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PART

V Conclusions

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17 Conclusions on the International Transmission of Inflation

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Science is organized knowledge.
Herbert Spencer

It is better to know nothing than to know what ain't so.
Josh Billings

The goal of empirical research in any science is to maximize the number of assumptions which can be securely included in the body of theory. While empirical research can never establish the truth of any statement about the world, conformity of the world to a particular hypothesis in repeated and varied trials does give us confidence to incorporate the hypothesis into the set of assumptions we use to make scientific predictions. In cases in which data or measurement tools are lacking, a hypothesis may gain wide currency on the basis not of solid empirical successes but of logical, aesthetic, or even political grounds. One example in economics would be the Phillips curve, another much of the Keynesian revolution. Because of awesome data problems, international finance has been particularly prone to intellectual fads in which particular assumptions achieve dominance on the basis more of the intellectual force of their proponents than of strength of supporting empirical evidence.

With many contending and inconsistent hypotheses in the field, once the data are available it merely takes hard work to find that some hypotheses are very unlikely to be true given the observations. Thus the greatest contribution of this project must be the creation of the consistent set of data on which the rest of our research is based. We have explored the conformity of this data set to the implications of certain popular hypotheses relevant to the international transmission of inflation. These tests, besides their intrinsic interest, served as a quality check on the data by highlighting any questionable observations.

Our conclusions from the tests reported in this volume can be organized around four related issues: monetary versus other explanations of inflation, the channels of international transmission of inflation, sterilization and monetary control, and alternative monetary arrangements. These are presented in sections 17.1 to 17.4, respectively. We write finis by proposing a number of topics for future research suggested by our analyses of the data.

17.1 Money versus Special Factors

Two very different views of what caused the inflation of the second half of the 1960s and the 1970s have been widely propounded. On the one hand, there are those who stress the role of special factors: the monopoly power of the business sector and of trade unions, the substantial rise in commodity prices in 1973, and, most important, the OPEC–induced increases in the price of petroleum in 1974–75.[1] On the other hand are those observers who regard inflation in general as a monetary phenomenon and this particular episode as just another member of the species. According to most proponents of this view, the United States played a key role in the process, its excessive monetary growth being exported abroad via the fixed exchange-rate system formally in existence until 1973.[2]

In broad outline, both explanations are consistent enough with the facts that neither can be ruled out. The relative prices of agricultural commodities did increase markedly immediately prior to and during the peak inflation years. So also did the relative price of oil. Increases in monopoly power might have accounted for inflation up until that point. At least there was general concern in government and among a relatively large segment of economists that they did. Moreover, inflation abated for a time once commodity prices fell in relative terms and oil prices ceased rising so rapidly.

By the same token, monetary growth in the United States accelerated substantially after 1965. Fixed exchange rates via a variety of channels would normally have been expected to spread that inflationary American monetary impulse to other countries. Moreover, monetary growth in

1. The clearest statement of the special-factor view was made by Kaldor (1976). See also, Bruno and Sachs (1979), Fried and Schultze (1975) on oil, and Perry (1975, 1980) on wage push. Laidler and Parkin (1975) and Gordon (1977) have provided particularly useful critical assessments of this view.

2. Laidler and Parkin (1975), Meiselman (1975), and Johnson (1976) provide clear statements of the monetary approach to worldwide inflation, but as we demonstrate in this chapter there is considerable room for disagreement among economists who agree that inflation is an essentially monetary phenomenon. Further, many economists who stress "special factors" assume that the central bank accommodates those factors by money growth.

most other industrial countries followed the same general pattern as monetary growth in the United States.

To students of economic history and the history of economic thought, the current debate about the causes of inflation provides just another illustration of the Ecclesiastes dictum "There is no new thing under the sun." In Britain during the bullionist controversy at the start of the nineteenth century and then again several decades later during the currency-school banking-school debate almost the exact same arguments were being voiced as today. The same is true for the widespread discussions of inflation in America at the start of this century.

So similar, in fact, have the views of the various participants on each side of this recurrent debate been that proponents of one position at one time almost appear to be responding directly to proponents of the other position during earlier and later periods. Consider Irving Fisher's (1920) discussion of explanations of inflation that rely purely on movements in relative prices as an example: "Obviously no explanation of a general rise of prices is sufficient which merely explains one price in terms of another" (p. 14). He soon added, "[n]or will special causes working on selected commodities prove to be general enough to explain the concerted behavior of commodities" (p. 16). Fisher concluded instead that the available empirical evidence indicated that "the chief disturber of the peace, so far as the purchasing power of money is concerned, has invariably, or at any rate almost invariably, been money itself, not the goods which money purchases" (p. 35).

Though Fisher was writing in 1920, his argument could easily have been a response to Thomas Tooke and William Newmarch, who more than sixty years before had concluded that "in every instance of a variation of Prices, a full explanation of the change is apparently afforded by circumstances affecting the Supply or Demand" (1857, reprinted in 1928, p. 233), or indeed to the modern-day advocates of that position.

Our own evidence lends very little support to the most recent reincarnation of the special-factor explanation of inflation. In spite of this hypothesis's broad popular appeal and rather widespread support in economic policy circles, we find that at best it can account for only a minor fraction of the inflation in the first half of the 1970s. Monetary factors, we find, explain the bulk.

Both the trade-union and monopoly-power versions of the cost-push or special-factor hypothesis would suggest that nominal money growth either lags behind price changes as central banks react to the unemployment resulting from wage and price increases or is unrelated to price changes. Cassese and Lothian in chapter 4 report just the opposite with lagged money growth significantly affecting prices but not vice versa. We conclude—as have others—that a viable special-factor hypothesis must rely on increases in the price of oil and other commodities.

Darby in chapter 8 reviews the theoretical underpinnings of the special-factor hypothesis as applied to oil before going on to test and otherwise evaluate its validity. The gist of the conclusions he reaches in the theoretical analysis is that for the special-factor hypothesis to make sense either of two things would have had to have happened: real income would have to have fallen or monetary growth have been increased in response to oil-price shocks.

To assess the importance of the first of these two avenues of influence, Darby incorporates oil-price terms into the real-income equations of the Mark III Model. Since these equations did not perform even tolerably well for three of the eight countries in the sample at the outset, he focuses upon the remaining five. In only three of these five cases are the oil-price terms taken as a group significant. These three countries—the Netherlands, the United Kingdom, and the United States—all had general price controls, however, that were removed more or less coincidentally with the increase in oil prices. Canada and Germany, the other two countries that Darby considers and for which he could uncover no significant effect, did not have controls during the relevant period. Given the tendency for price controls to affect the time pattern of changes in the real and price components of nominal income as well as the time pattern of movements in velocity, Darby concludes that the estimated reductions in real income may well be spurious.

So that he can also allow for the indirect effects of the oil-price increase on nominal money supplies and on real exports while assessing its direct influence on real incomes and hence price levels, Darby performs a simulation experiment with the Mark IV Simulation Model. Unfortunately, these results are not at all conclusive. For several countries, the simulations are distorted by theoretically perverse effects. In the remaining instances, the problem of price controls coupled with the differences in behavior among countries makes it impossible to say anything definitive about "the" influence of oil prices on the price level: The price level might be increased by anywhere from 0 to 5%. However, if we translate this into the effect on the 1971–75 inflation rate, this amounts to only a 0 to 1% per annum oil component as compared to the 3.5% per annum average increase in inflation over the previous quinquennium. Thus, while it is possible that the oil-price increase had a significant role in increasing inflation, it certainly was not a dominant one.

Incorporating oil-price terms directly into their price equation in chapter 14, Gandolfi and Lothian take a more direct approach than Darby but reach conclusions qualitatively similar to his. In almost all of the eight countries, they are able to uncover a significant effect in at least one formulation of their equation. However, the significance of such effects in a given country is not at all consistent among equations. It varies both by the model of the error structure and by the measure of the price level that

they use. Even if one ignores these differences and focuses upon the equation most favorable to the oil-price hypothesis, the estimated effects in most countries are still not terribly large.

In another set of tests, Gandolfi and Lothian incorporate the relative price of basic commodities as an additional variable in their price equations. The results of this exercise are unambiguous. In their regressions with a correction for second-order serial correlation, the commodity price variable enters significantly only two times: for Canada with the GNP deflator but not the CPI used as the measure of the price level and for Italy with the CPI but not the GNP deflator.

The other question that is highly relevant to the debate over monetary versus special factors, and which is logically antecedent to our discussion of channels of transmission, is the role of the United States as the reserve-currency country. Darby deals with this issue explicitly in chapter 16 from both the theoretical and empirical perspectives. Schwartz in her historical overview of the period in chapter 2 describes the principal events in the international monetary arena and the part the United States played both during the Bretton Woods years and afterward. Also of interest are Cassese and Lothian's analysis of movements in American and foreign money and Gandolfi and Lothian's estimates of expected money functions.

Darby's theoretical model in chapter 16 illustrates the importance of the reserve-currency country in a world of fixed exchange rates. In the model, the reserve-currency country's money supply (rather than the world money supply, which some others have stressed) is the ultimate determinant of the price level in the rest of the world as well as in the reserve-currency country. This exogeneity of the United States as a source of world inflation rests on two assumptions: that growth in its nominal money supply is independent of changes in its and other countries' reserves and that growth in its real money demand is similarly independent of foreign influences.

Darby evaluates this second assumption by estimating a simple distributed lag relation between inflation in the United States and growth in M1 over the previous sixteen quarters. He finds that as the data are averaged over progressively longer periods the explainability of the relation progressively increases to the point where, when he uses four-year averages, he can account for 97% of the variation in inflation. From this exercise, he concludes that if foreign influences were important, they only operated in the shorter term, affecting the transition to a new equilibrium rate of inflation, but not the equilibrium itself.

To examine the validity of the first assumption, Darby reestimates the Federal Reserve's reaction function and includes various measures of the balance of payments. He finds that he cannot reject the hypothesis that these variables had no influence, over either the full sample period or the

several subperiods that he examines. In contrast, in chapter 6 he and Stockman show that balance-of-payments variables do enter significantly in the money-supply reaction functions of the other seven countries' monetary authorities.

These findings moreover square with evidence that Cassese and Lothian present in chapter 4 and that Gandolfi and Lothian give in chapter 14. Using bivariate causality tests, Cassese and Lothian find no significant effect—positive or negative—of the lagged balance of payments on growth in American high-powered money. They do, however, find a significant negative effect running in the opposite direction.

Gandolfi and Lothian's estimates of the expected money functions that underlie their price equations tell a similar story: In each of the seven foreign countries, monetary growth in the United States or the domestic balance of payments—sometimes both—has a significant effect on monetary growth; in the United States, the balance of payments is not significant.

Schwartz's review in chapter 2 of the institutional framework of the Bretton Woods system supports the results of the econometric analysis. Securities denominated in U.S. dollars were the dominant source of increase in international reserves under Bretton Woods, and these outflows had no direct effect on the American money supply. The Federal Reserve System's response to continuing balance-of-payments deficits appeared to go little beyond public statements of concern and cosmetic operations.

We turn next to a detailed examination of the channels of international transmission which explicates how a homegrown American inflation was exported to the industrialized West.

17.2 Channels of Transmission

The international linkages among national macroeconomies follow four main channels: goods substitution, bonds substitution, currency substitution, and absorption effects. The previous chapters have disclosed evidence that all of these channels have been operative, but not so strongly as argued by respective proponents. In this section we examine these arguments and the empirical evidence. Section 17.3 then presents evidence on the extent to which central bank sterilization policies frustrated or delayed the international transmission of inflation under the Bretton Woods system.

17.2.1 Goods Substitution

There are two distinct traditions in the literature as to the nature of the linkages operating through tradable goods. The first, which we associate with David Hume, views internationally traded goods as substitutes, but

not perfect substitutes. Thus their relative prices may change temporarily as part of the adjustment process initiated by a monetary disturbance.[3] The second view, associated by Whitman (1975) with the "global monetarists" like Laffer (1975) and usually termed price arbitrage, assumes that internationally traded goods indeed are perfect substitutes with prices continuously and rigidly linked. Further consideration of factor competition between tradable and nontradable goods results in the "law of one price level," which states that purchasing power parity holds continuously, and not just in long-run equilibrium as in Humean analyses.[4] Thus the empirical question to be answered is to what extent are goods substitutable internationally, or as Isard (1977) wryly put it, "How far can we push the 'Law of One Price'?"

In this volume we have reported a variety of evidence to support the conclusion of such authors as Isard (1977), Kravis and Lipsey (1977, 1978), and Richardson (1978) that goods are substitutable internationally, but far from perfectly so. This evidence can be arranged on a spectrum from direct to most roundabout. The latter, which infers that goods (and assets) are imperfect substitutes from the ability of nonreserve countries to exercise independent monetary policies under pegged exchange rates, is presented at length in section 17.3. The remainder of the evidence is considered here.

The most direct evidence is found in the relatively weak price effects found in the export- and import-price equations estimated by Darby and Stockman in chapter 6.[5] Generally, the relative-price effect on the balance of trade is not large although it does increase over time. Experiments with the Mark IV International Simulation Model confirm that Humean movements in relative price levels are implied by monetary shocks whether originating in the United States or abroad.[6]

An only slightly less direct sort of evidence is provided by Cassese and Lothian in chapter 4. They use bivariate Granger tests to analyze two

3. Dietrich Fausten (1979) has persuasively distinguished the Humean tradition from the law of one price level discussed below. Either the law of one price level or interest arbitrage (discussed in the next subsection) together with ancillary assumptions can be used to establish the result that the nominal quantity of money demanded in a small economy maintaining pegged exchange rates is determined by foreign factors. Hence the conclusion, if money supply equals money demand, that reserve changes must supply the money not supplied via domestic credit and "the balance of payments is essentially a monetary phenomenon" (Frenkel and Johnson 1976, p. 21).

4. The relevant concept of purchasing power parity is a ceteris paribus one: The purchasing power ratio (real exchange rate) is unaffected in short-run and long-run equilibrium by a monetary disturbance. As discussed in note 1 to chapter 15 above, this equilibrium value may shift randomly due to such factors as *permanent* shifts in relative prices.

5. See tables 6.10 and 6.13.

6. We refer here only to the Humean effect on relative price levels, since for neither the United Kingdom nor Canada does Darby simulate the working of a specie-flow mechanism. For those countries sterilization prevented any substantial impact on domestic nominal money of an American money shock.

relations: domestic versus foreign inflation and domestic money growth versus domestic inflation. In the inflation comparisons, they use two different measures of foreign inflation. For the United States as well as the seven nonreserve countries, they use the percentage change in a nominal-income weighted index of the remaining seven countries' GNP (or GDP) deflators; for the seven nonreserve countries alone, they use the percentage change in the United States deflator. In both instances, the lagged foreign inflation rate was significant in fewer than half the countries.

For their tests of the domestic money-price relations, they used three measures of money—M1, M2, and high-powered money—and the consumer price index as well as the deflator. For all eight countries, they find a much more consistent effect running from lagged values of money to current inflation than the other way around. Furthermore, these relations exhibit no tendency to reverse themselves during the shorter fixed rate sample period ending in the third quarter of 1971. Cassese and Lothian's results thus stand at odds with the assumption of continuous price arbitrage with money supplies adjusting with a lag to changes in nominal money demand induced by foreign price shocks.

In chapter 14, Gandolfi and Lothian use their reduced-form price equation to conduct tests of the price arbitrage mechanism similar to those discussed in section 17.1 for oil and commodity prices. Like Cassese and Lothian, they use both the price level in the United States and a weighted average of the price levels in the seven countries other than the one being analyzed as alternative measures of foreign prices. In the great bulk of the comparisons these measures are not statistically significant. Moreover, in their regressions with the second-order correction, the United States price variable is only significant in both the CPI and GNP relations in Japan and the rest-of-world price index only significant in both the relations in France. They conclude: "Some evidence of price arbitrage, therefore, exists but even on the most favorable interpretation of the evidence it is weak and hardly universal." Similarly weak results with a preliminary version of the Mark III Model were reported in Darby (1979).

Darby examines the predictive power of purchasing power parity under floating exchange rates in chapter 15. His results do not speak to the issue of whether goods are perfect substitutes since changes in the parity value may occur due to permanent changes of relative prices.[7] The major implication for examining historical data is that as the period of

7. See Stockman (1980). However, Kravis, Heston, and Summers (1978) attempt to make international purchasing power comparisons based on standardized baskets and find these to differ from exchange-rate converted nominal income ratios.

observation is increased, the level of the purchasing power ratio becomes less predictable while its growth rate becomes more predictable.[8]

17.2.2 Asset Flows and Monetary Linkages

We have already suggested that the substitutability of goods may transmit inflation from country to country not only by direct price arbitrage but also by inducing changes in the money supply. The money supply changes are supposed to result from the effect of the trade balance on the balance of payments. Asset flows may provide important balance-of-payments effects even if the trade balance responds only weakly to a monetary disturbance. The extent to which the balance of payments affects the nominal supply of money is discussed at length in section 17.3.[9]

Recent presentations of the monetary approach to the balance of payments have come to stress "interest arbitrage" rather than price arbitrage on Dornbusch's (1976*b*, p. 1162) "assumption that exchange rates and asset markets adjust fast relative to goods markets." The essential idea is that assets are perfect substitutes internationally so that the interest rate in any nonreserve country must equal the interest rate in the reserve country plus the expected depreciation in the exchange rate. So long as the expected depreciation is independent of domestic monetary policy and the balance of payments, this interest parity relation fixes the domestic interest rate and hence the domestic nominal money supply, price level, and so forth as effectively as did the law of one price level in the early versions of the monetary approach.

This airtight conclusion breaks down if assets (bonds in the macroeconomic paradigm) are not perfect substitutes internationally because of nondiversifiable risk.[10] In this case capital flows will change the equilibrium domestic interest rate for a given foreign interest rate plus expected depreciation. This is the essence of the portfolio-balance approach pioneered by Branson (1968, 1970) and advanced by Dan Lee and Michael Melvin in chapters 12 and 13 of this volume.[11] With imperfect

8. Thus Darby shows that convergence of exchange-rate-adjusted inflation rates over longer periods of observation—such as noted by Gailliot (1970) and Lawrence (1979)—are consistent with the equilibrium value of the purchasing power ratio following a random walk. However, it is very difficult to distinguish statistically a random walk from a very slow adjustment process as argued by Frenkel (1980*b*, *c*).

9. To anticipate section 17.3 a bit, we find that the balance of payments generally does affect nominal money growth in nonreserve countries, but only very weakly at first.

10. This risk may be with regard to exchange-rate changes or to capital controls since exchange-rate crises were international events which would affect many countries simultaneously.

11. Even if assets were imperfect substitutes internationally, induced changes in the expected exchange-rate depreciation may limit the ability of a nonreserve central bank to choose nominal money growth rates much different from those consistent with interest-rate "parity." See chapter 15 above and section 7.3 below for details.

asset substitutability there may be movements in relative interest rates analogous to the movements in relative price levels during the adjustment period. Again, the balance-of-payments effect of the induced capital flows may induce the gradual changes in money supply which ultimately reestablish equilibrium. In this way, the portfolio-balance approach is the asset market analogue to the Humean relative price adjustment mechanism.

The evidence in this volume is generally consistent with the view that reserve flows induced by a portfolio-balance mechanism were an important channel of international transmission under the Bretton Woods system. However, the strength of this channel is not overwhelming, and, if we use the simulations as a guide, the actual transmission of effects through this mechanism appears to have been both fairly weak and rather drawn out over time. Besides the evidence of exercise of monetary control examined in section 17.3 below, our evidence is of several types: the tests and other assessments of the interest arbitrage mechanism by Cassese and Lothian and by Darby and Stockman and Darby's simulation results with the Mark IV Model.

Cassese and Lothian report in chapter 4 that for all seven nonreserve countries lagged American interest rates were a significant determinant of the domestic interest rates during the pegged rate period. With the exception of Canada, where the effect was largely in the current quarter, these effects were typically distributed over a number of quarters. Arbitrage therefore appears to have been rather limited in the short run in most countries, contrary to the implications of perfect asset substitutability, but more powerful in the long run.

Darby and Stockman on the basis of their estimates of capital-flows equations concur in chapter 6. With the exception of Japan and the United Kingdom, for which the estimated equations were exceedingly poor, they find a negative but weak relation between capital flows and either the level or first difference of the domestic versus foreign interest-rate differential adjusted for expected changes in the exchange rate. The chapter 7 simulation experiments confirm this impression. For Germany substantial capital flows result in *partial* contemporaneous harmonization of domestic money growth to an American monetary shock, but a domestic money shock does not induce large offsetting reserve flows. For the Netherlands, balance-of-trade effects seem quite as important as capital flows. However, in neither Canada nor the United Kingdom are the simulated effects of the increase in the nominal stock of money in the United States at all substantial. An important reason that the simulated capital flows are so weak and easily sterilized is the small estimated liquidity effect of money shocks on domestic interest rates.[12]

12. Recall from chapter 10 that the capital flows induced by a difference between domestic nominal money and its international "parity" value depend upon the *product* of

17.2.3 Other Channels of Transmission

The two remaining channels of transmission to be discussed are currency substitution and Keynesian absorption effects. Evidence on both channels comes from the simultaneous model, the estimates of the model presented in chapter 6, and the results of the simulation experiments described in chapter 7.

The theoretical rationale for currency substitution is that monetary assets denominated in the domestic currency are substitutes in demand with those denominated in the foreign currency. In the extreme case in which both are near-perfect substitutes, German money holders, for example, will be indifferent between deposits in dollars and in DM, so that any contraction in the supply of DM deposits will induce German money holders to increase their deposits denominated in dollars by an equivalent amount in terms of DM. As the supply of money in German DM declines, therefore, its velocity rises to offset decreases with the end result that income flows in Germany are left unaltered. This Radcliffesque view is contradicted by the existence of stable money demand functions, but it may well be that foreign moneys are substitutes in demand for domestic money.

One test of this proposition has been to include a foreign—usually United States—(uncovered) interest-rate variable in the domestic money demand function. Miles (1978) follows this procedure for Canada, justifying the inclusion of the variable within the context of a model similar to that used by Chetty (1969) in his investigation of the substitutability of monetary assets within the United States. Other studies of this type are Hamburger (1977) and Brittain (1981). An alternative procedure, which Brittain also follows, is to examine the cross-correlations of the residuals from simple regressions of velocity on time. The authors of all of these studies find support, to varying degrees, for the currency substitution hypothesis. Bordo and Choudhri (1982) note that the differential cost of holding foreign instead of domestic money is the expected change in the exchange rate, but this variable does not enter the Canadian demand for money. Further, their reexamination of Miles's work shows that his finding of currency substitution was spurious.

These tests are generally ill suited to differentiate between currency substitution and the more general concept of asset substitution. Indeed we would argue that foreign bonds (and domestic bonds!) are generally more important substitutes for domestic money than are foreign moneys. The return to a domestic holder of a foreign bond is the foreign interest

the interest-rate coefficient in the capital-flows equation and the derivative of the interest rate with respect to money. Thus, if the liquidity effect is small or nil, so will be the capital flows. Large liquidity effects are not consistent with a shock-absorber money demand function which distinguishes between unexpected and expected money growth; see Carr and Darby (1981).

rate plus the expected depreciation in the exchange rate.[13] This more general concept has been examined in this volume.

Darby and Stockman include a foreign interest rate plus expected depreciation term in each country's money demand function in the Mark III Model. For the nonreserve countries they use the three-month U.S. treasury bill rate; for the United States they use the three-month U.K. treasury bill rate.[14] Only for Japan and the United Kingdom is the foreign interest rate statistically significant. In both instances, moreover, the magnitude of the estimated coefficients is exceedingly small. One possible explanation for the disparity between our results and those reported in some other studies may be simultaneous equations bias since our results are obtained in the context of a simultaneous model and the others using single-equation approaches. We conclude that foreign asset substitution for domestic money is not an important channel of economic transmission among countries.

The traditional Keynesian absorption channel links one country's increase in real income to increased demand for imports and hence increased exports and real income in other countries. On the one hand, regressions of an extended Barro real-income equation (reported in chapters 6 and 9) find that the distributed lag coefficients on real export shocks are insignificant as a group for all countries at the 5% level and for all countries except the United States and Germany at the 10% level. These results suggest that the absorption channel is empirically irrelevant. On the other hand, absorption effects are the dominant channel of transmission in the simulation experiments for two countries, Canada and the United Kingdom. Their domestic money shocks, as already mentioned, were unaffected by the increase in the money stock in the United States. Increases in their exports, however, affected real income and, in the case of the United Kingdom, interest rates.[15] Whether the importance of the absorption channel and unimportance of monetary channels for these countries will survive further study is an interesting question.

17.2.4 Summary

Neither goods nor assets appear to be perfect substitutes, but both the trade balance and capital flows are responsive to movements in foreign prices and (expected-exchange-rate-change-adjusted) interest rates rela-

13. Including this variable and the domestic interest rate in the money demand function is equivalent to Bordo and Choudhri's approach to currency substitution under their assumption that bonds (but not moneys) are perfect substitutes internationally.

14. The expected changes in the exchange rates are proxied by the predictions of behavioral equations described in section 5.3.

15. Although the distributed lag coefficients on export shocks were insignificant as a group, individual coefficients passed the t statistic criterion for inclusion in the simulation model.

tive to their domestic counterparts, with the response increasing over time. Only weak evidence was found in support of either asset-substitution effects on money demand or absorption effects on real income.

17.3 Sterilization and Monetary Control

Monetary control by nonreserve central banks under pegged exchange rates implies an ability to move domestic interest rates and prices relative to their international parity values. So evidence of monetary control reinforces the direct evidence of imperfectly substitutable assets and goods. The exercise of monetary control is complete or partial according to whether induced reserve flows are completely or partially sterilized. If sterilization is complete, then the central bank chooses the money supply without regard to the induced variations in its reserve assets. Where only partial (or no) sterilization is practiced, the induced reserve flows move the money supply to a point intermediate between that otherwise desired by the central bank and that consistent with the international parity values.

In this section we will assess our evidence on three aspects of this larger issue: the prevalence and magnitude of sterilization among our sample of nonreserve countries, whether short-run monetary control was in fact exercised by these countries under pegged exchange rates, and the implications for dynamic stability of their exercise of short-run monetary control. Finally, we draw out the implications of this evidence for the effects of central bank intervention in the foreign exchange markets under floating exchange rates.

17.3.1 The Prevalence and Magnitude of Sterilization

Complete sterilization occurs if the contemporaneous scaled balance of payments (B/H) does not enter into the nonreserve central bank's money supply function.[16] No sterilization occurs if the contemporaneous scaled balance of payment enters that reaction function with a coefficient of 1 so that the money growth rate is $(B + \Delta D)/H$, where the scaled-domestic-credit change $\Delta D/H$ is determined independently of the balance of payments. Partial sterilization occurs if central bank behavior falls between these extremes.

Traditional presentations of the monetary approach such as Johnson (1976, pp. 152–53) have made the extreme assumption that nonreserve central banks do not sterilize the balance of payments at all. This assumption appears to be made primarily for analytical convenience, since it

16. To put it another way, the scaled balance of payments B/H enters the scaled-change-in-domestic-credit ($\Delta D/H$) reaction function with a coefficient of -1.

permits analysis to proceed conditioned upon an exogenously determined domestic credit. Mussa (1976, p. 192) makes it clear, for example, that a (partial) sterilization policy will merely result in exaggerated movements in the balance of payments under the other assumptions of the monetary approach. To the extent that proponents of the monetary approach have not taken this assumption seriously, it is hoped that the generalized monetary approach model presented in chapter 10 will demonstrate by example that sterilization presents no real analytical or expositional inconvenience.

In the past, at least, some monetary approachers have taken the no-sterilization assumption to be a true statement of how the world operates. The reasoning of Genberg (1976, p. 322) is typical: The nominal money supply is determined by the international parity values of prices and interest rates; so complete sterilization is impossible. Further, partial sterilization results in exaggerated movements in the balance of payments with no effect on the money supply; this is not attractive to a central bank, and so the policy will not be attempted. There are two empirical statements here: (1) Nonreserve central banks have no monetary control. (2) They are aware of that lack of control and averse to exaggerated movements in the balance of payments. Thus sterilization is an empirical, not a theoretical, question.

Nonreserve central bank behavior is quite strictly limited if they are to eschew sterilization. They must formulate their policy in terms of their holdings of assets denominated in domestic currency and forswear any goals as to domestic interest rates or money supply. Herring and Marston (1977) and Hilliard (1979) conducted exemplary studies indicating that the German and British central banks, respectively, indeed did follow active policies of sterilization. Obstfeld (1980*a*) confirmed Herring and Marston's results for Germany. Connolly and Taylor (1979) used a very simple monetary model, but still found significant evidence of sterilization for the ten developed countries they examined, even over periods as long as two years.[17] In work using preliminary versions of our data bank and single-equation methods, John Price (1978) also found evidence of substantial sterilization for five nonreserve countries.

Three separate investigations of the existence of sterilization policies have been reported above in chapters 4, 6, and 11. Although the approaches are diverse, the conclusions are identical: Partial or complete sterilization appears to have been a universal practice at least for this set of developed nonreserve countries.

Cassese and Lothian use bivariate causality tests in chapter 4 to examine the relation between changes in foreign reserves and changes in

17. The large standard errors for their seventeen developing countries precluded any definite conclusion for them, but all the point estimates indicated only slightly less active sterilization.

domestic credit. They find that generally the balance of payments Granger-causes changes in domestic credit, but only for the U.K. and Canada is there evidence of a relation going the other way. Since these tests are limited to the two variables and do not speak directly to the contemporaneous relation, we do not view them as more than suggestive.

Darby and Stockman estimate a uniformly specified nominal money reaction function for all nonreserve countries in the simultaneous-equation environment of the quarterly Mark III International Transmission Model. Their results for the pegged exchange-rate period are summarized in tables 6.7 and 6.8 above. The reaction function for Italy had little explanatory value, but for the other six countries, only for Germany and perhaps Japan could the hypothesis of complete contemporaneous sterilization be rejected.[18] Stated differently, between 87% and all of the contemporaneous effect of the balance of payments on money growth was eliminated by sterilization policies of the nonreserve central banks. However, lagged responses to the balance of payments ultimately induced a positive relation in all six countries.[19] Thus, while quarterly data indicate either complete or partial sterilization, only partial sterilization would be observed in annual data.

Laskar investigates a number of variants of the Mark III reaction functions in section 11.3 above. Aside from differences in estimation technique, the major innovation in Laskar's specification is the inclusion of the lagged scaled reserves *stock*. This variable enters positively and eliminates most of the explanatory power of the lagged balance-of-payments terms, but the results are qualitatively the same as those in chapter 6 except that the Netherlands replaces Japan as one of the two countries for which complete contemporaneous sterilization can be rejected.[20] In other variants of the reaction functions, Laskar found indications that in Japan payments surpluses were completely sterilized but deficits only partially so and that in the United Kingdom, Canada, and France speculative capital flows were partially sterilized while other components of the balance of payments were completely sterilized.

It is clear that money-supply reaction functions are a fertile area for

18. The contemporaneous balance-of-payments effect on money growth was significantly negative (!) for Italy, but little can be made of this given the poor fit of the regression.

19. In Italy, even the lagged response was negative.

20. The inclusion of scaled lagged reserves is preferable to four quarters of lagged balances of payments if a slow partial adjustment process is operative. Heller and Knight (1978), Heller and Kahn (1978), Bilson and Frenkel (1979), and Frenkel (1980*a*) have made recent contributions to the literature on the demand for reserves by central banks. Bilson and Frenkel have presented evidence supporting the slow partial adjustment mechanism for reserves. Note, however, that a slow partial adjustment of actual toward desired reserves could be accomplished entirely via changes in domestic credit with no effects on the money supply; this would correspond to the workings of the monetary approach to the balance of payments. So it is difficult to go directly from the reserves literature to the proper form for the money-supply reaction function.

future research, but the work reported here in conjunction with earlier work strongly indicates that partial or complete sterilization is standard operating procedure among nonreserve developed countries maintaining pegged exchange rates. Besides the implications for monetary control to be discussed immediately below, this implies that changes in domestic credit are simultaneously determined with the balance of payments. Therefore the standard single-equation estimates explaining the balance of payments by changes in domestic credit and money demand variables tell us little about the validity of the monetary approach to the balance of payments.[21]

17.3.2 Short-Run Monetary Control

The most striking conclusion of the monetary approach to the balance of payments was that nonreserve central banks are impotent with respect to their domestic money supplies and interest rates but can attain any desired balance of payments via their actions. Either or both of two assumptions have traditionally been offered to justify this conclusion: goods are perfect substitutes internationally, and assets are perfect substitutes internationally.[22] Darby in chapter 10 adds a third condition which would imply a lack of monetary control: expectations of depreciation which are too responsive to variations in the balance of payments.[23] In recent papers, Stockman (1979) and Obstfeld (1980*b*, *c*, *d*) have emphasized that even if assets are not perfect substitutes, it is sufficient that consumers completely discount future taxes for them to act as if government holdings of foreign bonds were their own. In this case a government exchange of foreign for domestic bonds will induce an exactly offsetting shift in private demands so that monetary control is again lost.

Since any one of these four conditions—and there are doubtless others—preclude monetary control, it is difficult to conclusively reject the impotence of nonreserve central banks with respect to their money supplies. Nonetheless, the hypothesis is a scientific one and so tests can be derived. Two types of tests have led us to the conclusion that nonreserve central banks did indeed exercise monetary control under pegged exchange rates: First, we have direct evidence on the two major conditions which indicates that neither goods nor assets are perfect substitutes internationally; this evidence was discussed in section 17.2 above. Second, we have evidence that the actual growth in the money supply is indeed determined, at least in part, by domestic policy goals.

21. See section 10.2 above and Darby (1980) on this.

22. As noted in chapter 10, these assumptions must be coupled with supporting assumptions that the *contemporaneous* effect of money on prices is positive and on the interest rate negative, respectively.

23. The last is a stability condition explaining perhaps how a central bank might induce overwhelming speculative capital flows; it is not applicable to explaining loss of control in the absence of such a speculative crisis.

One way to see whether nonreserve central banks in fact exercised monetary control is to specify and estimate a structural model and then determine the implications of the estimates. The Mark III International Transmission Model described in chapters 5 and 6 is our major effort of this sort. A simplified version (the Mark IV Simulation Model) was used in chapter 7 to determine how the significant channels of international transmission interact, particularly with respect to monetary control. Four nonreserve countries (United Kingdom, Canada, Germany, and the Netherlands) were examined in some detail, and only Germany displayed any evidence of the balance of payments limiting short-run monetary control. For Germany an immediate, albeit partial, response of domestic nominal money to increased U.S. money was observed, but the balance of payments only slightly offset an upward shift in the domestic money-supply reaction function. Thus the model estimates do indeed imply substantial short-run monetary control.

Daniel Laskar in chapter 11 deals with a set of smaller single-country models in the tradition of Kouri and Porter (1974), Argy and Kouri (1974), and Herring and Marston (1977). Although his estimation techniques allow for possible endogeneity of the balance of *trade*, Laskar's analysis of monetary control assumes that the only significant loss of control would occur via offsetting capital flows. The offset coefficient (the fraction of an increase in domestic credit offset by contemporaneous capital flows) is significantly less than one at the 5% level for all countries except Canada, for which the difference is significant at the 10% level. While some of the offset coefficients are nonetheless quite high,[24] Laskar measures the independence of monetary policy by a scalar A which takes account of the extent to which induced capital flows are themselves sterilized. This A indicates the fraction of a shift in the money-supply reaction function which will actually be reflected in money growth given the central bank's reaction to the induced balance of payments. Laskar's estimates of A are all significantly different from 0, and none are significantly different from 1. Thus a high degree of monetary independence is estimated for all seven nonreserve countries.

The results of both the Mark III International Transmission Model and Laskar's smaller models may be criticized as being due to some omitted channels such as that suggested by Stockman (1979) and Obstfeld (1980*b*, *c*, *d*) as described above.[25] A set of relatively model-free tests were performed, however, that confirm the results obtained from the structural models. These tests rely on the fact that in the absence of short-run

24. For example, the German offset coefficient of about 0.9 is as high as any of the estimates listed in Obstfeld's (1980*a*, p. 3) summary of the German evidence and higher than any of the simultaneous equation estimates, including Obstfeld's own.

25. A residual cross-correlation check for such omitted channels for the Mark III Model is reported in section 6.2. No pattern of significant correlations was found.

monetary control, movements in money-supply reaction function variables other than the current balance of payments will be uncorrelated with actual movements in the money supply. If unemployment increases, the central bank might want to increase money growth but the induced balance-of-payments deficit will dissuade it from doing so. As reported in chapter 10, the growth of the money supply is indeed dependent on these domestic policy variables in all the countries, except perhaps the Netherlands.

Taken as a whole, the evidence from this volume and the work of others can be summarized as follows: The central banks of developed nonreserve countries can exercise independent monetary control in the short run under pegged exchange rates. Induced changes in the balance of payments will deter them somewhat from deviating from the reserve country's policy, but domestic goals appear to be generally dominant in determining actual money growth.

17.3.3 The Dynamic Stability of the Bretton Woods System

The idealized Bretton Woods system survived only some fifteen years from the general restoration of dollar convertibility to the breakdown of 1971. We can now assess the weaknesses in the adjustment process which led to this dynamic instability and then consider briefly alternative means of achieving equilibrium.

The adjustment process can be described by the following salient features: (1) The evolution of American monetary and inflationary trends was determined by domestic factors with international forces playing only a transient role. (2) The proximate determinant of inflation in the nonreserve countries is to be found in their own past money-supply growth. (3) Changes in American money growth do not cause overwhelming capital flows abroad; trade-flow effects build up only as the resulting inflation shifts relative price levels. (4) These balance-of-payments flows have little or no contemporaneous effects on nonreserve money growth, although the cumulative lagged effect may be substantial.

The essence of the process is lagged adjustment to lagged adjustment to lagged adjustment. The long cumulative lag from an increase in American money growth to an increase in nonreserve inflation can explain the failure of the Bretton Woods system. Table 17.1 illustrates that the initial increase in American inflation in 1966–70 occasioned very little concurrent rise in inflation in the nonreserve countries. The cumulative effect was to shift relative price levels by some 8% since even as nonreserve money growth rates finally began to rise in response to growing balance-of-payments surpluses, their inflation rates would respond only with a lag. The large surpluses of the late 1960s and early 1970s ultimately produced sufficient money growth to surpass American inflation in 1971–75 and offset about half of the 8% change in relative price levels in

Table 17.1 Increase in Average Continuously Compounded Inflation Rates over 1956–65 Average

Period	United States	Nonreserve Countries	
		Unadjusted	Adjusted for Exchange-Rate Changes
1966–70	2.4%	0.6%	0.9%
1971–75	4.8%	5.6%	8.7%
1966–75	3.6%	3.1%	4.8%

Source. Table 1.1.

1966–70.[26] However, the surpluses ultimately became sufficiently large to induce a speculative capital flows which destroyed the Bretton Woods system. Furthermore, a full adjustment would have required an even sharper increase in the average nonreserve inflation rate during the catch-up period.

What lessons can be drawn? First, the asset-flows channel was too weak to induce large immediate balance-of-payments effects. This may reflect more the weakness of the liquidity effect on interest rates than the unresponsiveness of asset flows to movements in interest rates.[27] Second, Humean relative-price movements do characterize the adjustment process. Third, sterilization policies did result in exaggerated balance-of-payments flows—some speculative—which ultimately caused a very rapid increase in nonreserve money growth.

Besides this adjustment process, three other means were available to reconcile short-run monetary independence with long-run equilibrium: harmonization of inflation targets, progressive changes in trade and capital barriers, and revaluations. The first of these may be viewed as an alternative means of harmonizing foreign and American inflation rates while the latter two are means of avoiding that harmonization.

If the inflation targets of the Federal Reserve System and the nonreserve central banks were in harmony, the lagged adjustment process just described might be equal to the relatively small stress implied by

26. All of the inflation rates in table 17.1 are measured relative to the corresponding 1956–65 average inflation rates. This implicitly assumes that the 1.1 to 1.6% per annum higher nonreserve inflation rates in the earlier period reflect stable trends in purchasing power parity. If we were to insist that purchasing power parity has no trend, the 42% change in exchange-rate-adjusted relative price levels from 1955 to 1975 is difficult to explain.

McKinnon (1980) argues that the comparatively rapid nonreserve money growth and inflation rates in 1970–76 contradict the view that American monetary policy caused the world inflation. He obviously overlooks that lagged adjustment in the late 1960s requires overshooting of the corresponding American rates in the catch-up period. Such catch-up periods are characteristic of dynamic models in which variables lag behind changes in the growth rates of their long-run equilibrium values.

27. See note 12 above.

random, once-and-for-all shifts in purchasing power parities. Unfortunately the strong upward trend captured in the American money-supply reaction function was not reflected in any of the nonreserve reaction functions except the Netherlands.[28] Indeed, the average nonreserve inflation rates were 3.25%, 3.96%, and 4.25% in the three quinquennia ending with 1966–70, and the final increase can be attributed to the incipient effects of increased U.S. inflation. So while the trend in American money growth brought it closer to those countries (Britain and, later, Italy) which would prefer faster money growth, it simultaneously moved it away from countries such as Germany which would prefer a lower rate of inflation. Thus the incompatible money-supply rules pursued by the reserve and nonreserve central banks put the lagged balance-of-payments adjustment system to a test beyond its powers.

Given inconsistent money-supply rules and a weak balance-of-payments adjustment mechanism, only two means were available for reconciling the cumulating inconsistencies in price levels: changes in trade and capital controls or revaluation. Of course the former may be thought of as a covert and costly version of the latter. As recounted in chapter 2, these methods were used, usually sequentially, only *in extremis*.[29] The relaxation of controls at the time of revaluations is the apparent explanation for the generally much larger coefficients on foreign prices than exchange rates in both export and import-supply equations in the Mark III Model.[30]

In summary, the balance-of-payments adjustment mechanism was too slow and too weak to reconcile money growth in the face of inconsistent central bank inflation goals. Repeated revaluations and fluctuations in controls were a politically unacceptable alternative, and thus was born the floating regime which has evolved since 1971.

17.3.4 Intervention under Floating Exchange Rates

The short sample period permits little by way of direct evidence on the operation of the floating exchange-rate system. But our evidence on monetary control under pegged exchange rates does permit us to draw

28. The strong upward trend in American money growth is discussed in sections 6.2 and 16.2. It accounts for an increase of about 5.7 percentage points in the annualized American money growth rate between 1956 and 1976. For five of the nonreserve countries reported in table 6.7 the coefficient of the time trend was either insignificant or negative. Taking account of implied changes in inflation (but not the balance of payments), the Italian trend would increase money growth by far more (some 19 percentage points) while the Netherlands effect is similar in magnitude (about 7 percentage points).

29. In the simple monetary approach models—e.g. Dornbusch (1976*a*)—devaluations (appreciations) are means to induce domestic inflations (deflations) since international parities hold continuously. On the present Humean view, such revaluations are means of short-circuiting the adjustment process so that appreciations are used to avoid faster money growth and increased inflation.

30. See tables 6.10 and 6.13.

inferences about the efficacy of the widespread practice of central bank intervention. Monetary control is possible only if shifts in the central bank's portfolio between foreign and domestic assets can affect the exchange rate consistent with a given domestic money supply and foreign variables. Otherwise, the balance of payments would increase without limit if the nonreserve central bank chose a money supply inconsistent with the parity values of interest rates and prices. Thus our evidence on short-run monetary control directly implies that (sterilized) foreign exchange intervention can affect the exchange rate for a given money supply. This analysis is pursued by Dan Lee in chapter 12 along lines initiated by Branson, Halttunen, and Masson (1977), Girton and Henderson (1976), and Henderson (1977, 1979). Conversely, Taylor (1981) has found that central banks have been consistent money losers under floating exchange rates. While Taylor stresses the destabilizing nature of central bank intervention, central banks must have had an effect in order to have destabilized. So Taylor's evidence supports the feasibility of monetary control under pegged exchange rates.

17.4 Monetary Policy and the International Monetary System

The results summarized above have important implications for two related issues: the control of inflation and the relative economic merits of various international monetary arrangements. Discussion of either question, however, is to a large extent conditional upon the answer to the other. Accordingly, we first focus very briefly on the inflation issue and then go on to consider it further within the context of our discussion of monetary standards and exchange-rate regimes.

To us, the results reported in this volume establish beyond a shadow of a doubt the essential monetary nature of the inflation experienced both in the United States and in the seven foreign countries that we and our colleagues have investigated. Special factors—oil prices, in particular—may have had some impact on the price levels in these countries, but that impact was neither continual nor substantial. Controlling inflation therefore reduces to the problem of controlling the nominal stock of money in each of these countries. Therefore the fact that inflation was not controlled is attributable to the failure of policymakers in these countries to exercise control over the nominal stocks of money. In the United States, the reserve country, that failure was largely a domestic matter: The Federal Reserve because of either ineptness or, as we consider more likely, political pressure to pursue other goals, steadily increased the longer-term rate of monetary growth over this period. In the nonreserve countries, the inability to control monetary growth over the longer term was an inherent feature of the Bretton Woods system of pegged exchange

rates.[31] As we point out below, however, policymakers in some countries seemed to view that constraint differently from those in others, some apparently being content to see their domestic money stock increase with that of the United States.

Experience in the four years after our sample period ended is instructive in both regards. From the start of 1977 to the end of 1980, rates of inflation diverged fairly markedly among the countries in our sample. Japan and, to a somewhat lesser but still noticeable extent, Germany and the Netherlands have consistently had much lower rates of inflation than the United States. Two countries, Canada and France, have had approximately the same pattern of inflation as the United States while two others, Italy and the United Kingdom, have experienced considerably higher inflation. These figures are presented in table 17.2.

The experience suggests that in at least three of the seven nonreserve countries—Germany, Japan, and the Netherlands—policy in the United States was of paramount importance during our sample period. When they severed the fixed exchange-rate link, all three were able to contain inflation to a much greater extent than did the United States. Presumably, therefore, had they begun to float their exchange rates earlier, they would have avoided much of the increase in their inflation rates in 1971–75. The domestic political impetus to higher monetary growth would not have been strong.

In Italy and the United Kingdom, that most likely would not have been the case.[32] The subsequent behavior of inflation in both suggests that the high rates of monetary expansion and ensuing inflation would have occurred even in the absence of American monetary stimulus.

Canada and France are less clear-cut cases. The fact that both—Canada particularly so—have had broadly similar patterns of inflation to that of the United States since the early 1960s regardless of the exchange-rate system deprives us of a meaningful counterfactual experiment. But given the attempts of both to revalue their exchange rates vis-à-vis the United States dollar even before the formal break with Bretton Woods, we are inclined to view them also as heavily influenced by policy in the United States during our sample period.[33]

Comparison of the experience under floating rates with the experience under Bretton Woods and in its immediate aftermath suggests therefore

31. We interpret the Bretton Woods system here as prohibiting regular changes in valuations for these countries.

32. In Britain, in particular, the impetus to inflate appears to have been strong during our sample period: Darby and Stockman find that unemployment entered the Bank of England's reaction function while inflation did not.

33. The Canadian versus U.S. dollar exchange rate declined with only minor interruption in twelve quarters prior to the formal demise of fixed rates in February 1973. The franc-dollar rate underwent a similar quarterly decline beginning six quarters later in mid-1971.

Table 17.2 Average Continuously Compounded Growth Rates of Consumer Prices, 1977 through 1980

	Periods†				
Country	1977–80	1977	1978	1979	1980
United States	9.85%	6.53%	8.71%	12.48%	11.68%
Japan	5.11%	4.70%	3.45%	5.49%	6.79%
Germany	4.12%	3.29%	2.63%	5.24%	5.31%
Netherlands	5.02%	5.09%	3.76%	4.71%	6.53%
Canada	9.28%	9.07%	8.10%	9.32%	10.62%
France	10.45%	8.60%	9.27%	11.16%	12.77%
Italy	15.15%	13.10%	10.96%	17.19%	19.36%
United Kingdom	12.37%	11.46%	8.05%	15.90%	14.08%

Source. Economics Department, Citibank, N.A.

†All inflation rates are computed from the quarter immediately preceding to the quarter ending the designated period. The price index used is the CPI or other index of retail prices.

that fixed exchange rates are only viable if the domestic economic policy goals of the various countries involved are in harmony over the longer run. Conversely, floating rates provide those countries with the degree of freedom necessary to pursue different goals.

In this respect, the breakdown of Bretton Woods is almost a mirror image of the collapse of the gold standard in the early 1930s. In the thirties, many countries abandoned the fixed-rate gold standard because they did not want to import a further contraction in output from the United States. In the seventies, many countries abandoned the fixed-rate dollar standard because they did not want to import American inflation.[34] In both instances, the moves away from fixed and toward flexible rates successfully provided the countries making these changes with insulation from foreign disturbances. That fact, in and of itself, provides an additional bit of evidence corroborating our findings.[35]

34. An additional inflation-related factor, as Klein (1978) points out, may have been the decrease in the predictability of the longer-term United States inflation rate during these years that accompanied the increase in the average rate of inflation.

35. Writing shortly after the fact, Irving Fisher (1935) used the differences in the behavior of output abroad relative to that in the United States under the two different international monetary standards as a test of the hypothesis that the Depression was in the main engendered by money. In the seventies, the differences in the patterns of inflation under fixed and floating rate regimes provide an additional test in favor of the hypotheses we have advanced to explain inflation during our sample period.

Interestingly, Fisher's analysis is based, in modern terms, on a "Lucas" (price-level innovation) aggregate-supply curve and either "a law of one price level" or a Humean specie-flow mechanism for countries linked by fixed exchange rates. (It is unclear in this presentation whether Fisher contemplates a price arbitrage or monetary transmission, but the latter is used in Fisher 1920 cited here.) It appears from his charts that somewhat better explanatory power would have been obtained by concentrating on money flows and a

Why monetary growth in the United States increased and why some other countries were apparently content to accept if not add to the inflationary consequences of that monetary growth are the ultimate questions. Attempting to answer them would draw us far afield from this study. The burgeoning literature in the field of public choice and the related studies of regulation point to directions in which to search. Both suggest that political considerations that make inflation desirable to government policymakers and other officials are the root cause. How to quantify those returns from inflationary monetary policies, how to juxtapose them in a quantifiable way against the costs, not to mention what role ideas play in the process, are all crucial questions that at this juncture appear to us unanswerable.

The Federal Reserve System has operated under a legislative mandate as well as more subtle political pressure to weigh a variety of goals in formulating monetary policy. It is our judgment that this process is inconsistent with achieving price stability. Indeed we see no effective means of controlling inflation in the absence of the birth of a political consensus in support of an effective monetary constitution. Such a constitution might enforce single-minded pursuit of price stability by establishing a prespecified growth path for money and requiring the Federal Reserve System to continuously maintain money within 1% of that path; adoption of a fixed gold or other commodity standard would also serve.[36] In any case, it is important that the standard—whether fiat or commodity—be understandable and proof against well-meaning tinkering. Otherwise this monetary constitution—like other constitutional provisions and monetary standards in the past—might fail with no explicit repeal until long after the fact.

Had the Federal Reserve System been constrained by such a rule in the postwar period, we believe that the United States—and many other countries—would have been spared much of the economic loss that high and variable inflation and the periodic half-hearted attempts to check it have brought. As Leijonhufvud (1980) has persuasively argued, an appropriate monetary reform or transitional procedure could minimize or eliminate the transitional unemployment costs of ending the inflation

"Barro" (money-supply innovation) real-income equation, but the movements are large enough that either chain works.

A more recent statement of this hypothesis together with supporting empirical evidence virtually identical to Fisher's is Choudhri and Kochin (1980). Lothian (1981) contains a similar discussion of the interwar U.K. evidence.

36. We do not wish to suggest that a commodity standard would serve equally well in the short run. Shifts in gold's relative price might be a potent source of short-run instability and occur due to both monetary and nonmonetary factors. Nonetheless, over long periods of time the *average* inflation rate converges to 0 under a gold standard with a constant mint ratio.

within the context of a believable political consensus enforcing the new monetary constitution.[37]

For the United States, fixing an exchange rate with another country is not a viable basis for a monetary constitution. Other countries do have this option as well as the options open to the United States.[38] As the Bretton Woods system indicated, this option fails as a control on inflation if the reserve country itself lacks an effective monetary constitution or if there is insufficient feedback of reserve flows on the domestic money supply.

17.5 Areas for Future Research

At the end of a project like that described in this volume, researchers find it hard to be satisfied with what has been accomplished rather than troubled by all the questions which would have been studied had there been but time, money, and energy enough. The knowledge that any science develops in small increments and no one person or group can make more than a marginal contribution rings hollow against the wish to have done more. By way of exorcism for these futile wishes, we like our predecessors list the issues that we think particularly deserve further study.

The most obvious next step would be to extend our data bank and link it directly with currently available national data sources. Lothian is currently making efforts along these lines. When the extended data set becomes available, it will be possible to reestimate both the Mark III and Mark IV Models and a number of other relations applicable to the floating rate period. In particular, data for 1979–80 may permit much sharper estimates of the effects of changes in the real price of oil.

Daniel Laskar's work introduced a number of sophisticated approaches to the formulation of money-supply reaction functions. Those are well worth developing and applying to other data sets.

Stockman (1979) and Obstfeld (1980*b*, *c*, *d*) have shown that monetary control under pegged exchange rates need not obtain even if bonds are imperfect substitutes internationally. Although some of our tests apparently reject their ultrarationality postulate, it would be interesting

37. Feldstein (1979) has recently observed that these unemployment costs must be weighed against the very large present value of the benefits. Since the costs of inflation tend to grow with real income, their present value is much larger than might appear from previous estimates of relatively small annual cost. Since he analyzes a permanent reduction in inflation, Feldstein too must implicitly anticipate a monetary constitution which would prevent repetition of our past mistakes.

38. With the understanding, of course, that choosing a monetary constitution is simultaneously choosing an exchange-rate regime.

to see whether private-capital-flow functions do indeed shift in a partial if incomplete manner in response to sterilized foreign exchange operations.

Substitution in demand for domestic money by foreign money and foreign assets did not appear to be important in the tests we conducted. Some other economists have reported conflicting results. Further work is required to reconcile these differences.

The behavior of exchange rates in the floating period remains largely unexplained. However, Dan Lee's integration of the information set used in forming inflationary and exchange-rate expectations seems to be a valuable starting point. This approach is pursued to some extent in the expectational functions of the Mark III and Mark IV Models, but much remains to be done. Such an approach suggests that with consistent expectations in the bond and foreign exchange markets, a money shock will initially affect the exchange rate by an amount equal to the integral of the induced deviations between the domestic and foreign real interest rates.

Except for the United States, the Barroesque real-income equation did relatively poor and added little if anything to the explanatory power of short distributed lags on the actual changes in aggregate-demand variables. An errors-in-the-variables argument is capable of explaining the results numerically, but the weak evidence suggests the value of further research.

Finally, we propose an examination of the political economy of alternative monetary systems. This work has already begun, but is only at the earliest stage of development at present.[39] Given the probability that action to change the existing system will be taken in the near future whether in ignorance or not, the potential value of research here is great indeed.

Besides these major areas for further research, a number of additional topics have been suggested in the individual chapters. Furthermore, it is all too likely that the most important leads eluded our notice. We only hope that, if that be the case, our readers will correct our oversight as well as our other errors.

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39. Willett and Mullen (1982) contribute not only new insights but a careful review of this literature.

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