ADAM SMITH AND THE MONETARY APPROACH TO THE BALANCE OF PAYMENTS*

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This article attempts to resolve what Jacob Viner in his classic *Studies in the Theory of International Trade* [4; p. 87] and D. P. O'Brien in his *The Classical Economists* [2; p. 146] refer to as a major mystery in the history of economic thought. The mystery is Adam Smith's failure in the *Wealth of Nations* to incorporate either the quantity theory of money or the Humean price-specie-flow mechanism (two concepts with which he was thoroughly familiar and which formed the core of the classical theory of international adjustment) into his analysis of the balance of payments. Far from using these concepts to explain how excessive money growth inflates prices and how the resulting rise in domestic relative to foreign prices induces a trade balance deficit and a consequent outflow of specie, Smith contended that excess money would be drained off through the balance of payments without affecting prices.

Why did Smith fail to incorporate quantity theory and price-specie-flow elements into his discussion of the international monetary mechanism? It is argued below that the answer lies in his adherence to what is now known as the *monetary approach to the balance of payments*. That approach denies the validity of both the quantity theory of money and the price-specie-flow mechanism in the case of the small open economy operating under fixed exchange rates.[1] It rejects the price-specie-flow concept on the grounds that prices in the small open economy are determined in world markets and cannot deviate from foreign (i.e., world) prices. Likewise, it rejects the quantity theory on the grounds that since money flows in through the balance of payments to support the predetermined price level, causation necessarily runs from prices to money rather than from money to prices, contrary to the predictions of the quantity theory. Given the monetary approach's rejection of both the quantity theory and price-specie-flow concepts in the case of the small open economy operating under fixed exchange rates, it is not surprising that Smith, to the extent that he adhered to that approach, would also ignore those concepts.

The purpose of this article is to show that Smith did indeed adhere to the monetary approach and that this explains his failure to incorporate quantity theory and price-specie-flow elements into his analysis of the international adjustment mechanism. As a preliminary, however, it is necessary to spell out the basic essentials of the monetary approach in order to document Smith's acceptance of those essentials. Accordingly, the first half of the article outlines the monetary approach itself while the second half shows what Smith had to say about that approach.

What is the Monetary Approach to the Balance of Payments?

To demonstrate that Smith was indeed a proponent of the monetary approach, it is necessary to spell out the essentials of that approach. Basically, the monetary approach is a framework for analyzing how integrated open national economies eliminate their excess money supplies and demands in a regime of fixed exchange rates. As usually presented, the framework distinguishes between the individual small open economy itself and the larger closed world aggregate of which it is a part.

In the case of the closed world aggregate, all the familiar propositions of closed-economy monetarism hold. World money supply and demand determine the world price level. That price level adjusts to clear the world market for money balances by equating the real (price-deflated) value of the nominal world money stock (the sum of the national money stocks converted into a common monetary unit at the fixed rate of exchange) with the world real demand for it so that all world money is willingly held. Any rise in the nominal money stock such that actual real money balances exceed desired real

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[1] Note that the quantity theory is rejected only in the case of the open economy under fixed exchange rates. Neither Smith nor modern proponents of the monetary approach deny the validity of the quantity theory in the case of the closed world economy. Nor do they deny its validity in the case of the small open economy under freely floating exchange rates. On the contrary, they argue that in both of these cases money determines prices just as the quantity theory predicts.

money balances induces a rise in world prices that restores monetary equilibrium by adjusting actual to desired real balances. In short, in the case of the closed world economy, price level changes constitute the adjustment mechanism that equilibrates money supply and demand and the quantity theory holds in the sense of causation running unidirectionally from money to prices.

In the case of the small open economy operating under fixed exchange rates and trading its goods on unified world markets, however, adjustment cannot occur through price level changes since prices are determined on world markets and given exogenously to the small open economy. Instead, adjustment takes place through the balance of payments as domestic residents export money and import goods to get rid of an excess money supply, or export goods and import money to eliminate an excess money demand. More specifically, a rise in the nominal money supply such that actual real cash balances exceed desired real balances will generate a balance of payments deficit which itself causes the excess supply of money to contract as these excess balances are traded for foreign goods and securities. Via the balance of payments deficit this contraction will continue until the excess money is eliminated and monetary equilibrium is restored. Conversely, a rise in the world (and hence domestic) price level such that actual real cash balances fall short of desired cash balances will induce a temporary balance of payments surplus as domestic residents act to correct the monetary shortfall by exporting goods in exchange for imports of money. In this case, flows of money through the balance of payments constitute the adjustment mechanism that equilibrates money supply and demand and causality runs from prices to money rather than vice-versa as in the quantity theory. These points are clarified in the analytical model underlying the monetary approach.

Basic Monetary Model

To illustrate how the small open economy achieves monetary equilibrium through the balance of payments, proponents of the monetary approach employ a simple expository model consisting of the following four equations:

(1)	$M_d = kPY$	demand for money
(2)	$M_s = C + R$	money supply identity
(3)	$P = EP_w$	law of one price
(4)	$M_s = M_d$	monetary equilibrium condition.

Equation 1 expresses the demand for money M_d as a stable function of the product of domestic prices P and the level of real output Y, with the constant coefficient k being the fraction of nominal income PY that people desire to hold in the form of cash balances.[2] The price level P is treated as given on the grounds that the small open economy is too small to influence world prices and thus is a price taker on world markets. Likewise, real output Y is taken as given on the grounds that the small open economy can sell all it wishes on the world market at given world prices and thus always produces the full capacity level of output.

Equation 2 defines the money stock in terms of the assets backing it, namely domestic credit C extended by the banking system and foreign exchange reserves R acquired through the balance of payments. Of these two components, only domestic credit is exogenous and under the control of the central bank. By contrast, the foreign reserve component (and thus the money stock itself) is endogenous, responding passively through the balance of payments to changes in money demand.

Equation 3 expresses the law of one price according to which the price equalizing effect of commodity arbitrage renders domestic traded goods prices P the same as world prices P_w converted into a common unit of account at the fixed exchange rate E. Both world prices and the exchange rate are assumed to be given, which means that domestic prices are determined on world markets and given exogenously to the small open economy.

Equation 4 is the monetary equilibrium condition according to which money supply M_s equals money demand M_d so that all money is willingly held and the market for cash balances clears. Equilibrium in this system is attained via flows of money (i.e., foreign exchange reserves) through the balance of payments. To see this, substitute equations 1 through 3 into equation 4 to get

$$(5) \quad R = kEP_wY - C$$

which says that under fixed exchange rates foreign exchange reserves R must adjust to offset changes in real output Y, world prices P_w, and domestic credit C. In short, the model states that reserve flows through the balance of payments adjust to maintain monetary equilibrium in the face of autonomous

[2] A slightly more complex money demand function used in empirical studies is

$$M_d = kPY^a i^{-b}$$

where i is the interest rate and a and b are the income and interest rate elasticities of the demand for money.

shifts in the determinants of money supply and demand. Recognizing that the change in reserves $\dot{R}$ is[3] defined as the state of the balance of payments B, the self-equilibrating role of reserve flows through the balance of payments can be summarized by the expression

$$(6) \quad B = \dot{R} = b(M_d - M_s).$$

Equation 6 says that the state of the balance of payments B and the associated change in reserves $\dot{R}$ depends upon the excess demand for money, being positive when there is excess money demand, negative when there is excess money supply, and zero in the absence of excess money supply and demand. In short, the equation implies that reserve flows act to correct the very monetary disequilibrium that induces them.[4] Here is the key idea of the monetary approach, namely that when actual cash balances fall short of desired cash balances people will correct the discrepancy by exporting domestic goods and securities in exchange for imports of money.

Key Propositions

The foregoing model yields at least six propositions that characterize and identify the monetary approach to the balance of payments. They include the following:

1. PRICE LEVEL EXOGENEITY. The general price level is determined on world markets by world money supply and demand and given exogenously to the small open economy, i.e., the latter is a price taker on world markets.

2. MONEY STOCK ENDOGENEITY. The money stock in the small open economy is an endogenous variable that adapts to any given money demand. Money demand cannot adjust to money supply since all its determinants are exogenous. Instead money supply adjusts to money demand and does so via reserve flows through the balance of payments.

3. MONEY STOCK COMPOSITION. The monetary authorities in the small open economy can control the composition but not the total of the money stock. Given money demand, a policy-engineered rise in the domestic credit component of the money stock will induce an equal and offsetting fall in the foreign reserve component leaving the total stock unchanged.

4. PRICE-TO-MONEY CAUSALITY. Money adjusts to prices, not prices to money, in the small open economy. Thus, an exogenous rise in the price level such that money demand exceeds money supply induces a net inflow of money through the balance of payments sufficient to eliminate the excess demand and to support the higher price level. Conversely, an exogenous fall in the price level such that money supply exceeds money demand induces an outflow of reserves and a corresponding contraction of the money stock. Via the balance of payments mechanism, money adapts to prices rather than prices to money as in the quantity theory. Contrary to that theory, money flows in and out through the balance of payments to support (validate) the predetermined price level.

5. ABSENCE OF RELATIVE PRICE EFFECTS. Relative price effects such as those envisioned in Hume's price-specie-flow mechanism play no role in the international adjustment process. Instantaneous commodity arbitrage and the law of one price preclude discrepancies between national price levels of the type described by Hume. With prices determined on world markets and given exogenously to the small open economy, there is no way that domestic prices can get out of line with foreign (i.e., world) prices for any significant length of time. This means that Hume's mechanism, with its assumed rise in domestic relative to foreign prices, is inoperative. Adjustment must therefore occur through another channel.

6. DIRECT EXPENDITURE EFFECTS. Adjustment occurs through direct spending (real balance) effects rather than through relative price effects. With relative price changes ruled out, monetary adjustment requires another channel. Accordingly, the monetary approach postulates a direct spending channel. As explained by the monetary approach, an excess supply of money induces a rise in spending as cashholders attempt to get rid of their excess money balances by converting them into goods. With prices given and real output at full capacity, however, the increased spending spills over into the balance of payments in the form of an increased demand for imports. The result is an import deficit financed by an outflow of money. In this manner the excess money is worked off through the balance of payments in exchange for net imports of foreign goods and securities. The spending ceases when the monetary excess is eliminated and money balances are restored to their desired levels. No relative price changes are involved.

Constituting the central analytical core of the monetary approach to the balance of payments, these propositions must be found in Smith's work if he is

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[3] The dot over the reserves variable denotes the rate of change (time derivative) of that variable.

[4] To show how reserve flows operate to restore monetary equilibrium in this system, simply substitute equations 1 through 3 into equation 6 to obtain

$$(6') \quad \dot{R} = b(\overline{R} - R),$$

where $\overline{R} \equiv kEP_wY - C$ denotes the equilibrium or money market-clearing level of reserves. Equation 6′ is a first-order nonhomogeneous differential equation expressing the rate of change of reserves as a function of the gap between their actual and equilibrium levels. Solving this equation for the time path of reserves yields

$$R(t) = (R_o - \overline{R})e^{-bt} + \overline{R}$$

where t is time, R_o is the initial disequilibrium level of reserves, e is the base of the natural logarithm system, and b is the adjustment coefficient showing the speed of adjustment of actual to equilibrium reserves. This expression states that when the adjustment coefficient b is larger than zero reserves will converge smoothly upon their equilibrium level with the passage of time as $t \rightarrow \infty$, thereby ensuring the restoration of monetary equilibrium.

to be considered a proponent of that approach. Accordingly, the following paragraphs show what he had to say on each of the propositions listed above.

Before presenting Smith's views, however, it may be useful to identify the typical economy he had in mind in his discussion of the international monetary mechanism. As pointed out by David Laidler [1; p. 190], Smith's monetary analysis is largely based upon the actual experience of Scotland in the mid-eighteenth century. Using Scotland as his model, he makes it clear that he is dealing with an open economy whose money stock is too small a portion of the world stock to influence world prices and which takes its price level as determined in world markets ("the great market of the commercial world"). He assumes this economy adheres to a gold standard monetary system with a convertible paper currency and fixed exchange rates. That is, he takes for granted a monetary system in which paper (banknote) currency is instantly convertible into specie at a fixed price upon demand. Finally, like most classical economists, he also takes full employment as the normal state of affairs. In short, he describes a fully-employed small open economy operating a convertible domestic (paper) currency linked to the international (specie) currency via a fixed rate of exchange. Given the similarities between his model and that of the monetary approach, it is small wonder that he enunciates the major propositions of that approach. His views on these propositions are presented immediately below.

Price Level Exogeneity

If the notions of price level exogeneity, money stock endogeneity, price-to-money causality, and the absence of relative price changes in the adjustment mechanism typify the monetary approach, then Adam Smith was indeed a strong proponent of that approach. With respect to price level exogeneity, he contended that the general price level is determined on world markets by specie supply and demand and then given exogenously to the small open economy. He reached this conclusion via the following steps.

First, he argued that the price of goods in terms of specie is determined in "the great market of the commercial world" by the world stock of specie, which depends upon the productivity of the mines. The world specie price of goods ("the proportion between the value of gold and silver and that of goods of any other kind"), he declares,

> depends in all cases, not upon the nature or quantity of any particular paper money, which may be current in any particular country, but upon the richness or poverty of the mines, which happen at any particular time to supply the great market of the commercial world with those metals. [3; pp. 312-13]

Here is the notion that world prices are determined on world markets by the world money stock.

Second, he held that the gold convertibility of the currency ensures that, once determined, these same world prices will also prevail in the small open economy. For according to him, such convertibility renders domestic paper money "equal in value to gold and silver money; since gold and silver money can at any time be had for it." And since convertibility renders paper money as good as gold, it follows, he said, that "whatever is either bought or sold for such paper, must necessarily be bought or sold as cheap as it could have been for gold and silver." [3; p. 308] In other words, domestic paper money prices will therefore be the same as world gold prices expressed in domestic currency units at the fixed domestic money price of gold.

Underlying Smith's analysis of the equivalence of domestic and world prices measured in terms of a common currency is the relationship

$$(7) \quad P = EP_w$$

expressing the domestic paper currency price of goods P as the product of the domestic currency price of gold E (a fixed exchange rate when currency is convertible) and the world gold price of goods P_w. Under a convertible currency (gold standard) regime, the domestic currency price of gold is a fixed constant determined by the specified gold content of the domestic monetary unit. That is, so long as the currency is convertible, the market price of gold in terms of domestic currency will tend to equal the official (fixed) mint price. Likewise, the world gold price of goods (a proxy for the world price level) will be taken as given by the small open economy since the latter is too small to influence world prices. And with the domestic currency price of gold and the world gold price of goods both given, it follows that their product, the domestic price level, is also determined on world markets and given exogenously to the small open economy. Smith used this logic, albeit implicitly, in concluding that the small open economy is a price taker on world markets.

Money Stock Endogeneity

The second proposition of the monetary approach states that the money supply in the small open economy is a passive, demand-determined variable that adapts itself to the needs of trade. In other words, the volume of trade or level of economic activity determines the demand for money to which the money stock, via demand-induced money flows through the balance of payments, passively responds. Via this mechanism, money adjusts to support the given level of economic activity, which means that the latter determines the size of the money stock in the small open economy.

That Smith endorsed this proposition is evident from his statement that

> . . . the quantity of coin in every country is regulated by the value of the commodities which are to be circulated by it . . . . [3; p. 408]

Increase the demand for coins, he said, i.e.,

> increase the consumable commodities which are to be circulated . . . by means of them, and you will infallibly increase the quantity. [3; p. 409]

For, according to Smith,

> When . . . the wealth of any country increases, when the annual produce of its labour becomes gradually greater and greater, a greater quantity of coin becomes necessary in order to circulate a greater quantity of commodities: and the people, as they can afford it, as they have more commodities to give for it, will naturally purchase a greater and a greater quantity . . . . The quantity of their coin will increase from necessity. [3; p. 188]

Like modern proponents of the monetary approach, he argues that the money supply adjusts to the needs of trade through the balance of payments as domestic residents export goods abroad in exchange for imports of money. Let the real output of domestic goods and services increase, he said,

> and immediately a part of it will be sent abroad to purchase, wherever it is to be had, the additional quantity of coin requisite for circulating them. [3; p. 408]

That is, if real output and hence the demand for money rise, part of the new output will be exported through the balance of payments to obtain imports of specie. These specie imports will augment the money stock, which thereby expands to meet the needs of trade. In this way the money stock passively adapts to the increased demand for it, just as the monetary approach predicts. To demonstrate this result, Smith constructs a simple analytical model consisting of a money demand function, a money supply identity, a law of one price relationship, and a monetary equilibrium condition.

Regarding the money demand function, he argued that the quantity of money required by a country bears a certain proportional relationship to the value of its annual produce. As he put it,

> The quantity of money . . . annually employed in any country, must be determined by the value of the . . . goods annually circulated within it. [3; p. 323]

Here is the notion of the stable money demand function

$$(8) \quad M_d = kPY$$

that underlies the monetary approach. Consistent with that approach, Smith treats the variables on the right hand side of this equation as fixed and given in his analysis of the international adjustment mechanism. Indeed he states as much in his discussion of the "channel of circulation" (his expression for the demand for money). He says that, given prices and assuming the volume of

> goods to be bought and sold being precisely the same as before, the same quantity of money will be sufficient for buying and selling them. The channel of circulation, if I may be allowed such an expression, will remain precisely the same as before. [3; p. 278]

As noted by David Laidler [1; p. 189], Smith's concept of a channel of circulation whose capacity to carry money is fixed given the prevailing level of commerce is equivalent to the modern concept of a stable money demand function whose price and real output arguments are given.

With respect to the money supply identity, he held that in a mixed (paper/metal) monetary system where banknotes are convertible into specie upon demand at a fixed price, the money stock M_s consists of the sum of banknotes N and specie S in circulation.[5] That is

$$(9) \quad M_s = N + S$$

where N is the purely domestic (paper) component of the money stock and S is the international (metallic) component. Smith's distinction between paper and specie corresponds to the monetary approach's distinction between the domestic credit and foreign reserve components of the money stock.

As for the law of one price, he implicitly assumed that the domestic currency (paper) price of goods P is identical to the world gold price of goods P_w converted into domestic monetary units at the market price of gold E (a fixed exchange rate when currency is convertible), i.e.,

$$(10) \quad P = EP_w.$$

[5] See Smith [3; p. 277] where he explicitly refers to banknotes as "paper money" and asserts that under convertibility such notes "come to have the same currency as gold and silver money, from the confidence that such money can at any time be had for them."

He then argued that under convertibility the exchange rate E is fixed and given by the designated gold weight of a unit of the domestic currency and that the gold price of goods is determined on world markets by the demand for and supply of that monetary metal. From this he concluded that domestic currency prices are also determined on world markets and given exogenously to the small open economy.

Finally, Smith stated the monetary equilibrium condition

(11) $M_s = M_d$

according to which the stock of money M_s equals the demand for it M_d thereby ensuring that the market for cash balances clears and that all money is willingly held. He expressed this condition when he declared that

> The value of goods annually bought and sold in any country requires a certain quantity of money to circulate and distribute them . . . and can give employment to no more. The channel of circulation necessarily draws to itself a sum sufficient to fill it, and never admits any more. [3; p. 409]

Smith's model can be condensed to one reduced-form expression by substituting equations 8 through 10 into equation 11 to obtain

(12) $S = kEP_wY - N$

which expresses the dependent specie variable S in terms of the independent variables that determine it. The equation predicts that changes in the independent variables will be matched by corresponding changes in the specie component of the money stock so as to maintain monetary equilibrium intact. On this basis, Smith concluded that rises in the level of domestic economic activity (i.e., EP_wY, the national product measured in domestic monetary units) would induce accommodative inflows of specie. In this way, the *money stock would expand to meet the increased* needs of trade. Said Smith,

> The quantity of money . . . must in every country naturally increase as the value of the annual produce increases. The value of the consumable goods annually circulated within the society being greater, will require a greater quantity of money to circulate them. A part of the increased produce . . . will naturally be employed in purchasing, wherever it is to be had, the additional quantity of gold and silver necessary for circulating the rest. The increase of those metals will in this case be the effect, not the cause, of the public prosperity. [3; pp. 323-24]

In short, a rise in the level of economic activity induces the very monetary expansion necessary to support it. Conversely, a fall in the level of economic activity induces a monetary contraction through the balance of payments since

> The same quantity of money . . . cannot long remain in any country in which the value of the annual produce diminishes. The quantity of money . . . which can be annually employed in any country, must be determined by the value of the consumable goods annually circulated within it [and] must diminish as the value of that produce diminishes . . . . But the money which by this annual diminution of produce is annually thrown out of domestic circulation, will not . . . lie idle [but] will, in spite of all laws and prohibitions, be sent abroad, and employed in purchasing consumable goods which may be of some use at home. [3; p. 323]

In short, an autonomous reduction in the demand for money will induce an equivalent contraction of the money stock as domestic residents export money through the balance of payments in exchange for imports of foreign goods. Here is the proposition that money is a dependent, demand-determined variable in the small open economy.

Composition of the Money Stock

Smith also employed the preceding model in enunciating the third proposition of the monetary approach, namely the notion that the monetary authorities can determine the composition but not the total of the money stock. Assuming a given money demand (the first term on the right-hand side of equation 12), he argued that an increase in the paper (banknote) component of the money supply would induce an equal and offsetting decrease in the metallic (specie) component leaving the total money stock unchanged. He traced a chain of causation running from increased paper to excess money supply to increased spending to balance of payments deficit and corresponding specie drain to elimination of excess money and the restoration of monetary equilibrium. Via this mechanism, paper, he declared, would displace an equivalent amount of specie thereby leaving the aggregate money stock unaltered. In Smith's words,

> . . . as the quantity of gold and silver, which is taken from the currency, is always equal to the quantity of paper which is added to it, paper money does not . . . increase the quantity of the whole currency. [3; pp. 308-9]

From this he concluded that

> The whole paper money of every kind which can easily circulate in any country never can exceed the value of the gold and silver, of which it supplies the place, or which (the commerce [and thus the demand for money] being supposed the same) would circulate there, if there was no paper money. [3; p. 284]

Paper, he says, could never exceed the quantity of metallic money that would otherwise circulate in its place. For,

> Should the circulating paper at any time exceed that sum, as the excess could neither be sent abroad nor be employed in the circulation of the country, it must immediately return upon the banks to be exchanged for gold and silver. Many people would immediately perceive that they had more of this paper than was necessary for transacting their business at home, and as they could not send it abroad, they would immediately demand payment of it from the banks. When this superfluous paper was converted into gold and silver, they could easily find a use for it by sending it abroad . . . . [This gold and silver therefore will] be sent abroad, in order to find that profitable employment which it cannot find at home. [3; pp. 284-5]

The result would be a temporary balance of payments deficit financed by an outflow of specie. Via this mechanism, an increase in the banknote component of the money supply would result in the expulsion of an equivalent quantity of specie leaving the total money stock unchanged. Here is the origin of the proposition that the banking system (including the central bank) can affect the composition but not the total of the money supply in the small open economy.

Price-to-Money Causality

The fourth proposition of the monetary approach holds that causality runs from prices to money in the small open economy operating under fixed exchange rates. According to this proposition, prices are determined in world markets by world money supply and demand. And once determined, these prices are given exogenously to the small open economy by the operation of commodity arbitrage, which ensures that prices are everywhere the same. Finally, money flows in through the balance of payments to support or validate the given price level. In this way, causality runs from prices to money in the small open economy contrary to the predictions of the quantity theory. That is, while the quantity theory applies at the level of the closed world economy, it does not apply to the small open economy operating under fixed exchange rates.

That Smith endorsed this proposition is evident from his discussion of specie flows into the small open economy. He argues that one cause of these flows is a rise in world (gold) prices due to the increased fertility of the mines.[6] Under a convertible currency regime the rise in world prices translates into an identical rise in domestic prices and a consequent rise in the nominal demand for money. This rise in money demand then induces an accommodating inflow of specie that augments the money stock. The cause of the specie inflow and consequent rise in the domestic money stock, says Smith, "is no doubt . . . the diminution of the value of the precious metals" resulting from "the increased abundance of the mines." [3; p. 188] Here is the essence of the anti-quantity theory or reverse causation view that prices cause money and not money prices in the case of the small open economy in a convertible currency regime.[7]

Adjustment Via Direct Expenditure Effects Rather Than Relative Price Effects

Finally, Smith adhered to the last two propositions of the monetary approach. Those propositions state that international adjustment takes place through direct spending (real balance) effects rather than through relative price effects such as those suggested by Hume. Relative price effects are ruled out on the grounds that commodity arbitrage renders the price of traded goods everywhere the same so that (assuming all goods are traded) domestic prices cannot deviate from foreign prices. With divergent price movements ruled out, adjustment of actual to desired money balances must occur through a direct expenditure channel running from an excess supply of money to the demand for imports of foreign goods and securities.

That Smith did indeed accept these propositions is evident from his discussion (quoted below) of trade balance deficits and specie flows. Whereas Hume

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[6] "The quantity of the precious metals may increase in any country [he says] from two different causes: either, first, from the increased abundance of the mines which supply it; or, secondly, from the increased wealth of the people, from the increased produce of their annual labour. The first of these causes is no doubt necessarily connected with the diminution of the value of the precious metals; but the second is not." [3; p. 188] In other words, specie inflows stemming from rises in the world money stock are inflationary whereas those induced by expansions in domestic real income are not inflationary since they merely represent a redistribution of an unchanged world money stock. Thus expansions in the world money stock raise prices while expansions in the *domestic money stock* (world stocks constant) have no effect on prices. The quantity theory applies to the closed world economy but not to the small open economy.

[7] Note that Smith rejects the quantity theory only in the convertible currency (fixed exchange rate) case. He fully accepts the theory in the case of the small open economy operating with an inconvertible paper currency. Indeed, he points to the monetary experiments of the North American colonies as evidence that such a paper currency can be overissued, causing it to depreciate relative to goods and gold. [3; pp. 309-312] That is, he contends that in the absence of convertibility, excessive growth of the domestic money supply will inflate all prices including the price of specie (i.e., the exchange rate between paper and gold). Here is the quantity theory notion that causality runs from money to prices and exchange rates in an inconvertible currency (floating exchange rate) regime.

had argued that a money-induced rise in domestic relative to foreign prices is what generates trade balance deficits and the consequent outflows of specie, Smith attributed these phenomena solely to money-induced rises in direct foreign expenditures. He said nothing about price level changes. In his view, an excess supply of money would induce an increase in expenditures as domestic residents sought to convert the unwanted money balances into goods and services. With the economy operating at full employment and with prices given, however, the increased expenditure would spill over into the balance of payments in the form of increased demand for imports. The result would be a temporary trade balance deficit financed by outflows of specie. This would continue until the excess money was eliminated and monetary equilibrium restored. As Smith himself expressed it, if more money "is poured into" the "channel of circulation" than that channel can possibly hold, the excess

> cannot run in it, but must overflow . . . . [The superfluity] must overflow, that sum being over and above what can be employed in the circulation of the country. But though this sum cannot be employed at home, it is too valuable to be allowed to lie idle. It will, therefore, be sent abroad, in order to seek that profitable employment which it cannot find at home. [3; p. 278]

That is, it will be "employed in purchasing foreign goods for home consumption." [3; p. 279] In short, via these direct expenditure effects and the resulting trade balance deficit,

> Gold and silver . . . will be sent abroad, and the channel of home circulation will remain filled with . . . paper, instead of . . . those metals which filled it before. [3; p. 278]

Here is Smith's endorsement of the direct expenditure channel postulated by the monetary approach. His acceptance of this channel rather than the alternative price-specie-flow channel helps resolve the so-called mystery of his failure to incorporate Humean relative price effects into his analysis of the international monetary mechanism.

Summary and Conclusions

This article has documented Adam Smith's adherence to what is now known as the monetary approach to the balance of payments. His adherence to that approach helps resolve what some commentators perceive as a puzzle in his writings, namely his failure to incorporate quantity theory of money and Humean price-specie-flow elements into his analysis of the international monetary mechanism. Far from being a puzzle, however, his neglect of these concepts is perfectly compatible with the logic of the monetary approach. Consistent with that approach, he rejects the quantity theory on the grounds that causality runs from prices to money in the small open economy, contrary to the predictions of the quantity theory. Similarly, he rejects the price-specie-flow idea on the grounds that prices are given exogenously to the small open economy and cannot deviate from foreign (world) prices. For this reason he concludes that adjustment must occur through direct expenditure (real balance) effects rather than through relative price effects, the same conclusion reached by the monetary approach.

The article also suggests that Smith merits more consideration as a monetary theorist than he is usually granted. For, by arguing that money demand in a small open economy is exogenously determined and that any excess money supply will be automatically drained abroad in the form of specie flows as individuals work off their excess cash balances by increasing their net foreign expenditures, Smith may be said to have laid the groundwork for the modern monetary approach to the balance of payments.

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A PRESCRIPTION FOR MONETARY POLICY 1981

Marvin Goodfriend

Our Current Economic Difficulties It is no secret that the performance of the U. S. economy was far from satisfactory in the '70s. For example, real GNP rose at a 3.1 percent average annual rate from 1969 to 1979 compared with a 4.2 percent average annual rate of growth in the '60s. Besides lower real growth, the economy experienced two recessions in the '70s, in 1970 and 1974, and another in 1980, compared with only one in the '60s, in 1960. In addition, the 1974 recession was the most severe since the '30s. So not only has the U. S. economy sustained lower average growth, but it has also suffered greater instability as well in the '70s compared with the '60s.

These output statistics are even more disturbing when one notes that civilian employment grew at a faster 2.1 percent rate in the '70s than the 1.6 percent rate of the '60s. That is, more people were taking jobs, but output per man-hour or productivity growth slowed in the '70s.

Things were no less unsettling in international economic relations. The '70s began with a series of speculative attacks against the dollar until finally in 1973 the fixed exchange rate system among major western trading nations was abandoned for more flexible exchange rates. Another wave of speculative attacks against the dollar occurred in the fall of 1978. This loss of confidence in the U. S. dollar was associated with the spectacular rise of the dollar price of gold to about $800. On November 1, 1978 the U. S. Government announced a major new program to support the dollar.

The economic difficulties just summarized have been severe, but the most pervasive and perhaps in the long run potentially the most dangerous economic problem of the '70s has been inflation. During the '60s the price level, as measured by the CPI, rose roughly 24 percent. During the '70s the price level rose roughly 98 percent. This means that the purchasing power of the U. S. dollar was roughly cut in half during the '70s. Inflationary anticipations rose along with actual inflation rates and so became incorporated into interest rates at which money was borrowed and loaned. Consequently, nominal interest rates rose on average throughout the decade. For example, 4- to 6-month prime commercial paper yielded roughly 3.8 percent in 1960, 7.7 percent in 1970, and 11 percent in 1979. In December 1980 it was yielding roughly 16.5 percent per annum. Further loss of confidence in the dollar, again highlighted by run-ups in gold and other commodity prices, eventually led the Federal Reserve to make its October 6, 1979 policy decision to move away from interest rate targeting and toward reserve targeting in order to better control the monetary aggregates.

What the Federal Reserve Can Do This last comment brings us to the Federal Reserve, and in particular to the question of what the Federal Reserve can do to contribute to economic stability.

As everyone knows, the Federal Reserve makes monetary policy. At the risk of oversimplification, there are two competing views of the way in which monetary policy should be carried out. One view argues that the Fed has responsibility to manage interest rates. In its extreme form, some have argued that the Fed should keep interest rates relatively low in order to facilitate borrowing, spending, and economic growth.

A second view recognizes that managing interest rates is an extremely tricky business. When the Fed attempts to move interest rates below a prevailing market rate, it must do so by buying government debt in the open market with "freshly printed money" so to speak.[1] In other words, the Fed must accelerate

[1] The Federal Reserve influences security prices and interest rates by buying or selling securities and thereby affecting their supply. Security purchases drive security prices up and interest rates down; sales do the opposite. When it buys a security, the Fed pays for it by essentially creating new money, money that hasn't been in circulation before, and when it sells a security the Fed receives money that had been in circulation, taking it out of circulation.

The money that the Fed pays out to purchase a security may be held as currency or bank reserves. If it is held as currency, the new money is associated dollar for dollar with an increase in the money supply. If it is deposited in the banking system and becomes bank reserves, it can support a multiple expansion of the money supply. In either case, the money supply rises when the Fed purchases a security; analogously, the money supply falls when the Fed sells a security.

money growth at least initially to try to depress interest rates. On the other hand, if for some reason the Fed sees fit to raise interest rates above a prevailing market rate, it must sell government debt in the open market and thereby reduce the money supply or reduce money growth.

The problem with attempting to move the interest rate away from some prevailing market rate in either direction is that resulting effects on money growth will eventually feed back on the inflation rate and, in turn, on anticipated inflation. And anticipated inflation will feed back on interest rates in the opposite direction from which the Fed wanted to move them. For example, if the Fed were to attempt to depress interest rates, more rapid money growth and higher inflation would put *upward* pressure on nominal interest rates as higher inflationary anticipations are built into nominal rates. This greater upward pressure on interest rates would force the Fed to buy greater quantities of government debt to keep interest rates down. But in so doing the Fed would further raise money growth, causing even higher inflation, anticipated inflation, and more upward pressure on interest rates. The ultimate consequence of this type of policy is an ever increasing rate of inflation. In order to bring inflation under control, the Fed would have to abandon its attempt to depress interest rates.

If actively attempting to manage interest rates is difficult, why shouldn't the Fed at least try to stabilize interest rates around a long-run value believed to be consistent with its policy goals? First of all, it is virtually impossible to know what that long-run value is. Second, even if the Fed knew it, cyclical changes in economic activity affect the supply and demand for money and credit and cause cyclical swings in interest rates necessary to clear the money and credit markets. Even if the Fed were to try to hold interest rates at an appropriate long-run average level, as soon as cyclical movement began forcing interest rates to deviate from that average, a cumulative process of increasing or decreasing money growth would develop. Eventually, the Fed would have to allow interest rates to fluctuate cyclically to regain control of the money supply.

Unfortunately, Fed policy in recent years has been characterized by attempts to smooth interest rate movements, attempts which have reluctantly been abandoned time and again in order to restore control over money growth and inflation. Moreover, since these efforts have usually involved an effort to keep interest rates too low, Fed policy has produced rising money growth on average, as well as our current high average inflation and interest rates. This experience explains why the Fed has had to temper its direct concern for interest rates. However desirable low and easily predictable interest rates may be, economically speaking it has not been possible for the Fed to actively try to deliver that ideal.

So what can the Fed do? The Fed can and should concentrate on controlling the money supply. Specifically, the Fed should provide as steady a rate of monetary growth as possible over months, quarters, and years. There is little doubt that with appropriate control procedures the Fed could produce such close monetary control. To do so, however, the Fed must abandon its direct concern for wide swings in interest rates. Ironically, only by initially ignoring interest rate movements can the Fed hope to bring interest rates down, because only in this way can the Fed bring money growth down to a reasonably low rate and thereby bring inflation, inflationary anticipations, and interest rates permanently down as well.

Of course, pursuing such a policy takes nerve because the desired effects on inflation and interest rates may not appear immediately, mainly because it takes time to convince people that the Fed is serious. And it may appear to many that the Fed should be able to cope with its present difficulties by doing something active rather than by merely maintaining a steady rate of money growth. In addition, some people are afraid that by reducing the rate of money growth the Fed must produce a recession. Certainly this could happen if, for example, the Fed were to cut money growth sharply and in particular without warning.[2] However, this is not necessary. In principle, the Fed can announce and carry out a sufficiently gradual reduction in money growth to minimize potential adverse effects on employment and output.

Criticisms of Strict Monetary Control In the previous section it was explained why direct attempts to manage interest rates are counterproductive and that the most reliable way to keep interest rates low is to maintain a low rate of money growth. Six often-heard criticisms of the feasibility and advisa-

[2] Friedman and Schwartz [2] present extensive documentation that sharp sustained reductions in money growth below trend have generally preceded recessions. Barro's [1] work supports the view that it is primarily when reduction in money growth has been unanticipated that it causes a reduction in economic activity. This work suggests that the Fed should not allow money to grow below its pre-announced targeted path without sufficient forewarning, for example, to speed the reduction in inflation. To do so would produce an unanticipated reduction in money growth that would run a particularly high risk of causing a recession.

bility of a policy of strict monetary control are addressed in this section.

First: On Discretionary Policy The first criticism argues against strict monetary control on the grounds that money growth should be manipulated as required to stabilize real economic activity and inflation over the short run. Unfortunately, it is at present impossible to reliably judge the short-run effects of alternative hypothetical monetary policy options on real economic activity. Econometric model simulations of competing policy options are theoretically unsound. That is, we don't yet have the *technical means* of deciding how alternately proposed rates of money growth will impact on inflation and employment in any relatively short time period, such as a year.[3]

Only the long-run effect of money on the economy is firmly and generally agreed upon. In the long run, money growth leaves real output growth relatively unaffected but it is the primary determinant of the rate of inflation.[4] This fact, coupled with knowledge that past attempts at discretionary policy have led to ever higher money growth rates, inflation, *and* interest rates, suggests that the Fed should accept a more modest goal of achieving and maintaining a reasonably low and steady rate of money growth.

Second: On Reducing Inflation Without Recession There seems to be a relatively widespread belief that reductions in money growth cannot decrease the inflation rate significantly over any reasonably short period of time without producing a recession. The late Arthur Okun's view is typical of such current pessimistic thinking about bringing down the rate of inflation. Okun's rule-of-thumb calculation is that the cost in terms of lost output per each 1 percentage point reduction in the inflation rate is 10 percent of a year's GNP. In the last months (August 1922-November 1923) of the great German hyperinflation of the 1920s, the inflation rate averaged roughly 300,000 percent at an annual rate, but the German inflation was virtually eliminated in early 1924 at the cost of roughly a 10 percent GNP gap. In other words, once a firm commitment to reduce money growth was established and meaningful economic reforms of the money supply process were put in place, the inflation was brought under control almost immediately and with a relatively small downward shock to output and employment.[5]

[3] See Lucas [5].

[4] Documentation on this is extensive. See, for example, Friedman and Schwartz [2].

[5] See Sargent [7].

There is an important lesson in the successful restoration of price stability following the German hyperinflation which is relevant for our own time. A reduction in money growth can bring the inflation rate down significantly in a short period of time, with relatively minor temporary reductions in real economic activity. But it must also be emphasized that for such a policy to work well, i.e., to affect inflation and not real economic activity, it is essential that the monetary authority announce and carry out real meaningful reform of its money growth policy. Suppose the monetary authority is truly committed to eventually bringing down money growth, but it moves in fits and starts or disguises its intentions, for example, to forestall criticism from groups hostile to its policies. Reductions in money growth, when they do come, will impact less on prices and more on real economic activity because there may be some doubt as to whether the money growth reductions will be sustained. The policy will work well only if the monetary authority establishes a commitment to bring money growth down that is credible to the financial markets and the public in general.

Third: On Financial Innovation A third argument against the feasibility of a policy of low and steady money growth starts with recognition that innovation in recent years in the financial markets has enabled a given rate of money growth to support more inflation. This point can be expressed with reference to the equation of exchange. The equation of exchange is written $MV = PY$ where $P \equiv$ the price level, $M \equiv$ the money supply, $V \equiv$ velocity, and $Y \equiv$ real output. PY is money income. The effect of financial innovation allowing the money supply to serve more efficiently is represented in the equation of exchange by a rise in velocity. Real output is essentially secularly independent of velocity and money. Therefore, given the money supply (M), a secular rise in velocity (V) leads to a secular rise in the price level (P), i.e., to inflation.

What are the implications for monetary policy of the increase in velocity due to innovations in cash management? Whether or not velocity is increasing due to financial innovation, the Fed must still concern itself with the long-run money growth rate, because as seen from the equation of exchange both secular money growth and secular velocity movement determine the secular inflation rate. If it so desires, the Fed can always cause money to grow at a slow enough rate to offset the effect of the secular rise in velocity on inflation. In any case, the Fed must maintain a reasonably low long-run rate of money growth to produce a reasonably low long-run inflation rate.

Fourth: On the Choice of Monetary Aggregate An old criticism of the feasibility of monetary control argues that it is unclear which monetary aggregate should be strictly controlled. However, it does not matter so much which aggregate is chosen for the modest goal of maintaining a reasonably low secular rate of inflation. It is true that secular velocity movement associated with different monetary aggregates may differ. However, as mentioned above the Fed can take secular velocity movement into account in setting the rate of money growth for any monetary aggregate it decides to target. By appropriately compensating for the relevant secular movement in velocity, the Fed can achieve and maintain a low rate of inflation by directly controlling and targeting any well-defined monetary aggregate.

Currently the Fed is emphasizing M1B.[6] It includes all readily checkable deposits and it is currently the most inclusive aggregate for which all data are available at weekly intervals. However, the Fed could just as reasonably commit itself to controlling a narrower monetary aggregate such as the monetary base, or a broader aggregate such as M2.[7] However, what is crucially important is that one aggregate alone is chosen so that the Fed is not tempted to switch between one aggregate and another as a means of avoiding strict monetary control.

Fifth: On the Government Budget Deficit Many people seem to argue that government budget deficits, in and of themselves, constitute an independent impediment to monetary control. But what is the link people have in mind by which the Fed must finance government deficits? Since the Federal Reserve-Treasury Accord in 1951, the Fed has been under no formal obligation to monetize the government deficit, i.e., buy government debt, to maintain a given level of interest rates. Often, people have in mind an informal political constraint under which the Fed responds to increased government borrowing demands by monetizing the deficit so as to prevent interest rates from rising to levels that might be embarrassing. But really there is no difference between increased government and private credit demands as far as the Fed is concerned; resistance to upward pressure on interest rates from either source involves increasing the money supply. If the Fed were not to attempt to resist interest rate movements, it would not have to monetize government or private credit demands. In other words, the association of money growth with government deficits, if it occurs, is simply the outcome of the Fed's interest smoothing policy.

Sixth: On the Payment of Competitive Interest on Deposits Some argue that allowing the payment of competitive rates of interest on deposits could make monetary control more difficult. In fact, lifting regulatory restrictions on deposits would actually allow improved monetary control. If competitive rates of interest were paid on deposits, interest differentials between various types of deposits and other money substitutes would exhibit less variation, and the incentive for the public to switch among deposits and other money substitutes due to interest rate fluctuations would be reduced. Reducing such fluctuations in the public's holdings of liquid assets would improve the accuracy with which the Fed could forecast those holdings and thereby improve the Fed's ability to control whatever monetary aggregate it chooses to target.[8]

The Post-October 6, 1979 Federal Reserve Operating Procedure Having made the case for strict monetary control in the previous two sections, it remains to discuss the procedure for controlling the money supply. The Fed can control the money supply by either using the Federal funds rate or the volume of bank reserves as its control instrument. In the first case, the Fed directly manipulates the Federal funds rate to produce the desired money supply. In the second case, the Fed provides bank reserves so as to produce the desired money supply.[9]

Prior to October 6, 1979 the Fed had been utilizing the Federal funds rate as the monetary control

[6] M1B consists of currency, demand deposits at commercial banks, ATS accounts, NOW accounts, credit union share drafts, and other checkable deposits at thrift institutions.

[7] The monetary base consists of currency and bank reserves. M2 consists of M1B, overnight RPs issued by commercial banks, overnight Eurodollar deposits held by U. S. nonbank residents at Caribbean branches of U. S. banks, money market mutual fund shares, savings deposits at all depository institutions, and small time deposits at all depository institutions.

[8] If legally required reserves were uniformly and solely applied to the monetary aggregate being controlled, reserves were assessed contemporaneously, and total reserves were employed as the instrument of monetary control, then monetary control might be relatively unaffected by legal ceilings on deposit rates. However, none of the above conditions exist at present. See footnote 17 and the discussion surrounding it.

[9] To directly fix the Federal funds rate, the Fed must buy or sell securities as the market requires to keep the rate fixed. On the other hand, to provide a specific volume of bank reserves, the Fed must buy or sell only the volume of securities necessary to achieve that desired volume of bank reserves, regardless of what happens to the funds rate.

instrument. But on that date the Fed, after concluding that the Federal funds rate was an unreliable instrument for controlling the money supply, decided to move to "reserve targeting," i.e., utilization of bank reserves as the instrument.[10]

Subsequently, it has come to be understood that reserve targeting cannot be adequately implemented within the lagged reserve requirement rules currently in force.[11] To see why, suppose the Fed were to attempt strict control of total reserves under lagged reserve accounting. When required reserves differed from targeted total reserves, the funds rate would begin to adjust to clear the reserves market. But under lagged reserve accounting, banks could not affect current required reserves. If the Fed were to stick to a targeted volume of total reserves that was inconsistent with required reserves, funds rate movements could not adequately clear the reserves market. Excessive and essentially pointless funds rate volatility would likely be associated with strict total reserve control with lagged reserve requirements.

In practice, the Fed has provided a mechanism for reserve market clearing with lagged reserve requirements by allowing the volume of discount window borrowing to adjust to funds rate movements.[12] Unfortunately, this mechanism has resulted in other difficulties for reserve targeting. As a result of its discount window policy, the Fed retains direct control of only the *nonborrowed* portion of total reserves. When nonborrowed reserves supplied by the Fed are less than required reserves, banks are allowed to borrow the difference from the discount window.[13]

In this setup, total reserves do not determine deposits. The Fed merely accommodates the demand for reserves required to support deposits on the books of banks two weeks ago. The Fed must control deposits in any given week by manipulating the funds rate to influence other interest rates and the quantity of money demanded. In short, with the nonborrowed reserve control instrument and lagged reserve requirements, the funds rate still plays a central role as an intermediate target in the monetary control procedure; so the current operating procedure retains the major deficiency of pre-October 1979 means of monetary control, namely, effective reliance on the funds rate as an instrument.

The present procedure is even inferior to the old procedure in one important respect. The principal change involved in moving to nonborrowed reserve targeting has been that the Fed has affected the funds rate indirectly through the volume of borrowing it "forces" banks to do at the discount window. Because discount window administration imposes a nonpecuniary cost of borrowing that rises with volume, the more banks are "forced" to borrow at the window the higher they bid up the alternative cost of reserves in the Federal funds market, i.e., the Federal funds rate, relative to the discount rate. The Fed varies the "forced" volume of discount window borrowing by appropriately choosing nonborrowed reserve supply. This is how the Fed currently influences the funds rate and ultimately the money supply. However, the relationship between a given volume of "forced" discount window borrowing and the spread between the funds rate and the discount rate has appeared to the Fed as volatile and extremely difficult to predict.[14] In turn, the apparent instability of the relation between borrowing and the spread has made the short-term relationship between nonborrowed reserves and the funds rate difficult to predict. Consequently, the link between nonborrowed reserves and the money supply has been doubly weak under nonborrowed reserve targeting.[15]

The Fed has been considering moving to contemporaneous reserve requirement rules.[16] The main virtue of moving to contemporaneous reserve requirements is that it would allow the Fed to keep the

[10] See "The New Federal Reserve Technical Procedures for Controlling Money" [6].

[11] Lagged reserve requirement rules require banks to maintain reserves against deposits they had on their books two weeks previously.

[12] The Fed provides reserves in two ways: (1) through outright purchase of securities and (2) by lending reserves through the discount window. The former are called nonborrowed reserves; the latter are called borrowed reserves.

[13] For extended periods of time since October 1979 the Fed has let the funds rate decline below the discount rate. In such periods there has been no incentive to borrow at the discount window for reserve adjustment purposes, adjustment borrowing has fallen essentially to zero, and the Fed has reverted to using the funds rate as an instrument as it did prior to October 1979.

[14] See Goodfriend [4] and references contained therein.

[15] The new operating procedure is an improvement over the old in one important respect. Under the old procedure, when money growth and reserve demand moved up, the additional reserves were often supplied without an increase in the funds rate. Under the new procedure, when the additional reserves are provided through the discount window, the funds rate automatically rises as the additional reserves are supplied. The higher funds rate immediately works to bring money growth under control. See Goodfriend [3] for more discussion on this point.

[16] Contemporaneous reserve requirement rules would require banks to maintain reserves against deposits they have on their books in the current reserve statement period.

incentive to borrow at the discount window negative. This could be done, for example, by making the discount rate a fixed penalty rate slightly above the funds rate. Borrowed reserves would no longer have to be made available to assure that the reserve market clears. Contemporaneous reserve requirements would allow the banking system to bring current required reserves into equilibrium with targeted total reserves. In other words, contemporaneous reserve requirements would make it easier for the Fed to control total reserves.

The major potential attribute of total reserve targeting is that it could enable the Fed to manage money growth without concern for either the funds rate or borrowed reserves. If banks were to keep excess reserves, reserves held above legal requirements, to a minimum and reserve requirements were uniformly and solely applied to deposits in the monetary aggregate being controlled, then there could be a direct and relatively stable link between total reserves and deposits.[17] Monetary control could then be exercised directly through reserves with little concern for interest rates.

Now, a point which has been seldom made is that the degree to which strict total reserve control would improve monetary control depends critically on the behavior of excess reserves. Theory suggests that if the Fed were to tightly control total reserves and impose a large cost of reserve default, the demand for excess reserves would rise as a precaution against going deficient. If excess reserves were to become more significant, it would become more important to predict their volume in order to know the multiplier relation between a given quantity of total reserves and the money supply.

Since World War II, excess reserves have generally been relatively small. However, excess reserve behavior during that period is of little value in suggesting what excess reserve behavior might be in a regime of tight total reserve control. As pointed out above, excess reserve demand is critically dependent on the set of reserve management rules established by the Fed together with its monetary policy procedure, and the Fed has never attempted tight short-run control of total reserves. Rather the Fed has tended to supply those reserves that the banking system desired on a short-run basis, while allowing funds rate movements to proceed relatively slowly. The demand for excess reserves has been understandably small in that policy regime, but there is less reason to expect excess reserve demand to remain small under strict total reserve control. This last point is important because it means that even if contemporaneous reserve requirements are implemented, monetary control might not be most effectively achieved by moving to a fixed penalty discount rate and directly targeting total reserves.

If excess reserves should prove large and difficult to predict, then easing carryover restrictions, lengthening the reserve statement period, staggering reserve settlement periods, and/or alternative reforming of discount window administration might be considered.[18] Such reforms would allow the banking system more flexibility over time in meeting reserve requirements. The additional flexibility, especially if accompanied by timely publication of Fed informa-

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[17] Not all the above mentioned conditions are currently met in practice. For example, although they are being reformed under the Monetary Control Act of 1980, reserve requirements are not yet uniformly and solely applied to deposits in M1B, the aggregate of primary concern to the Fed.

The point in the text may be illustrated formally as follows:

Let TR(t) = total reserves provided by the Fed in period t

$R^D(t)$ = banks' demand for reserves

ER(t) = banks' demand for excess reserves

RR(t) = banks' required reserves

M(t) = the monetary aggregate being controlled

rr = legal reserve requirements on deposits in M

Reserve market clearing implies

$$TR(t) = R^D(t) \equiv ER(t) + RR(t).$$

Since $RR(t) = rrM(t)$,

it follows that

$$TR(t) = ER(t) + rrM(t).$$

If $ER(t) = 0$, then

$$M(t) = \frac{TR(t)}{rr}.$$

Under the above conditions the Fed can closely control the money supply M in period t with total reserves supplied in period t. In fact such close monetary control can be achieved even if excess reserves are neither zero nor constant, as long as they are reasonably predictable. Currency has been ignored, but taking it into account would leave the point illustrated here essentially intact.

[18] Easing carryover restrictions would essentially allow future reserve holdings to satisfy current reserve requirements. Lengthening the reserve statement period, by lengthening the period against which reserve holdings are averaged for the purpose of satisfying reserve requirements, would also essentially allow banks more time in meeting reserve requirements. Staggered reserve settlement and discount window reform could in effect allow such additional latitude for the banking system as a whole.

tion on reserve market conditions, should result in reduced day-to-day funds rate variability. In turn, less variability in the cost of reserves should help stabilize the demand for and improve the predictability of excess reserves.

On the other hand, given the demand for excess reserves, these reforms would make the relation between current reserve demand and reserve requirements against current deposits less predictable. The first effect would improve and the second effect would worsen the predictability of the relation between reserves supplied by the Fed and aggregate bank deposits. The overall value of these reforms in improving monetary control would depend on which effect dominates.

In summary, a strong case can be made for moving to contemporaneous reserve requirements from the point of view of monetary control. Because it allows the banking system to change current required reserves in response to current funds rate changes, contemporaneous reserve requirements should reduce funds rate volatility compared to lagged reserve requirements for any degree of reserve control. But what the Fed does with discount window administration affects the potential overall value of the move to contemporaneous reserve requirements. In particular, if current discount window administration is unchanged, then moving to contemporaneous reserve requirements would not allow the Fed to directly control total reserves. On the other hand, tight restrictions on discount window borrowing and strict total reserve control might increase the volume and unpredictability of excess reserves, thereby weakening the link between reserves and deposits. If excess reserves do prove a problem, then reforms such as those suggested above should be considered. At any rate, considerable study and perhaps experimentation will probably have to be done with subsidiary features of the monetary control apparatus to make the most of contemporaneous reserve requirements for improving monetary control.

Conclusion The main points underlying the prescription for monetary policy advanced in this article together with the prescription itself are summarized as follows:

(1) Attempts at directly managing interest rates require the Fed essentially to give up control of money growth and inflation. Sooner or later interest rates must be freed in order to restore control of money growth and to bring inflation under control.

(2) Since the Fed cannot directly manage interest rates as long as it wishes to retain control of money growth and inflation, it should abandon direct attempts to manage interest rates and concentrate on monetary control. By achieving and maintaining a low rate of money growth, the Fed can bring inflation and interest rates permanently down as well.

(3) Economists do not yet have the technical means of deciding how alternately proposed rates of money growth will affect inflation and employment in any relatively short time period such as a year, so discretionary manipulation of the money supply to influence economic activity is unreliable. Consequently, strict and steady control of the money supply is the most feasible and effective policy open to the Fed at present.

(4) Evidence from the German hyperinflation of the early 1920s demonstrates that a reduction in money growth can bring the rate of inflation down with a relatively small reduction in real economic activity, but this favorable effect requires that the monetary authority commit itself to a pre-announced and credible policy of reducing money growth.

(5) Financial innovation of recent years has allowed a given rate of money growth to support more inflation. Regardless of this fact, the Fed must achieve and maintain a reasonably low rate of money growth to produce a reasonably low rate of inflation. Moreover, the Fed can always cause money to grow at a slow enough rate to offset the effect of the secular rise in velocity on inflation.

(6) Any one of a number of monetary aggregates could be strictly controlled by the Fed, but it is less important which is selected than that the Fed chooses just one and does not switch among them once the choice is made.

(7) The size of the government deficit does not constitute an independent impediment to monetary control.

(8) The payment of competitive rates of interest on deposits would allow improved monetary control.

(9) On October 6, 1979, the Fed expressed a need to move from use of the Federal funds rate to reserves as the instrument of monetary control. Reserve targeting cannot adequately be implemented under the lagged reserve requirement rules currently in force. The Fed must go to contemporaneous reserve requirements as a necessary step in reaping the full potential benefit of reserve targeting in improving monetary control.

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INFLATION AND MONETARY GROWTH: EXPERIENCE IN FOURTEEN COUNTRIES OF EUROPE AND NORTH AMERICA SINCE 1958

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INTRODUCTION

The idea that inflation is strongly influenced by monetary growth—once actively debated within the economics profession—is readily accepted by a large majority of economists today, especially with respect to the United States. While disagreements persist over such issues as the precise manner in which monetary growth fosters inflation, the length of lags between changes in the money supply and related changes in the price level, the importance of non-monetary causes of inflation, and the optimal strategy for reducing inflation, there is an impressive body of empirical evidence supporting the linkage between money and U. S. inflation throughout its history.

Outside the United States there is less agreement on the sources of inflation. No other country has been subjected to as much empirical analysis by so many independent researchers as the United States, so there is more room for differences of opinion. Moreover, in most of the leading industrial nations there are reasons for thinking that various nonmonetary factors have distorted the relationship between monetary growth and inflation. For example, these countries are far less self-sufficient than the United States, and most of them have relied more aggressively on price-wage controls. In addition, several European countries have revamped their tax systems during the last decade or two in ways that may have affected the standard inflation measures.

This article examines the impact of monetary growth on inflation in fourteen industrial economies. The countries studied and their rates of inflation since 1958 are displayed in Table I and in Chart 1. We begin by developing a simple model of inflation in Section I. Then in Section II we present regression results for all countries, employing as nearly as possible a common model specification. In this way we hope to gain insights into similarities and differences across countries with respect to the role of monetary growth in recent inflations. Section III subjects the general findings to further analysis in an attempt to extract some broader implications from the results. The major conclusions are summarized in Section IV. An appendix contains detailed regression equations for individual countries.

Obviously, a study of this sort is subject to various hazards and limitations. By attempting to examine a large number of countries we are necessarily superficial in our treatment of any single country. Countries differ greatly in institutional frameworks and macro-policies, and these are unlikely to get the attention they deserve. Further, by applying a common model to all countries we run the risk of ig-

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Table I

MEAN RATES OF INFLATION, 1958 to 1977, SELECTED COUNTRIES OF EUROPE AND NORTH AMERICA

Country	Mean Inflation Rate* (percent)	Standard Deviations
Austria	4.43	5.02
Belgium	4.50	3.84
Britain	6.86	7.09
Canada	4.22	3.44
Denmark	6.59	5.49
France	6.19	4.82
Germany	3.47	3.03
Italy	6.71	6.51
Netherlands	4.95	5.46
Norway	5.61	4.92
Sweden	5.07	4.28
Switzerland	3.77	3.51
United States	3.94	2.50
Yugoslavia	11.46	12.28

* Except for the U. S., where the GNP implicit deflator is used, inflation is measured by the annualized quarter-to-quarter percent change in the consumer price index.

noring factors that may be pertinent to a particular country. We recognize these trade-offs, but we leave to others the task of building more elegant theoretical models and more precise empirical formulations.

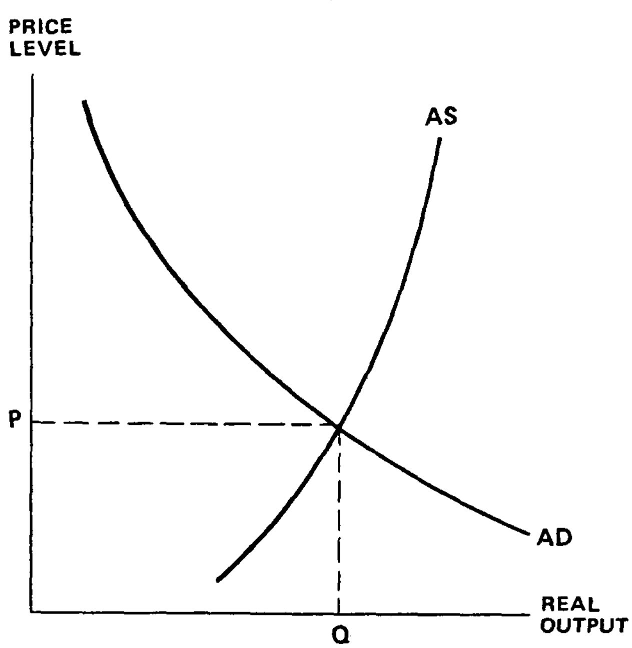
I.
A FRAMEWORK OF ANALYSIS

Money and Inflation It will be helpful at the outset to provide a general analytic framework that encompasses both monetary and nonmonetary sources of inflation. Figure 1 shows hypothetical demand and supply curves for total output for an entire economy. The curve labeled AD is referred to by economists as an "aggregate demand" curve. Its downward slope indicates that the quantity of output demanded will be greater at a lower level of prices than at a higher level. Similarly, the upward slope of the AS curve (i.e., "aggregate supply") assumes that producers will provide more goods and services at higher prices than at lower prices. In equilibrium, the price level (P) and the level of output (Q) are established by the intersection of AD and AS.

For present purposes there is little point in striving for greater rigor in our formulations of AD and AS.[1] The important point to recognize is that P may rise —i.e., inflation may occur—either because of a rightward shift in AD or because of a leftward shift in AS. The precise shapes of the curves and the exact nature of the forces that may bring about inflationary shifts are secondary issues as far as this article is concerned.

[1] See, for example, Dornbusch and Fischer [4], chaps. 11 and 12.

Figure 1



Economists hold that monetary growth influences inflation by affecting the position of the AD curve. Ordinarily a rise in the volume of money, M, will increase the nation's demand for goods and services; hence AD will move to the right and, under stable supply conditions, P will rise. There is less than unanimity among economists about the relative importance of changes in M and various other disturbances that might conceivably produce shifts in AD in the real world. For example, those who continue to view the world in terms of "Keynesian" models are apt to emphasize the importance of fiscal policies (quite apart from the monetary implications of these policies) as determinants of AD.[2] But even the Keynesians concede that monetary growth usually will result in inflation, unless it is matched by an equally rapid increase in AS.

Of course, inflation can come about because of nonmonetary disturbances. Supply conditions change from time to time, and the inflationary consequences need not be negligible. During the 1970s, in fact, there were some notable "supply shocks" relating to energy and food. Thus as Alfred Marshall reminded us nearly a century ago, there are two blades to the scissors. Failure to take account of the supply "blade" may well result in biased estimates of the role played by monetary growth and other demand disturbances.

An Empirical Model of Inflation One approach to an investigation of real-world inflations would be to develop full-blown aggregate demand and supply functions along the lines of the figure and to solve them simultaneously to determine both the inflation rate and the rate of growth of output. We do not adopt this "structural model" approach. Instead we work with a single-equation model that represents a modified version of the ancient Equation of Exchange, MV = PQ, where V is the velocity or turnover rate of money and the other symbols are as previously defined. For our purposes it is convenient to rearrange terms, add time subscripts, and convert from *levels* to *rates of change* by taking logarithmic first differences:

$$p_t = v_t - q_t + m_t. \qquad (1)$$

[2] An example may be found in Blinder [2].

Obviously, both forms of the equation of exchange are identities. In order to transform equation (1) into a theory of inflation we must impose constraints on the behavior of one or more of the variables on the right-hand side. One very simple constraint would be to assume that the sum of the growth rates of velocity and output, v_t and q_t, is equal to a constant:

$$v_t - q_t = k. \qquad (2)$$

This assumption allows the levels of V and Q, and their growth rates, to vary over time. By substituting (2) into (1), we obtain (3), which is not an identity:

$$p_t = k + bm_t. \qquad (3)$$

Note that the coefficient b which we have inserted into (3) is necessarily equal to unity in this simple model.

Equation (3) is not yet a promising hypothesis for empirical testing since it takes no account of monetary lags. A large amount of earlier work has established that changes in monetary growth rates do not have immediate effects, either on real economic activity or on prices.[3] In the case of prices, most U. S. studies have found average lags ranging between one and a half and three years. While the reasons for such long lags are not entirely understood, neither are they wholly surprising, given the prevalence of government-imposed price constraints in contemporary economies. Examples include the prices of goods and services that are provided directly by governments (e.g., postal rates and bus fares), as well as prices of private firms that are set by regulatory bodies (e.g., electricity and telephone rates).

We allow for monetary lags by substituting a lag expression for m_t:

$$p_t = k + \sum_{i=o}^{n} w_i m_{t-i}. \qquad (4)$$

There is little basis in theory for preferring a particular pattern for the weighting coefficients, w_i. All of the results reported in this article were obtained from polynomial distributed lag functions ("Almon" lags) using third degree polynomials, a specification that is compatible with a wide variety of weight configurations.

A second problem with (3), and with (4) as well, is that it ignores supply shocks. A related omission in these models is that they ignore the impact of price-wage controls. When effective, such controls may result in disequilibrium situations—i.e., combinations of P and Q at points other than intersections of AD and AS. Still another type of occasional shock arises when countries engage in major revampings of their tax systems, the most relevant example being the introduction of broad-based value-added taxes (VATs), usually as substitutes for other types of expenditure taxes, in several European countries during the 1960s and 1970s. There is no reason to think that either AD or AS will be affected permanently by such a shift; the only significant lasting effects would appear to be changes in the relative price structure. In the short run, however, the transition to VAT might well cause an inflationary spurt, especially if inflation is measured by a price index whose scope is rather narrow. Prices of newly taxed items would rise while prices of items that are now taxed less heavily than before might be slow to fall. Moreover, there might be a temporary surge of demand for durable goods immediately prior to the tax change, to be followed later by a fall-off in demand. It also is not unlikely that the central bank would attempt to accommodate the implied short-run rise in velocity (and in interest rates) by a "one-time" rise in M. In this latter case, of course, AD would shift to the right and there would be a permanent rise in P—and a transitory increase in the rate of inflation. But even if the central bank does *not* adopt an accommodative policy, one would expect a transitory jump in the inflation rate.

A simple but effective way of dealing with these "shocks" is to introduce dummy variables with values of 1 in the quarters when the shocks occur, and values of 0 in all other quarters. Thus we have:

$$p_t = k + \sum_{i=o}^{n} w_i m_{t-i} + \alpha_j D_j \quad (j = 1, \ldots m) \qquad (5)$$

where there are m separate shock dummies, D_j, and the α_j are their estimated regression coefficients. In some instances it is possible to adopt the more sophisticated procedure of constructing time series to measure the intensity of shocks. This can be done for energy by introducing the rate of change in relative energy prices as an explanatory variable. Similarly, rather than rely on a crude VAT dummy equal to 1 in the initial quarter of the tax and 0 in all other quarters, it seems preferable to substitute a time series of changes in actual VAT rates. This enables us to take account of the impact on inflation (if any) resulting from subsequent rate manipulations, which have been substantial in some countries. Incorporating these latter modifications, we obtain:

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[3] A useful recent discussion of the rates of monetary growth and inflation may be found in Carlson [3]. See also Berman [1] and Karnosky [5].

$$p_t = k + \sum_{i=o}^{n} w_i m_{t-i} + \alpha_j D_j + \Upsilon p_E + \sigma T \quad (6)$$

where p_E is the relative price of energy and T is the change in the standard tax rate under VAT.

The empirical results presented in Section II are derived from equations (5) and (6). There are additional problems, however, in formulations such as (3) which, though not addressed directly in the work reported in Section II, must be mentioned briefly at this point. These problems relate to the treatment of inflation expectations, the nature and importance of international transmission mechanisms, and the possibility of "reverse causality" running from inflation to monetary growth.

It has become common in recent studies of inflation to work with models that make the current rate of inflation p a function of expected inflation, p*, plus other variables such as the size of the gap between actual and potential real GNP. In such a model, monetary growth influences p largely through its effect on p*. Since p* is considered to depend primarily on the *trend* rate of monetary growth, transitory deviations of monetary growth from its trend are expected to have little impact on inflation. At the same time, factors other than the trend rate of monetary growth—e.g., the inflation rate in countries that are important trade partners—are held by some economists to play a role in determining p*. We shall return to this topic in Section III.

Even casual inspection of the chart on pages 24 and 25 suggests that inflation rates are highly correlated across countries.[4] Nevertheless, despite a literature on the international transmission of inflation which has grown rapidly both in size and complexity in recent years, there is considerable disagreement over the nature of the transmission mechanism. One simple hypothesis, which of course is compatible with equations (5) and (6), is that a country's rate of monetary growth is influenced by the rate of inflation in other countries. This is a plausible hypothesis under a regime of fixed exchange rates such as existed for most of our study period up to the winter of 1973, and it is also relevant to a situation in which central banks engage in "dirty floating" to moderate the swings in nominally flexible exchange rates.

According to this view, a country that was able to insulate its monetary growth rate from such external influences would be able to "go its own way" with respect to inflation. An alternative (though not mutually exclusive) hypothesis argues that inflation can be transmitted from one country to another independently of any immediate effect on the recipient country's monetary growth rate through a process known as "goods arbitrage." Thus a rise in the price of (say) automobiles in country A will soon result in higher auto prices in country B as traders switch orders from the high-price suppliers to those with lower prices. The rise in auto prices in B, according to this hypothesis, will be followed by more rapid monetary growth in B as its central bank acquires foreign exchange and expands bank reserves. In both hypotheses about the transmission mechanism, it should be noted, there will be a rise in monetary growth associated with an increase in inflation. However, the causal roles played by monetary growth under these alternative scenarios are entirely different.

This leads, finally, to the closely related issue of reverse causality. In our discussion of equations (5) and (6) we assumed implicitly that the rate of monetary growth is determined in each country by the policies of its own central bank. This is not to deny the existence of various feedback mechanisms whereby monetary growth can be influenced by the behavior of banks and their customers; it simply assumes that such feedbacks can be neutralized by the central bank's policies. We have already noted that under a regime of fixed exchange rates a central bank will be obliged to establish whatever monetary growth rate is compatible with maintaining the official exchange rate. Even in a closed economy, however, one can imagine situations (e.g., adherence through thick and through thin to an interest-rate or unemployment objective) in which the monetary growth rate would not be the focal point of policy deliberations. By and large we shall ignore such issues, just as we ignore any consideration of formal money-supply models. Undoubtedly this topic will receive attention from other researchers.

II.
THE MAIN EMPIRICAL FINDINGS

The basic regression results for all fourteen countries are summarized in Table II. More detailed results may be found in the appendix. For eleven countries the estimations were based on two complete decades of quarterly data, extending from 1958 I through 1977 IV. Shorter periods were used in the cases of Britain and Norway because of data limitations; in the case of Germany, because the long-period results were unsatisfactory.

[4] See Table V for a matrix of simple correlation coefficients of inflation rates.

Except for the United States, the dependent variable is the annualized percent change in consumer prices. U. S. regressions were run with both the CPI and the GNP implicit deflator; while the results were very similar, those with GNP prices had slightly higher R^2s, and they alone are reported here. Monetary growth rates were calculated from narrow measures of money in most instances. One exception is Yugoslavia, where currency was used. Another is Norway, where we found a much stronger effect of monetary growth on inflation when money was defined broadly. Britain provides a similar exception: British M1 produces much poorer results than the broad M3 measure, which includes even non-sterling deposits held by residents in British banks. In the United States, as well as most other countries, on the other hand, narrow money is more closely related to inflation rates than broad money is. Since we have no preconceptions about which money measure to use, we have selected whichever measure provides the best statistical fit. Discussion of various other data problems is left to the appendix.

The first and most important point to be noted in Table II is that in every country there is a statistically significant relationship between monetary growth and inflation. In two instances—Denmark and France—the summed monetary coefficients just barely passed the five percent significance test; the remaining countries' monetary coefficients were significant at the one percent level. The monetary

Table II

SUMMARY OF BASIC INFLATION REGRESSIONS

Country	Regression Number	Period	Money Measure Used	Sum of Monetary Coefficients (t statistics)	Mean Monetary Lag (t statistics)	$\bar{R}^2$	Standard Error of Regression	Durbin-Watson Statistic	Other Variables Included in Regression
Austria	1.2	581-77IV	M1	.939 (3.38)	7.0 (2.56)	.393	3.93	2.29	C,S,PCRELPEN−1 to −2
Belgium	2.2	581-77IV	M1	1.278 (7.82)	7.5 (4.10)	.672	2.21	2.03*	C,PCRELPEN0 to −5
Britain	3.4	631-77IV	M3	.927 (6.79)	8.9 (5.08)	.735	3.79	1.79	C,S,PCRELPEN0 to −5, WPCON
Canada	4.2	581-77IV	M1	.612 (5.50)	4.7 (2.62)	.681	1.93	1.90	C,PCRELPEN0 to −5
Denmark	5.3	581-77IV	M1	.565 (2.07)	10.1 (2.35)	.531	3.72	2.06*	C,S,PCRELPEN0 to −5, VATCHNGE
France**	6.1	581-77IV	M1	.431 (2.08)	6.0 (1.76)	.311	3.32	1.98*	C,S
Germany	7.3	641-77IV	M1	.805 (2.91)	5.8 (1.55)	.742	1.53	1.97*	C,S,PCRELPEN0 to −5, VATCHNGE
Italy	8.2	581-77IV	M1	1.290 (4.14)	11.1 (4.45)	.695	3.64	2.14*	C,PCRELPEN0 to −3, WPCON
Netherlands	9.2	581-77IV	M1	1.148 (5.90)	9.4 (5.07)	.626	3.36	2.42	C,S,PCRELPEN0 to −3, WPCON,VATCHNGE
Norway	10.2	641-77IV	M2	.816 (5.01)	13.2 (3.44)	.616	3.04	1.99	C,S,WPCON, VATCHNG
Sweden	11.2	581-77IV	M1	1.693 (5.40)	9.7 (5.50)	.550	2.88	2.08*	C,WPCON,DECON,OIL
Switzerland	12.2	581-77IV	M1	.598 (4.67)	10.6 (5.11)	.516	2.46	1.58	C,S,PCRELPEN0 to −5
United States	13.4	581-77IV	M1B	.801 (10.65)	7.1 (3.93)	.797	1.13	1.74	C,PCRELPEN−1 to −4, WPCON
Yugoslavia	14.2	581-77IV	Currency	1.580 (2.78)	8.5 (3.02)	.628	7.52	2.06*	C,S,REFORM

* Cochrane-Orcutt Procedure was applied.

** In the case of France, the Almon Lag Procedure was applied to the current and 15 lagged quarterly monetary growth rates.

Glossary: C, constant; DECON, dummy variable = 1 in quarter following suspension of wage-price controls; OIL, dummy variable = 1 in 73IV to 74II; PCRELPEN, percent change in ratio of energy prices to all consumer prices; REFORM, dummy variable = 1 in 65III; S, seasonal dummy variables; VATCHNGE, quarter-to-quarter change in standard value-added tax rate; WPCON, dummy variable = 1 in quarters of comprehensive (and binding) wage-price controls.

CHART 1

QUARTERLY INFLATION RATES OF SELECTED WESTERN COUNTRIES
1958 – 1980

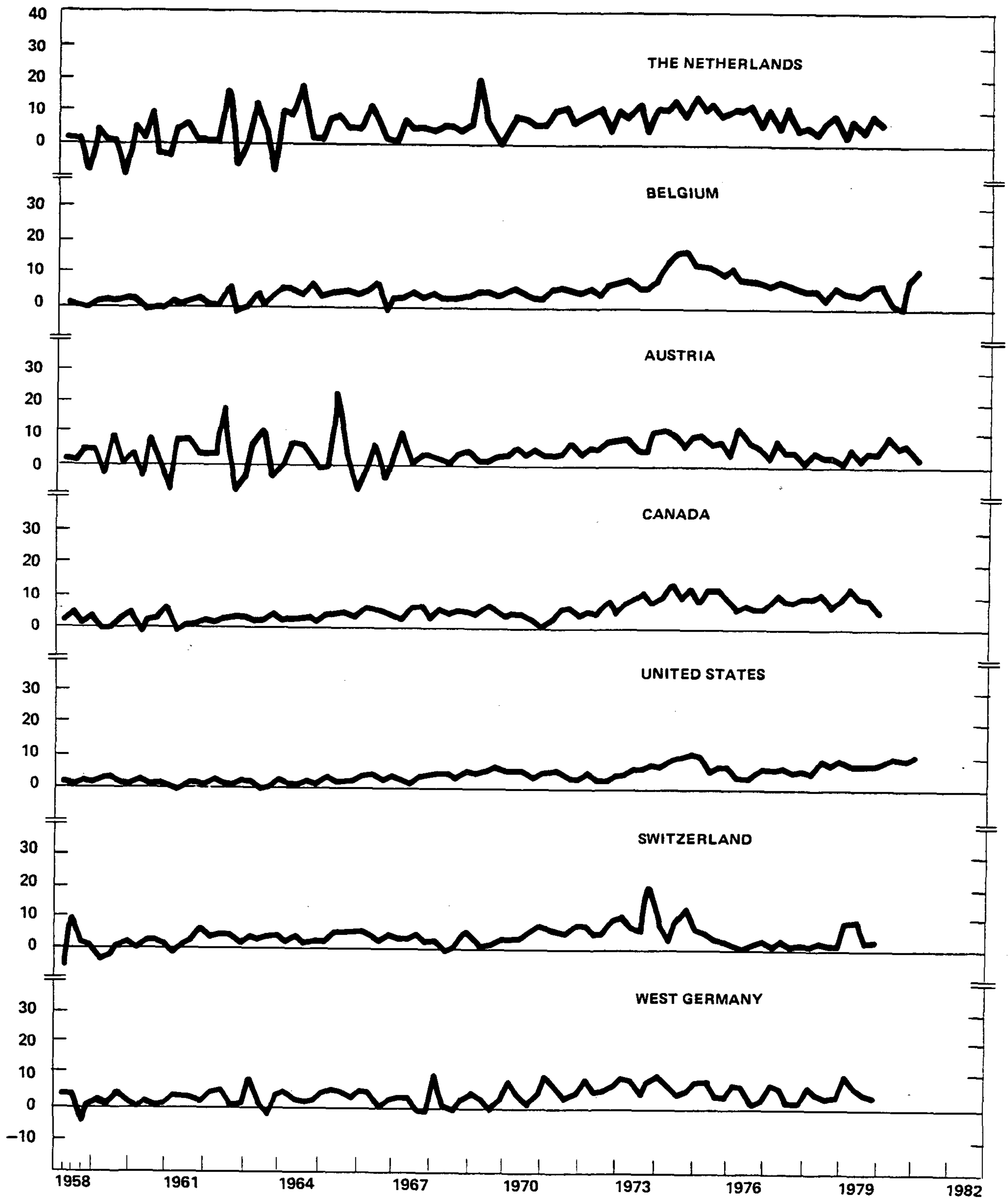
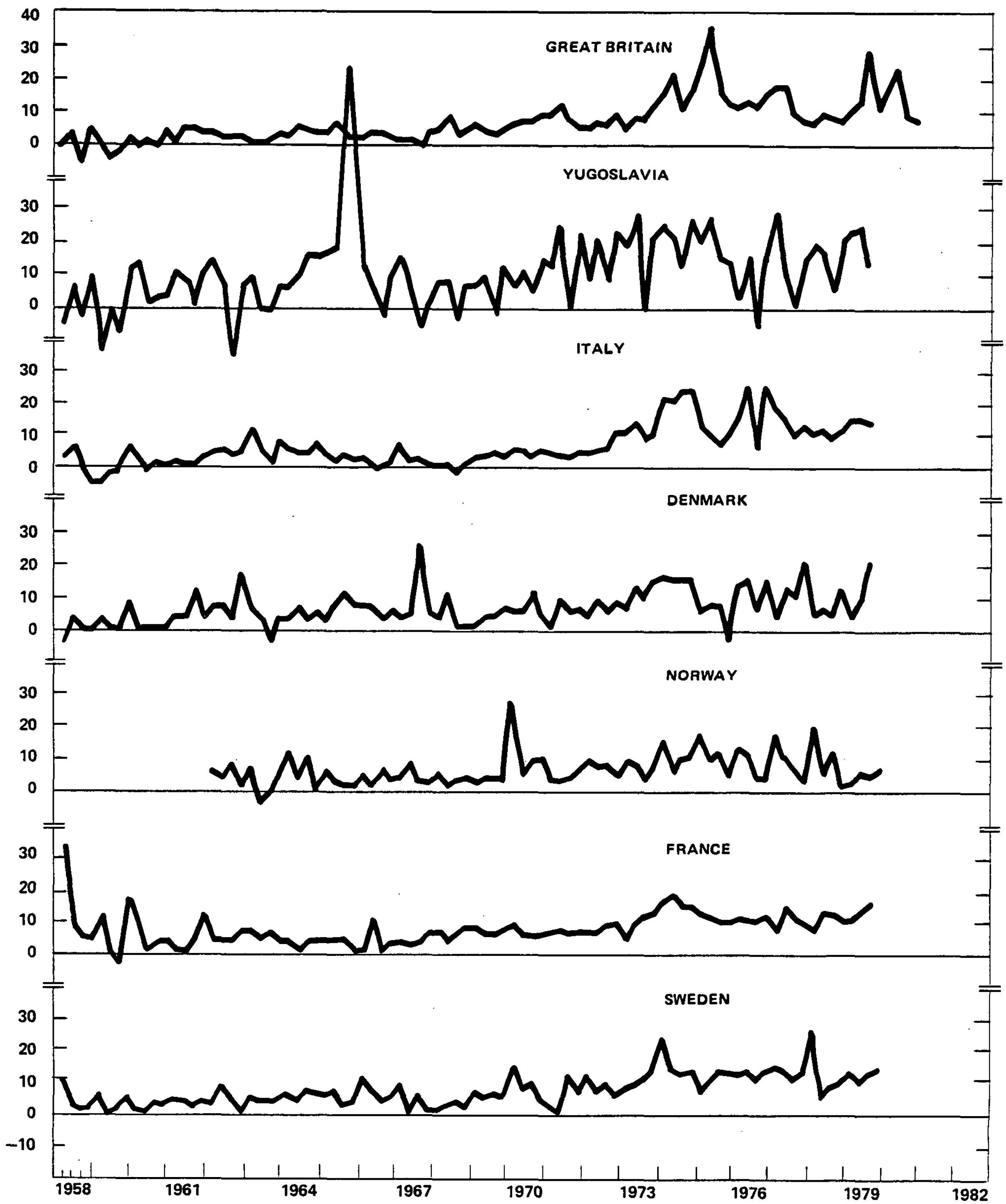


CHART 1 (Cont'd)

QUARTERLY INFLATION RATES OF SELECTED WESTERN COUNTRIES 1958 – 1980



coefficients vary from country to country, ranging between a low of .431 in France and a high of 1.693 in Sweden.

A second interesting aspect of Table II is the evidence that monetary growth affects inflation with long lags. Mean monetary lags range from a little over one year in Canada (4.7 quarters) to more than three years (13.2 quarters) in Norway. The estimates of mean monetary lags were significant at the five percent level in every country except France and Germany.

Except for France, all of the regression equations summarized in Table II includes variables other than lagged monetary growth rates. The most common additional variable is PCRELPEN, the quarter-to-quarter percent change in the relative price of energy.[5] We were interested to find that energy prices did not have a statistically significant effect on the inflation rate in five countries: Austria, France, the Netherlands, Norway, and Yugoslavia. However, in the Austrian equation the t-ratio on PCRELPEN narrowly missed the five percent significance level, and the French equation for 1968 I to 1977 IV (6.2) shows high significance levels for this variable. Thus in all but a couple of countries it appears that the relative price of energy played an important role in the inflations of 1958-77.

We obtained mixed results with regard to the impact of changes in value-added tax rates. Four countries—Canada, Switzerland, the United States, and Yugoslavia—have not adopted this form of taxation. In the case of Sweden, the rate of inflation is calculated net of changes in VAT rates. Among the remaining nine countries, we failed to find significant coefficients on VATCHNGE (the quarter-to-quarter change in the standard tax rate) in Austria, Belgium, Britain, France, and Italy. This may reflect the relatively low tax rates in some countries, the narrow scope of items that are taxed at the standard rate, or the fact that VAT may have replaced earlier excises on consumer goods. However, in countries such as Denmark, Germany, the Netherlands, and Norway it is clear that changes in VAT have had major (but transitory) effects on the rate of inflation. Denmark has relied heavily on frequent changes in VAT rates as a tool of macro-stabilization.

Finally, every country except Germany and Switzerland experimented with direct wage-price controls during 1958-77. Our attempts to use dummy variables to gauge the impacts of these controls on the behavior of inflation rates were only partially successful. Controls dummies ("WPCON") had significant negative coefficients in just four countries: Britain (65III-67II and 76I-76IV), Italy (73III-73IV), Sweden (70IV-71II), and the United States (71III-72IV). A plausible explanation of our failures in other countries is that many controls programs are not severely binding, due either to loose administration or to explicit loopholes. Another problem is that controls typically are dismantled piecemeal, which forces the researcher to make an arbitrary decision about the effective time span of WPCON. In countries such as Austria, France, and the Netherlands there is a further difficulty: interventionist policies are applied so continuously in these countries that one is hard-pressed to identify periods that are free of controls.

In summary, the regression results displayed in Table II provide strong evidence of a link between monetary growth and inflation in Canada, Yugoslavia, and most of the industrialized democracies of Western and Central Europe quite similar to the linkage that is known to exist in the United States. Given the wide differences among these countries in institutional settings and policy strategies, these findings suggest that the linkage between monetary growth and inflation is indeed robust.

III.
SOME FURTHER RESULTS

The empirical results in Table II are of considerable interest as they stand. There are, however, a number of unanswered questions that demand additional investigation. For example, has the inflation-monetary growth linkage been stable over time? In particular, is there any indication that lags have become shorter in recent years? Then there is the complicated issue of reverse causality which was mentioned in Section I. Still another important issue relates to the international transmission of inflation. We cannot provide definitive answers to any of these questions in the space that is available. Nevertheless we do have some pertinent evidence to present.

Stability Over Time A major impediment to the development of economic science is the tendency for human behavior to change over time. This may result from alterations in the basic institutional setting. Even in a stable setting, however, people discover new ways of attaining goals, and even their goals shift. Indeed, it has often been noted that economics tends to be self-invalidating, in the sense that the

[5] We were unable to calculate this variable for Sweden and Yugoslavia. For Sweden we relied instead on an OIL dummy (equal to one in 73IV and 74I) with good results.

discovery and publication of information about a regularity in economic behavior tends to cause changes in behavior as individuals begin to utilize the information for personal gain.

The economics of inflation is not exempt from this hazard. As inflation persists over time, individuals are likely to become more sophisticated in protecting themselves from its consequences. One result might well be a shortening of the lag between monetary growth and inflation. Thus regression equations based on one period's data may fit poorly a different set of observations. In fact, this could occur even without behavior changes if the basic institutional setting undergoes major transformations. An example might be the transition from pegged to flexible exchange rates early in 1973. Clearly, therefore, we need to investigate the temporal stability of the linkage between monetary growth and inflation.

The stability issue can be investigated in three ways. First, we can see how closely these inflation equations, which were derived from data through 1977, fit post-sample observations for 1978-80. Second, we can compare parameter estimates obtained within subperiods of the overall data set. Third, we can examine estimates of the mean monetary lags in earlier and more recent periods to see whether they appear to have changed. Since it would be extremely tedious to review all of the available evidence under each of these headings, we will limit ourselves to a few summary statements.

1. The weight of evidence supports the conclusion that money-based inflation equations of the sort presented in this article have been rather unstable since 1958. We do not know how these equations compare with alternative inflation equations in this respect.

2. With one or two exceptions (e.g., Germany and Denmark), the money-based equations did not do notably well in "predicting" inflation rates in 1978-80. This is hardly surprising, given the economic turbulence of the period and the poor track record of alternative models.

3. Separate regressions for 1958-67 and 1968-77 sometimes produced widely differing monetary growth coefficients. An extreme example is Italy, whose sum of monetary growth coefficients was .792 in a 1958-67 estimation compared with 2.180 in a similar specification for 1968-77. On the other hand, in Switzerland the estimates were virtually identical over the same periods (.614 vs. .596). It should be noted, of course, that short-period regressions involving cycle-sensitive variables would be expected to display considerable instability.

4. There is no convincing evidence in these regressions of a general shortening (or lengthening, for that matter) of lags between changes in monetary growth rates and inflation rates. Table III compares mean lag estimates calculated from 1958-67 and 1968-77 regressions for the six countries in which statistically significant estimates were obtained in both periods. In Britain, Switzerland, and the United States lags were shorter in the more recent period; in Belgium, Italy, and the Netherlands the opposite was true.

Reverse Causality As was noted briefly in Section I, the existence of a close historical relationship between monetary growth and inflation—such as we have found in all fourteen countries—can be interpreted in various ways, as far as causality is concerned. We have suggested that the main line of causality runs from monetary growth to inflation rather than the other way around. The fact that long lags were found between monetary growth and inflation does not "prove" that our interpretation is correct. However, it does represent a challenge to the proponents of reverse causality to formulate a hypothesis that is capable of explaining how changes in the rate of inflation can bring about *prior* changes in monetary growth—a nontrivial task.

On a more elementary level, it must be conceded that the results presented in Table II and the appendix do not really address the possibility that monetary growth rates are determined at least partially by prior movements in the rate of inflation. We have regressed the inflation rate only on current and past monetary growth rates. Conceivably there is also a statistically significant relationship between inflation and future monetary growth.

Table III

COMPARISON OF MEAN MONETARY LAGS, 1958-67 vs. 1968-77, SELECTED COUNTRIES

Country	1958-67 Regressions (quarters)	1968-77 Regressions (quarters)
Belgium	6.6*	10.1*
Britain	10.9*	9.0**
Italy	7.6*	12.9**
Netherlands	7.1**	10.7**
Switzerland	13.0**	10.8*
United States	10.0**	6.4**

* Significant at the 5 percent level.

** Significant at the 1 percent level.

Table IV presents some preliminary evidence on this possibility. For each country we selected a representative equation and added monetary growth in periods t + 1 through t + 4 as explanatory variables. The numbers in the table are "t" statistics on the regression coefficients for these leading monetary growth terms. It can readily be seen that not a single coefficient was statistically significant at the five percent level in the first three future quarters. In period t + 4 only three of the 14 countries had significant coefficients, and one of them had a significant *negative* coefficient. Altogether there were 15 negative coefficients among the 56 estimates. Negative coefficients, of course, contradict the hypothesis that central banks tend to validate inflations that originate from nonmonetary disturbances by promoting accelerated monetary growth.

Not surprisingly, the significant negative coefficient appeared in the United States regression. In fact, all four U. S. coefficients were negative. This result suggests that the Federal Reserve's policy reaction function is quite sensitive to inflation developments. A speed-up in U. S. inflation tends to be followed by monetary tightness (i.e., slower monetary growth). In Canada and Sweden, on the other hand, this evidence suggests a considerably more accommodationist stance by their central banks.

International Transmission of Inflation The inflation equations presented in this article do not pay explicit attention to international transmission mechanisms. This does not mean that we think that inflations cannot be imported. Obviously, the inflation rates in all of the countries studied here are sensitive in some degree to inflation elsewhere; this is suggested quite strongly by the chart, which shows broadly similar trends across countries. Rather, our model can be interpreted as assuming that the main way in which inflation is transmitted from one country to another is via external influences on monetary growth.

Table IV

T-STATISTICS ON LEADING RATES OF MONETARY GROWTH

	Eqn. No.	t+1	t+2	t+3	t+4
Austria	1.2	.79	.37	.29	−.21
Belgium	2.2	.75	1.29	1.65	1.76
Britain	3.3	−1.59	−1.55	.55	1.48
Canada	4.4	.40	1.06	1.58	2.11*
Denmark	5.3	.03	.74	1.00	1.16
France	6.1	.16	1.47	.51	.39
Germany	7.3	−1.15	.60	.06	−1.09
Italy	8.2	.07	1.17	1.74	.49
Netherlands	9.2	1.70	.85	.78	1.69
Norway	10.2	.38	−.91	.44	−1.33
Sweden	11.2	−.18	.70	.98	2.43*
Switzerland	12.3	.73	.39	1.52	.22
United States	13.4	−1.77	−1.29	−1.17	−2.37*
Yugoslavia	14.3	−.43	−1.46	−1.00	.45

* Significant at the 5 percent level.

To shed further light on the international transmission issue, we carried out three supplemental empirical exercises. First, we ran simple correlation matrices for inflation rates and for monetary growth rates for all countries. Second, we ran further regressions for the United States with lagged values of the trade-weighted value of the dollar as added variables. Third, for all thirteen countries other than the United States we ran further regressions with the U. S. M1B growth rate as an additional explanatory variable. These results and their implications are discussed briefly below.

1. *The Correlation Matrices.* Pairwise simple correlation coefficients among the quarterly inflation rates for all fourteen countries are displayed in Table V. Table VI contains a similar display for monetary growth rates, except that Norway has been excluded from the table.

The most striking feature of these tables is the contrast between them. Even though we made no allowance for possible lagged relationships between countries, all of the inflation correlation coefficients are positive and 72 (of 84) are significantly different from zero. On the other hand, 23 (of 78) money-growth correlations are negative, and 47 of them are not significantly different from zero. Clearly, inflation is much more strongly correlated across countries than monetary growth is.

The case of the United States is especially worth noting. Except for the correlations with Belgium and Britain (.32 and .37 respectively), U. S. monetary growth was correlated either very weakly or, in the case of Switzerland, negatively with monetary growth elsewhere during 1958-77. Despite this, the correlations between inflation rates in the United States and the other thirteen countries were consistently significant, ranging upward from .26 for Austria to .76 for Belgium.

2. *Exchange Depreciation and U. S. Inflation.* It is often asserted that exchange depreciation provides an important mechanism whereby a country may import inflation from its trade partners. According to this argument, if it takes more U. S. dollars (say) to buy a French franc, then dollar prices

Table V

MATRIX OF SIMPLE CORRELATION COEFFICIENTS: QUARTERLY INFLATION RATES, 1958-77

	Austria	Belgium	Britain	Canada	Denmark	France	Germany	Italy	Netherlands	Norway	Sweden	Switzerland	United States
Belgium	.45												
Britain	.40	.72											
Canada	.26	.75	.65										
Denmark	.24	.41	.33	.47									
France	.11	.44	.41	.42	.19								
Germany	.43	.52	.55	.36	.18	.25							
Italy	.33	.73	.63	.63	.57	.49	.45						
Netherlands	.54	.55	.59	.35	.35	.19	.60	.45					
Norway	.27	.44	.41	.38	.18	.22	.51	.48	.25				
Sweden	.39	.67	.49	.60	.40	.52	.40	.68	.39	.53			
Switzerland	.31	.38	.28	.31	.33	.01	.41	.31	.33	.28	.20		
United States	.26	.76	.61	.70	.43	.44	.40	.60	.42	.39	.52	.40	
Yugoslavia	.21	.38	.40	.26	.28	.04	.43	.36	.41	.17	.15	.39	.27

Note: Coefficients that exceed .22 are significantly different from zero at the 5 percent level of significance.

of French imports into the United States are bound to be higher, thus exerting upward pressure on the U. S. inflation rate. Despite an appealing surface plausibility, this argument suffers from the difficulty that most instances of exchange depreciation can be linked to either actual or expected inflation at rates exceeding those elsewhere. Thus we have another case in which the direction of causality is under question.

We have tested this hypothesis in crude fashion for the United States by regressing the 1958-79 inflation rate on M1B growth and the trade-weighted average value of the dollar against major foreign currencies. The latter variable was entered four

Table VI

MATRIX OF SIMPLE CORRELATION COEFFICIENTS: QUARTERLY MONETARY GROWTH RATES, 1958-77

	Austria	Belgium	Britain	Canada	Denmark	France	Germany	Italy	Netherlands	Sweden	Switzerland	United States
Belgium	.10											
Britain	−.04	.09										
Canada	.07	.10	.38									
Denmark	.48	.16	−.18	.10								
France	.45	.05	−.01	−.01	.61							
Germany	.66	−.04	−.11	.02	.53	.67						
Italy	.28	−.11	.02	.07	.45	.73	.66					
Netherlands	.03	.16	−.07	−.06	.13	.11	.13	.01				
Sweden	−.73	.12	.22	.11	−.31	−.39	−.66	−.29	.04			
Switzerland	.20	−.11	−.25	−.13	.28	.33	.45	.50	.12	−.23		
United States	.06	.32	.37	.08	.08	.02	.02	.02	.21	.06	−.05	
Yugoslavia	.59	−.06	−.03	.13	.51	.58	.68	.63	−.04	−.53	.38	.02

Note: Coefficients that exceed .22 (in absolute value) are significantly different from zero at the 5 percent level of significance.

times, with lags of one to four quarters. None of these four lagged terms were significant: their respective "t" statistics were —.14, —.45, .37, and —1.12. Perhaps more thorough testing would produce evidence of an important impact of exchange depreciation on U. S. inflation. However, these preliminary results offer no support to this particular version of the imported-inflation hypothesis.

3. U. S. Monetary Growth and Foreign Inflation. As a final empirical exercise we decided to explore the consequences of substituting U. S. monetary growth for own-country monetary growth for each of the thirteen foreign countries included in this study. The main features of these results are listed in Table VII.

In every country, U. S. monetary growth proved to be a significant explanatory variable—a surprising result in view of the absence of correlation between monetary growth in the United States and elsewhere. U. S. monetary growth, in fact, attained higher "t" statistics than domestic monetary growth in the cases of Britain, Denmark, Sweden, and Yugoslavia. However, the mean lag estimates in the right-hand columns show better significance levels—and greater plausibility—when each country's own monetary growth rates are used. Thus, despite the unexpectedly close relationship between monetary growth in the United States and inflation elsewhere, it still appears that in most instances one obtains more satisfactory results with own-country money growth.

Table VII

COMPARISON OF REGRESSION RESULTS WITH UNITED STATES AND OWN MONETARY GROWTH RATES

		t-statistics on ΣPCM		Mean Monetary Lag	
	Eqn. No.	Own PCM	U. S. PCM	Own PCM	U. S. PCM
Austria	1.2	3.38	2.97	7.4**	10.0*
Belgium	2.2	7.82	5.50	7.5**	7.5*
Britain	3.3	8.10	8.12	9.2**	15.8**
Canada	4.2	5.50	3.95	4.7*	4.3
Denmark	5.3	2.07	2.60	10.1*	17.9*
France	6.2	6.50	2.99	6.9**	9.5**
Germany	7.3	2.91	2.36	5.8	6.7
Italy	8.2	4.14	2.09	11.1**	13.3
Netherlands	9.4	4.90	4.60	10.4**	10.2**
Norway	10.2	5.01	2.26	13.2**	16.2**
Sweden	11.2	5.40	5.64	9.7**	12.6**
Switzerland	12.2	4.67	3.84	10.6**	—.4
Yugoslavia	14.3	2.54	3.37	8.6**	6.4

* Significant at 5 percent level.

** Significant at 1 percent level.

4. Tentative Conclusions on the Transmission Mechanism. Admittedly, we have not probed very deeply into the question of how inflation gets transmitted from one country to another. Nevertheless, we believe that these preliminary findings point toward cross-country influences on monetary growth rates as an important element in the transmission mechanism.

Our main results, summarized in Section II, show that each country's monetary growth rate has played a strong but delayed role in its inflation experience during 1958-77. Our pairwise simple correlation coefficients indicate that monetary growth rates are not closely correlated across countries. Yet we have found a surprisingly close relationship between U. S. monetary growth and foreign inflation.

The key to understanding this paradoxical set of results lies in the lag estimates reported in Table VII. Note that eight of the thirteen regressions with U. S. monetary growth substituted for own monetary growth produced statistically significant monetary coefficients. In six of these eight cases, lags were longer—sometimes substantially longer—when U. S. monetary growth was used. In a seventh case (Belgium) the lag estimates for U. S. and own monetary growth were identical, and in the eighth case (the Netherlands) the estimates were virtually identical. There is a strong suggestion, therefore, that U. S. monetary growth influences foreign inflation primarily through a delayed impact on foreign monetary growth. Because the correlation coefficients of U. S. monetary growth and monetary growth in the thirteen other countries take no account of lags, they turn out to be weak, but this does not mean that they are not in fact closely related.

It should be recalled that during most of our study period the world was operating under the Bretton Woods system of pegged exchange rates. The rules of this system required each central bank to maintain the external value of its currency within a narrow band around a stated par value. Thus a tendency for a country's currency to (say) appreciate vis-à-vis the dollar would require its central bank to buy dollars on the foreign exchange market. Ordinarily such purchases would result in a more rapid growth in the country's monetary base, and ultimately in its money supply. If we assume (as is plausible) that the original disturbance in the foreign exchange market reflected a speed-up in U. S. monetary growth, then we have a situation in which more rapid monetary growth in the United States leads, with a lag, to more rapid monetary growth in other countries.

This does not deny the possibility of other sorts of international transmission mechanisms, including even direct expectational links between a country's inflation rate and that of its principal trade partners. The strong correlation coefficients of inflation rates across countries are consistent with this type of link.

Clearly, many puzzles remain with respect to the transmission question. We expect to extend the work reported here by examining the lag structures among monetary growth rates for the various countries. We also intend to compare results for the Bretton Woods portion of our period, 1958-72, with more recent results under floating exchange rates.

IV.
CONCLUDING REMARKS

In this article we have developed a simple model that attempts to explain inflation primarily as the result of current and past monetary growth rates. In addition, our model allows for energy-price shocks, the effects of wage-price controls, and the impact on inflation rates from changes in value-added tax rates.

For the period 1958-77, and for various subperiods, we have developed quarterly inflation equations for the United States, Canada, and twelve European countries. In each country we found statistically significant regression coefficients on the sum of the current and nineteen lagged monetary growth rates. We also found in each country that the estimated mean lag between monetary growth and inflation was very long—it ranged from a minimum of one year to over three years at the maximum. On the other hand, other explanatory factors—the relative prices of energy, changes in value-added tax rates, and the use of wage-price controls—were important in some countries, unimportant in others. They did not exhibit the same degree of consistency in their contributions to inflation as monetary growth did.

As far as the United States is concerned, the findings reported here are consistent with previously published studies. The main novelty of the present work is its extension of the U. S. results to other countries, employing as nearly as possible a common format for all countries. Despite the obvious potential pitfalls in this approach, we believe that this exercise in cross-country comparisons has provided a useful perspective which suggests a substantial similarity across countries with respect to the nature of the inflation problem. Everywhere the main difficulty has been excessive monetary growth. A return to reasonably stable prices will require much slower monetary growth in the future than during the past quarter of a century.

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APPENDIX

Table A1

AUSTRIA

	1.1	1.2	1.3
Item/Period	58-77		68-77
ΣPCM1 (20 qtrs)	1.010 (3.60)	.939 (3.38)	.864 (5.34)
Mean Lag (qtrs)	7.4 (2.88)	7.0 (2.56)	6.6 (3.37)
PCRELPEN−1		.003 (.11)	.014 (.80)
PCRELPEN−2		.062 (1.99)	.035 (1.99)
SA1	.946 (.48)	1.023 (.53)	
SA2	8.393 (5.08)	8.120 (4.96)	
SA3	−1.837 (1.12)	−1.756 (1.08)	
SB1	5.332 (2.58)	5.523 (2.71)	3.548 (2.77)
SB2	1.552 (1.02)	1.385 (.92)	−.136 (.14)
SB3	2.404 (1.50)	2.267 (1.43)	.349 (.34)
C	−6.618 (2.47)	−5.949 (2.24)	−3.587 (2.11)
N	80	80	40
Mean Rate of Inflation	4.43	4.43	5.76
$\bar{R}^2$	.371	.393	.516
Standard Error of Regression	4.00	3.93	2.05
Durbin-Watson Statistic	2.25	2.29	2.02
Rho	—	—	—
F	5.7	5.3	5.6

Table A2

BELGIUM

	2.1	2.2	2.3	2.4
Item/Period	58-77		58-67	68-77
ΣPCMI (20 qtrs)	1.275 (6.91)	1.278 (7.82)	.637 (4.12)	1.456 (2.88)
Mean Lag (qtrs)	9.0 (4.68)	7.5 (4.10)	6.6 (2.55)	10.1 (2.71)
ΣPCRELPEN (6 qtrs)		.129 (2.10)		
Mean Lag (qtrs)		2.2 (.85)		
C	−3.581 (2.84)	−3.711 (3.32)	−1.002 (1.24)	−4.319 (1.05)
N	79	79	39	39
Mean Rate of Inflation	4.55	4.55	2.29	6.87
$\bar{R}^2$	.667	.672	.352	.767
Standard Error of Regression	2.23	2.21	1.96	1.79
Durbin-Watson Statistic	2.06	2.03	2.18	1.55
Rho	.39	.31	−.32	.69
F	40.0	21.0	6.2	32.3

Table A3

BRITAIN

	3.1	3.2	3.3	3.4	3.5
Item/Period	58-77			63-77	68-77
ΣPCM3 (20 qtrs)	1.016 (10.69)	1.025 (11.12)	.875 (8.10)	.927 (6.79)	.865 (3.45)
Mean Lag (qtrs)	10.2 (8.20)	10.3 (8.59)	9.2 (5.58)	8.9 (5.08)	9.0 (2.85)
WPCON		−3.075 (2.42)	−3.355 (2.72)	−2.885 (2.07)	−2.665 (.70)
ΣPCRELPEN (6 qtrs)			.343 (2.53)	.475 (2.49)	
Mean Lag (qtrs)			2.5 (4.06)	2.4 (4.52)	
PCRELPEN					.082 (.95)
PCRELPEN−1					−.009 (.12)
PCRELPEN−2					.171 (2.17)
PCRELPEN−3					.115 (1.35)
S1	.602 (.49)	.561 (.47)	.465 (.40)	1.018 (.70)	2.129 (.94)
S2	3.371 (2.76)	3.352 (2.84)	3.302 (2.81)	4.642 (3.09)	5.409 (2.43)
S3	−3.844 (3.15)	−3.853 (3.26)	−3.590 (3.06)	−3.096 (2.04)	−2.924 (1.29)
C	−.674 (.60)	−.264 (.24)	1.199 (.94)	−.141 (.08)	.160 (.05)
N	80	80	80	56	40
Mean Rate of Inflation	6.86	6.86	6.86	8.90	10.98
$\bar{R}^2$	.708	.726	.746	.735	.646
Standard Error of Regression	3.86	3.73	3.60	3.79	4.52
Durbin-Watson Statistic	1.57	1.69	1.83	1.79	1.80
Rho	—	—	—	—	—
F	28.4	27.2	20.3	13.7	6.9

Table A4

CANADA

	4.1	4.2	4.3	4.4
Item/Period	58-77		58-67	68-77
ΣPCM1 (20 qtrs)	.822 (10.28)	.675 (7.12)	1.081 (2.93)	.617 (3.40)
Mean Lag (qtrs)	5.2 (3.70)	4.9 (2.94)	10.4 (2.50)	4.0 (1.34)
PCRELPEN−1		.055 (1.70)	.097 (1.16)	.040 (1.03)
PCRELPEN−2		.047 (1.44)	−.006 (.07)	.052 (1.27)
C	−1.191 (2.19)	.093 (.13)	−1.695 (1.22)	.264 (.18)
N	80	80	40	40
Mean Rate of Inflation	4.22	4.22	2.04	6.40
$\bar{R}^2$	.632	.655	.101	.549
Standard Error of Regression	2.10	1.93	1.91	2.18
Durbin-Watson Statistic	1.88	2.03	2.26	1.74
Rho	—	—	—	—
F	34.9	26.0	1.7	8.9

Table A5

DENMARK

	5.1	5.2	5.3
Item/Period		58-77	
ΣPCM1 (20 qtrs)	.644 (2.53)	.366 (.93)	.565 (2.07)
Mean Lag (qtrs)	10.2 (2.84)	7.0 (.81)	10.1 (2.35)
ΣPCRELPEN (6 qtrs)			.139 (3.36)
Mean Lag			1.8 (1.23)
VATCHNGE		2.136 (8.12)	2.097 (7.69)
S1	−3.447 (1.87)	−2.264 (1.81)	−2.135 (1.66)
S2	.399 (.24)	−.876 (.78)	−.830 (.69)
S3	−1.653 (.92)	−2.272 (1.93)	−1.997 (1.65)
C	1.742 (.61)	4.120 (1.01)	2.031 (.70)
N	80	79	79
Mean Rate of Inflation	6.72	6.72	6.72
$\bar{R}^2$	.093	.490	.531
Standard Error of Regression	5.26	3.88	3.72
Durbin-Watson Statistic	1.56	2.25	2.06
Rho	—	.50	.29
F		10.4	8.4

Table A6

FRANCE

	6.1	6.2
Item/Period	58-77	68-77
ΣPCM1 (16 qtrs)	.431 (2.08)	.689 (6.50)
Mean Lag (qtrs)	6.0 (1.76)	6.9 (4.98)
PCRELPEN		.060 (3.28)
PCRELPEN$_{-1}$		.038 (1.93)
PCRELPEN$_{-2}$		.051 (2.61)
PCRELPEN$_{-3}$		.026 (1.41)
SA1	−1.180 (.74)	
SA2	−3.893 (2.57)	
SA3	−3.046 (1.96)	
SB1	2.456 (1.37)	
SB2	1.755 (1.27)	
SB3	1.745 (1.18)	
C	1.571 (.68)	1.090 (1.14)
N	79	39
Mean Rate of Inflation	5.88	7.98
$\bar{R}^2$	.311	.709
Standard Error of Regression	3.32	1.71
Durbin-Watson *Statistic*	1.98	2.09
Rho	.26	—
F	4.5	12.9

Table A7

GERMANY

	7.1	7.2	7.3	7.4
Item/Period		64-77		68-77
ΣPCM1 (20 qtrs)	.961 (3.59)	1.055 (2.95)	.805 (2.91)	.716 (1.84)
Mean Lag	7.8 (2.66)	8.5 (2.43)	5.8 (1.55)	10.7 (2.16)
ΣPCRELPEN (6 qtrs)			.035 (2.33)	
Mean Lag			2.5 (.22)	
VATCHNGE		.775 (5.31)	.782 (4.93)	1.036 (3.51)
S1	5.478 (4.46)	3.661 (3.21)	3.677 (3.33)	3.596 (2.82)
S2	2.413 (2.46)	1.655 (1.96)	1.730 (2.03)	1.248 (1.29)
S3	−.737 (.94)	−1.279 (2.02)	−1.145 (1.76)	−1.986 (2.75)
C	−5.665 (2.43)	−5.849 (1.92)	−4.139 (1.74)	−1.946 (.55)
N	55	55	55	39
Mean Rate of Inflation	4.05	4.05	4.05	4.55
$\bar{R}^2$	.616	.739	.742	.751
Standard Error of Regression	1.87	1.54	1.53	1.46
Durbin-Watson Statistic	2.05	2.06	1.97	2.10
Rho	.25	.56	.36	.56
F	13.4	20.1	13.9	15.3

Table A8

ITALY

	8.1	8.2	8.3	8.4	8.5
Item/Period	58-77		58-67	68-77	
ΣPCM1 (20 qtrs)	1.547 (5.27)	1.290 (4.14)	.792 (2.67)	2.180 (5.18)	1.997 (5.96)
Mean Lag (qtrs)	11.4 (5.79)	11.1 (4.45)	7.6 (2.29)	12.9 (6.78)	12.5 (7.49)
WPCON		−6.430 (2.01)			−7.316 (2.36)
PCRELPEN		.076 (3.00)			.074 (2.48)
PCRELPEN$_{-1}$		−.021 (.84)			.035 (1.09)
PCRELPEN$_{-2}$		.065 (2.65)			.052 (1.72)
PCRELPEN$_{-3}$		.036 (1.45)			.057 (2.06)
C	−15.524 (3.53)	−11.718 (2.55)	−6.365 (1.68)	−26.043 (3.67)	−23.530 (4.30)
N	79	79	39	39	39
Mean Rate of Inflation	6.74	6.74	3.47	10.17	10.17
$\bar{R}^2$	.619	.695	.286	.604	.758
Standard Error of Regression	4.07	3.64	2.88	4.60	3.60
Durbin-Watson Statistic	2.16	2.14	1.84	1.99	1.85
Rho	.46	.49	.16	.12	−.03
F	32.7	20.7	4.8	15.5	14.2

Table A9

NETHERLANDS

	9.1	9.2	9.3	9.4
Item/Period	58-77		58-67	68-77
ΣPCM1 (20 qtrs)	1.124	1.148	1.112	.898
	(5.37)	(5.90)	(2.73)	(4.90)
Mean Lag (qtrs)	9.1	9.4	7.1	10.4
	(4.50)	(5.07)	(2.02)	(4.29)
WPCON		−1.245		−1.304
		(.83)		(1.35)
VATCHNGE		1.060		1.116
		(3.61)		(5.75)
PCRELPEN				.010
				(.52)
PCRELPEN−1				−.013
				(.68)
PCRELPEN−2				.033
				(1.76)
PCRELPEN−3				.020
				(1.03)
SA1	2.965	3.091	3.587	
	(1.90)	(2.14)	(1.80)	
SA2	5.155	5.296	5.193	
	(3.31)	(3.67)	(2.61)	
SA3	−5.920	−5.804	−4.801	
	(3.83)	(4.05)	(2.42)	
SB1	1.715	.375		−.520
	(1.21)	(.27)		(.52)
SB2	2.089	2.330		2.456
	(1.47)	(1.75)		(2.69)
SB3	−2.788	−2.697		−3.675
	(1.97)	(2.06)		(3.87)
C	−4.739	−4.972	−5.632	−1.874
	(2.44)	(2.74)	(1.78)	(.78)
N	80	80	40	40
Mean Rate of Inflation	4.95	4.95	2.59	7.30
$\bar{R}^2$	.561	.626	.460	.731
Standard Error of Regression	3.64	3.36	4.42	1.91
Durbin-Watson Statistic	2.38	2.42	2.64	2.26
Rho	—	—	—	—
F	11.1	12.0	5.7	9.1

Table A10

NORWAY

	10.1	10.2	10.3
Item/Period	64-77		68-77
ΣPCM2 (20 qtrs)	.764	.816	1.091
	(3.46)	(5.01)	(5.00)
Mean Lag (qtrs)	13.5	13.2	10.5
	(2.48)	(3.44)	(3.94)
WPCON		−4.337	−3.189
		(1.88)	(1.62)
VATCHNGE		.994	1.222
		(6.08)	(7.75)
S1	5.940	5.428	5.439
	(3.32)	(4.04)	(4.34)
S2	.872	2.159	4.558
	(.45)	(1.49)	(3.03)
S3	1.207	2.106	3.727
	(.61)	(1.44)	(2.64)
C	−1.751	−2.838	−7.060
	(.71)	(1.55)	(2.66)
N	56	56	40
Mean Rate of Inflation	6.74	6.74	7.62
$\bar{R}^2$	.293	.616	.752
Standard Error of Regression	4.12	3.04	2.54
Durbin-Watson Statistic	1.98	1.99	1.88
Rho	—	—	—
F	4.3	10.8	14.1

Table A11

SWEDEN

	11.1	11.2
Item/Period	58-77	
ΣPCM1 (20 qtrs)	1.921	1.693
	(4.40)	(5.40)
Mean Lag (qtrs)	8.3	9.7
	(3.86)	(5.50)
WPCON		−6.522
		(3.06)
DECON		4.563
		(1.54)
OIL		9.950
		(4.20)
C	−11.016	−9.059
	(3.01)	(3.44)
N	79	79
Mean Rate of Inflation	5.01	5.01
$\bar{R}^2$	.390	.550
Standard Error of Regression	3.36	2.88
Durbin-Watson Statistic	2.09	2.08
Rho	.34	.21
F	13.5	14.6

Table A12

SWITZERLAND

	12.1	12.2	12.3	12.4
Item/Period	58-77		58-67	68-77
ΣPCM1 (20 qtrs)	.558	.598	.614	.596
	(3.93)	(4.67)	(2.30)	(5.46)
Mean Lag (qtrs)	13.2	10.6	13.0	10.8
	(5.45)	(5.11)	(2.79)	(6.04)
ΣPCRELPEN (6 qtrs)		.254	−.04	.133
		(3.90)	(.19)	(2.56)
Mean Lag (qtrs)		2.5	−24.9	1.9
		(5.40)	(.19)	(1.00)
S1	−2.557	−2.262	.120	−.894
	(2.74)	(2.57)	(.09)	(1.01)
S2	−1.974	−1.120	−.514	−2.411
	(2.14)	(1.40)	(.40)	(2.93)
S3	−1.900	−1.256	−.155	−2.076
	(1.97)	(1.42)	(.13)	(2.45)
C	1.263	.518	−1.335	1.772
	(1.05)	(.48)	(.56)	(1.87)
N	80	80	40	40
Mean Rate of Inflation	3.77	3.77	2.74	4.80
$\bar{R}^2$	.390	.516	.433	.823
Standard Error of Regression	2.76	2.46	2.09	1.65
Durbin-Watson Statistic	1.55	1.58	1.94	2.14
Rho	—	—	—	—
F	8.2	8.7	3.7	17.4

Table A13

UNITED STATES

	13.1	13.2	13.3	13.4	13.5	13.6
Item/Period	58-77				58-70	68-77
PCM1B (20 qtrs)	1.038	1.077	.798	.801	.765	
	(6.96)	(7.78)	(10.13)	(10.65)	(7.66)	
PCM1B (12 qtrs)						.690
						(2.24)
Mean Lag (qtrs)	7.9	8.5	6.7	7.1	12.4	6.4
	(3.38)	(3.99)	(3.40)	(3.93)	(2.99)	(3.04)
WPCON		−1.601	−1.344	−1.351		−1.432
		(1.87)	(2.50)	(2.55)		(2.74)
PCRELPEN (6 qtrs)			.134		−.116	.116
			(5.98)		(1.01)	(5.33)
Mean Lag			2.5		1.6	2.5
			(2.83)		(.14)	(1.98)
$PCRELPEN_{-1}$				.036		
				(2.54)		
$PCRELPEN_{-2}$				.050		
				(3.10)		
$PCRELPEN_{-3}$				.005		
				(.29)		
$PCRELPEN_{-4}$				.039		
				(2.72)		
C	−.050	−.041	.616	.631	.796	1.534
	(.07)	(.06)	(1.85)	(1.96)	(2.12)	(.90)
N	79	79	80	80	52	40
Mean Rate of Inflation	3.97	3.97	3.97	3.94	2.73	5.83
$\bar{R}^2$	.712	.720	.791	.797	.547	.732
Standard Error of Regression	1.35	1.33	1.15	1.13	1.13	1.04
Durbin-Watson Statistic	2.11	2.12	1.85	1.74	1.89	2.48
Rho	.46	.42	—	—	—	—
F	49.1	41.2	34.2	35.5	8.69	12.85

Table A14

YUGOSLAVIA

	14.1	14.2	14.3
Item/Period	58-77		
ΣPCC (20 qtrs)	1.956	1.580	1.451
	(2.43)	(2.78)	(2.54)
Mean Lag (qtrs)	8.4	8.5	8.6
	(2.55)	(3.02)	(2.81)
REFORM		66.031	66.396
		(8.76)	(8.76)
OIL			5.392
			(1.00)
S1	−4.948	−2.847	−2.614
	(.98)	(.81)	(.74)
S2	−2.061	−1.351	−1.220
	(.49)	(.46)	(.42)
S3	−9.605	−12.392	−12.046
	(2.67)	(4.93)	(4.72)
C	−24.376	−17.355	−15.082
	(1.44)	(1.46)	(1.27)
N	79	79	79
Mean Rate of Inflation	11.46	11.46	11.46
$\bar{R}^2$	.231	.628	.622
Standard Error of Regression	10.81	7.52	7.52
Durbin-Watson Statistic	2.01	2.06	2.05
Rho	.26	.27	.26
F	4.3	17.4	15.6