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The Strong U.S. Dollar: A Dilemma for Foreign Monetary Authorities

DALLAS S. BATTEN and JAMES E. KAMPHOEFNER

BOLSTERED by higher short-term market interest rates and a lower rate of inflation than those abroad, the U.S. dollar has been quite strong in foreign exchange markets since the middle of 1980. Its trade-weighted value has risen 35 percent from July 1980 to April 1982.[1] The general strength of the dollar has elicited sharp criticism from foreign monetary authorities who argue that a stronger dollar forces them to choose between two unpleasant alternatives: follow domestic policies that result in historically high interest rates or accept depreciation of their currencies.

Within the standard conceptual framework of exchange rate determination, movements of exchange rates, in the short run, are caused primarily by changes in interest-rate differentials.[2] Specifically, an increase in U.S. interest rates relative to those abroad should result in an increase in the foreign currency value of the dollar, other things equal. As the above criticisms demonstrate, however, exchange rate movements also may play an important role in influencing monetary policy actions in some countries, which will be reflected in turn by changes in their short-term domestic interest rates. That is, a foreign monetary authority's response to changes in the exchange value of its currency may be to pursue a policy that affects the levels of its domestic interest rates. Consequently, when observing movements of both the exchange rate and the interest-rate differential, it is not immediately clear whether a change in the differential causes the exchange rate to change or whether the interest rate change is a monetary policy response to the exchange rate movement.

This element of uncertainty has been especially prevalent for the first three quarters of 1981. Chart 1 presents the trade-weighted foreign currency value of the dollar and the difference between the U.S. three-month CD rate and the trade-weighted foreign interest rate. While these two series exhibit the expected positive relationship before the first quarter of 1981 and after the third quarter of 1981, they display no statistically significant relationship during the first three quarters of 1981.[3]

On the other hand, chart 2 contains the trade-weighted foreign currency value of the dollar and the trade-weighted *foreign* interest rate. The relationship between these two series shows a much different pattern than that between the dollar and the interest-rate differential. While demonstrating only a weak positive relationship before 1981, the trade-weighted value of the dollar and the trade-weighted foreign interest rate

[1]The trade-weighted exchange rate is an average of the value of the dollar against 10 other currencies weighted by each country's trade share. The countries included are Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland and the United Kingdom. For a more detailed explanation, see "Index of the Weighted-Average Exchange Value of the U.S. Dollar: Revision," *Federal Reserve Bulletin* (August 1978), p. 700. The trade-weighted *foreign* interest rate presented below is a weighted average of short-term market interest rates for the same countries using the same weights.

[2]To be technically correct, short-run exchange rate movements are motivated by differences in real interest rates, i.e., market interest rates adjusted for expected inflation. For a more thorough discussion, see Dallas S. Batten, "Foreign Exchange Markets: The Dollar in 1980," this *Review* (April 1981), pp. 22-30. Consequently, changes in market interest-rate differentials and movements of exchange rates should be positively related *only if* the changes in market interest-rate differentials reflect changes in *real* interest-rate differentials.

[3]The calculated correlation coefficients between the trade-weighted dollar exchange rate and the interest-rate differential reported weekly for the approximate periods, I/1980-IV/1980, I/1981-III/1981 and IV/1981-II/1982, are .795, .158 and .828, respectively. The corresponding critical values at the 5 percent level are .266, .320 and .339, respectively.

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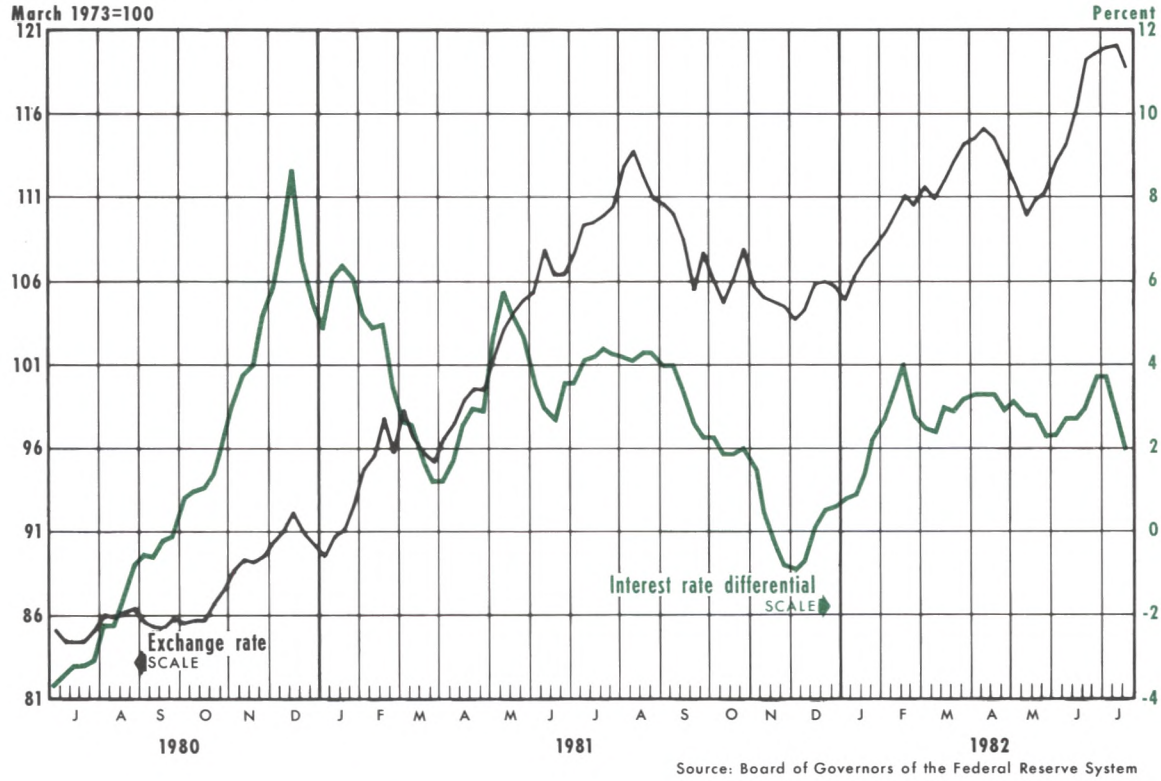
Chart 1
Foreign Exchange Value of the Dollar and U.S.-Foreign Interest Rate Differential



Source: Board of Governors of the Federal Reserve System

follow extremely similar paths during the first three quarters of 1981. Beginning in the last quarter of 1981, however, their paths diverge radically, with the trade-weighted foreign interest rate in April 1982 falling to its July 1980 level, while the dollar continues to rise in general.[4] Foreign monetary authorities apparently have been relatively more responsive to exchange rate movements (especially of the dollar) during most of 1981 than previously. Moreover, it also appears that foreign monetary authorities recently have changed their response to an increasingly strong dollar.

The purpose of this article is to examine this recent experience using an analytical framework that describes and evaluates the policy alternatives available to a foreign monetary authority whose currency is depreciating. Of particular importance are the relationship between external and internal policy objectives, the role played by exchange rate movements in the formation of domestic monetary policy and the consequences of the policy choice.

POLICY ALTERNATIVES

Since the difference between U.S. and foreign short-term interest rates is a primary determinant of short-run exchange rate movements, a monetary authority has essentially three policy choices when domestic interest rates (adjusted for relative inflation rates) are below those of another country. First, it can do nothing and allow its exchange rate to depreciate sufficiently to compensate for the interest differential. In this case the economy will incur increased domestic unemployment in the short run as domestic resources are reallocated from the production of non-tradable goods to the production of tradable goods in response to changing relative prices. If the exchange rate movement is expected to be only temporary, however, this reallocation may be undesirable since relative prices are expected to return to previous levels. Furthermore, it is possible that domestic prices

[4]The calculated correlation coefficients between the trade-weighted dollar exchange rate and the trade-weighted *foreign* interest rate for the periods listed in footnote 3 are .379, .899 and −.789, respectively. The critical values are the same as those in footnote 3.

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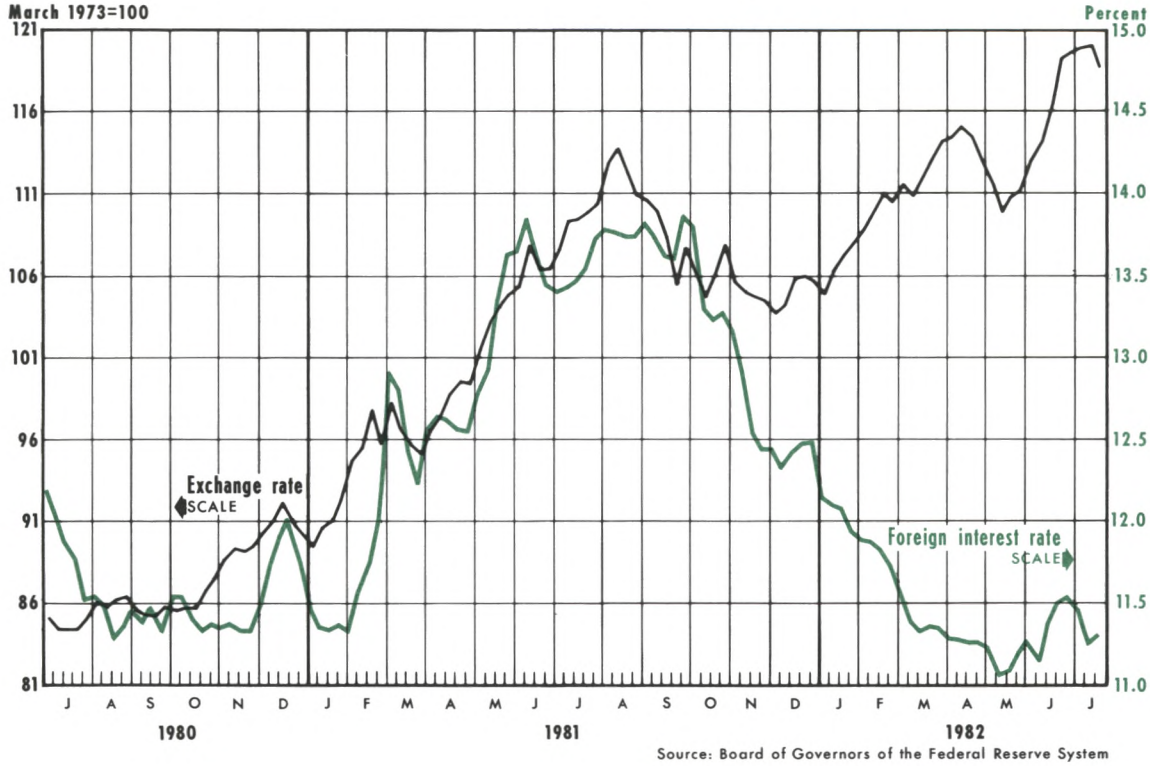
Chart 2
Foreign Exchange Value of the Dollar and the Foreign Interest Rate



Source: Board of Governors of the Federal Reserve System

may rise with the prices of imports as domestic demand shifts to import-competing products.[5]

Second, it can adopt a tighter monetary policy to raise short-term domestic interest rates, thereby reducing the interest-rate differential and mitigating the downward pressure on its exchange rate.[6] If this tighter stance conflicts with the country's domestic objectives, the short-run costs of this choice are increased domestic unemployment and lower real output growth.

Third, a monetary authority can intervene in foreign currency markets by purchasing its own currency with its reserves of foreign currency. This would increase the demand for domestic currency relative to foreign currency and produce, at least temporarily, a reduction in the downward pressure on its exchange rate. It is not immediately clear whether the intervention will affect the exchange rate permanently. Consequently, an investigation of the conditions under which intervention will permanently affect the long-run path of exchange rate movements is crucial in determining whether intervention can be effective in counteracting the impact of unfavorable interest-rate differentials on the exchange rate.[7]

In analyzing the permanent nature of the impact of central bank intervention on the exchange rate, one must distinguish sales or purchases of foreign currencies that affect the size of the domestic money supply

[5]See R. I. McKinnon, "Optimum Currency Areas," *American Economic Review* (September 1963), pp. 717-24.

[6]The monetary authorities of most of the industrial countries other than the United States employ interest rate targeting as a means of controlling their money supplies. Consequently, a desire to lower the rate of money growth will lead to an increase in market interest rates (at least in the short run). Casual observation of the relationship between short-term market interest rates and the rate of money growth in these countries supports this conclusion.

[7]Intervention policy may not be necessarily aimed at permanently affecting the exchange rate. Instead, its focus may be simply to smooth short-run exchange rate fluctuations without having any impact on the long-run path of exchange rate movements. In this latter case, intervention that only temporarily affects exchange rates is sufficient to accomplish this objective. See, for example, Michael Mussa, "The Role of Official Intervention," Occasional Paper No. 6 (Group of Thirty, 1981). The purpose of this article, however, is to analyze policy alternatives designed to counteract the impact of unfavorable interest rate differentials. Consequently, the presumed goal of smoothing short-run exchange rate fluctuations is ignored here.

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from those that do not.[8] Specifically, intervention is said to be "sterilized" if its impact on the domestic money supply is offset by the sale or purchase of domestic assets by the central bank. Intervention is said to be "unsterilized" if its effect on the level of commercial bank reserves and, consequently, the domestic money supply is not offset (see box).

Unsterilized Intervention and Exchange Rate Movements

Suppose, for example, that the Fed attempts to prevent the dollar from depreciating by purchasing dollars with Deutsche marks (DM). If this intervention is unsterilized, it can affect the exchange rate in at least three ways. First, because the Fed's purchase of dollars *temporarily* increases the *flow* demand for dollars relative to the supply of dollars, the immediate effect should be an appreciation of the dollar (or a depreciation of the Deutsche mark).[9] This result, however, will be only transitory unless the Fed continues to purchase dollars day after day, thereby maintaining the higher flow demand for dollars.[10]

Second, since this transaction is unsterilized, it causes the U.S. money supply to fall and the German money supply to rise. All other things equal, there will be an excess demand for U.S. money in the United States and an excess supply of German money in West Germany — a *stock* disequilibrium that can be rectified only if aggregate spending falls in the United States and rises in Germany. This decline in U.S. spending and rise in German spending will cause the general price level in the U.S. to fall and that in Germany to rise and, at the same time, motivate a *permanent* appreciation of the dollar.[11]

Finally, market participants may interpret the decrease in the U.S. money stock as an indication of further tightening of monetary policy by the Fed in the future. Since an exchange rate is the relative price of two specific financial assets (the two domestic monies involved), it is crucially influenced by expectations about the course of future events. Consequently, expectations of a tighter U.S. monetary policy in the future should place additional upward pressure on the current DM/dollar exchange rate as market participants anticipate the lower U.S. and higher German price levels described above.[12]

Sterilized Intervention and Exchange Rate Movements

The immediate impact of sterilized intervention is the same as that for unsterilized intervention; that is, it creates a transitory increase in the flow demand for dollars, causing a temporary appreciation of the DM/dollar exchange rate. The net effect of sterilized intervention, however, is simply a purchase of domestic securities with foreign securities. Consequently, neither country's money supply will be affected; instead, private portfolios will contain fewer dollar-denominated and more DM-denominated securities.

Inasmuch as sterilized intervention affects neither the monetary factors that influence the long-run behavior of prices nor the real factors that determine the relative competitiveness of the economies, it is unclear initially what lasting impact it has on the DM/dollar exchange rate. It can have a permanent impact on the exchange rate if the public views domestic and foreign securities as being *imperfect* substitutes for each other.[13] Because these securities are denominated in different currencies, it is argued, the impact of exchange-rate movements and the possibility of ex-

[8]For convenience, it is assumed that all intervention operations are performed by the central bank. See A. B. Balbach, "The Mechanics of Intervention in Exchange Markets," this *Review* (February 1978), pp. 2-7, for a discussion of various other types of intervention operations.

[9]If the purpose of the intervention activity is to "lean against the wind," its impact may be insufficient to offset completely the effect of changes in fundamental determinants of the movement of the exchange rate. Consequently, intervention activity may not completely reverse the direction of exchange rate movements, but only slow the *rate* of change.

[10]All other things equal, if the increased flow demand is not maintained, demand and supply conditions in foreign currency markets will return to what they were prior to the Fed's intervention activity. Hence, this impact would only be temporary. See Michael Mussa, "Empirical Regularities in the Behavior of Exchange Rates and Theories of the Foreign Exchange Market," in Karl Brunner and Allan H. Meltzer, eds., *Policies for Employment, Prices, and Exchange Rates*, Carnegie-Rochester Conference Series on Public Policy, supplement to the *Journal of Monetary Economics*, Volume 11 (1979), pp. 9-57, especially pp. 27-38.

[11]See, for example, Batten, "Foreign Exchange Markets."

[12]See Jacob A. Frenkel, "Flexible Exchange Rates, Prices, and the Role of 'News': Lessons from the 1970s," *Journal of Political Economy* (August 1981), pp. 665-705.

[13]See Dale W. Henderson, "Modeling the Interdependence of National Money and Capital Markets," *American Economic Review* (February 1977), pp. 190-99; Lance Girton and Dale Henderson, "Central Banks Operations in Foreign and Domestic Assets Under Fixed and Flexible Exchange Rates," in Peter B. Clark, Dennis E. Logue, and Richard J. Sweeney, eds., *The Effects of Exchange Rate Adjustments* (Government Printing Office, 1976), pp. 151-79; Peter Isard, *Exchange-Rate Determination: A Survey of Popular Views and Recent Models*, Princeton Studies in International Finance No. 42 (Princeton University Press, 1978).

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The Mechanics of Foreign Exchange Market Intervention

Suppose that the Federal Reserve purchases dollars (in other words, sells foreign currency — most often Deutsche marks) in foreign exchange markets in an attempt to prevent (or slow) the dollar from depreciating.[1] To do this, the Fed must have some Deutsche marks, which it typically acquires either by selling some of its non-negotiable DM-denominated securities to the Bundesbank or by borrowing DM from the Bundesbank in exchange for a DM-denominated account. Since both of these transactions are between central banks only, they have *no* impact on the size of either country's money stock.

The Fed then buys dollar-denominated demand deposits of foreign commercial banks held at U.S. commercial banks and pays for them from its DM deposits at the Bundesbank. This produces an increase in foreign commercial banks' reserve accounts at the Bundesbank and a decrease in their demand deposits held at U.S. commercial banks. On the other hand, for U.S. commercial banks, both their reserve accounts at the Fed and their demand deposit liabilities to foreign commercial banks have declined. Since U.S. commercial banks' reserves have fallen while German commercial banks' reserves have risen, the U.S. money stock will decrease and West Germany's money supply will increase as a result of this foreign exchange market operation.

As this example of unsterilized intervention shows, the U.S. money supply has not been insulated from the foreign exchange market transaction. If, however, central banks do not want their foreign exchange intervention to affect their domestic money supply, they may sterilize its impact with an offsetting sale or purchase of domestic assets. Continuing the previous example, if the Fed does not want U.S. commercial banks to lose reserves as a result of its foreign exchange intervention to support the dollar, it can purchase U.S. government securities equal to the amount of the reserves that banks lose, thereby maintaining the level of reserve accounts of the U.S. commercial banks. In this manner, the negative impact of intervention on the reserves of U.S. commercial banks is exactly offset with no subsequent change in the U.S. money stock.

In a similar fashion, the Bundesbank could neutralize the impact of the U.S. intervention on the German money supply by draining the newly created reserves from the West German commercial banking system.[2] If completely sterilized, the foreign exchange operation affects neither country's money supply. Private portfolios contain fewer dollar-denominated securities and more DM-denominated securities, while the Fed's portfolio contains more dollar-denominated and fewer DM-denominated securities.

[1]Although the Federal Reserve is portrayed here as the initiator of exchange market intervention, the analysis would not differ significantly in the case of intervention by foreign authorities.

[2]The institutional arrangements for accomplishing this may differ across the countries; the exact means used are not important here. Moreover, if the Fed acquired DM (used to purchase dollars) by selling DM-denominated securities in private capital markets, the German money supply would not be affected by the intervention activity, and the Bundesbank would not have to sterilize the operation.

change or capital controls adds an element of risk to the holding of foreign assets that cannot be totally eliminated with a diversified portfolio.[14]

If dollar-denominated and DM-denominated securities were perfect substitutes, no change in the exchange rate or in interest rates would be required to motivate investors to hold the new portfolio that contains fewer dollar-denominated and more DM-denominated securities. If, however, these securities are *not* perfect substitutes, investors will be unwilling to hold the new portfolio and, at the original exchange rate and interest rates, an excess demand for dollar-denominated securities (and an excess supply of DM-denominated securities) will exist. Consequently, investors will attempt to acquire additional dollar-denominated securities and sell DM-denominated securities in order to return their portfolios to the desired proportion of dollar-denominated to DM-denominated securities, placing upward pressure on the DM value of the dollar.[15] In other words, even though the two domestic money supplies have been unaffected by the intervention activity, the resulting portfolio disequilibrium (caused by foreign and domestic securities being imperfect substitutes) has a permanent impact on the exchange rate.

[14]See Girton and Henderson, "Central Bank Operations," pp. 152-53.

[15]The realignment of portfolios will, at the same time, place upward pressure on German interest rates and downward pressure on U.S. interest rates.

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Since the efficacy of sterilized intervention hinges on the imperfect substitutability of foreign and domestic securities, the degree of substitutability that actually exists is crucial. Empirical tests of the existence of this risk have yielded mixed results.[16] Thus, whether sterilized intervention has a significant lasting impact on exchange rates remains uncertain.

Intervention and Monetary Policy

It seems that if the monetary authority wants to influence permanently the path of its exchange rate, and not merely dampen short-run fluctuations, it must engage in unsterilized intervention. It is clear, however, that unsterilized intervention is tantamount to conducting monetary policy through foreign exchange market operations. Hence, in this case, intervention is not really an alternative to monetary policy but merely a variant of it. Only sterilized intervention is a distinct policy alternative.

Since there can be only a single monetary policy stance, the role of unsterilized intervention depends critically on the importance that policymakers place on the exchange rate in relation to other economic variables, as a factor influencing the conduct of monetary policy. In particular, the use of unsterilized intervention (with the concomitant impact on the domestic money supply) implies that the monetary authority places relatively more importance on reducing the risks and the real economic disturbances associated with exchange rate movements than on influencing domestic prices, output and employment.

Since the exchange rate is the relative price of two domestic monies, it is affected, among other things, by changes in the demand for foreign money, actual and expected policy changes of foreign monetary authorities, and whatever changes emanate from within the domestic economy itself. Directing domestic monetary policy at an exchange rate target, therefore, subjects the economy to both domestic and foreign influences. Consequently, the monetary authority loses its ability to control its own money supply independently of foreign actions and events.[17]

The desire to influence the movement of exchange rates without losing control of the money supply is the primary rationale for using sterilized intervention. As discussed above, however, it is not clear that sterilized intervention has a significant lasting impact on exchange rates. Sterilized intervention may be an appropriate policy to reduce unwanted short-run variability of exchange rates for which there may be no readily identifiable cause. When monetary authorities desire to alter the path of exchange rate movements, however, sterilized intervention may be inadequate. Consequently, monetary policymakers must choose between internal and external objectives.[18]

RECENT EXPERIENCE

Monetary authorities seldom choose the first policy alternative discussed above; they don't appear to like to "do nothing" about the problems that they face. Studies of central banks' demand for and use of foreign currencies, as well as reports from central banks themselves, indicate that large-scale intervention in foreign currency markets has continued since the movement to floating exchange rates in 1973.[19] If central bankers desire to influence exchange rates, the policy choice narrows down to sterilized or unsterilized intervention. Although policymakers might prefer sterilized intervention, since it appears to allow them to separate

[16]Jeffrey A. Frankel, "A Test of the Existence of the Risk Premium in the Foreign Exchange Market vs. the Hypothesis of Perfect Substitutability," International Finance Discussion Paper No. 149 (Board of Governors of the Federal Reserve System, August 1979) finds no support at all for the existence of a risk premium. Alternatively, Richard Meese and Kenneth J. Singleton, "Rational Expectations, Risk Premia, and the Market for Spot and Forward Exchange," International Finance Discussion Paper No. 165 (Board of Governors of the Federal Reserve System, July 1980) concludes that the failure of the forward exchange rate to be an unbiased predictor of the future spot rate is a consequence of the existence of a risk premium. Finally, Maurice Obstfeld, "Can We Sterilize? Theory and Evidence," NBER Working Paper No. 833 (January 1982) finds evidence of imperfect asset substitutability, but questions the ability of central banks to exploit it. That is, imperfect asset substitutability appears to be a necessary, but may *not* be a sufficient, condition for sterilized intervention to have a significant impact on the exchange rate.

[17]The extreme case is the one in which the monetary authority desires to maintain a completely fixed exchange rate. In this case, the monetary authority has no ability at all to influence the size of its domestic money supply. See Herbert G. Grubel, *International Economies* (Richard D. Irwin, Inc., 1977), pp. 375-80.

[18]For an example of a monetary authority's recognition of this dilemma, see *Monthly Report of the Deutsche Bundesbank* (February 1981), p. 7.

[19]See, for example, Dallas S. Batten, "Central Banks' Demand for Foreign Reserves Under Fixed and Floating Exchange Rates," this *Review* (March 1982), pp. 20-30; Jacob Frenkel, "The Demand for International Reserves Under Pegged and Flexible Exchange Rate Regimes and Aspects of the Managed Float," in David Bigman and Teizo Taya, eds. *The Functioning of Floating Exchange Rates* (Ballinger, 1980), pp. 161-95; H. Robert Heller and Mohsin S. Kahn, "The Demand for International Reserves Under Fixed and Floating Exchange Rates," IMF *Staff Papers* (December 1978), pp. 623-49; and John Williamson, "Exchange Rate Flexibility and Reserve Use," *Scandinavian Journal of Economics* (No. 2, 1976), pp. 327-39.

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Table 1

Quarterly Money Growth for Selected Countries (compounded annual rates, seasonally adjusted)

Country	III/80	IV/80	I/81	II/81	III/81	IV/81	I/82
Canada	13.2%	16.3%	1.1%	4.7%	−3.8%	−16.0%	14.8%
France	8.3	10.2	11.3	13.2	18.8	18.8	N.A.
Germany	4.5	9.5	−1.6	−4.8	−1.6	0.5	5.6
Italy	11.8	16.2	16.8	4.5	3.0	10.1	15.5
Japan	−6.1	−3.5	2.6	21.0	3.3	11.0	8.7
Netherlands	6.7	10.2	4.9	−5.3	−4.9	5.7	13.5
Switzerland	5.5	4.8	−10.4	2.8	−5.1	14.7	41.5
United Kingdom	−2.0	13.1	15.8	14.5	5.1	1.4	10.1

SOURCE: Federal Reserve Bank of St. Louis, *International Economic Conditions.*

exchange rate policy from domestic monetary policy, they have come to realize that sterilized intervention will not suffice, at least in some situations. The last year and a half provides a good example of the trade-off inherent in the choice of intervention policy.

From the middle to the end of 1980, the foreign currency value of the dollar rose along with U.S.-foreign short-term interest differentials. During this period (actually, since about November 1978), the U.S. monetary authority had intervened frequently and on a consistently large scale in foreign currency markets; it primarily "leaned against the wind," that is, bought dollars when the dollar was depreciating and sold dollars when it was appreciating.

With the advent of the Reagan administration, the Treasury announced that it (along with the Federal Reserve) would cease daily intervention except for periods of substantial exchange market volatility. This removed an extremely large and cooperative participant from foreign currency markets. Consequently, foreign monetary authorities who desired to remain active in foreign currency markets were faced with two policy options if they wished to have the same impact on exchange rates as before: either increase the amount of their intervention (if they wished to continue to sterilize it) or sterilize less of their existing intervention.

The magnitude of foreign central bank intervention activity has not changed significantly since the change in U.S. intervention policy. There is evidence, however, of more unsterilized intervention since this change. Table 1 contains the quarterly rates of M1 growth for several major industrial countries that are important trading partners of the United States. Except in France and Japan, M1 growth in each country displays a significant slowing during 1981.[20] The abruptness of this change can be seen more clearly in table 2, which reports three-month money growth rates for five of these countries. Not surprisingly, foreign short-term market interest rates also began to rise rather dramatically in early 1981. In fact, as shown in chart 2, market interest rates of the major trading partners of the United States generally moved with the trade-weighted exchange rate during the first three quarters of 1981, apparently because foreign monetary authorities were tightening their monetary policies in attempts to mitigate the rise of the U.S. dollar.[21]

[20]Even though Canada is the only country considered that explicitly targets on the M1 definition of money, this definition is employed because it has been found to be an appropriate indicator of monetary policy. See Dallas S. Batten, "Money Growth Stability and Inflation: An International Comparison," this *Review* (October 1981), pp. 7-12; and Dallas S. Batten and R. W. Hafer, "Short-Run Money Growth Fluctuations and Real Economic Activity: Some Implications for Monetary Targeting," this *Review* (May 1981), pp. 15-20. For France, however, M1 growth may be a poor indicator of the stance of monetary policy after Mitterand took office in mid-1981. The new administration imposed severe interest rate ceilings on savings and time deposits, which motivated relatively large flows from accounts *not* included in M1 to accounts included in M1. The net result was extremely rapid M1 growth.

[21]The relationship between the trade-weighted value of the U.S. dollar and the trade-weighted *foreign* interest rates (shown in chart 2) is much closer in the first three quarters of 1981 than in any interval since the beginning of the United States' pro-intervention stance. Obviously, all monetary policy actions taken by these countries do not necessarily reflect the desire to achieve exchange rate objectives. For example, Germany has experienced a large current account deficit and Canada and Switzerland have each encountered accelerating domestic inflation. The magnitude of the change in money growth at the beginning of 1981 and the fact that the timing of the response so closely paralleled the change in U.S. policy, however, certainly provide a casual verification that exchange rate objectives have played an important role.

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Table 2

Three-Month Money Growth for Selected Countries (compounded annual rates, seasonally adjusted)

	Date	Canada	Germany	Italy	Netherlands	Switzerland
1980	October	18.3%	9.6%	10.2%	11.9%	7.4%
	November	22.2	16.6	13.4	8.2	4.7
	December	8.9	2.5	24.5	10.4	2.4
1981	January	1.9	7.0	20.7	9.9	−6.3
	February	−4.3	−3.8	17.7	6.5	−7.7
	March	6.2	−7.1	11.7	−1.7	−16.8
	April	11.1	−11.5	5.7	−2.8	1.6
	May	8.2	−8.2	3.7	−4.8	2.7
	June	−4.6	6.0	6.5	−8.2	4.1
	July	6.7	2.9	5.2	−10.7	−2.9
	August	−7.0	3.4	2.2	−5.0	−5.7
	September	−10.6	−6.6	0.9	1.4	−6.8
	October	−28.7	−4.1	3.8	8.8	−17.1
	November	−19.8	0.8	6.6	9.8	−14.0
	December	22.7	5.1	21.9	−1.1	99.6
1982	January	32.6	9.9	24.7	8.6	88.2
	February	28.9	2.2	21.4	2.9	94.0
	March	−0.5	4.9	2.1	28.7	−17.7

SOURCES: *Bank of Canada Review; Monthly Report of the Deutsche Bundesbank;* Board of Governors of the Federal Reserve System; and International Monetary Fund, *International Financial Statistics.* Germany and Italy seasonally adjusted by this Bank.

These policy decisions to limit the rise in the exchange value of the dollar, however, were not cost-free, as charts 3 and 4 show. Continued economic stagnation was the price paid for redirecting monetary policy. Except for Japan, all countries experienced rising unemployment and little or no real economic growth during the first three quarters of 1981.

In light of the economic conditions at the time, it is not too surprising that foreign central banks responded differently to a rising U.S. dollar at the end of 1981 and the beginning of 1982 than they did at the beginning of 1981. In particular, the re-emergence of a strong dollar at the end of 1981 did not elicit a tighter monetary policy stance and the subsequent higher short-term interest rates that had occurred at the beginning of the year.[22] Since, in general, these countries have continued to experience economic stagnation, it appears that central banks were unwilling to exacerbate the situation by subjecting their economies to even tighter monetary conditions necessary to raise domestic interest rates further and moderate the rise of the dollar. In fact, foreign short-term interest rates fell considerably during the last quarter of 1981 and the first quarter of 1982. Thus, foreign central banks now seem willing to allow the foreign exchange value of their currencies to depreciate instead.

SUMMARY AND CONCLUSIONS

This article has attempted to describe, using a simple analytical framework, both the policy alternatives available to a central bank and their consequences. During the floating exchange rate period, central banks consistently have intervened in foreign currency markets. Because unsterilized intervention diminishes a central bank's ability to control its domestic money stock, it generally has opted to separate external and internal policy objectives by sterilizing the impact of intervention on its money stock. Sterilization, however, decreases the efficacy of intervention. Consequently, foreign central banks welcomed the U.S.' pro-

[22]The increase in the rates of money growth abroad at the beginning of the fourth quarter of 1981 most likely contributed to the subsequent rise in the foreign currency value of the dollar. The point made, however, is that once a relatively strong dollar re-emerged, foreign monetary authorities did not appear to respond in the same manner as they had at the beginning of 1981.

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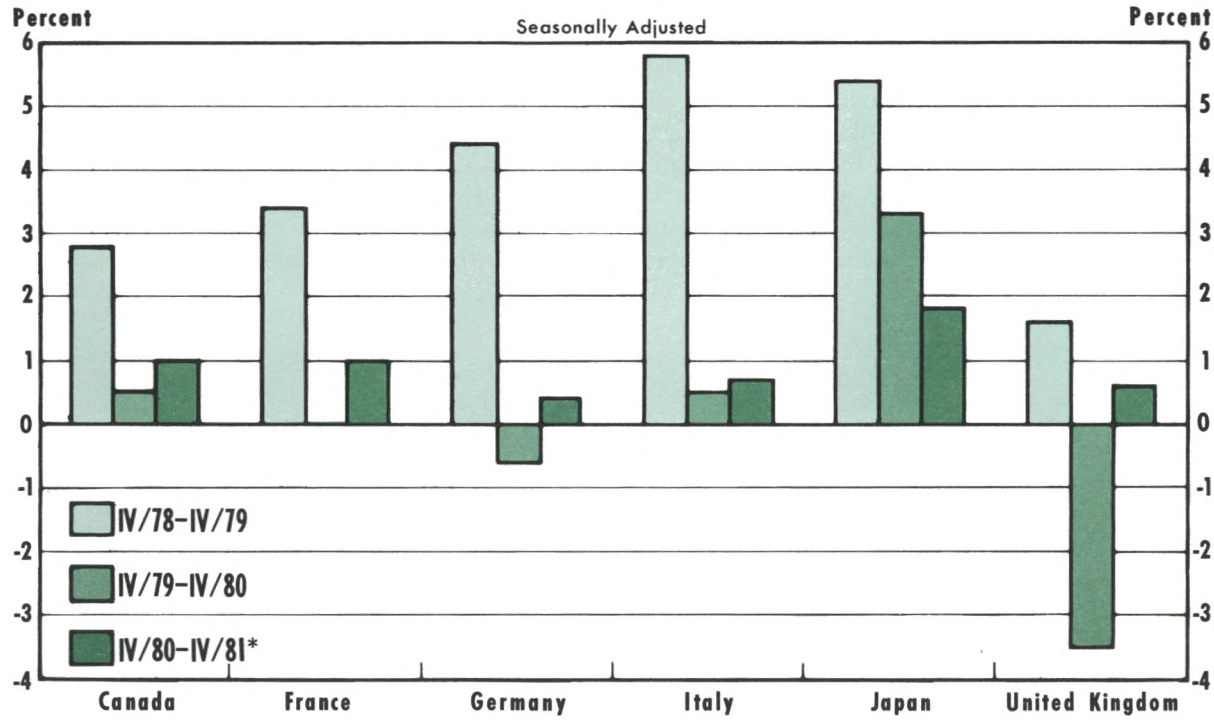
Chart 3

Growth of Real Output

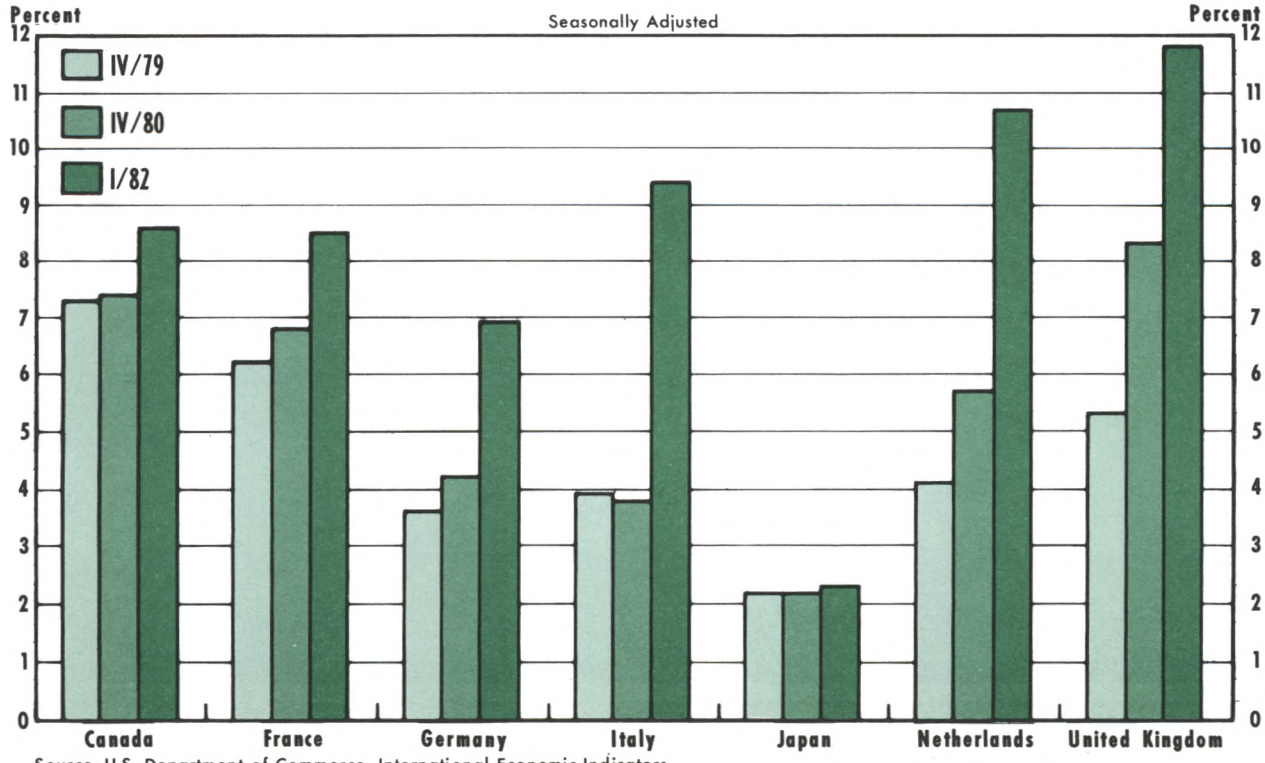


Source: Federal Reserve Bank of St. Louis, International Economic Conditions.

*For France, the data available is for III/81.

Chart 4

Unemployment Rate



Source: U.S. Department of Commerce, International Economic Indicators.

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intervention stance initiated in late 1978 and were disappointed with the Reagan administration's decision to abandon this position in February 1981.

The evidence presented in this article suggests that the February 1981 policy change has forced foreign central banks that wish to influence exchange rate movements to alter their domestic monetary growth rates. In particular, since the exchange value of the U.S. dollar generally has been rising during the past two years, foreign central banks have had to choose between allowing their currencies to depreciate and changing their monetary growth rates drastically. They chose the latter in early 1981. Money growth slowed dramatically, resulting in continued domestic economic stagnation in many of the countries examined. Since the end of 1981, they have opted for the former policy choice and, as a result, the foreign exchange value of the dollar has increased substantially while money growth in the various countries has eased.

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The Link Between Money and Prices in an Open Economy: The Canadian Evidence from 1971 to 1980

MICHAEL D. BORDO and EHSAN U. CHOUDHRI

SINCE 1970, Canada ostensibly has followed a flexible exchange rate policy that should have allowed their monetary authorities to focus directly on controlling the Canadian inflation rate. Since 1975, the Canadian monetary authorities have been publicly committed to reducing inflation by a policy of gradually reducing the rate of monetary growth. Yet Canada has fared no better than the United States and other industrialized economies in controlling inflation during the 1970s. As table 1 shows, the average rate of Canadian money growth decreased from about 13 percent in 1971-75 to 8 percent in 1976-80, while the average rate of inflation remained unchanged at about 8½ percent in these two periods.

In this paper, we use a quantity theory framework to examine Canadian inflation over the past decade. In addition to assessing the impact of money growth on price changes, we test for the influence of other factors commonly believed to have contributed to Canadian inflation, for instance, the relative price of energy, Canadian wage-push and the rate of unemployment. Finally, we examine the influence of U.S. monetary growth and inflation on Canadian money growth and inflation. We find that Canadian inflation is largely explained by lagged Canadian money growth. Furthermore, we determine that Canadian monetary policy has not been independent from that of the United States: we find evidence of a link between Canadian and U.S. monetary growth in addition to a direct link between the U.S. and Canadian inflation rates.

Table 1
Canadian Money Growth and Inflation

	Rate of money growth (M1)	Rate of inflation (GNP deflator)
1971	12.6%	3.2%
1972	14.2	5.0
1973	14.6	9.2
1974	9.5	15.3
1975	13.7	10.8
1976	8.1	9.5
1977	8.4	7.0
1978	10.4	6.4
1979	7.2	10.3
1980	6.4	10.6
1971-75	12.9	8.6
1976-80	8.0	8.7
1971-80	10.4	8.7

THE RELATIONSHIP BETWEEN MONEY AND PRICES: A GENERAL FRAMEWORK

One way to enhance our understanding of a complex system is to begin with a simple model of that system. Thus, it is instructive to consider first an economy in which market information is transmitted rapidly, and prices and wages adjust smoothly to maintain equilibrium continuously in all markets.

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The Money-Price Link in a Frictionless Economy

In a smoothly operating, frictionless economy, the rate of change in prices would be determined largely by the rate of growth in the money stock. This can be derived from the well-known quantity theory of money. The quantity theory is usually written as:

(1) $MV = PY$,

where M is the stock of money, V is the velocity with which money circulates (the number of times money is used on average to finance final transactions), P is the price level and Y is the level of real income or output. According to the modern version of the quantity theory, V is a stable function of a few variables such as long-term income, interest rates and inflationary expectations.[1] If V is constant or changing at a steady rate and Y is growing at a steady rate, changes in P would be directly related to changes in M.[2] Expressed as rates of change, the quantity theory can be expressed as:

(2) $\dot{p} = \dot{m} + \dot{u}$,

where lowercase letters represent the values in natural logarithms and a dot indicates a first difference. Thus, p is the rate of change in the price level, $\dot{m}$ is the rate of change in the money stock and $\dot{u}$ is a residual term that represents the difference between the rate of change in velocity and that in output ($\dot{u} = \dot{v} - \dot{y}$).

If output and velocity grow at the same long-term rate, the average value of $\dot{u}$ would equal zero and the average rate of inflation per year would equal the rate of monetary growth. Deviations in velocity or output growth from their long-term trend values could cause the value of $\dot{u}$ to deviate temporarily from zero. To the extent that such changes are transitory, they only temporarily influence the rate of inflation.[3] In this sense, inflation is essentially a monetary phenomenon; that is, continuous growth in the money supply is necessary to sustain it.

In the above environment, factors such as increases in either real wages (brought about, say, by aggressive labor unions) or the relative price of energy could play only a limited role in explaining the rate of inflation. These factors could temporarily affect $\dot{u}$ (via their potential effect on full-employment output and velocity), but as long as there is no monetary accommodation—that is, as long as $\dot{m}$ is not influenced by these factors—their effect is likely to be short-lived.

Furthermore, in a frictionless economy, no special problem is created if the domestic rate of inflation differs from those in other countries. In such a case, the exchange rate could adjust continuously to reconcile differences between domestic and foreign rates of inflation.[4] For instance, if the domestic rate of inflation is 10 percent and the rate of inflation in the foreign economy is only 5 percent, the exchange rate—denoted as the number of units of the foreign currency that could be purchased by one unit of the domestic currency—would depreciate by 5 percent in each period and only this specific depreciation would keep the *relative* price of domestic and foreign goods the same.

The Effect of Frictions on the Money-Price Link

We do not live in a frictionless world. There are frictions in the adjustment process, for example, that arise from lags in the transmission of price information from one market to another and from inertia in the movement of wages and prices.[5] Given these information lags and temporary wage-price inflexibilities, the effect of monetary growth on inflation will not be reflected fully in one period; rather, it will be distributed over a number of periods.[6] Taking these lags into account, the relationship between money and prices can be modeled as

(3) $p = \dot{\bar{m}} + \varepsilon$,

---

[1]See Milton Friedman, *A Theoretical Framework for Monetary Analysis* (National Bureau of Economic Research, 1971).

[2]Given smooth adjustment in our economy, long-term growth in real output would depend essentially on factors such as technological advance and population growth.

[3]For a discussion of the influence of nonmonetary factors such as a supply shock on the price level and the rate of price change, see Denis S. Karnosky, "The Link Between Money and Prices—1971-1976," this *Review* (June 1976), pp. 17-23.

[4]Real factors, such as changes in tastes, technology or the supplies of factors of production, also can affect the exchange rate.

[5]Information lags have been emphasized by Robert E. Lucas, "Expectations and the Neutrality of Money," *Journal of Economic Theory* (April 1972), pp. 103-24; "An Equilibrium Model of the Business Cycle," *Journal of Political Economy* (December 1975), pp. 1113-44. A recent explanation of wage-price stickiness is that, under conditions of uncertainty, transactions in markets with rapid price adjustments are costly, and therefore wages and prices may be changed infrequently to save these transaction costs. See Michael D. Bordo, "The Effects of Monetary Change on Relative Commodity Prices and the Role of Long-Term Contracts," *Journal of Political Economy* (December 1980), pp. 1088-1109.

[6]See, for example, the discussion by Keith M. Carlson, "The Lag from Money to Prices," this *Review* (October 1980), pp. 3-10.

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where $\dot{\bar{m}}$ is some *weighted average of past monetary growth rates*—call it the long-term or trend rate of monetary growth—and ε is a *residual* term.

Several caveats, however, should be added to this simple representation of the lag between money and prices. First, theoretical analysis does not specify the pattern of weights that should be used in calculating the long-term monetary growth rate—it must be discovered empirically. Also, because these weights represent the lags between money and prices embedded in a particular policy regime and institutional setting, they will shift with significant changes in policy and institutions.[7] Second, ε represents the influence of all factors other than monetary growth. The effect of these factors also operates with lags and cannot be simply dismissed, at least theoretically, as a temporary deviation. Finally, in a nonfrictionless economy, the exchange rate need not change smoothly to offset exactly the difference between foreign and domestic inflation rates.[8] Thus, the economy generally will not be immune from the influence of inflation in the rest of the world.

DETERMINANTS OF CANADIAN INFLATION DURING 1971-80

The Role of Long-Term Monetary Growth

We begin by examining the influence of long-term monetary growth. As discussed above, the specific long-term monetary growth rate that best explains inflation must be estimated empirically. We found that, for the I/1971-IV/1980 period, a simple 12-quarter average of past growth rates of Canadian M1 provides an adequate measure of the long-term monetary growth rate for Canada.[9] The effect of long-term monetary growth, thus measured, on the quarterly rate of inflation in Canada is shown in regression equation 1 in table 2 and is illustrated in chart 1. The chart shows: (a) the actual rate of inflation measured by the quarter-to-quarter change in the GNP deflator over the period and (b) the rate of inflation predicted by the long-term monetary growth rate from equation 1 in table 2.

As chart 1 shows, the predicted rate traces quite well the sharp rise in the inflation rate up to 1974 and the gradual decline in the subsequent three years. The chart also shows that the inflation rate was much higher than the predicted rate in 1974 and, more recently, in 1979 and 1980.

To facilitate a comparison between the U.S. and Canadian inflation experience, chart 2 presents the actual and predicted rates of inflation in the United States using the same procedure as for the Canadian data (regression estimates for the United States are shown in equation 4, table 2).[10] As in the Canadian case, the simple 12-quarter average of M1 growth predicts inflation quite well. Note, however, that the predicted rate shown in the chart also includes the effect of price controls in the United States.

Nonmonetary Influences on Canadian Inflation

Having accounted for the direct impact of monetary growth on the Canadian inflation rate, we now consider certain nonmonetary factors that are potential causes of the residual inflation rate (the difference between the actual inflation rate and the rate predicted by long-term monetary growth). First, it is possible that the Canadian wage and price controls adopted at the end of 1975 and terminated in the third quarter of 1978 had some impact on Canadian inflation. If these controls were effective, the residual inflation rate

---

[7]For instance, Robert E. Lucas, "Econometric Policy Evaluations," in Karl Brunner and Allan H. Meltzer (eds.), *The Phillips Curve and the Labour Market* (North Holland, 1976), has argued that the structure of the economy depends upon the conduct of policy.

[8]See Jacob Frankel, "The Collapse of Purchasing Power Parities During the 1970s," *European Economic Review* (February 1981), pp. 145-65.

[9]We regressed the rate of inflation on the simple average of past monetary growth rates, using three alternative definitions of money (M1, M1B and M2) and alternative averaging periods, differing by two-quarter intervals (2, 4, 6. . .). A 12-quarter average of M1 worked best in the sense of giving the lowest standard error of the regression. This procedure constrains the weights on past growth rates to be equal. To test this constraint, we estimated the following regression:

$$\dot{p}_t = a + \sum_{i=1}^{12} b_i \dot{m}_{t-i} + e.$$

In the above regression, the hypothesis that $b_1 = b_2 . . . b_{12}$, could not be rejected at the conventional 5 percent level. Finally, note that we have not constrained the coefficient of $\dot{\bar{m}}$ ($\dot{\bar{m}}_t = \sum_{i=1}^{12} \dot{m}_{t-i}/12$) to be equal to unity.

[10]A 12-quarter average of M1 worked best for the U.S. data. The U.S. evidence also was consistent with the hypothesis that the weights on lagged monetary growth rates are all equal. In the U.S. regression, we also have included price-control and decontrol dummies as defined in Carlson's paper.

Note that the coefficient on $\dot{M} > 1$ may reflect the impact of higher energy prices in the United States which are not captured explicitly in the U.S. equation. See Carlson, "The Lag from Money to Prices." This paper also provides estimates of the U.S. money-price relationship using Almon lags and including additional variables. Also see John A. Tatom, "Energy Prices and Short-Run Economic Performance," this *Review* (January, 1981), pp. 3-17.

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Table 2

Estimates of the Money-Price Relationship in Canada and the United States: I/1971-IV/1980

	Equation	Constant	$\dot{\bar{m}}$	DUMC	DUMA	$\dot{r}$	DW	R^2	SE × 10^2
Canada	(1)	.003	.772				2.14*	.375*	.725*
		(.40)	(2.29)						
	(2)	−.007	1.205	−.005	.009		1.94	.525	.687
		(−1.35)	(5.90)	(−2.18)	(2.33)				
	(3)	−.008	1.119	−.005	.009	.190	2.33	.597	.641
		(−1.71)	(5.77)	(−2.05)	(2.65)	(2.50)			
United States	(4)	−.006	1.555	−.004	.008		1.88	.706	.316
		(−1.75)	(6.66)	(−3.38)	(4.09)				

NOTE: The dependent variable is p where $\dot{p}$ is the log of GNP deflator. $\dot{\bar{m}} = (\sum_{i=1}^{12} \dot{m}_{t-i})/12$, where m is the log of M1. DUMC is the price control dummy (for Canada, equal to one over IV/1975-III/1978, zero elsewhere; for the United States, equal to one over III/1971-I/1974, zero elsewhere). DUMA is the dummy for the after-control period (for Canada, equal to one over IV/1978-III/1979, zero elsewhere; for the United States, equal to one over II/1974-IV/1974, zero elsewhere). r represents the log of an index of energy prices divided by the GNP deflator. R^2 is the coefficient of determination corrected for degrees of freedom, SE is the regression standard error and DW is the Durbin-Watson statistic. (t-values are shown in parentheses.)

*Equation 1 is estimated using Cochrane-Orcutt adjustment with $\rho = .357$.

should be negative during the period of controls and positive immediately thereafter.[11] This pattern is suggested by chart 1 and is confirmed by equation 2 in table 2, where the price control dummy (DUMC) is significantly *negative* and the dummy variable for the one-year period following the end of controls (DUMA) is significantly *positive*.

Second, the relative rise of energy prices, which has been regarded as a significant factor in explaining U.S. inflation, could similarly have affected Canadian prices in the 1970s.[12] This hypothesis is supported by equation 3 in table 2, which shows that a four-quarter average of changes in relative energy prices has a significant positive effect on the Canadian inflation rate.[13]

A third explanation that invariably arises in inflation discussions is that the rising prices were caused, at least in part, by wage-push.[14] In Canada we found that the rate of monetary growth is not systematically related to (current or past) wage changes and, thus, there is no direct evidence that the Bank of Canada followed a policy of validating wage increases by accelerating the growth in money.[15] Even without monetary accommodation, wage-push elements may still have influenced the residual inflation rate, at least in the short run. This possibility also was rejected by the Canadian evidence, which shows that the rate of wage change (in the current and past three quarters) does

[11]For a further discussion of the Canadian experience with controls, see the articles by Michael Parkin and Jack Carr in Jack Carr et al., eds., *The Illusion of Wage and Price Control* (Vancouver: The Fraser Institute, 1976).

[12]Tatom, "Energy Prices and Short-Run Economic Performance."

[13]Averages of relative energy prices for two, six and eight quarters also were considered, but the four-quarter average produced the strongest effect. The evidence also was consistent with the constraint (implicit in the simple four-quarter average) that the coefficients of current and three lagged energy-price terms were all equal.

[14]See Dallas S. Batten, "Inflation: The Cost-Push Myth," this *Review* (June/July 1981), pp. 20-26.

[15]Current and up to four lagged values of the rate of change in the wage index (hourly wage rate of manufacturing sector) were introduced in an autoregression of the rate of monetary growth (M1) containing four of its own lagged values. All wage terms were insignificant in this regression (estimated for the period I/1971-IV/1980). Also, see the evidence in Robert J. Gordon, "World Inflation and Monetary Accommodations in Eight Countries," *Brookings Papers on Economic Activity* (2:1977), pp. 409-68.

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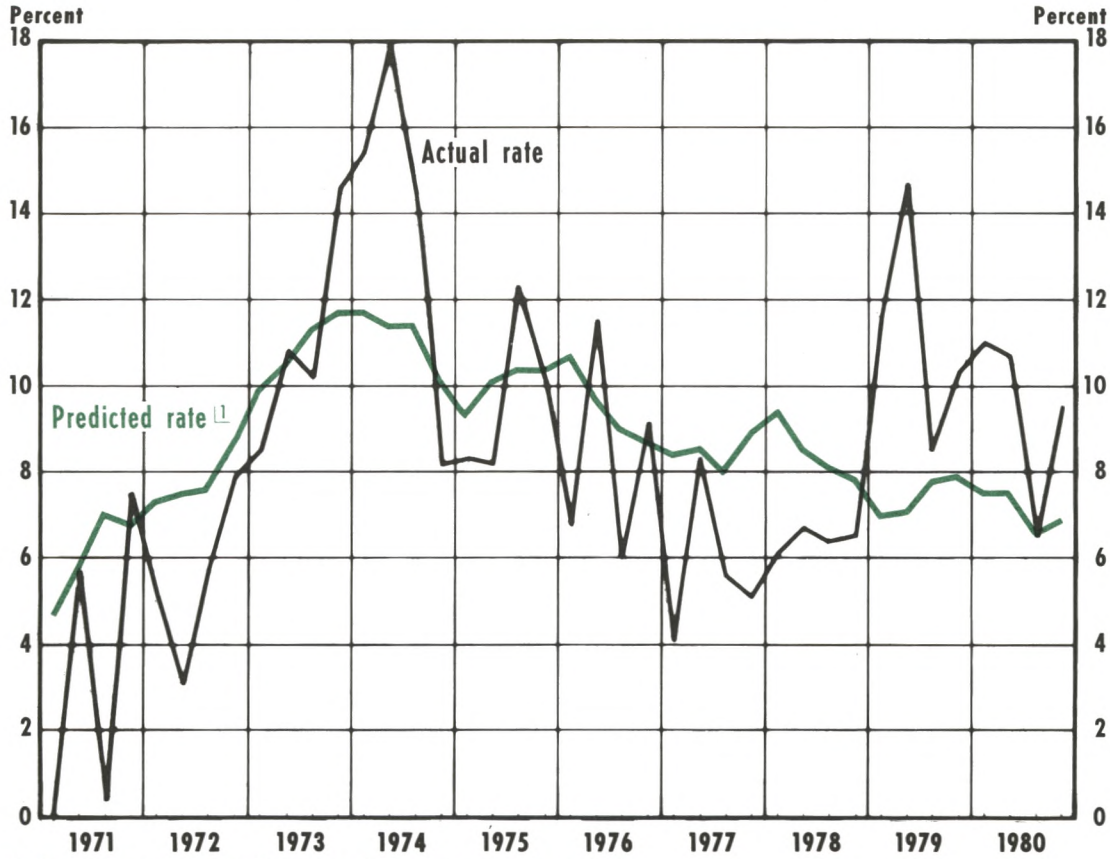
Chart 1

The Actual Vs. Predicted Rate of Inflation in Canada



[1] The rate predicted by Canadian long-term monetary growth.

not exert a significant effect in the money-price regression.[16]

A fourth explanation, suggested by the Phillips curve theory, is that the residual rate of inflation may reflect the effect of excess supply or demand (in goods and/or labor markets) as measured by the unemployment rate.[17] This explanation also was tested and rejected: the effect of the unemployment rate (in the current and past three quarters) is insignificant when introduced in the regression containing the long-term monetary growth rate.[18]

HOW U.S. MONETARY GROWTH AND INFLATION CONTRIBUTED TO CANADIAN INFLATION

Monetary growth and inflation in the United States could have influenced the Canadian rate indirectly through their impact on Canadian monetary growth,

[16]We estimated the following regression equation:

$$\dot{p} = a_0 + a_1 \dot{m} + a_2 DUMC + a_3 DUMA + a_4 \dot{\bar{r}} + \sum_{i=0}^{3} b_i \dot{w}_{t-i}$$

where w represents the log of the hourly wage rate in Canadian manufacturing, and other variables are as defined in table 1. In this regression, b_i's were insignificant individually as well as jointly. A four-quarter average of $\dot{w}$'s was tried, but its effect also was insignificant.

[17]In the standard version of the Phillips curve theory, a price-expectation term is added to the unemployment rate. See, for example, Rudiger Dornbusch and Stanley Fischer, *Macroeconomics*, 2nd ed. (McGraw-Hill, 1980). The above variant, in fact, represents a monetary-growth-augmented Phillips curve.

[18]As in the case of wage index, the coefficients of the current and three lagged values of the unemployment rate were insignificant both individually and jointly when added to the money-price regression (including control dummies and $\dot{\bar{r}}$). A four-quarter average of the unemployment rate also did not produce a significant effect.

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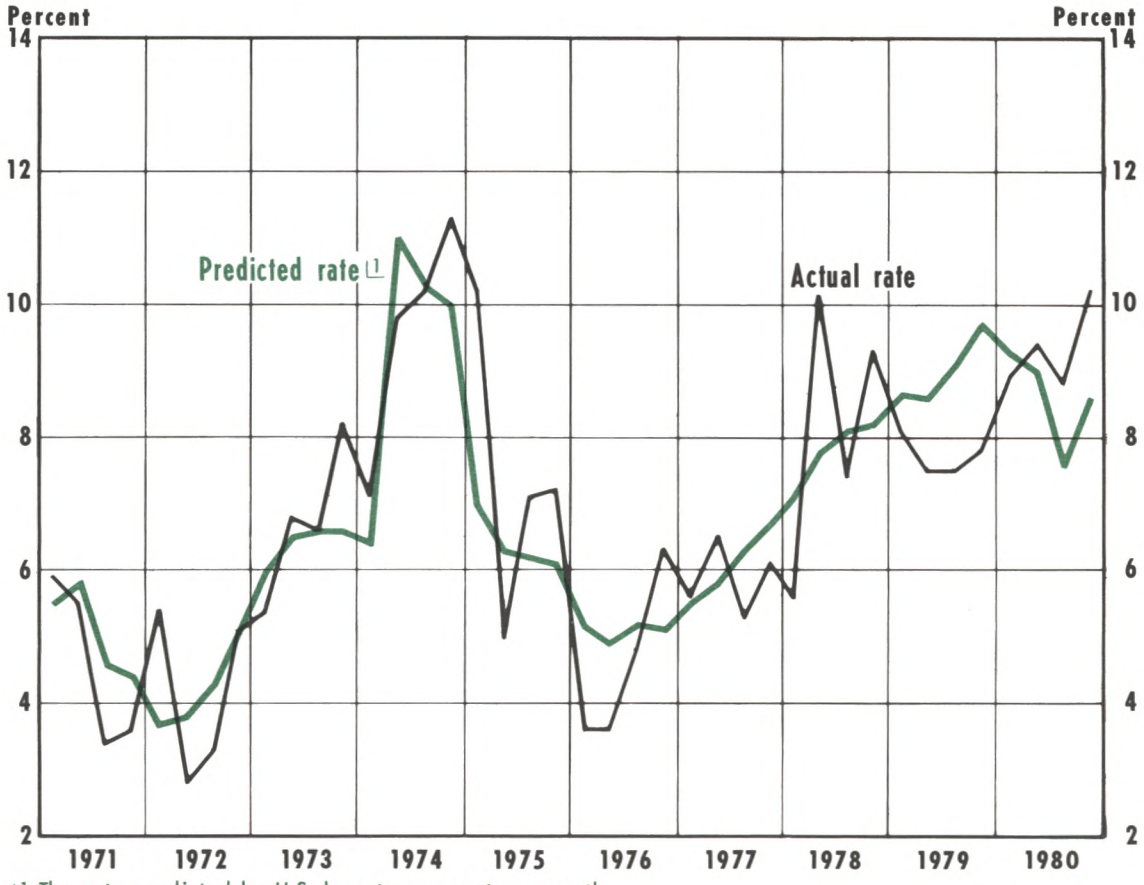
Chart 2

The Actual Vs. Predicted Rate of Inflation in the United States



[1] The rate predicted by U.S. long-term monetary growth.

directly through their impact on the residual inflation rate in Canada, or both. The possible channels are presented in the flow-chart in figure 1. Both of these channels are examined here.

The Impact of U.S. Money Growth on Canadian Money Growth

During the 1970s, despite the nominal existence of a flexible exchange rate system, the Bank of Canada often has attempted to control the movement of the Canadian-U.S. dollar exchange rate. This exchange rate intervention may have established a link between the Canadian and U.S. monetary growth. Because the Bank engages in interest-rate control to implement monetary policy, Canadian money growth is likely to be linked to U.S. money growth via interest rates in the two countries.[19] For instance, the Bank of Canada generally acted to move Canadian short-term interest rates in the same direction that the U.S. rates moved, in order to avoid large fluctuations in the exchange rate.[20] The positive relationship between Canadian

[19]Since 1975 the Bank of Canada began announcing target ranges for the growth of M1. However, it has continued to use the control of short-term interest rates as the policy instrument in the short run. For a further discussion of the Bank of Canada's approach to monetary policy, see Thomas J. Courchene, "On Defining and Controlling Money," *Canadian Journal of Economics* (November 1979), pp. 604-15.

[20]The relationship between the Canadian-U.S. interest rate differential and the exchange rate could be either positive or negative depending on whether the interest rate differential represents differences between expected inflation rates or real interest rates in the two countries. For a further discussion of the relationship between the exchange rate and interest rates, see Dallas S. Batten, "Foreign Exchange Market: The Dollar in 1980," this *Review* (April 1981), pp. 22-30.

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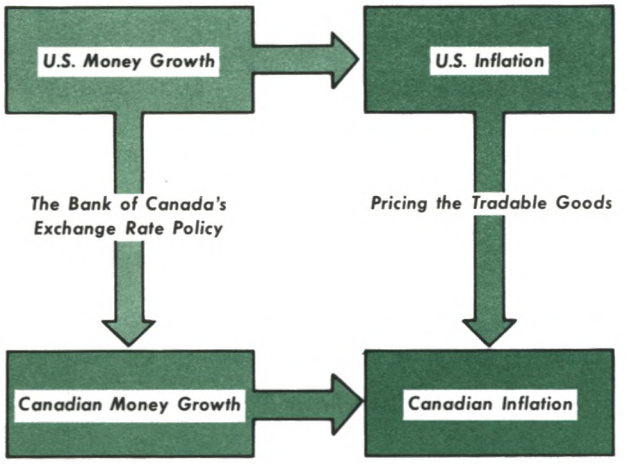
Figure 1
The Transmission of U.S. Money Growth to Canadian Inflation



and U.S. interest rates arising from this policy also is likely to imply a positive correlation between rates of monetary growth in the two countries.[21]

To explore whether Canadian money growth is systematically related to U.S. money growth, we regressed the monetary growth rate in Canada on current and lagged values of the U.S. monetary growth rate. The results show a statistically significant, synchronous relationship between the rates of growth in Canadian M1 and U.S. M1A.[22] Thus, the Bank of Canada's exchange rate policy appears to have established a link between U.S. and Canadian money growth. This link opens up a channel through which U.S. money growth can influence Canadian inflation.[23]

The effect of operating through this channel is illustrated in chart 3. In this chart, we show both the actual rate of long-term Canadian monetary growth and the rate induced by U.S. monetary growth because of Canadian exchange-rate intervention.[24] The difference between the two rates can be viewed as the result of Canadian monetary policy actions not related to exchange market intervention.

Two interesting points emerge from this chart. First, the portion of Canadian money growth induced by U.S. money growth has been sizable and relatively stable throughout the period (it has varied between 4.2 and 6.1 percent per year). Second, the residual growth rate, as represented by the gap between the actual and the U.S.-induced rates, rose sharply in the early 1970s but has been declining gradually since the mid-1970s. Thus, the Bank of Canada's anti-inflation policy adopted in 1975 appears to be effectively reducing the nonintervention portion of Canadian money growth, while having little impact on the contribution of foreign exchange market intervention to money growth.

The Impact of U.S. Inflation on Canadian Inflation

The Canadian rate of inflation also may be directly related to the U.S. inflation rate because of price linkages between Canadian and U.S. tradable goods. According to one hypothesis about these price linkages—called the "law of one price"—the Canadian price for goods produced both in the United States and Canada is the same as the U.S. price adjusted for the exchange rate. According to this hypothesis, the Canadian rate of inflation would depend on the U.S. rate of inflation adjusted for changes in the exchange rate.[25] It should be pointed out that even if Canadian money growth were held constant and there were no intervention in the exchange market, an increase in the U.S.

[21]The direction of the relationship between monetary growth and the rate of interest in each country also would depend on whether interest rate changes reflect changes in expected inflation or real interest rates. We assume that the direction of this relationship is the same in both Canada and the United States.

[22]The estimated regression equation is:

$$\dot{m}_t^{ca} = \underset{(1.96)}{.012} + \underset{(2.40)}{.894}\ \dot{m}_t^{US}$$

$$DW = 1.98,\ R^2 = .13,\ SE = .0164$$

where m^{ca} and m^{US} represent the logs of Canadian M1 and U.S. M1A. Up to four lagged values of $\dot{m}^{US}$ also were introduced in the regression but their effect was found to be insignificant at the 5 percent level. Using M1 as an alternative measure of the U.S. money supply, the results of the above tests were similar, but the effect of U.S. M1 on Canadian M1 was weaker than U.S. M1A. (Using U.S. M1 instead of U.S. M1A, the coefficient of $\dot{m}_t^{US}$ was equal to .666 in the above regression, with a t-value of 1.74.)

[23]Of course, the synchronous relationship between Canadian and U.S. money growth does not, by itself, imply anything about the direction of causation. We assume, however, that U.S. monetary policy actions are independent of Canadian monetary policy.

[24]Using the regression equation relating $\dot{m}^{ca}$ to $\dot{m}^{US}$ in footnote 22 and averaging over 12 quarters, the long-term monetary growth in Canada equals:

$$\dot{\bar{m}}^{ca} = .012 + .894\ \dot{\bar{m}}^{US} + u,$$

where u is the 12-quarter average of the residual error in the regression equation in footnote 22. From the above equation, we estimate the amount of Canadian long-term monetary growth induced by U.S. long-term growth to be equal to .894 $\dot{\bar{m}}^{US}$.

[25]For individual tradable goods, the law implies that the rate of change in the Canadian price would equal the rate of change in the U.S. price, plus the rate of appreciation of the U.S. dollar. The relationship between inflation rates in the two countries, however, would be generally weaker because: (a) some nontraded goods would be included in each country's aggregate price index and (b) the weights used in the aggregate index may be different for the two countries.

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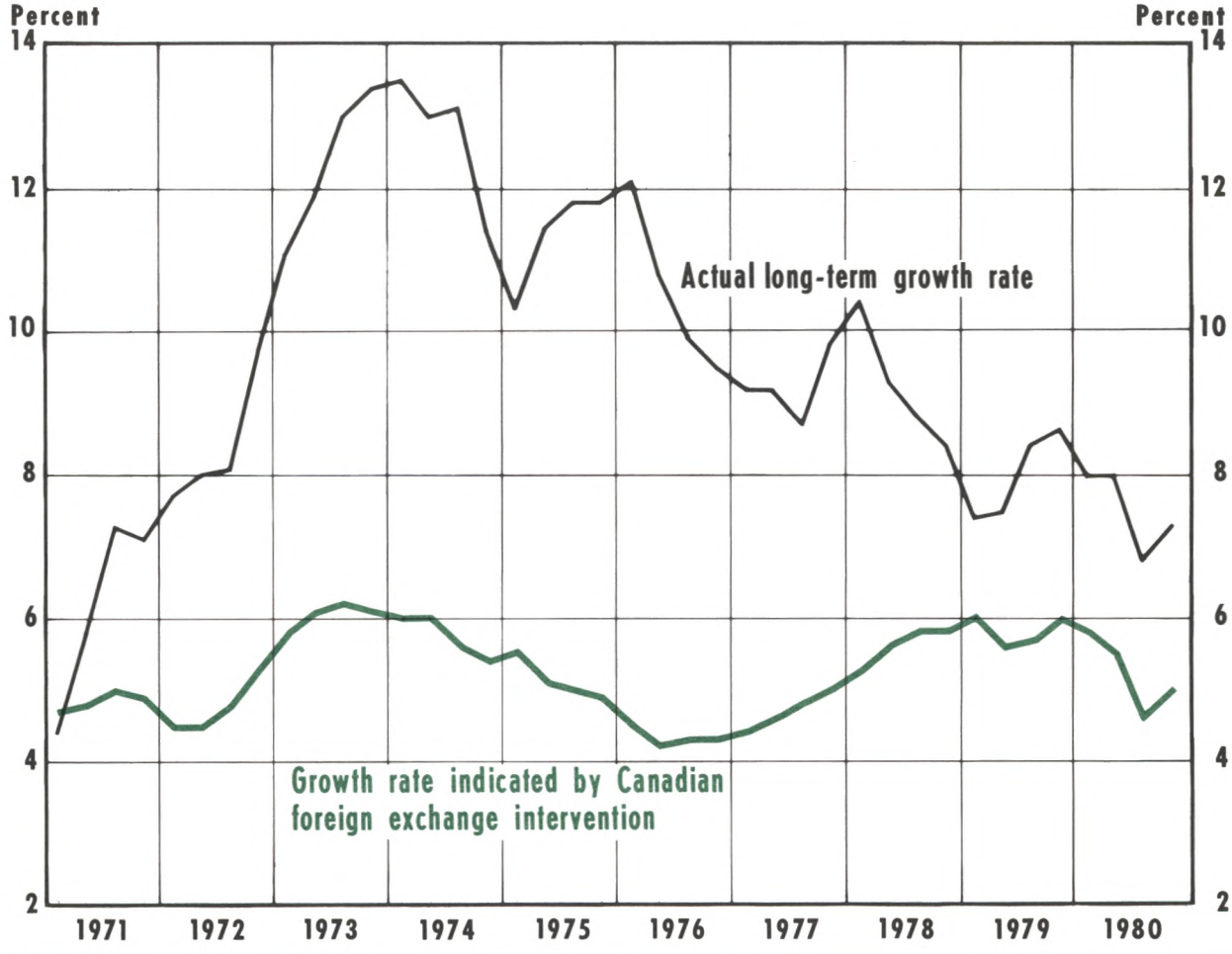
Chart 3

The Contribution of U.S. Long-Term Monetary Growth to Canadian Long-Term Monetary Growth



inflation rate need not be accompanied by an equal depreciation of the U.S. dollar in the short run. U.S. inflation, therefore, could *temporarily* affect the residual rate of inflation in Canada.[26]

The simple version of the law of one price is based on the assumptions that the costs of making price changes and undertaking arbitrage are negligible, the goods produced in the two countries are identical in all respects and perfect competition prevails. If one or more of these assumptions do not hold, the price relationship implied by the law of one price could be significantly altered.[27] For instance, if prices are costly to change, domestic prices may not respond to those changes in foreign prices and the exchange rate that are perceived to be transitory.[28] This modification of the law of one price suggests that Canadian price changes

[26]In terms of the quantity theory framework, the above effect implies that U.S. inflation can temporarily influence the rate of growth in velocity and/or output in Canada. Such an impact is possible in open-economy models which allow for capital mobility and/or distinguish between traded and nontraded goods. For a discussion of monetary adjustment in open-economy models, see Rudiger Dornbusch, *Open Economy Macroeconomics* (Basic Books, 1980).

[27]For empirical evidence on the depatures from the law of one price, see Irving B. Kravis and Robert E. Lipsey, "Price Behaviour in the Light of Balance of Payments Theories," *Journal of International Economics* (2:1978), pp. 193-246.

[28]The costs of making price changes would include not only administrative and labeling costs, but also the costs associated with advertising price changes, adverse reaction from customers and uncertainty about the response of competitors.

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Table 3

The Influence of U.S. Inflation in the Canadian Money-Price Relationship

	(1)	(2)	(3)	(4)
Constant	−.007 (−1.45)	−.012 (−2.28)	−.020 (−2.73)	−.026 (−3.81)
$\dot{m}^{ca}$	1.107 (5.68)	1.015 (5.31)	.994 (5.29)	.997 (5.43)
DUMC	−.004 (−1.81)	−.003 (−1.07)	−.001 (−.56)	
DUMA	.010 (2.72)	.007 (2.00)	.005 (1.38)	
$\dot{r}$	.214 (2.67)	.085 (.87)	.078 (.81)	
$\dot{p}^{US}+\dot{e}$	−.062 (−.96)			
$\dot{p}^{US}$		.474 (1.78)		
$\dot{e}$		−.140 (−1.92)	.141 (−1.98)	
$\hat{\dot{p}}^{US}$			.933 (2.35)	1.33 (4.40)
$\dot{p}^{US}-\hat{\dot{p}}^{US}$			.272 (.93)	
DW	2.39	2.37	2.42	1.90
R^2	.608	.653	.677	.579
SE × 10^2	.642	.613	.601	.638

NOTE: The dependent variable is $\dot{p}^{ca}$. e is the log of the exchange rate (Can. $/U.S. $). $\hat{\dot{p}}^{US} = -.006 + 1.555\ \dot{m}^{US}$, represents the fitted value of $\dot{p}^{US}$ from equation 4, table 2 (without the control dummies). Other variables are defined in table 2. (t-values in parentheses.)

are related to *long-term* movements in U.S. prices and the exchange rate.

To explore the direct link between the U.S. and Canadian inflation, we experimented with a number of tests. First, we added the exchange-rate-adjusted U.S. inflation ($\dot{p}^{US} + \dot{e}$, where e is the logarithm of the price of the U.S. dollar in Canadian dollars) to the money-price regression including price-control dummies and the relative energy price. As shown in equation 1, table 3, the effect of this variable is insignificant.[29] Next, we included the U.S. inflation rate ($\dot{p}^{US}$) and the exchange rate change ($\dot{e}$) as separate variables in the regression equation. In this test (see equation 2, table 3), while the U.S. inflation rate has a positive effect, the effect of the exchange-rate change is negative (both variables are significant at the 10 percent level, though not at the 5 percent level).[30] We are, thus, unable to find a consistent effect of the exchange rate on Canadian inflation. One explanation of this is that the exchange rate exhibited little or no time trend during the flexible exchange rate period.[31] Its movements, therefore, could have been considered transitory and largely disregarded in the adjustment of Canadian prices.

Finally, to examine the possibility that transitory and trend changes in U.S. prices may exert different effects on Canadian inflation, we divided the U.S. inflation rate in two parts: (a) the rate predicted by long-term U.S. money growth ($\hat{\dot{p}}^{US}$) and (b) the residual rate ($\dot{p}^{US} - \hat{\dot{p}}^{US}$). Each part was entered in the regression equation separately. As shown in equation 3, table 3, this test produced the interesting result that, although the effect of the U.S. monetary-induced trend rate of inflation is positive and significant, the effect of the residual rate is insignificant. It is also interesting to note that the effect of both price-control dummies as well as that of the relative energy price is insignificant in this regression.[32] In equation 4, table 3, we present the regression equation that emerges when

[29]Up to three lagged values of the exchange-rate-adjusted U.S. inflation also were added to the regression, but their effects remained insignificant.

[30]Again, up to three lagged values of both $\dot{p}^{US}$ and $\dot{e}$ were introduced in the regression, but none of these terms produced a significant effect. A four-quarter average of $\dot{e}$ was tried, but this variable also had an insignificant influence.

[31]From II/1970 to IV/1980, the exchange rate changed by only 12 percent. The U.S. aggregate price level changed by 102 percent over the same period.

[32]As these variables are correlated with the U.S. inflation rate, it is difficult to disentangle their separate influences on Canadian inflation. For example, the correlation coefficient between $\dot{p}^{US}$ and $\dot{r}$ is .655, between $\dot{P}^{US}$ and DUMC is −.237 and between $\dot{p}^{US}$ and DUMA is .198.

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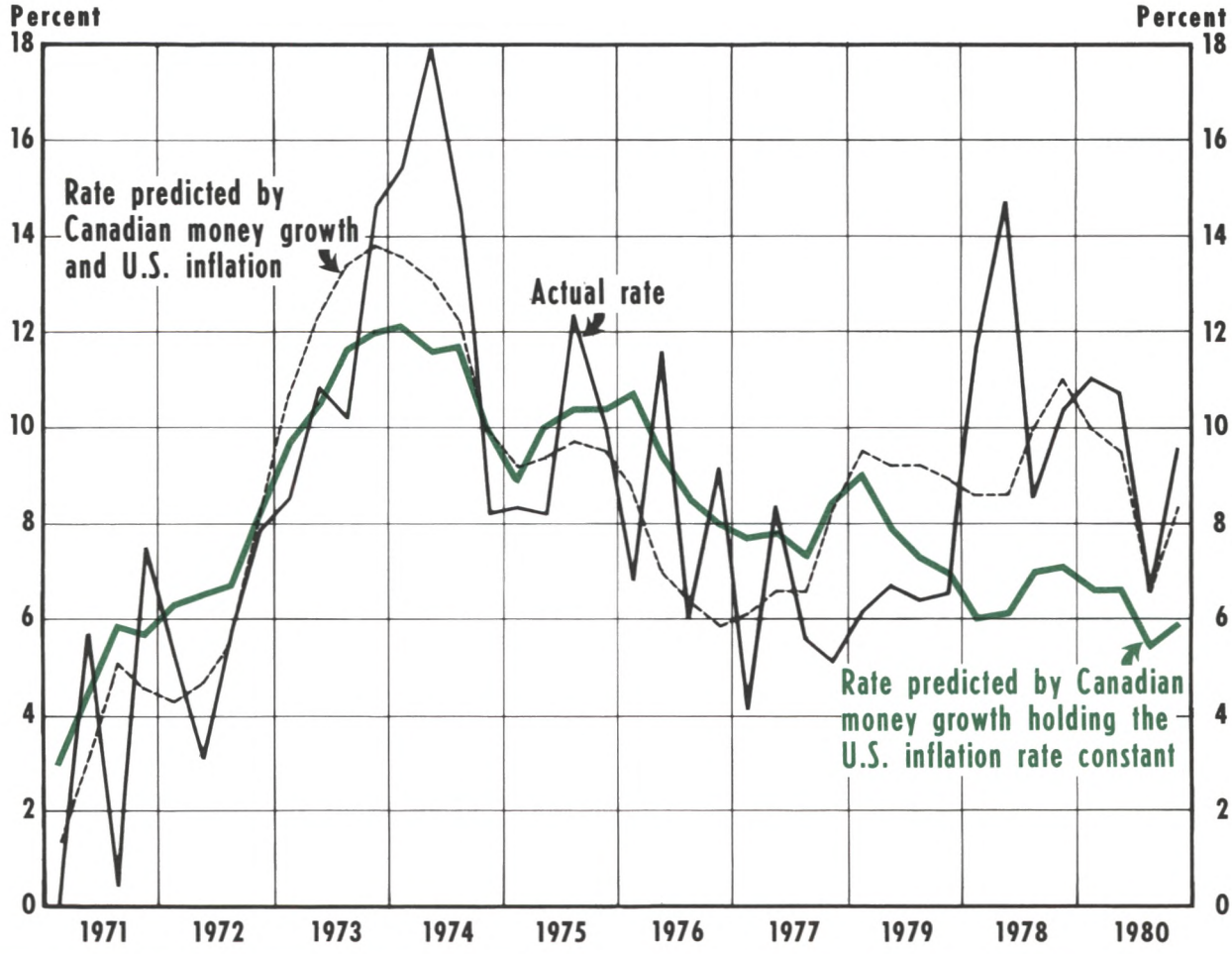
Chart 4

The Contribution of Monetary-Induced U.S. Inflation to Canadian Inflation



we exclude the dummy variables, the relative energy price and the exchange rate. In this equation, the Canadian inflation rate is explained by only two factors: (1) the long-term rate of money growth in Canada and (2) the U.S. monetary-induced or trend inflation rate.

The Canadian rate of inflation predicted by regression equation 4 in table 3 is shown in chart 4. To illustrate the role of U.S. inflation in the Canadian price equation, the chart also shows the Canadian inflation rate that would have been predicted by Canadian money growth if the U.S. inflation rate had remained constant throughout the period.[33] The difference between the two predicted rates can be interpreted as the contribution of the (money-growth-related) U.S. inflation rate to the rate of inflation in Canada. As the chart illustrates, while the U.S. influence (as operating through the U.S. inflation rate) has tended to lower the predicted rate of inflation in Canada during the early 1970s and in the control period, it has added to the predicted rate during the 1973-74 period and, more recently, in the post-control period.[34]

It was noted earlier that the Canadian rate of inflation has stayed well above the rate predicted by the

[33]The U.S. inflation rate is set constant at its quarterly average for the 1971-80 period (equal to .017 when expressed as a fraction per quarter). Under this assumption, the Canadian inflation rate is predicted by the equation: $\dot{p}^{ca} = -.003 + .997\,\dot{m}^{ca}$.

[34]It is interesting to note that because of lags between U.S. money growth and inflation, the effect of monetary-induced U.S. inflation on Canadian inflation in 1973-74 and the post-control period has, in fact, been produced by rapid U.S. money growth prior to these periods.

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Canadian long-term monetary growth in 1979 and 1980. Chart 4 shows that this difference can be explained for most of the period by taking into account the effect of the monetary-induced U.S. rate of inflation. As can be seen from the chart, although there are large deviations in the first two quarters of 1978, the predicted inflation rate (based on both Canadian money growth and U.S. trend inflation rate) tracks the actual inflation rate quite well in the remainder of the 1979-80 period.

The above discussion of the impact of U.S. money growth and inflation on the rate of inflation in Canada has highlighted two channels through which the effect of U.S. money growth is transmitted to Canadian inflation. As illustrated in figure 1, U.S. money growth influences inflation in Canada via: (1) Canadian money growth and (2) U.S. inflation. The first channel operates because of the Bank of Canada's policy of intervening in the exchange market. It is interesting to point out that this policy also may have strengthened the second channel. For instance, if the Bank of Canada had not attempted to influence the exchange rate and followed an independent monetary policy, the exchange rate may have shown a pronounced trend which may have offset, at least in part, the effect of monetary-induced U.S. inflation on Canadian inflation.

SUMMARY AND CONCLUSIONS

This article has examined the role of a number of factors in determining the rate of Canadian inflation over the last decade. The evidence shows that long-term monetary growth—as measured by the average rate of growth of Canadian M1 over the past 12 quarters—is a key determinant of Canadian inflation. Furthermore, after taking into account the effect of long-term Canadian monetary growth, factors such as wage-push and unemployment did not exert a significant effect on Canada's inflation rate.

The article also has examined the transmission of inflation from the United States to Canada. It finds that long-term U.S. monetary growth—also measured by a 12-quarter average of past money growth rates—contributed significantly to Canadian inflation in two distinct ways: (1) U.S.monetary growth directly affected Canadian monetary growth, and (2) the monetary-induced portion of U.S. inflation—the part of the inflation rate explained by long-term U.S. monetary growth—directly affected Canadian inflation (holding constant the effect of Canadian monetary growth). The link between U.S. and Canadian monetary growth arises, in our view, from the Bank of Canada's policy of not allowing the exchange rate to fluctuate freely. Indeed, it is possible that this policy of exchange rate management also may have strengthened the direct link between U.S. and Canadian inflation.

Recently, monetarism has been criticized in Canada because the Bank of Canada, while apparently successful in reducing the rate of growth of Canadian M1, has been unable to significantly reduce inflation. This article suggests that Canada's difficulties in controlling inflation can be explained, at least in part, by taking into account the effect of U.S. long-term monetary growth on Canadian inflation.

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Does 'Tight' Monetary Policy Hurt U.S. Exports?

DALLAS S. BATTEN and CLIFTON B. LUTTRELL

THE competitive position of U.S. exports in foreign commodity markets has deteriorated over the past year. Of the reasons proffered, the major one has been the adverse impact of the rising exchange value of the U.S. dollar in foreign currency markets. It is argued that a rising dollar makes U.S. exports less competitive in foreign markets by causing their foreign-currency prices to rise relative to those of commodities produced in other countries.[1] One sector especially affected is the farm sector. In fact, farm exports are expected to decline in fiscal 1982, the first such decline in 13 years (chart 1).

The ultimate "blame" for the dollar's strength has been placed on the Federal Reserve's current "tight" monetary policy stance, that is, its desire to reduce the long-run rate of money growth.[2] As one noted agricultural economist has remarked:

> A tight monetary policy, other things equal, leads to a rise in the value of the dollar and a decline in the competitiveness of the export sector in international markets. An easy monetary policy, on the other hand, leads to a decline in the value of the dollar and increased competitiveness. To put it simply, the trade sectors bear the adjustment of changes in monetary policy, and trade is now important to agriculture.[3]

This article assesses the validity of this claim that the reduced competitiveness of U.S. exports is due primarily to the Federal Reserve's monetary policy stance. Specifically, this article focuses on the impact of money growth on inflation and exchange rate movements over both short- and long-run periods to investigate how U.S. exports are affected.

THE DETERMINATION OF PRICES AND THE EXCHANGE RATE: A LONG-RUN VIEW

The domestic price level and the exchange rate are determined jointly by the supply of money relative to the amount that individuals desire to hold. The supply of money essentially is determined by the monetary authority. The demand for money (i.e., an individual's desire to hold a portion of his wealth in the form of money) is determined primarily by income, interest rates, prices and price expectations. The equilibrium price level, then, is the one (given the level of income, interest rates and price expectations) that induces individuals to hold the exact quantity of money that monetary authorities are supplying.[4] Any other price level motivates individuals to attempt to hold more or less money than is being supplied by altering their spending until the price level is driven to its equilibrium level.

Changes in the spending of consumers affect not only domestically produced goods and services, but commodities produced abroad as well. Altered demands for foreign commodities, in turn, produce changes in the U.S. demand for foreign currencies and, as a consequence, changes in the foreign exchange value of the dollar, all other things equal. In other words, a monetary disequilibrium, through its impact on aggregate spending, induces a change in the

[1] U.S. Department of Agriculture, *Agricultural Outlook* (March 1982), p. 10, and *Agricultural Outlook* (August 1981), p. 14. Similar views are found in the press and among academic economists. See, for example, Art Pine, "Strong Dollar, a Point of Pride to Reagan Is Said to Hurt Exports and U.S. Economy," *The Wall Street Journal*, May 13, 1982; G. Edward Schuh, "The Foreign Trade Linkages," in *Modeling Agriculture For Policy Analysis in the 1980s*, A Symposium Sponsored by the Federal Reserve Bank of Kansas City, September 24-25, 1981, pp. 82-87; "The Mighty Dollar Slams U.S. Trade," *Business Week* (April 12, 1982), pp. 30-32.

[2] See Schuh, "The Foreign Trade Linkages," p. 84; and Robert G. Chambers and Richard E. Just, "An Investigation of the Effect of Monetary Factors on Agriculture," *Journal of Monetary Economics* (March 1982), pp. 235-47. There are obviously factors other than monetary growth that induce short-run exchange rate movements. This article, however, ignores these, focusing solely on the short- and long-run impact of money growth on exchange rate movements.

[3] Schuh, "The Foreign Trade Linkages," p. 84.

[4] For simplicity, the analysis here is performed within a static framework. A dynamic analysis would be couched in terms of growth rates instead of levels of the variables examined.

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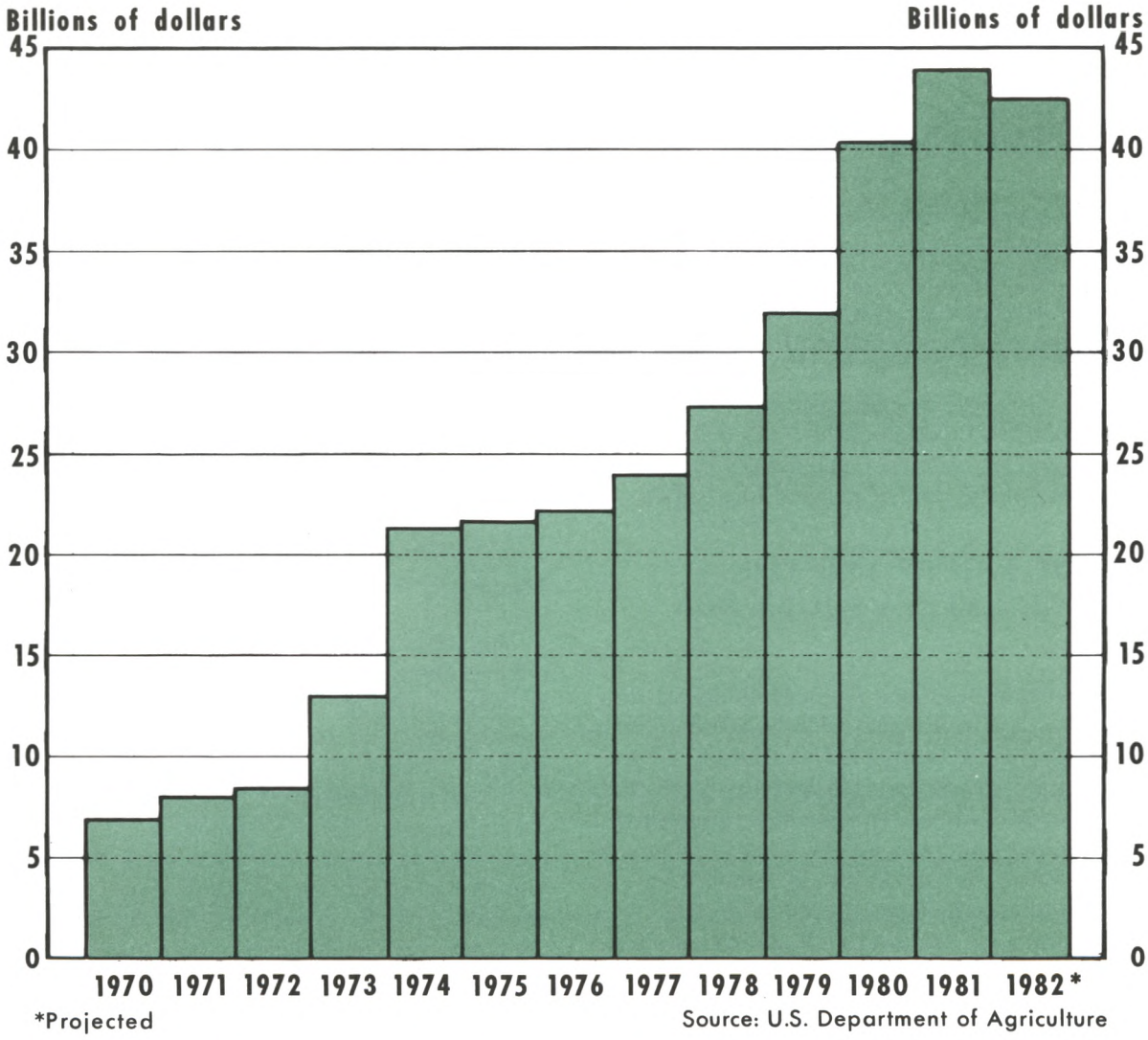
Chart 1

Market Value of U.S. Agricultural Exports



*Projected

Source: U.S. Department of Agriculture

domestic price level and, in the long run, an equal and offsetting change in the exchange rate.

For example, if the supply of money in the United States is less than the amount that individuals desire to hold, both an excess demand for money and an excess supply of goods, services and securities exist at current prices. In an attempt to increase their money holdings to the desired level, individuals decrease their spending on *all* goods and services, placing downward pressure on domestic prices.

This excess demand for money is associated with decreased spending, not only on domestically produced commodities, but also on commodities produced abroad. The decreased demand for foreign commodities motivates a decrease in the demand for foreign currencies by U.S. importers. With a given supply of foreign currency, the foreign currency value of the dollar will rise.

In the long run, the foreign currency value of the dollar should rise sufficiently to offset the differences between foreign and U.S. prices resulting from the initial excess demand for money. For example, if prices in the United States fall by 10 percent relative to those in Germany, then the Deutsche mark price of the

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dollar should rise by 10 percent, other things equal.[5] If domestic price level and exchange rate adjustments occur simultaneously and if export prices move with the general price level, the initial excess demand for money will have no long-run effect on either the foreign currency price of U.S. exports or the competitive positions of U.S. exporters in foreign markets. The domestic deflation (or, in dynamic terms, disinflation) would exactly offset the impact of the exchange rate appreciation on the foreign-currency price of U.S. goods.

This relationship can be seen quite clearly in chart 2. This chart displays (a) the trade-weighted foreign currency value of the dollar and (b) the difference between the U.S. rate of inflation (measured by the CPI) and the trade-weighted rate of inflation of the Group of Ten countries (excluding the United States) plus Switzerland.[6] It is apparent from the chart that, when the rate of domestic inflation in the United States falls relative to that of its major trading partners, the foreign currency value of the dollar rises and vice versa.[7]

DOMESTIC PRICES AND THE EXCHANGE RATE: A SHORT-RUN VIEW

In the short run, producers cannot tell immediately whether a decrease in aggregate demand (spending) is permanent or just a temporary aberration. Consequently, their initial reaction is to decrease production rather than to lower prices. That is, the excess demand for money initially induces a slowdown in economic activity. Of course, as soon as the decline in spending has been identified as permanent, producers will lower prices and increase production back to "normal" levels.[8] Thus, the impact of the excess demand for money on output eventually vanishes, leaving only prices permanently affected; however, these long-run effects are not realized immediately.

On the other hand, the exchange rate responds to this excess demand for money much more rapidly than do the prices of domestic commodities. This occurs because the exchange rate is the relative price of two assets (two currencies); unlike commodity prices, it is determined in highly organized markets that quickly assimilate new information in the same efficient manner as the prices of other financial assets (e.g., stocks and bonds). Therefore, the exchange rate will appreciate *before* prices of commodities fall sufficiently to eliminate completely the excess demand for money.[9]

During this interim period, U.S. exporters will face a deteriorating competitive position in foreign markets. The foreign currency prices of their products will have risen temporarily because the dollar appreciates before commodity prices fully adjust to the monetary disequilibrium.

INAPPROPRIATE POLICY RESPONSES

The argument that tighter monetary policy during the past few years has strengthened the dollar and thus reduced the competitiveness of U.S. goods in foreign markets has elicited several proposed policy responses. Among these are increased protectionism, increased subsidization of U.S. exports, a return to an easier monetary policy stance, and large-scale intervention in foreign exchange markets.[10] Since the impact of a tighter monetary policy on the competitive position of U.S. exports is only a short-run phenomenon, such policy reactions are inappropriate.[11] In particular, policy responses designed to rectify the short-run disequilibrium actually will exacerbate the equilibrating process and, consequently, lengthen the period of adjustment. Moreover, redirecting domestic

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[5]This condition is known as purchasing power parity. Even though it has been violated frequently in the short run during the 1970s, there is no evidence that its usefulness as a condition of long-run equilibrium has been mitigated. See Jacob A. Frenkel, "The Collapse of Purchasing Power Parities During the 1970s," *European Economic Review* (May 1981), pp. 145-65.

[6]The G-10 countries are Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom and the United States. See "Index of the Weighted-Average Exchange Value of the U.S. Dollar: Revision," *Federal Reserve Bulletin* (August 1978), p. 700, for a definition of the weights employed. The calculated correlation coefficients between (1) the trade-weighted exchange rate and the inflation differential and (2) changes in the trade-weighted exchange rate and changes in the inflation differential are −.892 and −.533, respectively. Each is statistically significant at the 5 percent level.

[7]Chart 2 is *not* intended as a proof of purchasing power parity, but simply a demonstration that the rate of inflation and the exchange rate are jointly determined by excess money growth; that is, one does not cause the other.

[8]The normal level of production and its path over time is determined primarily by the availability and the rate of growth of productive resources.

[9]For additional support of this argument, see Frenkel, "The Collapse of Purchasing Power Parities."

[10]See Pine, "Strong Dollar, a Point of Pride;" "The Mighty Dollar Slams U.S. Trade;" and Chambers and Just, "An Investigation."

[11]Jacob Frenkel, "Flexible Exchange Rates, Prices, and the Role of 'News': Lessons from the 1970s," *Journal of Political Economy* (August 1981), pp. 665-705, finds that such policy responses also may be inappropriate when the short-run deviation from purchasing power parity is motivated by changes in determinants of exchange rates other than money growth.

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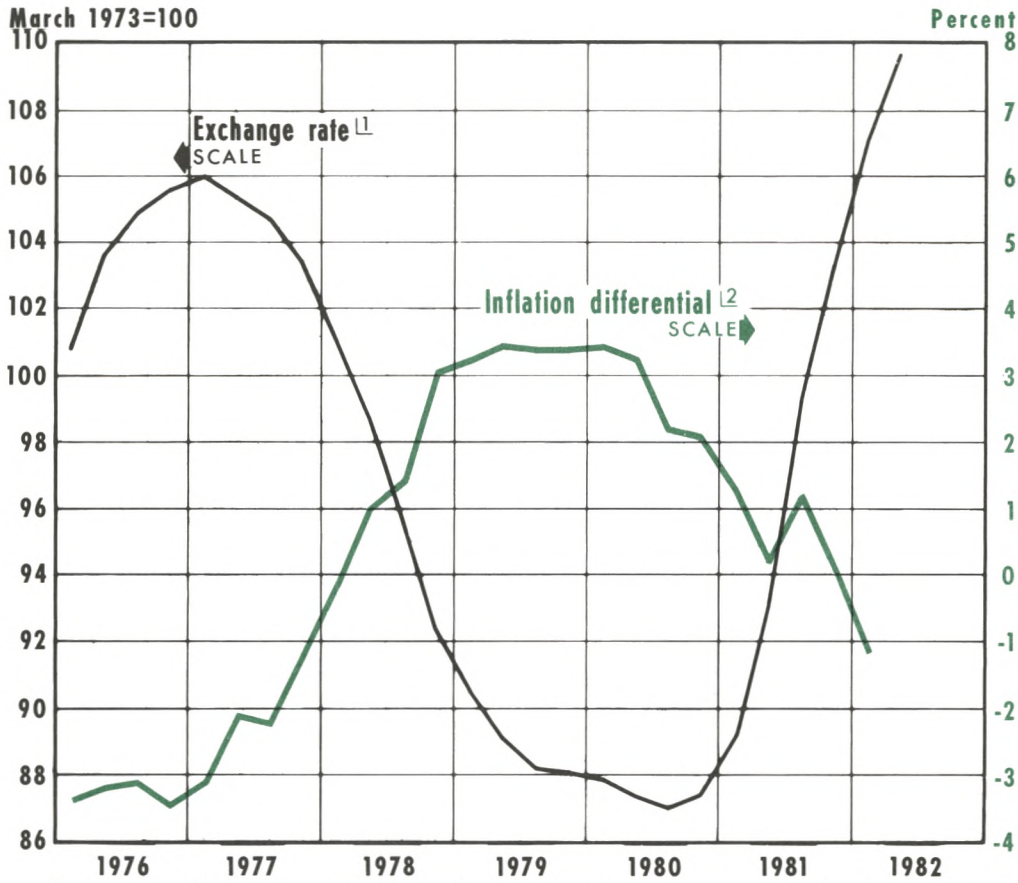
Chart 2

Exchange Rate and Inflation Differential



Sources: Board of Governors of the Federal Reserve System, and International Monetery Fund, International Financial Statistics

[1] 4-quarter moving average

[2] Year-over-year U.S. CPI growth minus growth of trade-weighted CPI.

monetary policy (directly or by intervening in foreign exchange markets) to external objectives, by definition, subordinates the domestic objectives of monetary policy. Any acceleration of money growth to alleviate the short-run effect of past policy actions ultimately would have no favorable long-run impact on U.S. competitiveness in foreign markets. It would result simply in a higher rate of U.S. inflation and a lower exchange value of the dollar.

SUMMARY AND CONCLUSIONS

Those who feel that exports have been harmed by a tight monetary policy have overlooked the fact that the same monetary policy that causes the dollar to strengthen in foreign currency markets also causes the rate of domestic inflation to decline relative to that in other countries. These two events (i.e., a rising dollar and falling U.S. inflation) exactly offset each other over time. Consequently, foreign importers of U.S. products can purchase fewer dollars with a given amount of their currency but can purchase more U.S. goods with those dollars.

A tighter monetary policy in the United States relative to monetary policies abroad is reflected in the exchange value of the dollar more quickly than in the relative prices of export goods, which reduces temporarily the competitiveness of U.S. exports. Such a policy, however, has no impact on our long-run competitive position. Consequently, foreign exchange market intervention, trade restrictions or other policy responses designed to offset this short-run disequilibrium situation are neither necessary nor justified.

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Money and Inflation in Israel: The Transition of an Economy to High Inflation

ZALMAN F. SHIFFER

ISRAEL is a small, open economy with a population of about 4 million and a per capita national income in 1981 of about $5,400.[1] For a long period, until the beginning of the 1970s, it had experienced relatively low inflation and high real economic achievements in terms of employment, economic growth and consumption. During the 1970s, however, Israel's economic performance deteriorated sharply: real GNP growth fell from about 9 percent to 3 percent per year, and the rate of inflation accelerated dramatically to over 100 percent per year (unemployment, however, remained relatively low for most of the decade). At the same time, the import surplus — the difference between the value of imports and exports — rose to levels that were considered unmaintainable in the long run (see tables 1 and 2).[2]

The dismal experience of the Israeli economy, like similar developments in other countries, was related to the economic adjustment to higher energy prices. Other countries also were subject to lower real growth and higher inflation since 1973. However, the acceleration of inflation was particularly acute in Israel (see table 3). In addition to the oil price shocks, Israel faced changing military and political conditions that resulted in higher levels of defense expenditures and government deficits. The deterioration of the Israeli economic performance in the 1970s was, therefore, also related to the effect of the external burdens imposed on Israel. Finally, the rapid transition to high inflation also reflected the relative low priority assigned by policymakers to the goal of price stabilization and the specific mix of policy measures used to achieve the different policy goals.

The purpose of this article is to discuss the sources and mechanisms of monetary growth in Israel I in particular the inflationary process during the past decade. Section 1 discusses the relative importance of the changes in money demand and money supply in the Israeli inflationary process. Section 2 surveys the sources of money supply growth, with special emphasis on the financing requirements of the public sector. Section 3 discusses how the exchange rate policy and the debt management policy have created a highly adaptive money supply process, and section 4 deals with the short- and long-run implications of this structure on the inflationary process. Section 5 analyzes the historical evolution of the inflationary process and, finally, section 6 offers some concluding remarks.

1. MONEY DEMAND, SUPPLY AND INFLATION

Inflation can be defined as a sustained increase in the general price lvel or, equivalently, as a sustained erosion of the value of money (i.e., the amount of goods and services that one unit of local currency — say a dollar or a Shekel) will buy.[3]

The equilibrium value of money, like that of any other commodity, depends on its demand and supply. People generally are not interested in the number of monetary units that they possess — their *nominal* money holdings; instead they are concerned about the

[1]The degree of the openness of an economy is measured by the importance of its economic relations with the rest of the world. In 1981 imports and exports were, respectively, equal to 68 percent and 48 percent of GNP in Israel (compared with 9 percent and 8 percent in the United States).

[2]Since the establishment of the state, Israel has always imported more than it exported, financing the difference by foreign grants and by the accumulation of foreign debt (which reached $18 billion at the end of 1981). The authorities were concerned about the possibility of future reduction in the availability of international finanacing and, to avoid the potential high costs of a rapid adjustment to a lower import surplus, aimed at its gradual reduction.

For additional information (in English) on the Israeli economy in general and on monetary policies and developments in particular, see Bank of Israel *Annual Reports* and *Economic Review*. See in particular Stanley Fischer, "Monetary Policy in Israel," Bank of Israel *Economic Review* No. 53 (May 1982), pp. 5-30. For an earlier period, see Nadav Halevi and Ruth Klinov-Malul, *The Economic Development of Israel*, (Praeger, 1968). See also Nadav Halevi, "Economic Policy Discussion and Research in Israel," *American Economic Review*, Supplement (September 1969).

[3]In 1980, Israel changed its monetary unit from the pound (IL) to the shekel (IS) at the ratio of 10 IL per IS.

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Table 1

GNP, Prices and Unemployment

Period	Nominal GNP growth	Real GNP growth	Change in implicit GNP price deflator	Unemployment rate[1]
1960-65	18%	9.5%	8%	3.8%
1966-69	12	7.5	4	7.1
1970	17	7.9	8	3.8
1971	25	11.0	13	3.5
1972	28	12.3	14	2.8
1973	26	4.1	21	2.6
1974	41	4.6	35	3.0
1975	42	3.2	37	3.1
1976	29	1.3	27	3.6
1977	45	1.3	43	3.9
1978	63	4.1	55	3.6
1979	89	3.0	82	2.9
1980	133	2.7	128	4.8
1981	137	4.6	126	5.1

[1]As a percent of the civilian labor force.

SOURCE: Central Bureau of Statistics, *Statistical Abstracts of Israel* (1981).

Table 2

Allocation of Economic Resources

Period	Private consumption	Public consumption Total	Public consumption Defense	Investment	Import surplus[1]	Import surplus[2]
	(as a percent of GNP)					
1966-69	66%	28%	17%	22%	19%	$ 645
1970	61	36	25	29	27	1288
1971	58	34	23	32	24	1226
1972	57	31	21	33	21	1101
1973	59	44	33	34	37	1794
1974	62	42	30	33	33	3324
1975	62	45	35	33	40	4106
1976	65	42	32	28	34	3200
1977	63	37	25	25	25	2535
1978	65	40	27	27	31	3283
1979	64	36	23	29	29	3943
1980	62	37	25	24	23	3927
1981	63	39	27	22	20	4430

[1]The difference between the value of imports and exports.

[2]In millions of U.S. dollars

SOURCE: Central Bureau of Statistics, *Statistical Abstract of Israel* (1981).

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Table 3
International Rates of Inflation (annual average percentage[1])

Country	1960-69	1970-73	1974-75	1976-78	1979-80
Israel	5.2%	12.7%	39.5%	39.2%	103.0%
United States	2.3	4.9	10.1	6.6	12.4
United Kingdom	3.4	8.0	20.0	13.5	15.7
Italy	3.7	6.6	18.1	15.3	17.9
West Germany	2.4	5.3	6.5	3.6	4.8
Argentina	22.2	40.3	86.6	245.7	128.3
Chile	28.5[2]	89.5	436.1	103.1	34.3
Brazil	44.2	17.9	28.3	41.5	67.1
Industrial countries	2.9	5.8	12.2	8.0	10.6
Western Hemisphere (excluding U.S. & Canada)	21.1	20.5	36.1	48.8	51.8
World	4.1	6.8	14.4	10.8	13.5

[1]Based on rates of change for average yearly price levels.

[2]Computed for 1964-69 period.

SOURCE: International Monetary Fund, *International Financial Statistics Yearbook 1981.*

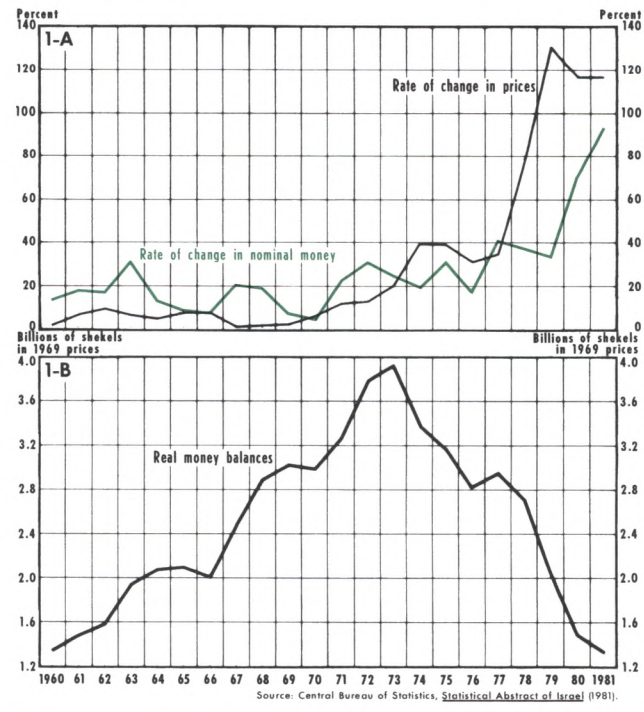
quantity of goods and services that their money balances can purchase — the *real value* of these holdings. In other words, the equilibrium value of money, or the price level, depends on the demand for real money balances and on the nominal money supply.[4]

Over time, the rate of change of the price level (i.e., the rate of inflation) will reflect the difference between the rates of growth of the nominal money supply and of the real money demand.[5] In analyzing an inflationary process, therefore, it is instructive to consider the forces governing the changes in real money demand and nominal money supply.

Chart 1a shows the rate of change of the narrowly defined money supply M_1 (local currency and demand deposits) and the rate of change of the consumer price level;[6] the difference between these two rates is the rate of change of the real quantity of money. An index of the real quantity of money is presented in chart 1b.

Chart 1 reveals that, since 1973, the real value of the money stock has decreased dramatically (by about 70 percent between the end of the 1973 and the end of

Chart 1
Money and Prices



Source: Central Bureau of Statistics, Statistical Abstract of Israel (1981).

[4]Formally, in equilibrium, $P = M^s/(M/P)^d$, where P is the general price level, M^s is the nominal money supply and $(M/P)^d$ is the real money demand.

[5]At any point in time, the price level may not equate exactly the demand for and supply of money; however, these deviations are of secondary importance when a longer period is considered. The exact relation among the equilibrium rates of change of the price level, money supply and money demand is $\hat{P} = (\hat{M}^s - \hat{M}^d)/(1 + \hat{M}^d)$, where $\hat{}$ represents a rate of change.

[6]Casual observation suggests a considerable use of foreign exchange bills and of checks drawn upon overdraft facilities for transactions in Israel. It has been suggested, therefore, that a more accurate definition of the "means of payments" should include foreign exchange cash holdings and lines of credit for overdraft; unfortunately, the statistical coverage of these variables is highly unsatisfactory.

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1981). This reduction mainly reflected the reaction of the real demand for money to the increase in the cost of holding money — which bears no interest — as the rate of inflation accelerated and interest rates increased. The increase in money velocity was facilitated by financial innovation which, to a large extent, was also induced by the rise in the cost of holding money.[7] Some "autonomous" financial innovation was also present, and the demand for money also may have been affected by changes in real wealth.[8]

Even if the reduction in the real quantity of money were fully attributable to shifts in money demand, it could only explain a small part of the accumulated increase in prices.[9] Since the reduction in the real money balances was, in fact, primarily a product of inflation, the main factor explaining the Israeli inflationary experience is the behavior of the money supply.

2. THE SOURCES OF MONEY SUPPLY CHANGES IN ISRAEL

Changes in the nominal quantity of money can be apportioned between those originating from changes in the monetary base and those resulting from changes in the "money multiplier" (the ratio between the quantity of money and the monetary base).[10] Table 4 shows the extent to which the Israeli money multiplier has fluctuated from year to year. In some years, it has been an important determinant of the change in the money supply; over the long run, however, its changes have had only a secondary effect on the money supply. We shall, therefore, focus the analysis on the factors affecting growth in the monetary base.

Changes in the monetary base are created by the net flow of payments between the economic authorities and the private sector. In Israel, changes in the monetary base equal:

a) The domestic deficit of the government and other parts of the public sector in its nonfinancial activities;[11]

plus b) The net flows of loans from the public sector and the central bank to the private sector. These loans are granted on favorable terms to investors, exporters and to housing mortgages;

minus c) The net sale of foreign exchange by the Bank of Israel (B.O.I.) to the private sector;[12]

minus d) The net sale of government and B.O.I. debt to the private sector.

To demonstrate the significance of these flows, table 5 presents the evolution of the changes in the monetary base and in the flows affecting these changes as a

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[7]The cost of holding money is the difference between the nominal return on other assets — physical assets and interest-bearing financial assets — and the zero nominal return on money. As the rate of inflation increases, the gap between the return on physical goods and money widens, and the rates of interest on financial assets adjust upward (either as a result of the incorporation of inflationary expectations in nominal rates of interest or the higher return gained on indexed assets). In recent years, there has also been an increase in real rates of interest in Israel (i.e., after allowing for the effect of higher inflation on the rate of interest).

The effect of the cost of holding money on financial innovation takes time to work out. This may at least partly account for the fact that real money balances continued to decrease for two or three years after each of the two major episodes of inflationary acceleration in Israel.

The income velocity of money, defined as the ratio between nominal GNP and M_1 (or, alternatively, between real GNP and real money balances) increased from 6 in 1973 to 24 in 1981.

[8]The real demand for money has been investigated by Leonardo Leiderman and Arye Marom in "New Estimates of the Demand for Money in Israel" (Bank of Israel [B.O.I.] Research Dept., June 1981) and by Rafael Melnick in "Two Issues Concerning the Demand for Money in Israel" (B.O.I. Research Dept., January 1982). Both studies point to strong effects of the cost of holding money on its demand. They found some parameter changes in the post-1977 period, but were unable to reject the hypothesis of the function stability by a Chow Test. (1977 was chosen as a possible turning point because of the many changes accompanying the foreign exchange reform, including the autonomous introduction of a new class of money substitute — see below.)

These authors did not investigate the impossible effect of a wealth shock on the demand for money around 1974. Such a shock may have resulted from the combination of the effect of the oil price increases and the increase in defense outlays. However, a wealth shock also should have affected the demand for private consumption, and there is no indication of a shift in consumption demand at the time.

[9]At the end of 1981, the price level was about 100 times higher than at the end of 1969 (and about 55 times higher than at the end of 1973).

[10]In this article, we use the Israeli "Broad Money Base." This aggregate excludes bank liquidity deficiencies, which are the Israeli counterpart of the U.S. borrowing at the discount window. For the purpose of money supply analysis, this aggregate is similar to the U.S. nonborrowed monetary base.

[11]The direct transactions of the Israeli government with the rest of the world have no effect on the monetary base and therefore only domestic deficits are included. The financial transactions of the authorities with the (domestic) private sector are included in (b), (c) and (d).

[12]Except for a few years, the B.O.I. has been a net seller of foreign exchange to the private sector and net purchaser of foreign exchange from the government. The government acquires foreign exchange through foreign borrowing and unilateral transfers from abroad, spends a part of the proceeds on its direct imports and sells another part to the B.O.I. to finance its domestic expenditures. As a result, the government has not accumulated a large debt to the B.O.I.

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Table 4

The Money Multiplier and Its Contribution to Money Growth

Period	Money multiplier[1] (end of period)	Rate of change in the money multiplier	Contribution of change in the money multiplier to the change in money supply[2]
1961-69	1.23	0.1%	3%
1970	1.16	−4.9	−37
1971	1.04	−10.3	−37
1972	1.02	−1.9	−6
1973	1.07	4.9	14
1974	1.08	0.9	9
1975	1.24	14.8	67
1976	1.13	−8.9	−33
1977	1.07	−5.3	−13
1978	1.20	12.2	26
1979	1.28	6.7	23
1980	1.35	5.5	5
1981	1.14	−14.9	−18
1970-81	1.14	−1.3	—

[1]The ratio of M_1 to broad monetary base.

[2]Change in the money multiplier times monetary base at the beginning of the period divided by the change in M_1 during the period (and multiplied by 100).

SOURCE: 1960-69: Moshe Sanbar and Saul Bronfeld, "Monetary Thought, Policy and Development 1948-72," *Israel Economic Quarterly Review* (April 1973) and (September 1973).
1970-81: Bank of Israel Annual Reports.

Table 5

Sources of Change in the Monetary Base (as a percent of GNP)

Period	Domestic deficit of the public sector[1]	Net public credits		Sales of foreign exchange by the B.O.I.	Sales of public debt to the private sector	Change in the monetary base
		Government	B.O.I.			
1960-70	4.4%	—	—	—	—	2.0%
1971-72	5.2	—	—	−7.8%	—	5.5
1973-74	14.6	—	2.4%	4.0	—	3.0
1975-76	14.2	—	1.2	5.6	—	2.1
1977	9.2	3.5%	4.3	5.5	7.7%	4.0
1978	6.1	4.4	5.1	2.3	11.0	2.2
1979	3.7	4.2	5.1	6.4	5.4	1.2
1980	5.2	4.9	3.6	5.1	6.1	2.4
1981	10.2	4.2	−0.5	5.9	5.4	2.5

NOTE: Dash indicates data unavailable from accessible sources.

[1]Excluding financial operations. Based on national account data for 1960-76 and B.O.I. estimates of actual flows for 1977-81. The national account estimates for the share of domestic deficits in GNP for 1977-81 are respectively 11%, 10%, 8%, 8% and 15%.

SOURCE: Same as table 4.

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percentage of GNP.[13]

The share of the domestic deficits of the public sector in GNP, already high by international standards in the 1960s, rose dramatically to 15 percent in 1973-74 and thereafter decreased, through remaining relatively high. These deficits increased primarily because of the higher level of defense expenditures imposed on the Israeli economy since the Yom Kippur War. Domestic defense expenditures rose from an average of 9 percent of GNP in 1968-72 to 16 percent in 1973-81.[14]

While we do not possess adequate quantitative information about the net flows of public loans to the private sector in the 1960s, we know that their magnitude (relative to GNP) was much lower than in the 1970s. Most of these loans were granted, until recent years, at low nominal interest rates that were adjusted to the increase in the rate of inflation only partially and belatedly.[15] This policy brought about a considerable increase in the difference between the flow of new loans, which reflected current prices, and the flow of old loan repayments, which was determined by the historically low prices and rates of interest.

Table 5 reveals that the increase in the share of public deficits and loans in GNP has not been accompanied by an increased reliance on monetary base expansion as a source of government finance (i.e., in the ratio of new monetary base creation to GNP). The average ratio of monetary base change to GNP over the 1973-81 period was equal to its 1960-72 value (2.5 percent). In other words, the net increase in purchases of public debt and foreign exchange by the private sector essentially offset the increase in the public deficits and credits.

3. THE ENDOGENOUS NATURE OF THE MONEY SUPPLY IN ISRAEL

The previous discussion raises the question: "Why did the Bank of Israel not increase the sale of foreign exchange and public debt to the private sector and thus bring about a lower rate of money growth and inflation?" The answer to this question is that open market operations in these two assets were governed by considerations other than achieving monetary control.

Sales (and purchases) of foreign exchange by the B.O.I. to the private sector are used mainly to stabilize the exchange rate, not to control money (and are generally not sterilized). The B.O.I. offers to sell (or buy) whatever quantities of foreign exchange that are necessary to stabilize the exchange rate at a policy-determined level (with minor fluctuations being tolerated in recent years). The rate of exchange determination and, consequently, the open market operation in foreign exchange is perceived as an instrument for achieving a gradual reduction in the import surplus, which is considered unmaintainable in the long run. In recent years, the B.O.I. has aimed at stabilizing the *real* rather than the nominal rate of exchange by equating the rate of exchange depreciation to the difference between the domestic rate of inflation and the rate of inflation in Israel's main trading markets.[16]

Most public debt was in the form of government bonds (some of which were held directly by the public and some of which served as coverage for long-term saving schemes, pension funds and the like). These bonds were indexed to the consumer price index and sold to the public in practically unlimited amounts at real rates of interest that were changed infrequently and within a relatively narrow range. Open market operations in public debt were used, to a large extent, to stabilize the real rate of return on government bonds in the secondary market. This policy may have reflected an evaluation that the demand for direct and indirect holding of government bonds is very sensitive to variations in the real rate of return.[17]

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[13]Due to the way in which monetary base data were published, it is difficult to apportion the sources of change in the monetary base according to our functional classification for the full period considered.

[14]Due to increased defense imports, the increase in the share of total defense outlays in GNP was even higher (see table 2). Defense imports, like other direct government imports, however, have no effect on the monetary base (see above).

[15]Most loans to exporters have been indexed to the foreign exchange rate since 1977. The indexation of investment and mortgage loans, however, was delayed until 1979-81.

The structure of interest rates on public credits had significant adverse effects both on the efficiency of the allocation process and on income and wealth distribution.

[16]The real rate of exchange is defined as EP^*/P, where E is the nominal rate of exchange (domestic price of foreign exchange), P^* is the level of foreign prices and P that of domestic prices. Its rate of change is $\hat{E} - (\hat{P} - \hat{P}^*)$, where $\hat{}$ is a notation for rate of change and $(\hat{P} - \hat{P}^*)$ is the difference between the local and foreign rates of inflation. Note that the implications of a fixed real rate of exchange are different from those of a fixed nominal rate of exchange. While both imply an effect of the balance of payments on the monetary base, a fixed nominal rate of exchange tends to reduce the sensitivity of the local price level to expansionary domestic policies, by shifting the adjustment to the balance-of-payments flows.

[17]If this were the case, the government could have lowered the average rate of interest that it had to pay on a given amount of debt by its policy of real interest rate stabilization. This also may have affected the rates of interest charged on nongovernmental borrowers.

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Some public debt was in the form of foreign-exchange-indexed deposits, the volume of which was determined in recent years by the private sector demand. The return on these deposits depended on the change in exchange rates and on international interest rates and was, therefore, not subject to manipulation for the purposes of monetary control.

Given the elastic supply conditions of foreign exchange and public debt, the private sector was able to determine its net acquisition of these assets and, thus, the net change in the monetary base. As a result, the quantity of money was largely endogenous — that is, determined by the economy rather than by explicit policy decisions. Thus, a recent econometric study has shown that the rate of money growth was significantly affected by past price changes.[18] This does not mean, of course, that the money supply played no crucial role in the inflationary process. It merely indicates that under the institutional arrangements prevailing in Israel the growth of money accommodated and validated prior price changes. The endogeneity of the money stock has an important bearing on the dynamics of the Israeli inflationary process.

4. INFLATION WITH AN ENDOGENOUS MONEY SUPPLY

A largely endogenous money supply has important implications for the behavior of short-run price increases, for the determination of the long-run rate of inflation and for the stability of the inflationary process.

The general price level is often subject to short-run movements that cannot be traced to previous changes in money growth or to shifts in the long-run demand for money. The general price level may react to changes in international prices, fiscal actions and many other forces that affect the equilibrium in commodity, factor and asset markets (e.g., by creating imbalances between the physical and financial components of the public's portfolios). If the money supply is endogenous, the adjustment of money growth can easily magnify and prolong the effect of these disturbances on the general price level — especially since the public is aware of the accommodating nature of the money supply. This could affect the public's inflationary expectations, resulting in further price increases, even higher growth of the endogenous money supply and downward adjustment of the real demand for money.

This mechanism, which has been at work in Israel for at least part of the period surveyed, explains why accelerations in the rate of price increases have tended to precede accelerations in money growth. Two factors especially have contributed to this mechanism in Israel: (a) The extensive system of indexation transfers price increases from one sector to another quickly and inflates the nominal values of indexed financial assets; (b) The experience with high and rising inflation has increased the speed with which prices adjust and shortened the lag between present price experience and changes in inflationary expectations.[19]

The endogeneity of the money supply also affects the determination of the long-run rate of inflation. With an exogenous money supply, the rate of inflation will converge in the long run to the difference between the given rate of nominal money growth and the rate of growth of real money demand, which depends principally on long-run real economic growth and the elasticity of the demand for money with respect to real GNP. When, however, the money supply is endogenous, as is the case in Israel, there is no predetermined rate of money growth to which the rate of inflation adjusts itself. In this case, both the long-run rates of money growth and inflation are determined simultaneously as a part of a larger and more complex full-equilibrium solution.[20]

A long-run equilibrium interpretation of the acceleration of inflation in Israel has been suggested by

[18]Elise Brezis, Leonardo Leiderman and Rafael Melnick, "Inflation and Monetary Variables: Their Interrelationship in Israel" (B.O.I. Research Dept., September 1981). Using a Granger exogeneity test, these authors found that information about past price changes improves the regression of money change on its past values both when short lags (several months to a year) and longer lags (up to two years) are considered. On the other hand, they found that information about past money changes improves the regression of price change on its past values only in the long run.

The long-run results were derived from annual data over a long period (1954-80). We have repeated these exogeneity tests using quarterly data over the 1965-80 period. These tests yielded a significant effect of money growth lagged up to three years on prices (and vice versa). When the 1970-80 period was considered, the effect of lagged money growth on prices was insignificant. Whether this result reflects a change of structure in the 1970s or is due to the small number of the degrees of freedom is unclear.

[19]The sensitivity of inflationary expectation formation to the level of inflation was investigated in Daniel Gottlieb and Sylvia Piterman, "Inflationary Expectations in Israel 1965-80" (B.O.I., Research Dept., 1981).

For more evidence on the adjustment of the Israeli economy to inflation, see Zalman F. Shiffer, "Adjusting to High Inflation — the Case of Israel," forthcoming in this *Review*.

[20]This solution will include the determination of long-run equilibrium values of the different components of table 6.

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Melnick and Sokoler.[21] The essence of their argument is that the long-run equilibrium rate of inflation increased in the 1970s, because (a) the ratio of the revenue from money creation to GNP (the monetary base change/GNP ratio) has been kept unchanged, and (b) in view of the reduction in the rate of real GNP growth, the maintenance of a given monetary base change/GNP ratio required a higher rate of inflation.[22]

The unchanged average level of the share of revenue from money creation in GNP does not, by itself, prove that the inflationary experience of the last decade reflects a transition between long-run equilibrium rates of inflation. Alternatively, this experience could be viewed as the result of a sequence of disturbances, that, given the dynamics of an endogenous money supply, have not necessarily brought the economy to a new long-run equilibrium.[23] Under this view, the impact of money creation on the public revenue would be interpreted as a result of the acceleration of inflation, instead of its cause.

5. THE HISTORICAL RECORD OF MONEY AND INFLATION IN ISRAEL

Table 6 contains data relating the dynamic evolution of prices to money growth and other variables over the last decade. This table presents annualized rates of change of the price level, money (M_1), two larger monetary aggregates (M_4 and M_5), short-term bank credit and the local price of imports. M_4 is the sum of M_1 and a group of relatively liquid money substitutes — time deposits, CDs, some types of foreign-exchange-indexed deposits and tradable, CPI-indexed government bonds.[24] M_5, the largest monetary aggregate on which data are available for the whole period, is the sum of M_4 and some less-liquid savings accounts and foreign-exchange-indexed deposits. Similarly, short-term bank credit represents the largest credit aggregate on which data are available on a long-run basis. The domestic price of imports depends on the rate of exchange and on international prices.[25]

The last four measures are included, because they help illuminate the nature of the relationship between money and prices. These variables reflect, at least partially, the results of policy measures and external shocks and have affected real demands and costs. In particular, statistical tests indicate the existence of

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[21] Rafael Melnick and Meir Sokoler, "The Government's Revenues from Money Creation and the Inflationary Effects of a Decline in the Rate of Growth of National Income" (B.O.I. Research Dept., 1981).

[22] Monetary expansion affects the public sector finances not only through the direct revenue that it generates, but also through the effects of the resulting inflation on taxation, government spending, the sale of indexed public debt and the erosion of the real value of the unindexed loans given by the public sector to the private sector. According to B.O.I. Report 1980 (p. 240), the loss due to loan value erosion is higher than the direct revenue from monetary expansion.

Given these relationships, there is no reason to assume that the authorities maintained a policy aimed at stabilizing the ratio between the direct revenue from monetary expansion (the monetary base change) and GNP. Note, however, that the Melnick-Sokoler argument does not depend on the existence of such a policy, but on the claim that there is a causal effect from the direct revenue from money creation to the rate of inflation. Their argument would also hold if, for example, this revenue was endogenously determined by the levels of public deficits and loans and by the foreign exchange and debt policies. The alternative view discussed below is that the main causal effect is from the rate of inflation to the revenue from money creation, and not vice versa.

Assuming, for simplicity, that the monetary multiplier is 1, the ratio of the direct public revenue from money expansion to GNP is: $\Delta M/PY = \hat{M}(M/PY)$, where Δ represents absolute change, $\hat{}$ proportional change and M, P and Y are respectively the nominal quantity of money, the general price level and real GNP. In the long-run equilibrium, $\hat{M} = (M/PY)^{\hat{}} + \hat{P} + \hat{Y} = \hat{P} + \hat{Y}(1 + \eta)$, where η is the elasticity of the desired money-GNP ratio to real GNP. The long-run equilibrium revenue from money creation is $(M/PY)[\hat{P} + \hat{Y}(1 + \eta)]$, where (M/PY) depends on the expected rate of inflation, which in the long-run equilibrium is equal to the actual rate $\hat{P}$. This expression is a positive function of $\hat{Y}$, since $(1 + \eta) > 0$. When the rate of inflation is increased, (M/PY) decreases, but the "inflationary tax" $(M/PY)\hat{P}$ increases, provided that the elasticity of the demand for money with respect to inflation is lower than unity in absolute terms; this is the case in Israel as well as in most other countries.

[23] The problem of the convergence of an economy with an endogenous money supply to a long-run stable inflationary equilibrium is discussed in D. Chappell and D. A. Peel, "On the Dynamic Stability of Monetary Models when the Money Supply is Endogenous," *Manchester School* (December 1979), pp. 349-58. The authors assume that the government maintains a given real level of revenue from money creation.

In recent years, it has been argued that the Israeli economy might have moved into a stage of "bubble inflation" in which the rate of inflation is indeterminate and can explode as a result of any disturbance or change in expectations. This extreme view is not supported by the evidence: as discussed below, the two principal stages of inflationary acceleration in Israel have been triggered by nontrivial sequences of events and culminated in periods of relative inflationary stability.

[24] The liquidity of these assets is enhanced by the above-discussed policies of foreign exchange and real bond interest rate stabilization. While none of these assets serves as a direct means of payment, each is largely held as temporary abode of purchasing power due to its relatively low real risk. Due to the low level of transaction cost relative to the rate of return, these assets are largely purchased for periods of a few weeks. At the end of the 1970s, the velocity of the liquid foreign exchange deposits was close to the velocity of checking accounts at the beginning of the decade.

[25] Due to data limitations, the rate of change of this variable is based on end-of-period quarters (and not months). This implies that a large import price increase which occurs at the end of a quarter (like the 1974 devaluation) will also affect the next quarter data.

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Table 6

Rates of Change of Prices, Monetary Aggregates and Credit

Period	Consumer price index	M_1	M_4	M_5	Short-term bank credit[1]	Import prices[2]
1971	13%	28%	35%	36%	1%	26%
1972	12	29	28	25	42	9
1973	26	32	50	47	32	31
1974	56	18	73	60	71	51
1975	23	22	17	26	32	32
1976	38	27	19	33	39	36
1977	43	39	45	67	85	62
1978	48	45	58	61	55	52
1979	111	30	83	100	101	102
1980	133	90	148	141	110	133
1981	101	78	91	100	87	—
6/70-9/73	15	26	34	34	23	19
9/73-12/74	53	24	46	56	64	48
12/74-9/77	30	29	18	30	37	32
9/77-12/78	56	41	78	90	86	77
12/78-12/81	96	59	92	98	87	—

NOTE: M_1 = Cash and checkable demand deposits.

M_4 = M_1 + unindexed time deposits + certificates of deposit + foreign-exchange-indexed residents deposits (excluding deposits originating from personal restitution payments from the Federal Republic of Germany) + tradable government bonds.

M_5 = M_4 + long-term saving schemes and deposits + foreign-exchange-indexed deposits originating from personal restitution payments from the Federal Republic of Germany.

[1]Includes both credit directed by the B.O.I. and "free" credit. This series is not fully consistent over time.

[2]Based on quarterly data. These data currently are undergoing revision at the B.O.I.

SOURCEs: B.O.I. and Statistical Abstracts for Israel data.

short-run effects from both M_4 and short-run bank credit to prices.[26] The interpretation of the relationship between these variables and prices, however, must be done carefully, since they are themselves largely endogenous. In particular, the broader monetary aggregates and credits include sizable indexed components, and the rate of exchange also is strongly affected by prices (especially since 1979).

The Early Period: From Mid-1970 to September 1973

The transition of the Israeli economy from low to high inflation began in mid-1970; until then, Israel had experienced 16 years of low inflation at about 5 percent per year.[27] The rate of price increase hit the 10 percent range in 1970, rose marginally in 1971-72 and in the first nine months of 1973 (before the outbreak of the Yom Kippur War) accelerated to an annual rate of 21 percent.

The first round of the higher price increases in 1970 was due to increased indirect taxation, not to an earlier

[26]See Brezis, Leiderman, Melnick, "Inflation and Monetary Variables." They found a strong short-run effect from credits to prices, weaker effects of M_4 on prices and strong effects of prices on both M_4 and credit. Credit and the large monetary aggregates have (not surprisingly) more stable velocities than M_1.

In recent years, the B.O.I. has used M_4 and short-run bank credit as principal monetary indicators and policy targets. The short-run effect of bank credit on prices may be due to their effects on the short-run business liquidity. In Israel businesses have limited access to alternative sources of finance in the short run and react to credit squeezes by reducing inventories — both through changes in production and through changes in pricing decisions.

[27]The country had experienced higher inflation during World War II and its first years of independence.

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increase in the growth of the money supply M_1.[28] However, money growth took off in the second half of 1970, reaching an average annual rate of growth of 26 percent between June 1970 and September 1973 (compared with a 15 percent average annual increase in prices — see table 6). This monetary accumulation was part of a general build-up of financial assets. Both M_4 and M_5 grew at 34 percent per year over the same period as a result of high net sales of foreign exchange by the public to the Bank of Israel.[29]

It would, however, be inaccurate to attribute the acceleration of inflation in that period solely to forces operating on the supply of money. Between June 1970 and September 1973, the domestic price of imports rose at an annual rate of 19 percent, following the imposition of import duties in 1970, a 20 percent devaluation in 1971 and international price increases in 1972-73. Had the quantity of money continued to grow at a low rate, these import price increases would have had a much smaller effect on the general price level (probably joined with lower real activity). However, the fact that money growth began to accelerate only after the first round of price increases (in spite of an earlier increase in the larger monetary aggregates) indicates that it was, at least in part, adjusting to the short-run effects of higher import prices.[30]

Finally, one should note that in this period, the increase in the local price of imports was to a certain extent exogenous to the inflationary process, since it was caused by higher foreign commodity prices. On the other hand, lower money growth may have prevented the 1971 devaluation or reduced its size.

From the 1973 War to the Foreign Exchange Reform

The October 1973 war and the ensuing political and economic international events had strong and lasting effects on the Israeli economy. The real rate of growth fell, higher defense and oil import bills widened the current account deficit and the rise in domestic defense expenditures increased governmental deficits.

Following the outbreak of the war, the B.O.I. conducted a permissive policy, in particular encouraging rapid credit growth. As time passed, however, economic policy began to reflect the growing concern over the balance-of-payment situation. Monetary policy became more restrictive, indirect taxation was increased and, in November 1974, the rate of exchange was devaluated by 43 percent.

The effect of the international oil price increase, the changes in taxation and the devaluation led to sharp price increases which were largely accommodated. The larger monetary aggregates grew rapidly throughout 1974 (although more slowly than before in real terms). The growth of M_1, on the other hand, was considerably lower than that of the price level, thus squeezing the real value of the money balances. This development reflected mainly a downward adjustment of real money demand to the higher rate of inflation (see section 1).

The transition to restrictive policies had visible effects in the 1975-77 period. Domestic and foreign deficits shrank, economic activity was low, and all the monetary aggregates grew more slowly than the price level. The rate of inflation came down from its 1974 peak; it remained, however, considerably higher than in the pre-war period.

In June 1975, the government adopted a policy of small and frequent devaluations of about 2 percent per month (a "crawling peg system").[31] This policy was motivated by the continuing concern about the balance of payment and a desire to avoid the strong destabilizing effects of large, infrequent devaluations.[32] As a result of this policy and the absence of external supply shocks, the fluctuations in the rate of inflation were reduced considerably.

From October 1977 to the Present

In October 1977, the government embarked on a foreign exchange reform intended to contribute to

[28]The quantity of money rose at an annual rate of 13 percent between the end of 1966 and mid-1970 (compared with an average 9 percent real GNP increase) and increased even more slowly in the last 18 months of that period.

[29]The increased sales were due to the combination of an improvement in the private current account and a capital inflow induced by relatively high domestic rates of interest and a booming economy.

[30]That the quantity of money was adjusting to demand and not just to supply conditions is evident from the fact that its growth was considerably lower than that of the large monetary aggregates both in 1973 and afterward, as higher inflation affected the real demand for money.

[31]The transition to the crawling peg system at that time might have been interpreted as a signal that the government was more committed to adjusting to inflation than to undertaking strong anti-inflationary policies.

[32]The expectations for the 1974 devaluation had produced large private capital flows, and the devaluation itself brought about a sharp increase in the general price level.

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greater economic efficiency. This reform included:

1) further steps in the liberalization of foreign transactions, in particular of international capital inflows and direct holding of foreign-exchange bills;

2) the creation of a universally accessible class of foreign-exchange-indexed deposits;[33]

3) the abolition of direct export subsidies and the reduction and unification of import duties;

4) a transition from the crawling peg system to a market-determined, flexible exchange rate.

As the reform was enacted, the exchange rate depreciated by 47 percent and the general price level partially adjusted upwards.[34] As a result of the automatic indexation, the value of financial portfolios also increased.

Between the reform and the end of 1978, the larger monetary aggregates rose at exceptionally high rates, even when the effect of indexation is taken into account. Thus, M_4 and M_5 grew respectively at 78 percent and 90 percent annual rates between September 1977 and December 1978 compared with a 56 percent annual increase in the CPI. This increase was fed, to a large extent, by sizable public loans to exporters and arge capital inflows, which were made possible by the reform and induced by the difference between the foreign and domestic interest rate.[35] This upsurge in public loans and capital inflows reduced the level of real interest rates. The new foreign-exchange-indexed deposits, which offered an attractive mix of liquidity and rate of return, increased rapidly; on the other hand, the growth of M_1 was slower than that of the price level.

The increase of the large monetary aggregates and the lowering of real interest rates played a major role in the increase of real domestic demand and economic activity in 1978 and early 1979.[36] As the stock of financial assets rose relative to both physical assets and income, the private sector increased its demand for physical assets and other goods and services (especially as investment and purchases of durable goods had been low in previous years). The housing market, a traditional leading sector, experienced a boom, GNP increased rapidly and wages also rose with the demand for labor. Unconstrained by the largely adaptive money supply process, these developments culminated in a dramatic acceleration of the rate of price increase to about 80 percent in annual terms at the end of 1978 and the beginning of 1979.[37]

The authorities were alarmed both by this sudden acceleration of price increases and by the fact that, since the reform, the rate of exchange rose considerably more slowly than the general price level. At the beginning of 1979, the B.O.I. imposed restrictions on capital inflows and domestic bank credit growth and began to stabilize the real rate of exchange through intervention in the foreign exchange market.[38] The restrictive effect of these measures, which were continued throughout the next years, was reinforced in 1979 by a more restrictive fiscal policy and increased purchases of foreign exchange by the private sector from the B.O.I.[39]

[33]Before the reform, foreign exchange deposit holding was limited to agents engaged in foreign trade, banking institutions, recipients of foreign incomes and non-residents. Strictly speaking, the introduction of the new deposits was not part of a foreign exchange reform, since they are domestic deposits indexed to the foreign exchange, not claims on foreign exchange. These deposits are not checkable.

[34]The high depreciation reflected in part the adjustment of the formal rate of exchange to the reduction of export subsidies and import duties. The price level rose by 18 percent in the last quarter of the year, compared with an average of 6.5 percent in the three former quarters. Most of the price increase in the last quarter occurred immediately after the depreciation.

[35]The domestic cost of foreign borrowing is $i^* + \hat{E}^e$, where i^* is the foreign rate of interest and $\hat{E}^e$ the expected rate of exchange depreciation. Capital inflows at the end of 1978 also were affected by the anticipation of the imposition of constraints on their movements (see below).

[36]High public demand and expectations related to the beginning of the peace-making process with Egypt also contributed to the heating up of the economy.

[37]This was twice the annual rate prevailing during the first three quarters of 1978.

Some observers have argued that the end of 1978 price acceleration reflected a delayed reaction to the end of 1977 massive depreciation and relative increase in the price of tradable goods. Such a delayed reaction would have been unusual compared with earlier (and later) adjustments to cost shocks. In addition, the correction of an "excessive" increase in the relative price of tradables would have implied logically only a future lower rate of increase in the rate of exchange relative to the rate of inflation, not necessarily an acceleration of inflation.

[38]Starting in 1979, the B.O.I. generally imposed periodic ceilings on bank credit growth. These ceilings were partially accommodated to deviations of the rate of price increase from its projected path to reduce the effects of strong real credit crunch on private economic activity. The B.O.I. also imposed a levy on foreign exchange credits (exempting exporters and other favored borrowers).

The aim of the intervention in the foreign exchange market was to equate the average monthly rate of depreciation to the difference between the local and foreign rates of price increase (thus controlling the average real rate of exchange along a "purchasing power parity" path). The B.O.I. did not intervene to prevent "tolerable" daily fluctuations of the rate.

[39]The private sector's current account deficit increased as a result of the rise in oil prices and the high demand for imported durables at the beginning of the year. The demand for the highly taxed durables also affected the government deficit.

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Due to the effect of indexation and higher inflation, the large monetary aggregates increased more rapidly in 1979 than in 1978, but they were squeezed in real terms. M_1 increased at an even slower rate than in the previous year and its real value decreased by 38 percent. This reduction may have been affected by the supply forces that reduced the real values of financial portfolios in general, but principally it reflected a reaction of the demand for (non-interest-bearing) money to higher inflationary expectations.

Real rates of interest on private credits increased dramatically and real demand and economic activity slowed down in the second half of 1979 and in 1980.[40] Still, the rate of the price increase rose to a new annual peak of 150 percent in the second half of 1979, reflecting the short-run effects of energy prices and the reduction of price subsidies.

The rate of inflation remained stubbornly high in 1980 (133 percent), apparently as the higher rates of recent price increases were incorporated into inflationary expectations and the still remaining nominal contracts. The growth of the large monetary aggregates outpaced that of price increase and M_1 grew at 90 percent — still falling in real terms.[41]

The economy resumed a higher real rate of growth in 1981, and, at the same time, the rate of inflation went down. This decrease was led by the short-run effect of a reduction in indirect taxation, which brought the rate of price increase to 94 percent in annual terms in the first two quarters of the year. Later on, the rate of price increase rose again.

As a result of the reduction in indirect taxation and the adjustment of income tax brackets, there was a sharp increase in the share of the domestic public sector deficit in GNP in 1981. This effect, however, was offset to a large extent by a reduction in the net flow of B.O.I. loans to exporters. The real value of the M_1 balances continued to fall, but the growth of M_5 kept up with the rate of inflation.[42] In addition, there was a sharp increase in the real growth of other financial assets.[43]

6. CONCLUDING REMARKS

The Israeli experience demonstrates the inflationary hazards of economic policies that subordinate monetary management to the achievement of other goals.

The inadequate monetary control was technically caused by the expropriation of open market operations in public debt and foreign exchange from the arsenal of monetary instruments. More basically, it reflected the low priority of price stability when compared with other policy goals. This preference was due, to a large extent, to the ability of different economic groups to reduce some of the costs of inflation by indexation and other adjustment mechanisms.

Under the favorable conditions prevailing in the 1950s and 1960s, the Bank of Israel was able to maintain a reasonable monetary growth despite the constraints on its policy tools. This situation changed in the 1970s. In that decade, the Israeli economy was taxed heavily by changes in its defense requirements and the international economic environment. The control over monetary growth was lost, and the economy veered rapidly toward high inflation.

Israel has gone a long way along the path of adjustment to inflation, but has been unable to neutralize fully its long-run disruptive effects. The experience with the implementation of partial anti-inflationary measures in 1979-81 reveals also that indexation and other contrivances have not eliminated the short-run costs of disinflation.

The return to reasonable price stability requires effective control over monetary growth.[44] To achieve

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[40]Real demand and certain financial demands also were affected by the anticipation of additional stricter government measures.

[41]The increase in the large aggregates was due, in part, to the effects of lower economic activity and real demands on taxation and the current account, a reversal of the 1979 developments. In addition, the real market value of government bonds, which had fallen in 1979, went up again.

[42]M_4 was reduced somewhat in real terms. This was due to the successful marketing of new saving schemes with shorter redemption periods (saving schemes are included in M_5 but not in M_4).

It is interesting to note that, while real M_1 continued to decrease in 1981 in spite of the reduction in the rate of inflation, the demand for unindexed money substitutes (mainly CDs) increased rapidly. As a result, the value of M_1 plus the unindexed money substitutes (known as M_2) increased in real terms — for the first time since 1972.

[43]In recent years, financial concerns have largely intervened in the stock exchange market to minimize reductions in the *real* market value of their stocks. This behavior has led to the argument that financial shares may be close in liquidity to government bonds. If the market value of these shares is added to M_4 and M_5, the rate of growth of these "augmented" aggregates would be much higher than the price level in 1981. Pension funds and other forms of long-term savings that are not included in M_5 have also grown rapidly in recent years.

[44]The choice of the specific target aggregate should depend on the nature of the relationship between different alternative aggregates and prices and on the controllability of different aggregates. While the first of these issues has been only partially investigated in Israel, it seems that aggregates that are tied to an unindexed monetary base (like M_1) could be more easily controlled than others (like M_4).

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this, the management of at least one of the major sources of monetary base change must be subordinated to monetary considerations. Given the committment to real exchange rate stabilization in Israel, it seems that the best way to achieve monetary control in Israel is through the use of public debt management as an instrument of monetary control — a solution adopted in many other countries. It should be recognized, however, that if, at the same time, the real value of public deficits and loans is not reduced, the Bank of Israel will be confronted continuously with pressures to adopt accommodating policies.[45]

The optimal pace of disinflation in Israel may be more rapid than in lower-inflation economies that have not developed similar price adjustment mechanisms. Whatever the pace chosen, it is important that disinflation be carried out in a consistent way, since stop-go policies reduce the credibility of the policymakers and raise the pains of disinflation; in a democratic society like Israel, such policies may even altogether frustrate the disinflationary effort.

[45]These pressures may arise in reaction to two possible effects of high levels of public deficits and loans: a) these deficits and credits may create short-run upward pressures on the rate of inflation — either through the direct effect of the demand that they finance, or through the effect of rapid public debt accumulation by the private sector; b) to the extent that large net sales of public debt are used to finance public deficits, they exert upward pressure on real interest rates and crowd out private borrowers.

While the reduction of public deficits and loans also can contribute to a more efficient resource allocation, the use of direct cost-reducing measures in the process of inflationary deceleration is more problematic (cost-reducing measures include reductions in indirect taxation, the lowering of the real rate of exchange and intervention in private price and wage determination). Such measures may increase the public sector deficit, induce destabilizing speculation and interfere with the efficiency of resource allocation. They should, therefore, be considered only as a short-run expediency and as a part of a comprehensive policy based on monetary control and lower public deficits and loans.

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