns out to be analogous to that underlying the "overshooting proposition", which asserts that during the transition from low to high price and monetary growth, the inflation rate will on average exceed the difference between monetary and real output growth. The analogy is not exact, however, because our result refers to comparative steady states, not transients.

Footnotes

[1]Technical side-issues are relegated to footnotes. The level of exposition is similar to that of Corden (1977).

[2]This definition differs from one popular economic usage: for countries that do not face exogenously given terms of trade.

[3]During the transition from low to high price and monetary growth, the inflation rate will on average exceed monetary growth less real output growth. Miller and Upton (1974) attribute this proposition to Milton Friedman, thus dubbing it the "Friedman surge effect". No doubt there are precursors.

[4]Denote the growth rate of population by n, and denote the rate of labour-augmenting technical progress by λ. It follows that $\rho = n + \lambda$. Note that each of these three rates is assumed to be equal from one country to another.

[5]The subsequent analysis can be rigorously justified by postulating identical consumers each with a strongly separable utility function that is quadratic in the good produced by the monopolist and linear in one other commodity ("other goods"). In consequence the welfare cost triangle in Figure 1 is unambiguous; CV and EV are the same.

[6]In the Sidrauski (1967) framework this would pose the problem of a divergent objective functional, but the simple golden rule presumably could be recovered by invoking the "overtaking" optimality criterion; see Weizäcker (1965).

See Miller and Upton (1974) for a clear exposition of positive golden rules in monetary economies.

[7]Cagan and Bailey postulated a semilog demand function; here and elsewhere in this paper, it makes no essential difference whether one uses a linear or semilog form. On the other hand, the analysis does not go through under the double-log (constant elasticity) form. Essentially we require demand functions that conform to what has been termed "Marshall's Law": the (absolute value of the) price elasticity of demand must increase with price.

[8]Formally, and assuming without loss of generality that each of the B bonds is a £1 p.a. consol, we have

$$G - T + (B - \dot{B}/r) = \dot{M}$$

in nominal terms. Upon defining $B/Pyr \equiv b$ we can rewrite the above as

$$\delta + [(r - \pi - \rho)b - \dot{b} - (\dot{r}/r)b] = \dot{m} + (\rho + \pi)m$$

which is in real intensive terms. In steady state this reduces to

$$\delta + (r - \mu)b = \mu m.$$

(Here and elsewhere, this paper is silent on the vexed issue of adjustment paths--autoregressive versus rational expectations and all that. It is also silent on the related problem of what determines the level of b*; it suffices for our purposes that b* be determinate.) Finally, invoke the simple golden rule to obtain the expression in the text.

[9] It might appear that this formula neglects the Swan (1970)-Auhrenheimer (1974) point: since our result is simply the linear-demand-curve counterpart of Cagan's (1956) solution (viz., $\mu^* = 1/\alpha$) it seemingly disregards the fact that money is durable and therefore yields a once-over "setup" gain to the issuer. But it is easily verified that Auhrenheimer's formula reduces to the standard Cagan result if the interest rate conforms to the simple golden rule.

[10] The qualification "post 1950" is necessary, since Cagan's (1956) study of seven hyperinflations (all before 1950) yielded elasticities greater than unity.

[11] Part of the explanation may stem from the fact that the marginal revenue from money creation, $k - 2\alpha\mu$, decreases with the growth rate of money, whereas the marginal deadweight efficiency loss, $\alpha\mu$, increases with that rate. Thus the marginal "collection cost" of revenue from money creation, $(\mu/2)/[(k/2\alpha) - \mu]$, is a strongly increasing function of monetary growth, assuming $\mu < k/2\alpha$.

[12] This tacitly assumes, inter alia, that t is non-distorting (e.g., a poll tax).

[13] What about the corresponding figures for the 1950s and 1960s? Whereas equation (2) assumes the ratio of interest-bearing public debt to GNP is stationary over the "long" period one chooses to study, in fact the U.S. debt ratio declined sharply throughout the two postwar decades preceding the 1970s, as the massive U.S. war debts of the 1940s were amortized without being rolled over. Hence the figures in question do not clearly conform to (2).

[14] Note too that if US monetary growth caused US inflation (and fiscal deficits) during the 1950s and 1960s, then it is natural to hypothesize that US monetary growth caused price and monetary growth in various peripheral economies. However Feige and Johannes (1979) report that Haugh tests and Sims tests on monthly data reject such hypotheses. On the other hand, it is by no means settled that these tests are relevant to a "long-run" (or even short-run) causality hypothesis. Also, the results of earlier Sims tests by Genberg and Swoboda (1975) were somewhat more favourable to simple monetarism, although these authors focused on "world" (rather than US) monetary growth.

[15] The algebra is as follows. From (3):

$$1 = m^*(d\mu^*/d\bar{\delta}) - \alpha\mu^*(d\mu^*/d\bar{\delta}) = m^*(1-\eta^*)(d\mu^*/d\bar{\delta}) \,.$$

Thus

$$d\ln\mu^*/d\ln\bar{\delta} = (\mu^* m^* \cdot d\mu^*)/(\mu^* \cdot d\bar{\delta}) = m^*(d\mu^*/d\bar{\delta}) = 1/(1-\eta^*) > 1.$$

That is, a 1 percent increase in the fiscal deficit (net of debt interest) will raise long-run monetary growth by more than 1 percent.

Cagan's (1956) semilogarithmic money demand function, $k\exp(-\alpha\mu^*)$, yields the same elasticity formula, viz. $1/(1-\eta^*)$.

[16]At first sight the well-known study by Barro (1977) incorporates similar notions. On closer inspection, however, the Barro model is seen to be more like our Section I model: long-run monetary growth is assumed to be independent of public purchases and taxes.

[17]These definitions presuppose a traditional two-sector trade model (i.e., a distinction between "exportables" and "importables") with specialization in production. The analysis applies equally to a two-sector model with "tradeables" and "non-tradeables", provided that money demand and the fiscal deficit are both independent of the relative prices of goods. (Currently there is no accepted theory of the role of relative prices in either money demand or the fiscal deficit.) Alternatively, pace Mundell (1972), one can think of a world in which there is only one good produced and consumed.

[18]Adding ρ to both sides of (4) also yields:

$$r^* = r_f^* + \epsilon^*,$$

that is, (long-run) interest rate parity. In our model, however, this standard relationship is not a deduction from the assumption of perfect capital mobility (our analysis is silent on international capital mobility), but from the assumption of equal real output growth rates at home and abroad, together with the "simple golden rule" that was introduced in Section I.

[19]I am indebted to J. M. Parkin for the idea underlying the remainder of this section.

[20]The simplest way rigorously to justify this set up is to assume a fixed-endowment model wherein individuals at home and abroad are identical and fixed in number, there is only one good and no equity or bonds, there are two Friedman-style helicopters distributing the monies and where utility functions are strongly separable between "goods" and "real balances" (linear in the former and quadratic in the latter) and characterized by a zero rate of time preference.

[21]The foregoing list is not exhaustive. A richer analysis would allow for non-dollar-denominated assets in official portfolios, such as gold, SDRs, the pound sterling, and the French franc. Another desirable addition would be investigation of aggregation up to a single "world" market for money, as proposed by, e.g., Parkin (1974) and Harberger (1978). Our analysis, by contrast, confines attention to aggregation up to a market for "n^{th} currency", on the one hand, and a market for non-n^{th} currency, on the other, with supply in the latter effectively determined by equilibrium in the former. In consequence, and in contrast to Parkin (1974) and Harberger (1978), the n^{th} country's currency is effectively the only high-powered money of the entire n-currency system.

[22]The same implications may be derived from international reserves that earn interest at a rate less than, and proportional to, $\tilde{\mu}_a (= r_a^*)$. Such an arrangement has been proposed for SDR's: the proportion currently mentioned is 0.8.

[23]At S: slope of LL_B = slope of GG_B,

i.e., $d(k_b - \alpha_b\mu_b^*)/d\mu_b^* = d(\bar{\delta}_b/\mu_b^*)/d\mu_b^*$,

i.e., $-\alpha_b = -\bar{\delta}_b(\mu_b^*)^{-2}$, or $\alpha_b\mu_b^* = c_b^*$

Hence $\eta_b^* = 1 - \phi^*$, as required.

Cagan's (1956) semilogarithmic specification of money demand yields the same result--cf.n. 15.

[24]At T: slope of CC_T = slope of GG_B,

i.e., $\partial[(1-\phi^*)(k_b - \alpha_b\mu_b^*)]/\partial\mu_b^* = d(\bar{\delta}_b/\mu_b^*)/d\mu_b^*$,

i.e., $-(1-\phi^*)\alpha_b = -\bar{\delta}_b(\mu_b^*)^{-2}$, or $\alpha_b\mu_b^* = m_b^*$.

Hence $\eta_b^* = 1$, as required.

Again, the semilogarithmic money demand function yields the same result.

[25]Recall in particular the second and third paragraphs of Section V.

References

Auernheimer, L. (1974) "The Honest Government's Guide to the Revenue from the Creation of Money," Journal of Political Economy 82, 598-606.

Bailey, M. J. (1956) "The Welfare Cost of Inflationary Finance," Journal of Political Economy 64, 93-110.

Barro, R. (1977) "Unanticipated Money Growth and Unemployment in the United States," American Economic Review 67, 101-15.

Brunner, K. (1976) "A Fisherian Framework for the Analysis of International Monetary Problems," in J. M. Parkin and G. Zis (eds.), Inflation in the World Economy, Manchester University Press, 1-37.

Cagan, P. (1956) "The Monetary Dynamics of Hyperinflation," in: M. Friedman (ed.), Studies in the Quantity Theory of Money (University of Chicago Press: Chicago), 25-117.

Claassen, E. (1972) "Optimum Balance of Payments Deficit: Comment," in E. Claassen and P. Salin (eds.), Stabilization Policies in Interdependent Economies (North-Holland: Amsterdam), 91-4.

Corden, W. M. (1977) Inflation, Exchange Rates and the World Economy: Lectures on International Monetary Economics (Clarendon Press: Oxford).

Dutton, D. S. (1971) "A Model of Self-Generating Inflation: The Argentine Case," Journal of Money, Credit and Banking 3, 245-62.

Feige, E. L. and J. Johannes (1979) "Has the United States been the Catalyst for Worldwide Inflation?" Working Paper #7913, Social Systems Research Institute, University of Wisconsin, Madison.

Friedman, M. (1969) "The Optimum Quantity of Money," in: The Optimum Quantity of Money and Other Essays (Aldine Publishing Co.: Chicago), 1-50.

Friedman, M. (1971) "Government Revenue from Inflation," Journal of Political Economy 79, 846-56.

Genberg, H. and A. K. Swoboda (1975) "Causes and Origins of the Current Worldwide Inflation," Graduate Institute of International Studies Discussion Paper #6.

Girton, L. and D. W. Henderson (1976) "Financial Capital Movements and Central Bank Behavior in a Two Country Short Run Portfolio Balance Model," Journal of Monetary Economics 2, 33-61.

Girton, L. and D. Roper (1977) "A Monetary Model of Fixed and Flexible Exchange Rates Applied to the Postwar Canadian Experience," American Economic Review 67, 537-48.

Harberger, A. C. (1978) "A Primer on Inflation," Journal of Money, Credit and Banking, 505-21.

Kingston, G. H. and S. J. Turnovsky (1978) "A Small Open Economy in an Inflationary World: Monetary and Fiscal Policies under Fixed Exchange Rates," Economic Journal 88, 18-43.

Laidler, D. E. W. (1977) "The Welfare Costs of Anticipated Inflation in the Neoclassical Theory," in: E. Lundberg (ed.), Inflation Theory and Anti-Inflation Policy (Macmillan: London).

McKinnon, R. I. (1972), Comment on p. 87 of E. Claassen and P. Salin (eds.), Stabilization Policies in Interdependent Economies (North-Holland: Amsterdam).

Miller, M. H. and C. W. Upton (1974) Macroeconomics: A Neoclassical Introduction (Irwin: Homewood, Illinois).

Mundell, R. A. (1972) "The Optimal Balance of Payments Deficit," in E. Claassen and P. Salin (eds.), Stabilization Policies in Interdependent Economies (North-Holland: Amsterdam), 69-87.

Parkin, J. M. (1974) "Inflation: A World Problem," paper presented at the 1974-75 Session of the Manchester Statistical Society, Manchester, U.K.

Sargent, T. J. and N. Wallace (1973) "Rational Expectations and the Dynamics of Hyperinflation," International Economic Review 18, 59-82.

Sidrauski, M. (1967) "Rational Choice and Patterns of Growth in a Monetary Economy," American Economic Review (Papers and Proceedings) 57, 534-44.

Swan, P. L. (1970) "Durability of Consumption Goods," American Economic Review 60, 884-94.

Swoboda, A. K. (1973) "Monetary Policy under Fixed Exchange Rates: Effectiveness, The Speed of Adjustment and Proper Use," Economica 40, 136-54.

Turnovsky, S. J. (1978) "Macroeconomic Dynamics and Growth in a Monetary Economy: A Synthesis," Journal of Money, Credit and Banking 10, 1-26.

Weizäcker, C. C. von (1965) "Existence of Optimal Programs of Accumulation for an Infinite Time Horizon," Review of Economic Studies 32, 85-104.