WORLD MONEY SUPPLY, OUTPUT AND INFLATION:

AN EMPIRICAL STUDY

By

JAYANTI L. JAIN

Bachelor of Arts
University of Udaipur
Udaipur, India
1969

Master of Arts
University of Udaipur
Udaipur, India
1971

Master of Arts
Wichita State University
Wichita, Kansas
1976

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
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for the Degree of
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Thesis Approved:

Frank S. Stenel
Thesis Adviser

Gerald M. Lage

Leo B. Blakley

John D. Ren

Norman N. Durham
Dean of the Graduate College

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CHAPTER I

THE RESEARCH PROBLEM

Introduction

In 1972, Harry G. Johnson formulated a monetary equilibrium model for the world economy as a whole, in the process of developing the monetary approach to the balance of payments (MABOP). Subsequent contributions on the subject, however, have drifted towards constructing monetary models of the balance of payments (BOP) and exchange rates for individual economies and assessing the empirical evidence for such theoretical constructs. Substantial contributions have been made to the MABOP, much of which is developed in and summarized by Frenkel and Johnson, 1976; IMF, 1977; Kreinin and Officer, 1978 and to the monetary approach to exchange rates by Frenkel, 1976; Frenkel and Johnson, 1978; Bilson, 1978, 1979. These constributions have laid the foundations of the two important concepts of the world money supply and the world price level.

World Money Supply

The monetary approach regards the BOP and exchange rates as monetary phenomena; i.e., it explains each via an analysis of the money market. A BOP surplus or deficit in a particular country is considered to be a reflection of disequilibrium between the demand for and supply of money. An excess supply of money causes a BOP deficit because the

former results in an outflow of capital and/or a trade deficit through the increased purchases of foreign goods, services and assets. Similarly, an excess demand for money causes a BOP surplus as the former leads to an inflow of capital and/or a trade surplus through the reductions in purchases of foreign goods and services. In the absence of sterilization policy, the MABOP envisages that the system is self-correcting because the excess demand or supply of money is dissipated abroad and the money market equilibrium is restored.

Further,

> . . . the monetary approach to the exchange rate may be viewed as a dual relationship to the monetary approach to the balance of payments. These approaches emphasize the role of money and other assets in determining the balance of payments when the exchange rate is pegged, and in determining the exchange rate when it is flexible (Frenkel, 1976, pp. 200-201).

Thus, the monetary approach to the BOP and exchange rates views the monetary aspects of international adjustments as the core and essence of the mechanism. These approaches attempt to establish its propositions by way of building and testing monetary models of open economies. As a result of these developments and their primary emphasis on adjustment of stocks rather than flows, the adjustment mechanism of the money market as the determinant of a disequilibrium in the BOP has paved the way for formulating a comprehensive concept of the world money supply in a stock sense. However, the latter approach visualizes the world economy as a closed system. It is only in a global framework that one can analyze a global aggregate. The concept of world money supply provides one of the building blocks for the present study.

World Price Level

Another aspect of the development of the monetary approach to the balance of payments and exchange rates represents a return to the price-specie-flow mechanism of David Hume[1] and is characterized as "global monetarism."[2] It is called "monetarism" because of the conviction that macroeconomic phenomena can be explained best via the money market and "global" because of the further conviction that macroeconomic phenomena can be analyzed best by treating the world as a whole as an integrated economy and not as comprising of separable national economies (see Whitman, 1975).

Global monetarists have largely confined their research to testing the "law of one price" or what is known as the market integration hypothesis (see Gaillot, 1970; Laffer, 1975; Whitman, 1975; Lee, 1976; Genberg, 1976a, 1976b, and 1977; Isard, 1977; and Kreinin and Officer, 1978). The basic idea of this law is that currency devaluations do not fundamentally alter a country's prices relative to world prices. Devaluations cause the country's prices to rise or cause the foreign prices to decline or lead to a combination of both changes until the international price equalization is re-established. The market integration hypothesis implies some form of the purchasing power parity doctrine. Using the principal component analysis, Genberg (1977) tested the hypothesis of interdependence of inflation rates in various countries. Acceptance of this hypothesis provides a justification for formulating the concept of world price level. His calculations show that the first principal component accounts for 90% of the variance of consumer price indexes of 21 countries. Genberg (1976b) also compared inflation rates in 16 OECD countries with the idea of testing the

hypotheses that the inflation rates of various countries are all equal up to a random error term associated with the measurement difficulties. Using the data of quarterly consumer price indexes for the period 1959-70, he found that the variations among countries were no greater than that within the U.S.[3] "Since the U.S. is generally assumed to constitute an integrated market as far as macroeconomic analysis is concerned, I concluded that it is legitimate to treat the world economy likewise" (Genberg, 1977, p. 236). Like Genberg, the empirical results of Gaillot, Lee, and Laffer support the market integration hypothesis.

This market integration hypothesis is further elaborated by what is known as the Mundell-Laffer hypothesis which has been attributed to the the writings of Laffer (1973 and 1974) and Wanniski (1974 and 1975). For further details, see Cordon, 1977; Claassen, 1976; Kreinin and Officer, 1978 and Chapter II of this study. This hypothesis emphasizes the asymmetrical price responses to exchange rate adjustments. Changes in exchange rates are incapable of correcting the BOP disequilibrium. Devaluing countries bring about international price equalization through price increases in their countries; prices do not decrease in appreciating countries and, hence, the asymmetrical price responses. As a result of this, every exchange rate change causes the world price level to go up. Thus, both the market integration hypothesis and the Mundell-Laffer hypothesis have helped to develop a notion of world price level.

The present study empirically develops the concepts of world money supply and world price level. In addition, it also develops an empirical measure of global economic activity. This study makes use of the measures of these three world aggregates and explores the

relationships among these global aggregates.

Nature of the Present Study

The monetary approach to the balance of payments and exchange rates and global monetarism often attempted to substantiate their propositions regarding the stock of money and market integration hypothesis by formulating models of an open economy of a country or several economies and examining whether such models were empirically valid. In contrast, this study treats the world economy as a whole to be a closed system and discusses whether the world money supply is an important determinant of global activity.

The primary objective of this study is to examine the relationships among the three world aggregates in the same manner as the empirical studies on monetary theory for a closed domestic economy use the corresponding national aggregates to test their propositions. More precisely, the purpose of this study is threefold:

1. to examine the money-income nexus for the world economy as a whole and establish the direction of causality if any;
2. to examine whether the rate of world inflation is explained by the unanticipated changes in the world money supply, output, and worldwide inflationary expectations; and
3. to examine whether there are output-inflation tradeoffs for the world economy as a whole.

Some of the important studies on closed domestic economies describing interrelationships among the national aggregates of money supply, output, and price level are referred here to help explain the nature of the present study.

Friedman and Schwartz (1963), Friedman and Meiselman (1963), and Anderson and Jordon (1968) emphasized and provided an evidence of the relationships between money and income in the U.S. Sims (1972), Williams et al. (1976), and Mills and Wood (1978) tested the direction of causality implicit in the money-income framework. Sims found the direction of causality from money to income using the U.S. data and Williams et al. found no evidence of causality between money and income for the United Kingdom (U.K.). Mills and Wood suggested the direction of causality from income to money for the U.K. and also emphasized the importance of an exchange rate regime and reserve currency country in determining the nature of causality. Thus, Mills and Wood considered the question of money-income causality in the international context. This study discusses the money-income nexus for the world economy as a whole and examines the empirical evidence in this respect. It also attempts to examine the evidence on the question of direction of causality for the world economy.

In recent years, a great deal of attention has been paid to the international aspects of inflation (see, for example, OECD, 1973; Parkin and Zis, 1976a, 1976b; Frisch, 1977; Brunner and Meltzer, 1977; Kravis and Lipsey, 1977; Parkin, 1977; and Chapters IV and VII of this study). Brunner and Meltzer examined the relative importance of various impulses in the generation of inflation in various countries and their empirical results strongly supported the operation of financial impulses in general and monetary impulses in particular. They also found an evidence of the operation of external impulses on inflation of individual countries. The OECD study concluded that the international transmission of inflation is brought about through the movements of prices of

internationally traded goods, excess demand effects, excess money supply effects and through international inflationary expectations. The present study examines the importance these channels of international transmission of inflation have on the money-income framework for the world economy as a whole. In particular, this study aims at examining whether the rate of world inflation is explained by the unanticipated changes in the world money supply, output, prices of internationally traded goods and worldwide inflationary expectations.

Lucas (1973) presented some international evidence on the output-inflation tradeoffs for several individual economies. Using rational expectations, Lucas formulated a model for the determination of aggregate output and price level and estimated the model for several countries. He found that in volatile price countries, there were no discernible tradeoffs but in a stable price country like the U.S., there was some evidence of tradeoffs between output and inflation. Arak (1977) used a modified version of the Lucas model and did not find an evidence of tradeoffs for the U.S. Thus, the question of tradeoffs remains controversial for national economies. The current study examines whether there are discernible output-inflation tradeoffs for the world economy as a whole; i.e., when the world as a whole is treated as a closed system.

Plan of Study

Chapter II reviews the pertinent literature that has emphasized the growing international monetary interdependence among countries of the world. It also examines specifically the argument whether floating exchange rates insulate national economies from external monetary

disturbances. It further discusses the traditional argument that international reserves are indispensable in a fixed exchange rate regime and that inflation is fundamentally a national phenomena under a flexible exchange rate regime.

Chapter III describes the interdependence of money aggregates of developing oil-exporting and developed countries using the principal component analysis. It further deals with the concept of world money supply - its measurement and components. Empirical estimates are presented on the relationships between the aggregate of domestic money supplies of countries and the aggregate of domestic monetary bases of countries. Empirical estimates are also provided on the relationships between the world money supply and world monetary base. It is concluded that an appropriate measure of world money supply needs to incorporate not only the aggregate of domestic money supplies of individual countries but also some international components like foreign exchange reserves and eurocurrencies. Similarly, it is further concluded that a suitable measure of the world monetary base should be inclusive of an international component such as foreign exchange reserves.

Chapter IV delineates the money-income transmission mechanism for the world economy using a two-country framework. The money-income nexus is illustrated for tradeable and nontradeable goods, for fixed and flexible exchange rates. The effects of a change in money supply are explained with the help of many channels. It refers to the channels of international transmission of inflation and the international transmission of inflation is described and treated as an indispensable link in the money-income relationships. This chapter also describes the role of rational expectations in generating changes in the levels of money

supply, output, and prices.

Chapter V provides the empirical findings for the relationships between the world money supply and the measure of global economic activity. The evidence is presented for the world economy as a whole and for groups of countries. The importance of U.S. money supply in generating nominal activity for groups of countries and for the world economy has been discussed. The question of the direction of causality in money-income relationships is examined for the world economy in this chapter. A weak evidence is found for the unidirectional causality from money to income for the world economy.

Chapter VI discusses the measure of world prices and uses a weighted (GDP weights) average of individual countries consumer price indices as a measure of world price index. Using rational expectations, the measures of the channels of international transmission of inflation are developed. It provides an empirical evidence on the relationships among the rate of world inflation, unanticipated changes in money supply, output, the prices of internationally traded goods and inflationary expectations. No strong evidence is found on the possible output-inflation tradeoffs for the world economy as a whole.

Chapter VII summarizes the main results of this study and describes their implications for understanding of the economic phenomena in an international context.

FOOTNOTES

[1]Hume described the interrelationships between a country's balance of trade, the quantity of money and the general price level. A precise explanation of the price-specie mechanism can be found in Mundell (1968): "The diminution of the money supply causes a rise in interest rates that induces both a fall in prices and an inflow of capital, while the resulting balance of payments surplus brings in the additional foreign exchange reserves necessary to support a monetary expansion and, eventually, the original level of prices; this is the price-specie-flow mechanism of Hume" (p. 222).

[2]Whitman (1975) discussed at length the propositions of global monetarism and commented that "far from being new, these propositions of global monetarists represent a return to a tradition far older than the Keynesian approach they are challenging- to the price-specie-flow mechansim of David Hume, who argued that the international flows of reserves engendered by a payments imbalance would, through their effects on national money supplies and price levels and thus on the trade balance, automatically restore external balance" (p. 495).

[3]To compare his results of 16 countries with the U.S., Genberg (1976b) took a sample of 15 large cities within the U.S.

CHAPTER II

FOUNDATIONS FOR THE STUDY

Introduction

In a study pertaining to the world aggregates, it is crucial to treat the world economy as a closed system. A cursory glance at the world economy suggests that except in case of some extremely closed economies, e.g., the communist countries, the economic boundaries among nations are very thin. Most economies are linked to neighboring or remote economies and are integrated in the world as a whole. However, much economic theory employs the closed economy assumption. As one moves from the closed national economies to a world economy for establishing relationships among the world aggregates, it is appropriate to discuss the underlying reasoning for the hypothesized relationships.

Two basic considerations underlying this study are as follows:

1. There is a high degree of interdependence in the behavior of money aggregates across countries; with the money aggregates across countries being behaviorly interrelated so that they tend to influence the nominal activity and the rate of inflation around the globe.
2. Whatever the differences between fixed and flexible exchange rate regimes regarding international monetary adjustment mechanism, it is maintained that these differences have

> little impact on the relationships between the world aggregates envisaged here. At best, such discrepancies are minimal and marginal. They are not likely to influence the basic qualitative relationships among the world aggregates although the degree of such relationships might be slightly altered in the two exchange rate regimes.

At the outset, it may not be inappropriate to mention that the two considerations are not strictly independent of each other. Most economic literature on the controversy about fixed and flexible exchange rates maintain that under the former there is monetary interdependence, whereas under the latter, it is often argued, countries insulate their national economies from the rest of the world so that the monetary disturbances abroad have no bearing on the domestic front, hence a flexible rate regime is characterized by monetary independence.

International Monetary Interdependence

The modern world is more complex and interdependent than the world of earlier centuries. Vast changes in the technology of communications and transportation have integrated the world financial markets. The impact of purely domestic events is transmitted through money markets, balance of trade and balance of payments accounts to other countries (see Chapter IV). The freer the international flow of goods and money and the greater the size of the economy relative to the world economy, the more effective the transmission mechanism. The proliferation of multinational corporations around the globe has, in addition to the above factors, promoted the de facto internalization of domestic economies. The breakdown of the Bretton Woods agreement and the oil

crisis have produced monetary shock waves around the globe and have made the world realize how interdependent the national economies are.

The increasing international interdependence has led most countries to use foreign economic policy instruments. These instruments refer to the policies relating to exchange rate changes, export subsidies, import controls, export controls, import liberalization, tariffs, quotas, etc. (see Bergsten and Cline, 1976). Countries tend to use these instruments to reduce the negative effects of outside policy changes and to manipulate events for their own gains. To see that some of these countries do not harness the events to their utmost benefits at the expense of others, it is increasingly realized that structural changes are required in the world monetary order and other economic arrangements. Policy makers both of individual countries and of international economic institutions have little theoretical or empirical basis for global strategies and issues in view of the mushrooming growth of the foreign economic policy instruments.

The economic significance of political boundaries becomes ambiguous in view of economic arrangements among several countries or groups of countries. Some of these, for example, are Central American Common Market (CACM), East African Community (EAC), Economic Community of West African States (ECOWAS), European Economic Community (EEC), Organization of Petroleum Exporting Countries (OPEC), Organization of Arab Petroleum Exporting Countries (OAPEC), Organization for Economic Cooperation and Development (OECD), etc. All these have enhanced economic interdependence among several countries of the world. Further, international economic institutions like the World Bank, the International Monetary Fund, and some of the United Nations agencies have promoted international

economic cooperation and interdependence.

The development of eurocurrency markets is a part of the general process of internalization of economic activities involving trade, direct investment, portfolio investment and short- to medium-term banking operations. It has inextricably linked economies of the major countries of the world. This new international monetary system has strengthened the interdependence among nations such that no single country can exert enough power to stop the ramifications of the huge amount of money that is available in the global financial market. The unbriddled growth of the eurocurrency market transcends national boundaries (see Chapter III for details). It has led to the growth of what is called the 'stateless economy'. Hewson and Sakakibara (1975) in their discussion of the development of the eurocurrency market concluded that

> . . . the key for success in the reform of the international monetary system is therefore seen as the recognition, on the part of the authorities of countries concerned, of their increasing interdependence, and of the need to construct a new international system that would be both stable and flexible. . . (pp. 9-10).

Thus, the growth of the eurocurrency market in the 1960's and 1970's is a part of the general equilibrium system of international and domestic finance and is the logical result of internationalization and liberalization of financial operations indicating the growing international interdependence.

Monetary Insulation and Exchange Rate Regime

There were several notable contributions to the subject of fixed and flexible exchange rates, the most prominent being Friedman (1953), Meade (1955), Caves (1963), and Johnson (1973). These were prior to

the recent experience of floating rates. As Crocket and Goldstein (1976, p. 509) put it, they were "primarily concerned with the role of exchange rate regimes in adjustment processes" and as such not directly relevant for this study. Recently, the MABOP has contended that the money market determines the BOP position under fixed exchange rates. In such a system, countries peg the value of their currencies to some common (reserve) currency and, thereby, make that currency a perfect substitute for the domestic currency. An increase in money supply relative to its demand creates excess supply in the domestic market leading to a balance of payments deficit vis-a-vís other countries. This would affect the balance of payments position and the excess supply of money would flow out. The BOP deficit in the expanding country would be reflected in BOP surpluses abroad and, thus, the world money supply would increase.

Alternatively, under a flexible exchange rate system, external monetary disturbances do not affect the national economies because countries can always insulate their economies from external disturbances through sterilization policies. That is, flexible exchange rates make currencies nonsubstitutable. There are no net movements of money flows. The BOP is always balanced. There is monetary independence as regards the currencies of different countries.

Miles (1978) formulated a model of constant elasticity of substitution (CES) production function for the services of money and derived a testable model of currency substitution for Canada. He found a high degree of substitution especially during the period of floating rates. The degree of substitution may differ among the various countries depending upon the relative importance of that currency in the

international markets. However, the higher the degree of substitution, the greater the monetary interdependence and vice versa. Kouri (1976), Calvo and Rodriguez (1977), and Barro (1978) have also constructed models of currency substitution that emphasized that money might be held in a portfolio of currencies under a floating exchange rate regime.

Peter Kenen (1978) examined the ability of a floating exchange rate to insulate the national economy from an external disturbance. His model shows that there is no insulation in the case of an external asset market disturbance, not even in the long run. For example, an increase in the foreign interest rate causes pressures on the domestic currency to depreciate permanently and also causes increases in income through a trade balance effect. Further, in case of a foreign goods market disturbance, insulation is not instantaneous; it is achieved in the long run. Consider an increase in foreign price levels that raises domestic output (income) and, hence, increases the demand for money. The money supply being exogenous under floating rates, equilibrium in the money market can be restored through an appreciation of home currency. It would lead either to a worsening trade balance and reduced income or to capital losses on domestic holdings of foreign bonds and reduced wealth. In any case, the process that causes the income to return to the initial level occurs in the very long run. Thus, it seems no longer plausible to stick to the conventional argument of monetary independence under flexible exchange rates.

International Reserves and Exchange Rate Regime

It is frequently argued that international reserves are indispensable in a fixed exchange rate regime so that these can be used to

alleviate pressures on the exchange rate and the same need disappears with flexible exchange rates (see, for example, Haberler, 1977). But the experiences of floating rates contradict our theoretical understanding. The IMF's Annual Report, 1974 observed that "there is not yet any statistical evidence of a reduction in utilization of reserves by countries that have allowed their currencies to float" (p. 39). Williamson (1974), in a similar manner, found no strong evidence of any differences between the reserve use in the two exchange rate regimes. The IMF's Annual Report, 1978 reported "the countries that increased their reserves outnumbered those that reduced them during 1977" (p. 46).

Heller and Khan (1978) undertook an empirical study of the demand for international reserves during the period of floating exchange rates, 1973-76. They estimated reserve demand equations for six country groupings and used tests of stability. They found that the function explaining reserves behavior continued to be stable in the period of managed floating. This holds good for both industrial countries and developing countries. Frenkel (1978) estimated reserve demand function for the two periods and statistical tests were carried out to determine if the functions for the two periods were different. He concluded that the patterns of country holdings and usages of reserves during the floating rate period resembled the behavior prescribed for a regime of fixed exchange rates.

When exchange rates are viewed as relative asset prices, it seems hard to contend that one can really distinguish between fixed and flexible exchange rates in a dynamic sense. Even under the so-called fixed exchange rate, when the central bank supplies reserves or financial assets to maintain a fixed exchange rate, there are instantaneous

changes in the valuation of assets and the private portfolios are adjusted accordingly. Owing to continuous monetary expansion, overall inflationary trends, increases in the stock of wealth and foreign assets, the relative prices of assets are continuously changing. The factors that underlie the exchange rate determination whether monetary or real undergo continuous changes and vary stochastically. All these make the distinction between two exchange rate regimes very difficult.

Inflation and Exchange Rate Regime

It is often maintained in the literature on fixed versus flexible rates that the phenomenon of inflation is fundamentally a national problem under a system of flexible rates and the contrary holds in case of a fixed exchange rate regime. This argument essentially springs from the belief in the insulation capability of flexible exchange rates from external price disturbances and the sensitiveness of fixed exchange rates in this respect. This distinction appealed to many theorists for a long time. But the introduction of floating rates in the early 1970's seems to have no impact on lowering the rate of inflation around the world and, thus, the belief is shaken on the empirical grounds.

Crockett and Goldstein (1976) examined the generation, transmission, and control of inflation under fixed and flexible rates and concluded that "we find it hard to escape the overall conclusion that the type of exchange rate system has relatively little influence on the average rate of world inflation" (p. 537). However, they further remarked that a priori plausability and past experience (and not any strong empirical evidence) suggest that flexible exchange rates tend to create more inflationary pressures than its counterpart.

The monetary or asset approach to exchange rates views the latter as a relative price of monies that equilibrates the international markets for various financial assets. Dornbusch (1976) discussed the theory of flexible exchange rates in a general equilibrium framework which is characterized by the interaction of all markets (and countries). He examined the three perspectives on the determination of exchange rates and their interaction with macroeconomic equilibrium and aggregate policies. First, the exchange rate is determined by both real and monetary factors when all markets are allowed to clear in the long run.[1] Second, the conditions of equilibrium in asset markets and expectations in these markets dominate the course of exchange rate changes in the short run.

> The liquidity effect of money on the interest rate has a counterpart in the immediate depreciation of the spot rate that has to be sufficient to cause the existing stock of domestic assets to be held. It is in this sense that in the short run the exchange rate is determined in the asset markets (Dornbusch, 1976, pp. 262-263).

Third, it is demonstrated that with sticky prices and exchange rate expectations, the short run monetary and foreign price disturbances tend to be transmitted internationally.

Dornbusch's demonstration, particularly the third perspective, refutes the validity of the argument that a flexible exchange rate provides insulation from price and monetary disturbances of other countries, at least in the short run. The basic argument is as follows. An increase in the nominal quantity of money, given the equilibrium level of exchange rate and prices, lowers the rate of interest. The latter creates an excess demand for home goods. In order to restore equilibrium in the domestic goods market, the exchange rate and price level would

have to increase in the same proportion as the quantity of money. Since the elasticity of exchange rate expectations is less than unity in the short run, the exchange rate and the price level do not increase proportionately. Likewise, an increase in the foreign currency price of traded goods, given the exchange rate, increases the domestic currency price of traded goods, the price level and interest rate. Again, because of the less than unitary elasticity of exchange rate expectations in the short run, the price level and interest rate would not rise proportionately. Thus, Dornbusch rejects the argument that a flexible exchange rate regime provides insulation from price and monetary disturbances of other countries.

Similarly, Cordon (1977, p. 66) in his discussions on exchange rates, inflation and the world economy reached the conclusion that one cannot say that "for the world as a whole either the fixed or floating rate is more inflationary" and that there are several other factors along with the exchange rate regime that create inflationary pressures on a country or countries. Cordon (1976) maintained that inflation rates are determined in a general equilibrium system where countries "trade" their surpluses and deficits. Nothing in general can be said for the world as whole whether fixed or flexible rates are more conducive to inflation. In fact, one encounters two contradictory theories in this respect.

"The Haberler argument" as Cordon (1977) calls it, dubs the fixed rate regime as having an inflationary bias. The essence of the argument is that the prevailing downward price rigidities in modern times make it possible to rectify the BOP disequilibrium by raising the price level in the surplus country or countries and the price level does not decline in the deficit countries. On the other hand,

the Mundell - Laffer argument" asserts that floating rates are inflationary (Claassen, 1976).[2] With flexible rates, the price level goes up in the weak currency country in view of price rigidities.[3] Cordon argues that both "the Haberler argument" and "the Mundell-Laffer argument" are not valid in a world in which all countries are inflating. There is no need for asymmetry in the responses of deficit and surplus countries. The BOP equilibrium can be restored for a deficit country simply by lowering its inflation rate and the necessity of negative inflation does not arise.

Summary

The above discussion shows that monetary interdependence among several countries of the world prevails irrespective of the exchange rate regime. Neither a priori considerations nor empirical evidence support the view that an economy with a floating exchange rate is insulated. The implication of this discussion is that the basic world aggregates of money, output, and inflation can be related over time without paying inordinate attention to exchange rate considerations. That is, in spite of the so-called different international monetary adjustment mechanisms implicit in the two exchange rate regimes, the basic qualitative relationships between the world aggregates remain unaltered. The evidence on international monetary interdependence is further shown in Chapter III using the principal component analysis and the relationships between the world money supply and world monetary base have been discussed for the two exchange rates regimes.

FOOTNOTES

[1]Mussa (1976) has emphasized the similar argument that both the real and monetary factors determine the balance of payments position in the long run. In the Dornbusch argument, the real aspects include an explicit consideration of relative price structures.

[2]This argument is attributed in the press to Mundell and Laffer (see Wanniski, 1974) but it is not clear whether they would fully subscribe to this view. However, this view seems to have become an important part of literature on flexible exchange rates.

[3]The basic argument is as follows:

> If the system of flexible exchange rates produces a greater number of depreciations than appreciations, there will be an increase in the world quantity of money provided that the latter is expressed in terms of the currency unit of the depreciating countries. On the other hand, a change in the exchange rate causes an upward price pressure in the appreciating country. If there is a price rigidity in the latter country (the so-called ratchet effects), it will pursue an expansionary monetary policy in order to avoid unemployment - a behavior which gives rise to another increase in the world quantity of money (Claassen, 1976, p. 356).

CHAPTER III

THE MEASURE OF WORLD MONEY SUPPLY

Introduction

It is the primary objective of this study to extend the monetarist analysis developed on the basis of the assumption of a closed national economic system to the case of a world economy and test the corresponding relationships with global output and price variables on lines similar to that of a closed system. What follows in other chapters hinges on the very concept of the world money supply itself. Hence, this chapter is devoted to a detailed analysis of the measure of world money supply used in this study.

How is the stock of money defined in an international context? The conventional monetary approach for a closed economy centers around M1, M2, etc. In spite of the less than perfect substitutability of various national currencies, unequal purchasing power and a plethora of issuing and regulating monetary authorities, the global money supply can be conceived unambiguously. The monetary approach to the balance of payments and exchange rates and the global monetarism have abundantly made clear the role of money supply in the international transmission of monetary and other economic effects and, thus, have paved the way for expanding on the concept of world money supply.

Measures of World Money Supply

The purpose of this section is to list the important measures of the world money supply found in the literature and then discuss the major considerations that need to be acknowledged for a suitable measure of the world money supply in the context of this study.

There are four measures of world money supply found in the literature, which are as follows:

1. An aggregate of national money supplies converted into a common unit such as the U.S. dollar. Parkin, Richards, and Zis (1975) used the U.S. dollar as a common unit to determine the money supply[1] for the Group of Ten under the fixed exchange rate period, 1961-71. Logue and Sweeney (1978) used the dollar values to measure an aggregate of national money supplies for the O.E.C.D. countries and tested the hypothesis whether the U.S. money supply is a significant factor in determining nominal activity for the O.E.C.D. countries.
2. A geometric mean of the individual country money supply indices as provided in International Financial Statistics (IFS) as published by the International Monetary Fund. It is calculated using 1970 GDP converted into the U.S. dollar as weights. Day and Heller (1977) further extended this concept as referred to in the measure (4).
3. Sum of international reserves converted into the U.S. dollars. Keran (1975) treated the sum of international reserves as the world money supply. Chrystal (1977) termed this sum as the "international money".

4. Day and Heller (1977) provide a measure of the world money supply which is similar to that of the IMF except that they use moving weights equal to the value of GDP in the previous year. They present data for the world monetary expansion rates for the period 1958-1975 using alternative conversion measures: (i) U.S. dollar, (ii) basket SDRs, (iii) 1975 GDP as weights, (iv) moving GDP weights, and (v) moving money weights.

Measures (2) and (4) are flow measures attempting to provide monetary expansionary rates or indices and measures (1) and (3) are stock measures. Measures (1), (2), and (4) are deficient for the purposes of this study in that they do not take into account either foreign exchange reserves or eurocurrency in their concept of world money supply. There are at least three major considerations that must be acknowledged in any concept of world money supply in view of our experiences in the last two decades. These three considerations relate to the measure of conversion, international reserves, and eurocurrency.

First, the fixed exchange rate regime following the Bretton Woods arrangement centered around the dollar and made it convenient to express all currencies under consideration in a common unit. However, the Bretton Woods system no longer exists nor does it seem imminent that the system would be re-established. Fluctuations in dollar values in the international market in 1970's have rendered this kind of analysis less reliable so far as the global analysis is concerned. Most contributions on the MABOP base their conclusions under the assumption of fixed exchange rate system. At best, the assumption of fixed exchange rates confines the analysis to a period prior to 1971 and may not essentially

reflect the vast monetary changes the world has undergone during 1970's.

An alternative conversion measure that has been employed in this study employs SDR rates. The SDR rates provide a constant and convenient reference point in time and across countries. In as much as SDRs came into effect in 1970, it smoothes the fluctuations of 1970's and links them with the 1950's and 1960's, allowing for an easy comparison devoid of many of the exchange rate considerations. SDRs transcend national currencies and provide a global flavor to the variable under study. It is not merely a convenient conversion measure, it is a good weighting scheme. The value of SDRs is determined by a basket of 16 currencies. The SDR rates reflect the relative importance of countries in the export of goods and services.

Second, the Bretton Woods system envisaged a world in which exchange rates were pegged and there was a reserve currency in which most countries of the world held their international reserves. Owing to some historical factors and post-war international monetary problems, the U.S. dollar was adopted as a reserve currency by the rest of the world. These reserves can be treated as quantities of money as they are used for international transactions and payments. In such a system, the whole world can be analytically equivalent to a closed economy (Grubel, 1976).

Neither national money supplies nor international reserves in isolation adequately represent the world money supply. At the global level, international reserves perform the role of money. These are used as a medium of exchange and store of value. They are a source of liquidity. Changes in international reserves cause changes in the

monetary base of a country and have their impact on a nation's money supply. Changes in international reserves give the monetary authorities the impression of ease or tightness of their reserve position and lead them to pursue expansionary policies or contractionary policies as the case may be. Changes in international reserves thus have effects over time on the money supply of a particular country and for the world as a whole. Therefore, international reserves need to be incorporated into any study dealing with the world money supply.

There are four components of international reserves: foreign exchange reserves, gold reserves, Special Drawing Rights reserves, and reserves with the IMF. However, it is the foreign exchange reserves that are readily accessible to pay for the transactions across countries. They serve the same purpose as demand deposits and currency in circulation. Reserves with the Fund or SDRs may not be direction responsible for expansion of the world money supply. Individual countries might rely more on what they have on hand rather than what they have with the Fund.[2] Similarly, the motives for gold reserves are different for decades, gold stocks have not been determining factors in money supplies (see Kriz, 1967). Reserves other than foreign exchange reserves are maintained to serve as a basis for foreign borrowing or to preserve confidence in the currency both at home and abroad. It is the increases in foreign exchange reserves that lead to monetary expansion. In the absence of leakages and sterilizations, dollars or pounds earned by the Japanese imply a corresponding increase in domestic money supply because the people or businesses are paid the domestic equivalent of foreign exchange earned. In view of these considerations, this study intends to use only the foreign exchange reserves as a component in the world money

supply. For the developing countries of Asia, Africa, and Latin America, foreign exchange reserves are indispensable for acquiring technology, expertize and other paraphernalia needed for development. It is a commonplace experience of the 1960's and 1970's that increases in foreign exchange reserves among the oil-exporting countries led to a wide variety of development activities attracting a large number of people and businesses from around the world. Thus, foreign exchange reserves do generate activity around the globe and these have effects on prices and output. As the latter constitute a major part of this study, foreign exchange reserves need to be incorporated in the concept of world money supply.

Heller's empirical study (1976) emphasized the role of international reserves in the world money supply. The basic hypothesis tested was that there exists a causal link between the changes in international reserves and the changes in world prices. He argued that changes in the global international reserves influence the world money supply and the changes in the latter in turn influence the rate of world inflation. Examining the case of individual open economies, he attributed the changes in a nation's money supply to the changes in the international base component, changes in the domestic base component and changes in the monetary base multiplier. Using annual percentage changes from 1951 to 1974, he found that the current and lagged international reserves expressed in dollars accounted for 57 per cent of the variation in the world money supply (as measured in IFS). He estimated an average lag of about one year in the said relationship.

The IMF's Annual Report, 1978 observed that the rapid growth of reserves in Korea, United Kingdom, and Germany in 1977 contributed to a

high rate of monetary expansion in those countries. Further,

> . . . it is conceivable that reserve increases in some non-oil developing countries could subsequently give rise to a shift to more expansionary demand policies that the automatic expansionary effect of reserve growth in the monetary aggregates cannot be easily offset (p. 47).

Last, the past decade has witnessed a tremendous expansion of the eurocurrency market. It has grown relative to the money markets of European countries and has become an integral part of the money market of industrial countries. Both the terms, "eurodollar" and "eurocurrency" (often used interchangeably), transcend their semantic connotations. These are neither European nor confined to dollars. Markets for eurocurrency can be found in Japan, Canada, Bahamas, Singapore, Hong Kong, and other places. A precise definition of the eurocurrency market is difficult and so are the precise statistical data on the market. The Bank of International Settlements, however, reports data on the banks' foreign currency liabilities and assets which yield some reasonable approximation of the most likely volume of funds in the eurocurrency market.

For the purpose of this study, it is important to provide a raison d' etat as to why the eurocurrency should be included in the concept of world money supply. This explanation of the process, it is hoped, would throw some light on the nature of market.

Banks in Europe and elsewhere do a considerable business in foreign currencies; i.e., banks accept deposits and advance loans in currencies other than their local currency. This has led to an emergence of an efficient interbank transfer system which facilitates channeling of short-term funds from lenders to borrowers across countries. European and other banks dealing with this market keep demand and time deposits

in different financial markets of the world, e.g., New York, London, etc. A typical eurodollar transaction is settled by transfer of claims on a New York bank. At any point in time, the claims on a New York bank serve as the reserves for a eurobank. It is not necessary in this process that the dollar deposits or holdings of a eurobank be acquired through dollar deposits. It could simply be a conversion of deposits from one currency to another currency.

The eurocurrency market coexists and competes with traditional foreign exchange banking (see McKinnon, 1973). This is a case of offshore unregulated markets and the onshore regulated ones. The existence of differences in exchange rate regulations and interest rate differentials has made this business profitable to both the borrowers and lenders. For example,

> If Exxon earns $100 million on sales in Europe and deposits in a U.S. bank's London branch, the money becomes eurodollars, and the bank can lend it to some other company to build a plant in Turin or Trenton. Because the dollars are outside the U.S., the bank is free from Federal Reserve rules that require it to keep as much as 16.25% of its U.S. demand deposits frozen rather than loaned out. Since this freedom lowers the bank's costs, it can pay perhaps 1% more interest on the dollar deposited with it abroad than in the U.S., and it can offer loans at lower rates (Time, November 5, 1979, p. 81).

Thus, the whole process is very much akin to any typical banking transactions and with a large amount of interbank claims with which they deal, it is imperative to treat this as a part of the world money supply. Swoboda (1978) examined various theoretical possibilities in a simplified model of world money stock and concludes:

> . . . a switch from traditional national currency holdings to eurodollar deposits, be it by the European public, the U.S. public, or the European central bank, tends to expand the world money supply, other things being equal . . . (pp. 637-8).

International Monetary Interdependence: An Exploratory Approach

In Chapter II, a case has been made for the monetary interdependence of several national economies. However, there is no specific theory that delineates the relationships between money aggregates of several countries or groups of countries. That is, for example, there is no generally accepted theory that explains why changes in the U.S. money supply lead to the changes in the money supplies of less developed countries. Similarly, in the preceding section of this chapter, the importance of international reserves and eurocurrency in the concept of world money is discussed but the preceding section does not provide an explicit theory that supports the inclusion of these variables. Further, it is not clear analytically why all of the components need to be incorporated when some of them are not used for international transactions and settlement of accounts in the sense of money. Therefore, this study employs the principal components analysis as an exploratory approach for the following reasons:

1. This study wants to show that the money variables of several countries (or groups of countries) are interdependent. Principal components analysis combined interdependent variables into factors, which by definition are independent of each other (see Harman, 1967 and Rummel, 1970).
2. There seems to be no precise model to specify the relationships among money supply variables across countries. In an interdependent system of relationships, principal components analysis throws some light on the pattern of association of variables (money in this case) and the clustering of variables.

3. Principal components analysis can help to identify the money variables of groups of countries that have a world money dimension. Principal components analysis assigns each variable to the factor with which it has the highest correlation. The highest correlation coefficient would help in picking up the money variables that have the world money dimension. The selected variables can be used in developing the aggregate of world money supply.

This study employs the technique of the principal components which transforms a given set of variables into a composite of variables.[3] An important feature of this technique is that the first component contributes most to the total variance of variables used in the study. The second component contributes second most to the residual variance of those variables and so on. This study is limited in using the principal components in the sense that it seeks to identify the factor associated with the world money supply and world monetary base from the several money supply and monetary base variables.[4]

The money supply and monetary base variables used in the principal components analysis are listed in Table I.[5] Before the results of this technique are examined, a brief note on the reasons for using these variables is imperative. In any study of aggregates, it is important to understand whether the components (constituents) of an aggregate behave differently. It is often argued that the degrees of openness of economies differ and economic forces that underlie the working of economic systems of different countries vary. Most studies that attempt to extend their results for the world economy confine their discussion of the world economy to developed countries largely because of their

TABLE I

LIST OF VARIABLES

CPI	= commodity price index of internationally traded goods
CPI*	= anticipated commodity price index of internationally traded goods
DFER	= foreign exchange reserves of developed countries
DFR	= reserves with the Fund and SDRs of developed countries
DGDP	= gross domestic product of developed countries
DGR	= gold reserves of developed countries
DMB	= monetary base of developed countries
DMS	= money supply of developed countries
EC	= eurocurrency
EUSDGDP	= gross domestic product of developed countries excluding the U.S.
EUSDMB	= monetary base of developed countries excluding the U.S.
EUSDMS	= money supply of developed countries excluding the U.S.
EUSGWP	= gross world product excluding the U.S.
FER	= foreign exchange reserves of all countries
FR	= reserves with the Fund and SDRs of all countries
GWP	= gross world product
GWP*	= anticipated gross world output
LFER	= foreign exchange reserves of less developed countries
LFR	= reserves with the Fund and SDRs of less developed countries
LGDP	= gross domestic product of less developed countries
LGR	= gold reserves of less developed countries
LMB	= monetary base of less developed countries
LMS	= money supply of less developed countries
MS_j	= money supply of j th country
OFER	= foreign exchange reserves of oil-exporting countries
OFR	= reserves with the Fund and SDRs of oil-exporting countries
OGDP	= gross domestic product of oil-exporting countries
OGR	= gold reserves of oil-exporting countries
OMB	= monetary base of oil-exporting
OMS	= money supply of oil-exporting countries
RGWP	= real gross world product
RGWP*	= anticipated real gross world product
TDMB	= total monetary base of all countries
TDMS	= total money supply of all countries
USMB	= U.S. monetary base
USMS	= U.S. money supply
WMB	= world monetary base
WPI	= world price index
WPI*	= anticipated world price index
WMS	= world money supply
WMS*	= anticipated world money supply

TABLE I (Continued)

Note: 1. All variables are expressed in SDRs. The term 'money supply' refers to the M2 concept of money supply and the term 'monetary base' refers to currency plus reserves for country groupings. However, WMB = DMB + OMB + LMB + DFER + OFER + OFER and WMS = DMS + OMS + LMS + DFER + OFER + LFER + EC. See text for details.

2. The groupings of countries into the developed or industrialized (U.S., Canada, Japan, Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, and United Kingdom) and oil-exporting countries (Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Saudi Arabia and Venezuela) are similar to the ones in International Financial Statistics except that the U.A.E. has been omitted because of the lack of necessary data. For the category of developing countries, the sample (Argentina, Brazil, Colombia, Egypt, Gautemala, India, Israel, Korea, Pakistan, Philippines, (Rep.) China, and Sri Lanka) draws from Asia, Middle East, and Latin America. Availability of the data was the main consideration in selecting these countries.

dominance in terms of international trade (see, e.g., OECD, 1973; Keran, 1975; Shaw, 1975; Bisignano, 1975). However, their trade itself is an important force in generating economic activities in all countries. As such, the interdependence of national economies dictates that reliable results can be derived only when all groups of countries are considered. This study considers the three broad types of national economies - developed, developing and oil-exporting countries. The classification of economies into these three divisions is the same as reported by the IMF in IFS. For a particular variable of interest, the economies are aggregated over each group. The important variables considered are money supply (M2), monetary base, foreign exchange reserves, gold reserves, reserves with the Fund, and SDRs and eurocurrency.

Table II shows the results of the principal components analysis for 14 money variables.[6] Each entry in the table shows the relative effect of a given factor (composite variable) on the corresponding observed variable. When an entry is squared, the resultant number indicates the proportion of variance in a variable accounted for by the corresponding factor. The squared number called the communality (h^2) is closely related to R^2 in regression analysis.[7] The R^2 of a variable measures the proportion of the variance in the given variable accounted for by the identified factor. And if the R^2's of a variable are summed for all factors, it measures the variance of a given variable accounted for by all factors. The factors are assumed to be orthogonal to each other; i.e., they are uncorrelated (see Harman, 1967).

Factor 1 (F1) accounts for 80% of the total variance in 14 money variables. This composite variable is highly correlated to EUSDMS, OMS,

TABLE II

PRINCIPAL COMPONENTS FOR 14 MONEY VARIABLES

Variables	F1	F2	F3	R^2 for F1
EUSDMS	.992	.052	.031	.984
OMS	.961	-.078	-.249	.924
USMS	.972	.187	.086	.945
LMS	.984	.059	.048	.968
EC	.984	-.087	-.043	.968
DFFR	.965	-.024	.149	.931
OFER	.890	-.211	-.369	.792
LFER	.938	-.236	-.062	.880
DFR	.990	.039	-.020	.980
OFR	.857	-.133	-.472	.734
LFR	.895	.020	.374	.801
DGR	-.609	.644	-.422	.371
OGR	.784	.353	.280	.615
LGR	.605	-.786	.037	.366
Contribution %	80.44	9.52	6.13	
Cumulative % of variance	80.44	89.96	96.09	
Eigen Value	11.26	1.33	.855	

Note: The cut-off point for the extraction of factors in this study is based on a positive eigen value equal to one or close to one. Table reports R^2 for the first factor loading (F1) because the main interest of this exercise is to identify the world money dimension and other factor loadings or dimensions are not of much significance.

USMS, LMS, EC, DFER, OFER, DFR, OFR, and LFR as indicated by the high correlation coefficients. That is, for example, the factor loading of .972 for USMS in the first column is the correlation coefficient between the variable USMS and factor 1. It further implies that 94.5% $=(.972)^2$ of the variance in this variable is accounted for by factor 1 (looking at the corresponding entry in the last column). The signs of factor loadings show the patterns of association between the factor and variables. Most money variables have positive signs except DGR.[8] There seem to be high correlation coefficients for all the domestic money supply variables corresponding to M2 concept of money supply of developed countries (excluding the U.S.), oil-exporting countries, the U.S., and less developed countries. The eurocurrency also has a high correlation coefficient. Foreign exchange reserves of all the three country groupings are highly correlated with the first factor. All these variables have positive signs indicating the direct relationships. In view of these results, the first factor loading has a world money dimension. The implication of this result is that the concept of money supply in the world context needs to include EUSDMS, DMS, LMS, USMS, EC, DFER, OFER, and LFER. This argument was made in the preceding section. This section provides the necessary empirical evidence to support that argument.

As has been mentioned earlier, 80% of the variance in 14 money variables is explained by the first factor which has the world money dimension . However, the variances explained by DGR, OGR, and LGR variables as indicated by R^2 for factor 1 are quite low. Similarly, the R^2 of OFR is low compared to R^2 of other variables, lower than the variance explained by all the variables for the first factor. That is, gold reserves and Fund reserves/SDRs of different country groups do not

unambiguously account for the larger variance in the first factor which has the world money dimension. In the preceding section of this chapter, a case was made for the exclusion of these variables and the results yielded by the principal component method are consistent with the previous explanation. These empirical results further support the elimination of gold reserves from the concept of world money supply.

Table III reports the results of factor loadings for 13 monetary base variables. The first factor loading explains 78% of the total variance in 13 monetary base variables. Like earlier results, here again one notices that the domestic monetary base of developed countries, oil-exporting countries, and developing countries have high correlation coefficients. The same is true of their foreign exchange reserves. Gold reserve variables have quite low R^2s for all the three country groups. The Fund and SDR reserves variable of oil-exporting countries explains less variations (73%) than the variance explained by all the variables for the first factor loading. These results are consistent with the earlier results in case of money supply variables. Thus, the principal components method shows that the concept of world monetary base needs to incorporate the domestic monetary base variables and foreign exchange reserves. The positive signs associated with these variables show their positive relation to the world monetary base.

World Money Supply and World Monetary Base

The preceding section elaborated on the variables that need to be incorporated into the concepts of world money supply and world monetary base. Employing these concepts, this section empirically establishes the relationships between WMS and WMG. It also establishes the importance of the domestic and foreign components of the world monetary base in

TABLE III

PRINCIPAL COMPONENTS FOR 13 MONETARY BASE AGGREGATES

Variable	F1	F2	F3	R^2 for F1
EUSDMB	.994	.060	.007	.988
OMB	.951	-.098	-.273	.904
USMB	.951	.181	.141	.904
LMB	.908	-.048	.054	.824
DFER	.966	-.019	.136	.933
OFER	.890	-.214	-.371	.792
LFER	.937	-.231	-.066	.878
DFR	.988	.045	-.032	.976
OFR	.854	-.133	-.477	.729
LFR	.898	.025	.361	.806
DGR	-.600	-.788	.056	.360
OGR	.783	.373	-.431	.613
LGR	-.616	.629	.272	.379
% of variance	77.63	10.18	6.77	
Cumulative % of variance	77.63	87.81	94.58	
Eigen Value	10.09	1.32	.88	

Note: same as for Table II.

explaining the variations in WMS.

According to measure (1) of world money supply, the WMS is the sum of domestic money supplies of all countries converted into a common unit of measurement:

$$TDMS_i = \sum_{j=1}^{n} s_{ij} MS_{ij}$$

where: i is time subscript and j is a country subscript.

s_{ij} refers to the SDR rate per unit of domestic currency for j^{th} country.

TDMS denotes total domestic money supplies of n countries for i^{th} period.

MS refers to the money supply of an individual country using the M2 concept of money supply.

Similarly,

$$TDMB_i = \sum_{j=1}^{n} s_{ij} R_{ij} + \sum_{j=1}^{n} s_{ij} C_{ij}$$

where: TDMB refers to the total monetary base of n countries for i^{th} period.

R refers to reserves of the banking system.

C indicates currency outside the banking system.

Further,

$$TDMS_i = m_i^d \, TDMB_i \qquad (1)$$

where: m^d is the world money multiplier using measure (1) of the world money supply.

Equation (2) stipulates the relationship between the aggregate domestic monetary base and the aggregate domestic money supply. As has been mentioned earlier, increases in foreign exchange reserves are considered to be responsible for the expansion of world money supply. That is, in relation (1), FER should be added to TDMS treating the former as money and FER should be included in the world monetary base because the former serves as the base for that given expansion of money supply. Similarly, the aggregate of eurocurrency needs to be incorporated into the WMS concept in view of the earlier discussion in this chapter. After allowing for these adjustments, one gets

$$WMS_i = m_i^w \, WMB_i \, . \qquad (2)$$

Since WMB is TDMB plus FER, it follows

$$WMS_i = m_i^{w1} \, TDMB_i + m_i^{w2} FER_i \qquad (3)$$

where: m^{w1} and m^{w2} are money multipliers for domestic and international components of the world money supply, respectively.

m^w is the combined money multiplier for the world economy.

Relations (1) and (2) suggest that once the foreign exchange reserves are treated as a component of world monetary base, it is expected that m^w will be a weighted average of m^{w1} and m^{w2}.

Table IV presents estimates of relations (1), (2), and (3). When the world money supply is treated as the aggregate of domestic money supplies, a mean estimate of m^d is 8.01. However, the broader concepts of world money supply and world monetary base yield a lower estimate of 6.41. Estimates of m^{w1} and m^{w2} being 6.38 and 6.49, respectively, are consistent with the a priori expectations. Estimates

TABLE IV

EMPIRICAL ESTIMATES ON THE RELATIONSHIPS
BETWEEN WMS AND WMB,
1953-1976

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(1) TDMS = 8.01 TDMB
(22.80)
R^2 = .99 D.W. = 2.06 ρ = .91
(10.41)

(2) WMS = 6.41 WMB
(42.91)
R^2 = .99 D.W. = 2.00 ρ = .88
(8.99)

(2a) WMS = 338.35 D1 + 332.73 D2 + 6.08 WMB
(1.61) (1.43) (18.33)
R^2 = .99 D.W. = 2.05 ρ = .96
(15.51)

(3) WMS = 6.38 TDMB + 6.49 FER
(14.73) (5.56)
R^2 = .99 D.W. = 1.99 ρ = .88
(8.96)

(3a) WMS = 6.31 (TDMB.D1) + 5.17 (TDMB.D2) + 7.18 (FER.D1)
(9.53) (8.02) (1.99)
+ 10.00 (FER.D2)
(6.24)
R^2 = .99 D.W. = 1.75 ρ = .91
(10.26)

Note: Figures in the parentheses are t-statistics. In estimation (1), the constant has been suppressed. When relation (1) is estimated with a constant, the following results are obtained

TDMS = -272 + 8.53 TDMB
(-5.02) (34.73)
R^2 = .99 D.W. = 1.84 ρ = .56 (3.28)

of relations (1) to (3) are satisfactory from the viewpoint of test statistics like R^2, D.W. statistic and t-statistics. The results have been corrected for serial correlation using the Cochrane-Orcutt iterative technique. Further, the F-test is used to test whether the coefficients m^{w1} and m^{w2} are significantly different. The test showed that these two coefficients are indeed significantly different.

Reference has been made to the voluminous literature on the distinction between fixed and flexible exchange rates. It was explored in this study whether the change in exchange rate regime affected the basic relationships between WMS and WMB. Since a change in the exchange rate regime was a structural change in the international monetary system, it was decided that two dummies corresponding to these exchange rate periods would capture the impact of such a change. Dummies D1 and D2 were employed for the fixed and flexible exchange rate regimes, respectively.[9] Using dummies for relation (2), the results suggest that the coefficients of both dummies are not significant at 5% level. This suggests that the basic relationship between WMS and WMB has remained unaltered irrespective of exchange rate regime. It was further explored whether the exchange rate regimes affected the behavior of domestic and international components of WMB. The results of Equation (3a) in Table IV show that both dummies are significant. That is, the coefficients of both TDMB and FER are influenced by each exchange rate regime in an unique manner. The coefficients of both components are significant. Thus, the qualitative relationship between world money supply and world monetary base remains unaltered and so does their components. However, each exchange rate is unique in the sense that it involves a particular process of international

adjustment such that the process of adjustment significantly affects the components. In a way, this is what it meant when it was said in Chapter II (in the section on monetary interdependence and exchange rate regime) that the notable contributions of Friedman, Meade, Caves, and Johnson on the controversy over fixed and flexible exchange rates were primarily concerned with the role of exchange rate regimes in adjustment processes and not so much on their impact on output and inflation.

In the framework of this study, it is not possible to delve into eurocurrency as the monetary base concept. In the absence of information on reserve holdings behavior of eurobanks, it is difficult to estimate the eurodollar multiplier. Similarly, there is no structural portfolio model employed in this study. The literature on the subject is not of much help. On the one hand, Bell (1964) and Friedman (1969) suggested that the eurodollar multiplier would be potentially quite large. Makin (1972) estimated it to be an average of 18.45 during 1964-III to 1970-IV. On the other hand, Klopstock (1968) suggested it to be in the approximate range of 0.5 to 0.9, Lee (1973) estimated it to be 1.51 during the period 1963-I to 1969-IV, and Hewson and Sakakibara (1975) found it to be around unity during 1968-72. There are no well specified reserve assets held by eurobanks. These banks do not obey any uniform and stable reserve requirements or reserve practices. Thus, neither the multiplicant nor the multiplier is known (Machlup, 1972). Therefore, this study incorporates the eurocurrency as a component in the world money supply but excludes it in the concept of world monetary base, the latter being developed and used as parallel to the world money supply.

Summary

It has been shown in this chapter that a proper measure of world money supply needs to incorporate not only the aggregate of domestic money supplies of individual countries but also some international components like the foreign exchange reserves and eurocurrency as the latter are frequently used in international transactions. Likewise, an appropriate measure of the world monetary base includes the international component such as foreign exchange reserves besides an aggregate of domestic monetary base of individual countries. The two measures developed in this chapter are employed in subsequent chapters. This chapter also establishes the relationships between WMS and WMB and highlights the importance of the domestic and foreign components of the world monetary base in explaining the variations in WMS.

FOOTNOTES

[1]Parkin et al. (1975) distinguished between a narrow world money defined as notes and coins in circulation plus demand deposits and a broad world money supply defined as narrow money plus quasi-money. They also considered the broad money with and without eurocurrencies.

[2]This argument is based on intuition and is not based on any empirical findings, However, this itself may be an interesting testable proposition. The results of principal component analysis later in this chapter indirectly provides some evidence to support this argument. Moreover, reserves with the Fund, SDRs or gold reserves are a small fraction of the total world money, not significant enough to affect the stock of money at least in the short run.

[3]Many intercountry analyses have used the technique of principal components. This note cites two examples where the technique has been used in case of the monetary variables. Genberg (1977) employs the technique to provide the evidence on interdependence of consumer price indexes of several individual countries. Parkin et al. (1975) used the principal components method to explain variances in discount rates across countries.

[4]The factoring technique used in this study is to define the dimensionality of data and a basis of space, so that the world as a whole can be treated as a closed system. The interest of this study is to see the linkages among the variables and determine the dimensionality in the common factor space.

[5]Table I is a comprehensive list of variables used in this study. Money variables are used in this chapter to arrive at an aggregate of the world money supply. Money variables and income variables are employed in Chapter V. Price variables along with others are used in Chapter VI. Since the U.S. enjoys a unique position in the world economy, separate measures are employed.

[6]In Table II and III, the entry of a number below F1 corresponding to a variable indicates the correlation coefficient between the variable and the factor. The sign of a correlation coefficient indicates the pattern of association (positive or negative) and the high correlation coefficients of several variables for a factor indicate the inter-relationships among those variables in explaining the relevant factor or dimension. The purpose of principal components analysis in this study is to identify the world money dimension. Hence, the high correlation coefficients of money variables for factor 1 show the interrelationships among those money variables and such money variables need to be incorporated in the concept of world money supply.

[7]Note that factors are by definition uncorrelated, it is possible then to sum the squared factor loadings across rows to obtain communality (h^2) of a variable in question. h^2 of a variable measures the proportion of the variance in that factor accounted by all the factors. It has been demonstrated that h^2 is closely related to R^2 (see Harman, 1967, p. 82). Since the interest of this study lies in the first factor loading, each entry in the first column has been squared and reported as R^2 for the first factor loading and the squared factor loadings across rows are not summed.

[8]It is difficult to provide the rationale for this sign. Gold reserves variables of developing, developed and oil-exporting countries do not have high R^2s and are excluded from the concept of world money supply. Thus, the negative signs do not pose any obstacles in this study.

[9]The period 1953-70 is considered to be the one belonging to the fixed exchange rate regime and the period 1971-76 is assumed to be that of floating exchange rates.

CHAPTER IV

MONEY-INCOME TRANSMISSION MECHANISM

Introduction

Having established the concepts of world money supply and world monetary base, it is imperative to examine the money-income nexus for the world economy, as this constitutes one of the main objectives of this study. An analysis of the world money supply per se may not be very interesting unless there is a basis for establishing that the world money supply is an important determinant of world output and that the variations in the former can be explained satisfactorily by the variations in the latter. This chapter delves into this aspect by first delineating the money-income nexus or money-income transmission mechanism in the international context and then discussing the international transmission of inflation which is an indispensable link between the world money supply and world output.

Money-Income Nexus

In the international context, the mechanism that relates the world money supply and world output seems to be a little more difficult than its counterpart in case of a closed (or open) domestic economy. It is useful to employ a two-country framework - countries A and B to explain the underlying mechanism. The assumption of a "small" country is not deemed necessary in the general discussion that follows except that the

analysis presupposes a given level of commodity and asset prices. In view of the discussion in Chapter II, the monetary interdependence between the two countries is taken for granted. Consistent with given commodity and asset prices, it is further assumed there exists a given level of the money supply. This analysis intuitively deals with both tradeable and non-tradeable commodities and assets. It also examines the reaction of the economy to a given money supply change under the fixed and flexible exchange rate regimes.

In short, the process of money-income transmission is illustrated with the help of Figure 1. Assuming a general equilibrium framework, the effects of an increase in the money supply are transmitted in international markets and these effects create pressures on prices of goods and returns of financial assets through excess demand conditions in the commodity and bond markets. In the process of adjustments in these markets, expectations are generated regarding future prices which further affect the levels of prices and output. Alternatively, excess demand conditions bring about the changes in the balance of payments and these changes affect prices through the changes in exchange rates. Changes in relative prices of commodities and of assets among countries due to a change in the exchange rate would stimulate production of commodities that are relatively cheaper and would increase the returns on assets. This is likely to result in increased income levels. Similarly, even absolute changes in prices of internationally traded goods, not only transmit inflation, but also affect the level of real income; e.g., increases in the price of oil has meant a large increase in the real income of the OPEC countries and that further caused changes in their balance of payments positions.

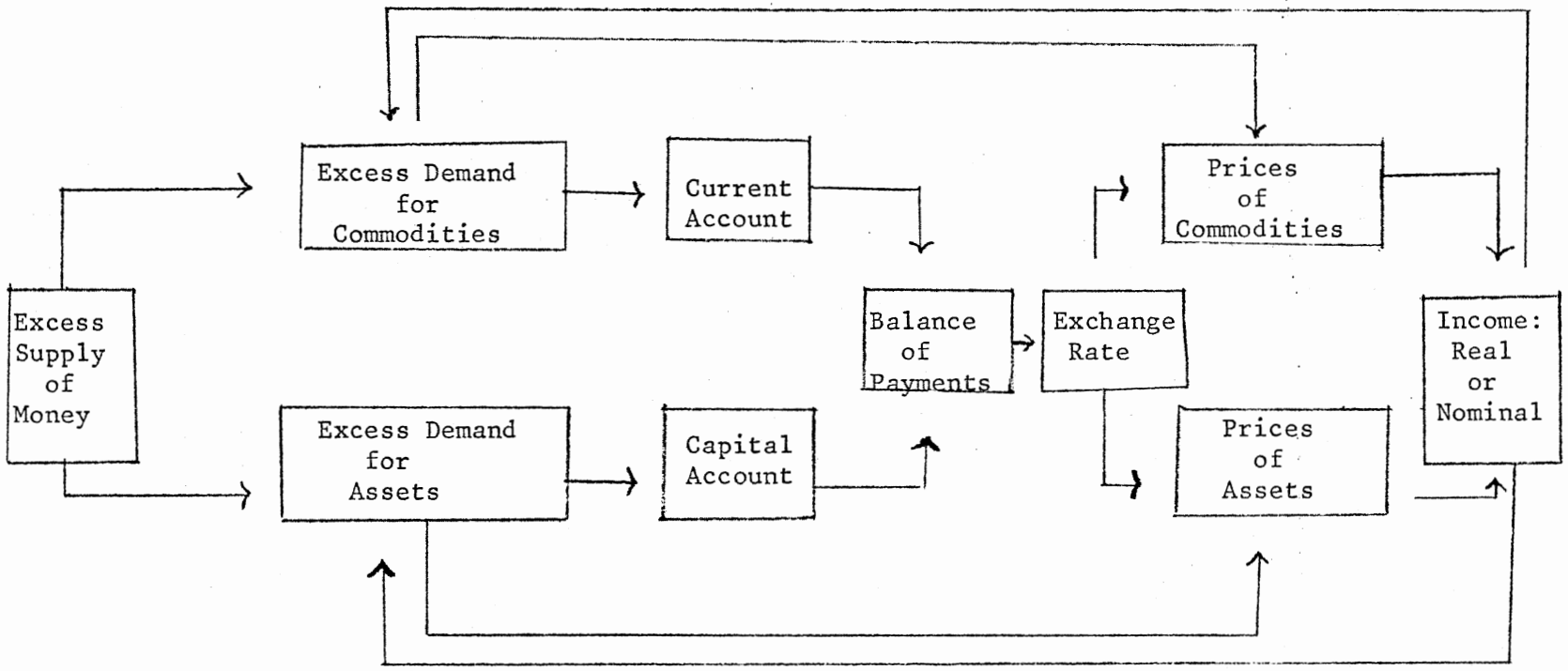

Figure 1. Flow Chart of Money-Income Transmission Mechanism

Let there be an increase in the monetary base and the money supply of country A. The domestic excess supply of money in A is reflected in excess demand for commodities and financial assets. An excess demand for commodities spills over into the current account and the excess demand for financial assets spills over into the capital account of the balance of payments. These changes lead to a deficit in the balance of payments owing to a relatively larger extent of financial claims or commodities being acquired from country B.

In order to cater to the increasing demand for commodities in country A, the output of country B expands and the demand for financial assets in country B enhances the returns on financial assets of country B, both leading to the increased income levels of country B in the short run.

If the increased money supply results in excess demands for financial assets and nontradeable commodities in country A, the prices of these goods or assets increase and encourage the output of those commodities and enhance the returns on financial assets. This would result in increased income levels in A. In general, the excess supply of money would not create excess demand exclusively for tradeable commodities or financial assets. It partly affects both the tradeables and nontradeables, commodities and financial assets. Thus, the income levels of both countries, A and B are affected due to a given change in the money supply conditions.

What has been delineated above is most easily seen in the case of a fixed exchange rate regime. With flexible exchange rates, the transmission mechanism becomes somewhat more complex. The deficits in the balance of payments caused by the change in A's money supply creates

pressures on the exchange rate of country A vis-a-vis country B. If the exchange rate is allowed to be flexible, the relative prices of commodities or returns on the financial assets would change. This encourages production of certain commodities at home (A) resulting in increased domestic output. It stimulates imports of certain goods that are relatively cheaper to buy from B resulting in the increased production in B.

Let us consider the role of expectations in this money-income nexus. For example, take the case of expectations in the asset market. According to the monetary approach to exchange rates, the relative prices of national monies are determined in the asset market (Frenkel, 1976). The short-term fluctuations in asset prices are thought to be caused by the expectations of asset holders concerning the returns they expect to accrue to particular assets. One of the critical variables affecting the asset holders' expectations regarding the returns is their forecast of the future supplies of various national monies (in general equilibrium sense, it refers to excess supply of or demand for money). It has been shown that expectations regarding the money supply generate exchange rate expectations (see, e.g., Black, 1972, 1973; and Mussa, 1978). The basic idea is that if the currency of A is expected to appreciate, the increase in demand to hold that currency forces its appreciation, unless the central bank of country A expands its money supply to match the entire additional demand. If the central bank fails to do so, or partially expands the money supply, exchange rate expectations are likely to affect the prices of internationally traded goods and, thus, cause fluctuations in the short run output. Moreover, as the demand for money increases, it affects the variables that enter into the money demand function; i.e., prices, income and expected returns on asset holdings.

The essence of the above explanation is that changes in the money supply, irrespective of the country of origin, affect income levels of other countries; the impact of those changes is not confined to the country of origin. In that case, it is the world money supply or world output or world price level that assumes significance. In a dynamic sense, the process does not stop where this analysis does. The central banks or governments or international financial institutions like the World Bank and the IMF might react to changing income, employment and price level conditions that might result in further changes in the money supply and repeating the whole process. Real variables like the real income are crucial in affecting the exchange rate and the balance of payments. As countries undergo rapid growth of real income, it is reflected by the rapid growth of demand for money. This is shown in Figure 1 by counter-clockwise arrows. Fluctuations in real income around the normal trend are likely to affect the exchange rate and balance of payments. It becomes increasingly difficult then to determine whether the change in the money supply is a consequence of the change in income or vice versa. The question of causality becomes important in this context.

It is important to allay an impression one may tend to get from this study. It is not the intention of this study to demonstrate that the world money supply exclusively determines world money income. Non-monetary considerations are equally important. The underlying reasoning is that non-monetary disturbances or changes spill over into money supply and demand conditions. The impact of factors such as tariffs, quotas, exports, imports, transfer of technology, international movements of labor and capital and other such similar factors would reflect on money supply changes that countries might undergo in terms of changes in

foreign exchange reserves or in the domestic money supply or in the balance of payments. In the absence of a specific model, it may not be appropriate to analyze the impact of each of these factors on the world money supply, output and price level. For example, take the effects of a tariff in country A. A tariff increases the domestic money prices of imported goods and import substitutes in country A. The increased prices in A reduce the real value of initial nominal money stock and cause disequilibrium in the money market. The latter sets in motion a process of adjustments. The process of adjustments will vary from model to model (see Mussa, 1976 for details). However, the BOP is nothing but the difference between income and expenditure, a tariff affects the BOP to the extent that it affects the said discrepancy. Once the BOP is affected, it affects money supply or income through the various channels as shown in Figure 1.

International Transmission of Inflation

In the above discussion, the money-income transmission mechanism has been elaborated wherein the price level is considered to be an indispensable channel that links the money supply with income. The money-income nexus for the world as a whole is conspicuously absent in the relevant economic literature. However, a great deal of attention has been paid to the phenomenon of world inflation. Jean Bodin and David Hume were concerned about the problem of inflation at the world level. In 1912, Fisher considered this problem and wrote the following:

> The whole civilized world is now eager to know whether in the future the high cost of living is to advance further, recede or remain stationary. Opinions are plentiful but the data supporting them are few. Even the best forecasts I have seen appear to be based on a very incomplete comprehension of the problem. Many conceive it as a problem of ordinary supply and

> demand and discuss the general price level as they would discuss the price of wheat or other commodity, overlooking the fact that causes affecting price levels are as distinct from those affecting an indiviaual price as the causes affecting the tides are distinct from those affecting an individual wave (p. 531).

Several decades after Fisher wrote the above, the concern remains more or less the same. In wake of the demise of the Bretton Woods system and oil-crisis that accelerated the pace of inflation in 1970's, a great deal of attention is being paid to the world prices (see, e.g., Hinshaw, 1972; Johnson, 1975; Laffer, 1975; Meiselman, 1975; Parkin and Zis, 1976a, 1976b; Frisch, 1977). The global monetarists dealing with the law of one price usually test for equality of inflation rates in various countries (see Genberg, 1976a, 1976b, 1977; Isard, 1977; Kravis and Lipsey, 1977, 1978). Most studies on the market integration hypothesis examined the problem of inflation for several open economies and are not directly relevant for this study where the world as a whole is treated as a closed system. However, these studies serve the purpose of providing a good background against which a case of the world economy can be examined. They illustrate the international transmission of inflation that underlies the present study in its treatment of the world economy as a whole to be a closed system. The following section briefly deals with the international transmission of inflation to provide a complete and comprehensive account of money-income transmission mechanism.

Following an OECD survey (1973) and Frisch (1977), the international transmission of inflation under a system of fixed exchange rates can be grouped into four channels:

1. Price Effects: It refers to the external influences on domestic prices and costs; i.e., a direct transmission of inflation via internationally traded goods. It is argued that the arbitrage for traded

goods in the international markets equates real domestic good prices with foreign prices allowing for adjustments of exchange rates. Such effects could originate from the imports of raw materials that cannot be produced domestically or from the competitive imports or from an overall rise in the world market prices. The monetary approach to the balance of payments (Johnson, 1972; Swoboda, 1976) and the Scandinavian "structuralists" (e.g., Odd Aukrust, 1976) emphasized this channel. Bela Balassa (1964) explained that the differing rates of inflation across nations in the world are the result of varying rates of inflation for non-traded goods among countries.

2. Demand Effects: Excess demand for goods spills from one country to another and, thereby, generates inflationary demand pressures. The LINK-models (e.g., Waelbroeck, 1976) have emphasized this channel of transmission of inflation.

3. Liquidity Effects: The MABOP focuses on the interrelationships between the BOP, the supply of money and nominal income (Johnson, 1972). These models assume the stability of demand for money function and the operation of the real balance effect (Swoboda, 1976). The basic idea is that the excess demand for goods may result from the excess real balances held and, thereby, affect the BOP position.

4. International Inflationary Expectations: Movements in the prices of internationally traded goods and the movements in the prices of non-traded goods across countries may generate inflationary price expectations. It is unlikely that a country can remain an 'island of stability' in the world of inflation (OECD, 1973).

These four channels are said to be valid only in the case of fixed exchange rate regime. The literature on fixed versus flexible exchange

rates maintains that the monetary effects of external transactions can be sterilized under the latter and, hence, the same channels of international transmission of inflation are not valid in case of flexible exchange rates. As has been maintained in Chapter II, the distinction between the two exchange rate regimes is very thin. It is assumed in this study that the same channels hold good in the case of present floating exchange rates. Machlup (1975, p. 58) observed, "under managed floating, official interventions, however unsystematic, may temporarily set in operation the same mechanism that transmits inflation from country to country under a system of fixed rates." He explained that the present system of floating has not eliminated the transmission of international inflation and concluded that inflation had made the departure from fixed rates inevitable.

The channels of international transmission of inflation can be delineated in terms of Figure 1 that depicts the money-income transmission mechanism. The price effects as representing the external influence on the domestic prices and costs (imported inflation) can originate from the BOP disequilibrium and will lead to price changes via changes in exchange rates. Demand effects run in terms of excess demand for goods that lead to the price changes via BOP and exchange rate changes. The liquidity effects channel is, in fact, the excess money supply argument that leads to the price changes via different international adjustments as shown by the arrows in Figure 1. International inflationary expectations can arise at many of the adjustment channels envisaged in Figure 1. Such expectations can be formed looking at one or many of these adjustment channels; excess supply of money, excess demand of goods or financial assets, BOP position, and exchange rate changes.

It may be argued that the price effects and demand effects imply that monetary variables follow a passive and accommodative course, whereas liquidity effects might imply that the monetary variables are more important determinants of price formation (see OECD, 1973). As far as this study is concerned, this is a misconception. Price effects and demand effects are the products of the broader problem of disequilibrium in the world money market. The excess demand for goods is the result of the excess supply of money and the price effects that originate from the different channels shown in Figure 1. These effects are in the first place caused by the excess supply of money.

Summary

The major thrust of this chapter was to delineate the money-income transmission mechanism and international transmission of inflation for the world economy as a whole in a two-country framework. The purpose of this study has been to examine the interrelationships among world money supply, world income (output), and inflation. That is, to what extent the world aggregates of output and money supply help predict the world inflation. In other words, it is assumed that whatever the causes of worldwide inflation, they are expected to influence the money supply and output variables. Money supply could be a surrogate for monetary factors affecting inflation and output variable is a proxy for non-monetary factors affecting inflation.

CHAPTER V

MONEY-INCOME NEXUS: EMPIRICAL EVIDENCE

Introduction

The foregoing chapter narrated the money-income nexus. This chapter is an attempt to provide empirical evidence on the relationships between the world aggregates of money supply and output. While there are a plethora of studies on money-income relationships for individual countries, no such study exists for the world economy as a whole. The MABOP, the monetary approach to exchange rates and the global monetarism are primarily concerned with the problems of BOP, exchange rates and the 'law of one price', respectively. These approaches consider the open economy models of individual countries but do not address the question of global money-income relationships when the globe itself is considered as an economic unit. To fill the above gap, the money-income nexus is established in this chapter using the money supply and income data of 36 countries for the period, 1953-76.

This chapter is divided into two main sections. First, the world is disaggregated into the three major groups as is done in Chapter III. The reasons underlying this disaggreagation are the same as explained in that chapter. The hypotheses of relationships between the nominal activity and money supply are examined for each group. The model used to test the hypotheses takes the general form of establishing relationships among variables. The purpose of this section is to make it clear

that the basic relationships envisaged are the same for all the groups and the constituents do not in fact exhibit different behavior patterns. Second, an attempt is made to establish the causal relationships between the world money supply and nominal income and establish the direction of money-income relationships if any. This section further elaborates on the likely distribution of the lag structure of money-income relationships for the world economy.

Hypotheses

The following hypotheses are stipulated in order to examine the basic relationships between the world money supply and world output, between the money supply and output for each group and to determine the role of U.S. money supply in influencing the global nominal activity:

Global

GWP = f (WMS)

GWP = f (EUSWMS, USMS)

GWP = f (EUSWMB, USMS, OMS, LMS)

GWP = f (WMB)

GWP = f (EUSDMB, USMB)

GWP = f(EUSDMB, USMB, OMB, LMB)

Developed Countries

DGDP = f (DMS)

DGDP = f (DMS, USMS)

DGDP = f (DMB)

DGDP = f (DMB, USMB)

DGDP = f (EUSDMS, USMS)

DGDP = f (EUSDMB, USMB)

Oil-exporting Countries

OGDP = f (OMS)

OGDP = f (OMS, USMS)

OGDP = f (OMB)

OGDP = f (OMB, USMB)

Developing Countries

LGDP = f (LMS)

LGDP = f (LMS, USMS)

LGDP = f (LMB)

LGDP = f (LMB, USMB)

It has been often observed that U.S. monetary expansion caused worldwide inflation and, hence, influenced nominal activity around the world. In this context, it is worthwhile to examine whether the U.S. money supply did influence global activity and whether this influence is dominant, be it the developed countries, oil-exporting countries, or less developed countries.

Since the U.S. is the largest constituent of the world economy as far as money and output aggregates are concerned, this itself can be considered as one of the groups. This further disaggregation is done in order to isolate and discuss the impact of the U.S. money supply on the world economy and on the other constituents of the latter like the developed countries excluding the U.S., oil-exporting, and developing countries.

Logue and Sweeney (1978) investigated the hypothesis whether the money stock of the so-called World's Banker, the U.S., is more important than the rest of the money stock of OECD countries in the determination

of nominal activity for the same group. The authors examine various regression models for 16 OECD countries for the period under fixed exchange rates. The study suggested that the U.S. money supply was responsible for nominal activity in 16 OECD countries. The same hypothesis has been more extensively examined in the present study including the oil-exporting and developing countries.

On a global level, it is cumbersome to analyze how different monetary policy instruments affect nominal activity. Assuming that monetary policy changes are likely to affect the monetary base, the latter has been employed as an argument in relations stipulated above for each group.

IFS is the main source of data. Measures of nominal activity are obtained from the annual data of GDP for 36 countries in terms of their respective groups. The money supply concepts are the same as developed in Chapter III. GDP data are weighted by SDR rates for a given country in order to have a common denominator and for smoothing of fluctuations in currency values due to exchange rate changes. The reasons for using SDR weights are the same as explained in Chapter III where these weights were used in constructing the aggregate of world money supply.

Empirical Results

In this section, hypotheses mentioned above are examined with the help of standard statistical testing procedures. The first part considers the money-income relationships for the world as a whole and elaborates on the relationships between the money and income aggregates of respective groups of countries. Second, the effects of U.S. money supply and monetary base on the nominal global activity are examined

and, third, the impact of U.S. money supply and monetary base on the nominal activity for the country groups is discussed.

Table V reports the empirical results of the relationships between money and income for the world and group aggregates during 1953-1976. All estimates are satisfactory in terms of R^2 and t-statistics. The estimates have been corrected for the first order autocorrelation using the Cochrane-Orcutt iterative technique. The coefficients for money supply measures such as WMS, DMS, OMS, and LMS are significantly different from zero in explaining variations in the corresponding output measures of GWP, DGDP, OGDP, and LGDP. The same results hold good for the monetary base measures such as WMB, DMB, OMB, and LMB. The coefficient of money supply is the largest for developing countries, followed by oil-exporting and developed countries. This indicates that an unit increase in the money supply in developing countries generates relatively more nominal activity, possibly because of underemployment of resources. In contrast, the coefficients of monetary base of less developed and oil-exporting countries are relatively small.

In order to test for the equality of slope coefficients of three groups (i.e., the coefficients of DMS, OMS, LMS in Table V), the technique of seemingly unrelated regression estimation (SURE) proposed by Zellner (1962) is used for a group of three equations. The test considers the hypothesis that DMS, OMS, and LMS have the same slope coefficients in their relations to GWP:

$$H_0 : \beta_{DMS} = \beta_{OMS} = \beta_{LMS} \quad .$$

Following Zellner, this study uses the likelihood ratio test for

TABLE V

STATISTICAL RESULTS FOR MONEY-INCOME RELATIONSHIPS, 1953-1976

Dependent Variable	Independent Variable	Estimated Coefficient	Constant	SSE	R^2	ρ	t-Statistic for ρ
GWP	WMS	1.161	210.592	.055	.997	.741	5.036
		(28.998)	(2.585)				
DGDP	DMS	1.415	347.156	.062	.994	.686	4.528
		(22.723)	(4.420)				
OGDP	OMS	1.745	25.649	.084	.995	.883	9.001
		(20.772)	(2.792)				
LGDP	LMS	2.959	31.506	.171	.985	.598	3.583
		(17.267)	(2.939)				
GWP	WMB	6.084	692.405	.072	.995	.934	12.524
		(11.163)	(2.009)				
DGDP	DMB	9.422	105.496	.636	.991	.786	6.009
		(14.792)	(6.654)				
OGDP	OMB	2.307	61.629	.116	.996	.954	15.308
		(19.846)	(3.218)				
LGDP	LMB	2.751	220.162	.364	.981	.946	14.014
		(7.543)	(4.294)				

Note: 1. All estimates of coefficients are significantly different from zero at 5 percent level.

2. Estimates have been corrected for serial correlation using the Cochrane-Orcutt technique and hence estimates of ρ and its t-Statistic are presented. OLS estimation for each equation showed indications of serial correlation.

3. Figures in parentheses are t-Statistics.

micro-regression coefficient vector equality. Using the SURE technique, the log likelihood functions are obtained with and without the restrictions on the coefficients and estimated log likelihood ratio (log λ) is obtained.

The test is performed in the following manner:

$$-2 \log \lambda \sim \chi^2_{m-1}$$

where λ is the ratio of estimated likelihood function with and without the restrictions on the coefficients. Converted into the log form, it is the difference between the log likelihood functions with and without restrictions on the coefficients, and m refers to the number of equations. In the present study,

$$-2(-310+299) \sim \chi^2_{m-1}$$

$$-2(-10) \sim \chi^2_2$$

χ^2 table value with 5 percent level of significance and 2 degrees of freedom is 5.99. Thus the hypotheses of the equality of slope coefficients among the three groups is rejected.

Note the above result that the increase in the value of output due to a change in the money supply is greater in the underemployment resource economies than in the full employment resource economies. This is true since it is not necessary in the underdeveloped countries to reduce the output of one good to increase the output of another. More explicitly, in the case of internationally traded goods, it is not necessary for developing countries to reduce the output of the export good in order to increase the output of the import good (import

substitute) or vice versa. These changes affect the balance of trade. It may be recalled from Chapter IV that it is the BOP that links the two economies. Changes in the BOP set in motion a process of adjustments that causes changes in money supply or output. The above results indicate then that the monetary approach to the balance of payments is not limited to the fully employed economies; it may equally apply to the developing countries or to a "Keynesian" model.

Statistical results for the importance of U.S. money supply and monetary base for the world economy are presented in Table VI. The previous section on hypotheses described the reasons for isolating the impact of U.S. money supply on the global activity. Both the U.S. money supply and global money supply excluding the U.S. money supply account for substantial variations in the global nominal activity. The coefficient of U.S. money supply (1.72) remains larger than that of the world money supply excluding the U.S. (1.05). This suggests that the U.S. money supply wields strong influence on the world nominal activity. When the world money supply is further disaggregated into the four aggregates of EUSDMS, USMS, OMS, and LMS, the U.S. money supply remains significant. However, the size of the coefficient of USMS is less than that of OMS and LMS, a result that is consistent with the results and explanation of Table V.

F-tests for each of the estimates in Table VI using restricted and unrestricted regressions showed that USMS and USMB are significantly different from zero and USMS is an important factor in generating worldwide nominal activity.

When the monetary base aggregates are used instead of money supply aggregates, the same results are obtained except that the order of the

TABLE VI

U.S. MONEY SUPPLY, U.S. MONETARY BASE, AND WORLD NOMINAL ACTIVITY, 1953-1976

Dependent Variable	Independent Variable	Estimated Coefficient	t-Statistic	R^2	ρ	t-Statistic for ρ
GWP	EUSWMB	5.175	10.549	.998	.792	6.227
	USMB	26.146	7.853			
GWP	EUSWMS	1.045	6.920	.997	.690	4.568
	USMS	1.721	2.445			
GWP	EUSDMB	5.930	4.052	.998	.789	6.153
	USMB	25.749	7.503			
	OMB	7.929	4.836			
	LMB	4.643	3.076			
GWP	EUSDMS	.005	3.016	.998	.527	2.971
	USMS	3.681	8.447			
	OMS	5.637	4.836			
	LMS	8.496	3.383			

Note: same as in Table V.

size of coefficients changes. The size of USMB remains substantially high and that further emphasizes the importance of the U.S. in influencing the global nominal activity.

A further disaggregation of the measure of global nominal activity is done in terms of the major country groups to ascertain the impact of U.S. money supply on each country group. The results are shown in Table VII. For the developed countries, both the USMS and USMB are significant with or without including USGDP. The estimates of coefficients of USMS and USMB are relatively larger than that of DMB and DMS with or without the relevant U.S. aggregate. This suggests the prominence of the U.S. money aggregates in generating nominal activity in the developed countries. In the case of oil-exporting countries, both USMS and USMB remain statistically significant, but the size of the coefficients is relatively smaller; i.e., relative to their own corresponding money aggregate. This indicates that both USMS and USMB are significant in generating the nominal activity in the oil-exporting countries but not to the extent as in the other developing and the developed countries.

For developing countries, the USMB is significant but USMS is not. The insignificance of USMS for the developing countries in influencing the nominal activity is surprising in view of our commonplace understanding that the developing countries need the dollar to buy technology and other paraphernalia of development. It is likely that the demand for the U.S. dollar is reflected in their foreign exchange reserves which are not large enough relative to the other groups of countries. Hence the level of the U.S. money supply does not dominate the generation of nominal activity in the developing countries. It is

TABLE VII

USMS, USMB, AND NOMINAL ACTIVITY FOR COUNTRY GROUPS, 1953-1976

Dependent Variable	Independent Variable	Estimated Coefficient	t-Statistic	R^2	ρ	t-Statistic for ρ
EUSDGDP	EUSDMS	0.856	6.635	.995	.518	2.098
	USMS	1.064	2.897			
EUSDGDP	EUSDMB	4.727	5.591	.992	.785	6.607
	USMB	12.746	3.618			
DGDP	EUSDMS	0.796	4.286	.995	.478	2.607
	USMS	3.222	6.114			
DGDP	EUSDMB	5.591	5.188	.995	.818	6.826
	USMB	27.283	6.078			
OGDP	OMS	1.598	23.068	.995	.204	1.002
	USMS	.084	5.921			
OGDP	OMB	2.231	20.234	.995	.519	2.912
	USMB	.842	5.281			
LGDP	LMS	2.867	7.344	.985	.570	3.328
	USMS	.025	.315			
LDGP	LMB	2.939	9.538	.988	.604	3.632
	USMB	2.392	6.261			

rather the excess of demand for the U.S. dollar in the developing countries that determines the direction of dependence. It is partly reflected in the significance of the U.S. monetary base.

Money-Income Nexus and Causality

At the outset, it is appropriate to discuss the concept of causality. Zellner (1979) reviewed the concept of causality[1] as used in the economics and econometrics literature and concluded that

> . . . the mechanical application of causality tests is an extreme form of 'measurement without theory', perhaps motivated by the hope that application of statistical techniques with the delicate and difficult work of integrating statistical techniques and subject matter considerations will be able to produce useful and dependable results . . . this hope is generally naive and misguided (p. 51).

He maintained that the concept of causality needs to be defined in terms of predictability according to a theory. Predictability without theory is not causation. However, good predictability itself may not be sufficient enough to support causality. Tobin (1970) pointed out the dangers of accepting the time series evidence as empirical proofs of the propositions about causality. Using an ultra-Keynesian model where money has no causal relation, he showed that the model yielded more favorable results to the idea that money is causally important than did Friedman's own model. In view of these, the results of the present study in terms of causality test should be taken as suggestive rather than as proofs of certain propositions.

As far as this study is concerned, the preceding chapter provided the theory relevant to the money-income relationship for the world as a whole, the direction of causation being expected a priori from money to

income. Alternatively, it was also suggested in that chapter that the changes in the income levels may affect the money demand function causing a disturbance in the money market, i.e., the direction of causality may be expected from income to money.

This section examines empirically the direction of causality using a simple specification in terms of allowing the possibility of two sided relationships between world money supply and world nominal income. The test is performed in terms of sets of coefficients representing the lead and lagged variables of interest. Filtering and transformations of series are avoided in view of the principle of parsimony and simplicity in modeling relationships (Zellner, 1979). The general procedure followed is similar to Mills and Woods (1977) who examined the money-income relationships for the British economy under the fixed exchange rate regime.

In this study, the time series of world money supply is computed from year-end stock data of various countries and the time series of world nominal income is calculated from the nominal GDP series for 36 countries; the GDP is a measure of the annual flow of activity. Assuming that the world money supply generates nominal gross world product, the world money supply of the current period needs to be treated as a lead value because the current stock variable might be causing the lead flow variable. Similarly, if GWP causes WMS, the contemporaneous GWP can be treated as a lag observation because the current stock observation of money supply could be affected by the lagged flow observation of nominal output. Thus, even within a particular year, there is an implied causal relationship either WMS causing GWP or GWP causing WMS.

The following model is used to test for the causality of money-income relationships:

$$GWP_t = \lambda_{10} + \lambda_{11}T + \sum_{i=0}^{2} \gamma_{1i} \; WMS_{t+i} + \sum_{j=1}^{2} \theta_{1j} \; WMS_{t-j} + \varepsilon_{1t} \qquad (1)$$

$$WMS_t = \lambda_{10} + \lambda_{21}T + \sum_{i=1}^{2} \gamma_{2i} \; GWP_{t+i} + \sum_{j=0}^{2} \theta_{2j} \; GWP_{t-j} + \varepsilon_{2t} \qquad (2)$$

To account for the flow and stock distinction made above, Equation (1) treats WMS_t as a lead variable in spite of its being contemporaneous and GWP_t is considered as a lag variable in Equation (2) for the same reason.

A linear time trend (T) has been added in the specifications (1) and (2) which partially accounts for serial correlation as lagged variables are likely to be correlated overtime. For the precise results and significance tests, it is assumed that the error terms are generated by first order autoregressive processes and the Cochrane-Orcutt technique is used to account for this serial correlation.

To test for unidirectional causality from WMS to GWP, the following conditions are hypothesized:[2]

$$\gamma_1 = \{\gamma_{10}, \gamma_{11}, \gamma_{12}\} = 0$$
$$\theta_1 = \{\theta_{11}, \theta_{12}\} \neq 0$$
$$\gamma_2 = \{\gamma_{21}, \gamma_{22}\} \neq 0$$
$$\theta_2 = \{\theta_{20}, \theta_{21}, \theta_{22}\} = 0$$

Similarly, for unidirectional causality from GWP to WMS, it is expected that

$$\gamma_1 = \{\gamma_{10}, \gamma_{11}, \gamma_{12}\} \neq 0$$
$$\theta_1 = \{\theta_{11}, \theta_{12}\} = 0$$
$$\gamma_2 = \{\gamma_{21}, \gamma_{22}\} = 0$$
$$\theta_2 = \{\theta_{20}, \theta_{21}, \theta_{22}\} \neq 0$$

If the first set of conditions holds, changes in GWP are caused by the changes in WMS and the reverse holds if the second set of conditions is satisfied. If none of the sets of conditions is satisfied, it implies that the relationships between money and income is not unidirectional.

The results of the estimation of (1) and (2) are reported in Table VIII. The overall fit of the Equations (1) and (2) is satisfactory in terms of the high R^2, F-statistic, and the Durbin-Watson statistic. The time trend variable included in both the equations is significantly different from zero. The Cochrane-Orcutt iterative technique is used, but it yields the low estimates of ρ. This suggests that in the time series measures of the world money supply and nominal activity used in this study and specified in terms of Equations (1) and (2), the error terms are not autocorrelated. Whatever time dependency is there in the series is explained by the time trend variable. Thus, the estimations of (1) and (2) seem to be quite satisfactory and the results of this empirical estimation are very reliable.

The tests of significance of the hypotheses noted above in terms of the first and second sets of conditions are conducted by looking at the F-statistics that are computed from the estimates of (1) and (2) with and without the relevant restrictions specified above. The results are reported in Table IX.

Note that the formula used in computations of F* is

TABLE VIII

EMPIRICAL RESULTS FOR WMS-GWP RELATIONSHIPS, 1953-1976

	Equation 1			Equation 2	
Coefficient	Est.	Standard Error	Coefficient	Est.	Standard Error
γ_{10}	.62	.15	γ_{21}	.04	.01
γ_{11}	-.05	.04	γ_{22}	.04	.01
γ_{12}	-.02	.01	θ_{20}	.73	.18
θ_{11}	.22	.12	θ_{21}	.29	.16
θ_{12}	.20	.08	θ_{22}	.09	.09
λ_{10}	116.55	24.7	λ_{21}	-205.88	29.2
λ_{11}	30.72	4.1	λ_{21}	-36.77	6.5
ρ	.32	.19	ρ	.29	.19
D.W.	1.82		D.W.	1.82	
SSR	3314		SSR	2477	
R^2	.99		R^2	.99	
F	498		F	271	

TABLE IX

MONEY-INCOME NEXUS: F-TEST FOR THE TWO SETS OF HYPOTHESES

	Restrictions			
	Equation 1		Equation 2	
	$\gamma_1 = 0$	$\theta_1 = 0$	$\gamma_2 = 0$	$\theta_2 = 0$
SSR(R)	6645.5	15879.1	34878,4	4103,4
n	24	24	24	24
q	3	2	2	3
F*	4.2	13.9	55,6	2,2
$F_{(.01)}$	4.7	4,3	4,3	4,7
Conclusion	$\gamma_1 = 0$	$\theta_1 \neq 0$	$\gamma_2 \neq 0$	$\theta_2 = 0$

$$\frac{SSR(R) - SSR(NR)}{(n-q) - (n-k)} \div \frac{SSR(NR)}{n - k}$$

where: R refers to the restricted estimates and NR denotes no restrictions.

SSR = error sum of squares.

n = number of observations.

k = number of parameters (7 in this model).

q = number of restrictions.

F* is calculated F-statistics.

These are the symbols that are used in Table IX.

Since the joint test of hypotheses is a sharper test and the statement of a unidirectional causality of money-income relationships is a strong assertion, it may be important to evaluate these results employing a higher level of significance. Hence employing 1 percent significance level, the first set of conditions are satisfied where it is found that $\gamma_1 = 0$, $\theta_1 \neq 0$, $\gamma_2 \neq 0$, and $\theta_2 = 0$. These results suggest that the causation runs from money to income for the world economy as a whole. The condition that $\gamma_1 = 0$ implies that the future money supplies do not affect the current level of nominal output. The hypothesis that $\theta_1 \neq 0$ suggests that the one and the two period lagged values of the world money supply affect the global nominal activity in the current period.[3]

As regards the coefficients of Equation (2), the lead coefficients, γ_{21} and γ_{22} are significant although the value of coefficients is very low (.04). But the condition that $\gamma_2 \neq 0$ is satisfied. The significance of the lead variables implies that the future levels

of nominal activity are influenced by the current level of the world money supply. This is consistent with the condition, $\theta_1 \neq 0$, in that the past levels of money supply affect the current level of global nominal activity. In Equation (2), the coefficients θ_{21} and θ_{22} are not significant. This suggests that the current level of money supply is not influenced by the past levels of the measure of global nominal activity.

However, the conventional econometric results are interpreted at 5 percent level of significance. When the computed F-statistics are viewed this way, $\gamma_1 \neq 0$, $\theta_1 \neq 0$, $\gamma_2 \neq 0$ and $\theta_2 = 0$, the results do not satisfy either set of conditions. Since γ_1 is not significant at 1 percent level but significant at 5 percent level, it is undesirable to reject the hypothesis for γ_1. This implies that there is no evidence for a strict unidirectional causality from either money to income or vice versa. Rather, there is a possibility of simultaneous or bidirectional causality as far as money-income nexus for the world economy is concerned. The same point is emphasized and illustrated in Chapter IV. Given the validity of the methodology used in this study, the results seem to lend some support to the unidirection of causality from money to income; the results, however, do not support the alternative hypothesis.

In order to highlight the role of the world monetary base in the determination of GWP, the WMS is replaced by WMB in Equations (1) and (2) and the empirical estimates are reported in Table X. Once again, the results are quite similar. The F-test on the two sets of hypotheses indicated that neither set of conditions is satisfied. This is interpreted to mean that there may not be a strong unidirectional

TABLE X

EMPIRICAL RESULTS FOR WMB-GWP RELATIONSHIPS, 1953-1976

	Equation 1			Equation 2	
Coefficient	Est.	Standard Error	Coefficient	Est.	Standard Error
γ_{10}	3.39	.83	γ_{21}	.08	.002
γ_{11}	-.41	.72	γ_{22}	.08	.002
γ_{12}	-.14	.98	θ_{20}	.15	.003
θ_{11}	1.11	.59	θ_{21}	.23	.02
θ_{12}	1.08	.43	θ_{22}	.99	.02
λ_{10}	-153.41	46.6	λ_{20}	-.60	14.6
λ_{11}	64.41	6.4	λ_{21}	-9.88	2.3
ρ	.57	.18	ρ	.66	.16
R^2	.95		R^2	.90	
F	326		F	111	

relationship from WMB to GWP or vice versa. The possibility of simultaneous or bivariate relationship is not ruled out.

Distributed Lag Structure for Money-Income Relationships

The above test did not use any kind of distributed lag model. However, some inference can be drawn about the likely pattern of lags from the estimates of coefficients of WMS. The largest variations in nominal activity are explained by the contemporaneous world money supply, followed by WMS lagged one period, and WMS lagged for two periods. Similarly, when WMB is used as a surrogate for the monetary changes, the coefficient value of contemporaneous WMB is the largest, followed by one and two period lags, respectively.

An attempt was made to obtain the distributed lag structure estimates for the WMS-GWP and WMB-GWP relationships. After several trials, it was found that a third degree polynomial with far or near restrictions yielded satisfactory results given the number of observations. The results were corrected for the first order serial correlation using the Cochrane-Orcutt iterative technique. The results are reported in Table XI. The results are very much similar to those reported in Table VIII and X. The t-statistics for the distributed lag structure for both WMS and WMB suggest the coefficients of contemporaneous and one period lagged variables are significantly different from zero. The reported lag structure seems good in terms of R^2, D.W. and the estimates of coefficient of first order autocorrelation. In both the estimates, the contemporaneous coefficients have larger values compared to the one period lagged estimates of coefficients. However,

TABLE XI

DISTRIBUTED LAG STRUCTURE FOR WMS-GWP
AND WMB-GWP RELATIONSHIPS

GWP = f(WMS)

lag	Coefficient	t-Statistics
0	1.110	2.431
1	.761	3.861
2	-.145	-.491
3	-.699	-1.341

R^2 = .98 D.W. = 2.08 ρ = .83 t-statistic for ρ = 7.244

GWP = f (WMB)

lag	Coefficient	t-Statistics
0	4.931	2.240
1	3.982	4.143
2	.568	.405
3	-1.898	-.760

R^2 = .97 D.W. 1.98 ρ = .71 t-statistic for ρ = 4.76

Note: Estimates have been corrected for first order serial correlation using the Cochrane-Orcutt iterative technique.

there seems to be apparent conflict for the second period lagged values in estimations of (1) and (2) and distributed lag estimation. The explanation for this apparent conflict lies in the form of data and specification that are used in this study. As WMS relates to the year-end stock data while GWP is derived from the annual flow data, two period lagged variables do not become significant unless some lead variables are used as done in the estimations of (1) and (2). This gives an impression that actual lags involved lie between one and two years, perhaps on average, say 18 months.

Summary

This chapter provides the empirical evidence on the money-income relationships for the world economy as a whole and for each group of countries. It shows that the U.S. money supply is an important factor in generating the nominal activity for the world economy as a whole and for each group of countries. The question of causality in money-income relationship is discussed and the empirical evidence lends some support to the idea that the direction of causality may be from money to income. However, the empirical evidence is weak. The possibility of simultaneous or bidirectional causality is not ruled out. The results indicate that it takes about an average of 18 months for the money supply to influence the level of the global activity.

FOOTNOTES

[1]This note briefly discusses some of the important studies on money-income causality for individual economies. Sims (1972), used a direct test for the existence of unidirectional relationship in most effieicnt techniques of distributed lags. Using the U.S. data for the period 1947-1969, Sims concluded that

> . . . the main empirical finding is that causality is unidirectional from money to income agrees with the post-war U.S. data, whereas the hypothesis that causality is unidirectional from income to money is rejected . . .

and that

> . . . the evidence agrees quite well with a null hypothesis that causality runs entirely from money to GNP without feedback (p. 54).

Williams, Goodhart, and Gowland (1976) attempted to replicate the same exercise using the U.K. data with a presumption that the Sims' results might be peculiar to his sample and may not have general validity in all economies. They concluded that ". . . the evidence indicating the direction of causality between money and income in U.K. is much less clear cut than that which was found in his (Sims) examination of U.S. data" (p. 423). The authors alluded to a possibility of simultaneous causality which might be the result of a more complicated relationship between money and income.

The question of causal relationship between money and income takes another dimension when Mills and Wood (1978) provided alternative interpretations of failure to find causality in case of U.K. data and reconcile the issue by recognizing the importance of exchange rate regimes in determination of money - income relationships. However, they concluded that ". . . there is unidirectional causality between Y and M, the direction of causality being from Y to M . . ., there is no evidence to suggest that there is any causality running from M to Y" (p. 25).

[2]These conditions are similar to those of Mills and Wood (1978, p. 25) in testing the causality of money-income for the U.K. under a regime of fixed exchange rates.

[3]This evidence is consistent with the empirical evidence on the MABOP. For example, Mussa (1976, p. 337) commented: ". . . the empirical evidence which justifies the assumption of a stable money-supply process and a stable money-demand function applies to periods of a year or more, rather than to periods of a month or a quarter."

CHAPTER VI

INFLATION AND UNANTICIPATED CHANGES IN WORLD MONEY SUPPLY AND OUTPUT

Introduction

Chapter V dealt with the empirical evidence on the relationships between the world aggregates of money supply and output. This chapter attempts to link the two world aggregates to a third one, an aggregate measure of the world price level. This chapter has three main sections. First, the measure of the world price level used in this study is described. The second section discusses the importance of the channels of international transmission of inflation in explaining variations in the rate of world inflation. The channels are defined using the concept of rational expectations. In the third part of this chapter, it is examined whether the rate of world inflation has adversely affected the growth of world economy. That is, it considers the output-inflation tradeoffs for the world economy as a whole employing the two corresponding measures as developed in the previous chapters.

The Measure of World Inflation

Keran (1975, p. 23) used "the average of the prices of goods which are traded in international markets" as a measure of world prices. His focus was on the markets which are worldwide in nature and which

represented a common influence on the domestic prices of all countries. His study was confined to examining the case of the developed countries because of their dominance in international trade. They are collectively assumed to determine the prices of internationally traded goods. Keran used the export price index (unit value) of industrial goods of developed countries measured in dollars, published by the United Nations, as a measure of world prices. Keran's measure is defective in several respects. It is limited only to developed countries. It has been shown in Chapter III that money variables of several groups of countries are interrelated and, hence, it is likely that price variables might be interrelated.[1] In Chapter IV, it is stated that monetary disturbances are important factors in explaining the variations in price level and nominal activity for the world as a whole. Further, it restricts itself to the internationally traded goods -- a very narrow view in terms of the treatment of the world economy as a closed system in the present study. In addition, it is argued in Chapter IV that the prices of internationally traded goods constitute one of the channels of international transmission of inflation. Moreoever, using the principal components analysis, Genberg (1977) has shown that consumer price indices should be used in formulating the concept of world price level. However, Genberg's study like Keran is confined to developed countries.

Genberg (1977) argues for a choice between the two contending indices as the best representative of the world price level: an expenditure (GNP) weighted average of individual countries' consumer price indices and the first principal components of all the individual country series of consumer price indices. Genberg advocated the use of the former in a world of "correctly" computed indices and argued for the use

of the latter when there are errors of various kinds in data. Most likely measurement difficulties in country data are due to the differences attached to each commodity in expenditure weights, timing of recording of prices, treatment of quality of goods, periodic revisions of weights in country indices and indirect taxes. He concluded that the choice would ultimately depend on the empirical usefulness of the index. Since the purpose of this study is to relate world money supply, world output and prices, it uses the weighted average of individual country consumer price indices. If there are errors of various kinds in country data of consumer price indices, such errors are likely to be common to the other measures such as money supply and output, particularly the latter. Countries differ widely in their computations and compilations of national accounts. If a pure (error free) measure of the world price level is used, it becomes imperative to use the error free measures of the world money supply and output for precise relationships among the three world aggregates.[2]

The present study does not use the world price index as such in its estimation. Rather, it uses the rate of inflation as a variable of interest. Hence, even if consumer price indices have an error component, it is unlikely to affect significantly the rate of world inflation.[3] As far as this study is concerned, the world price index (WPI) is constructed from the consumer price indices of 36 individual countries as published in International Financial Statistics with 1975 as the base year. The consumer price index of each country is weighted by its respective GDP share.[4] The GDP weights are changed every fifth year following the standard practice in obtaining the global measures in International Financial Statistics. The WPI derived in this way is

taken to be the representative of world prices. The rate of change of the WPI is the measure of world inflation employed in this chapter.

Rational Expectations and Measures of Channels of Inflation

In order to employ a measure of rational expectations, Modigliani and Shiller (1973), Sargent (1973), Sargent and Wallace (1973), and Lucas (1973) have utilized the rational expectations concept of Muth (1961). Muth defined rational expectations about a variable to be equivalent to its predicted values or forecasts. Rational expectations "are essentially the same as the predictions of the relevant economic theory" (p. 316). The present study in particular uses the technique employed by Lucas. The essence of the method employed in this study is to isolate the normal and cyclical components of a given variable. Since there is no precise way of measuring these components, it is assumed that the normal or secular component follows the trend line and the cyclical component varies with the situation as perceived by the economic agents. To measure these components, first the log values of a given variable are regressed on a trend variable and a trend line is obtained by fitting the least squares from the sample period. The fitted values represent the normal or secular observations of a variable. The residuals in this estimation are considered to be the indicator of cyclical component. This cyclical component has been assumed to represent the unanticipated changes.

In Chapter IV, four channels of the international transmission of inflation were considered; they were represented as (a) price effects in terms of internationally traded goods, (b) excess demand

effects, (c) liquidity effects, and (d) international inflationary expectations. For convenience, the four channels are divided here into the two major groups: (1) non-price channels - include (b) and (c); and (2) price channels - refer to (a) and (d). The following section explains the measurement of these four channels using the concept of rational expectations as delineated in the preceding paragraph.

The International Financial Statistics publishes a wholesale price index series for internationally traded commodities.

> The index includes thirty seven wholesale price series chosen as representative of the commodities exported by the primary producing countries. It excludes petroleum. The commodity price relatives are weighted by average export earnings during the years 1968 through 1970 in ninety-eight countries which do not include industrial and major oil exporting countries (IFS, April, 1978, p. 396).

This index is used as representative of prices of internationally traded goods (commodity price index - CPI). The log of CPI was regressed on a time trend and the fitted values of price level are obtained and are considered as the normal or expected level of prices of internationally traded goods (CPI*).[5] The difference between the actual level of prices and normal level of prices was deemed to be the representative of unanticipated changes in the prices of internationally traded commodities.

Another price channel refers to the international inflationary price expectations. The construction of the world price index is delineated in the preceding section. As the WPI is taken to be the representative of world prices, international inflationary expectations are are measured using this series, Regressing the log of WPI on a time trend variable and a constant, the normal or expected values of the world price index (WPI*) are calculated and the discrepancy between the

expected and actual world price level is taken as representing the unanticipated changes in the world price level and as a proxy for the international price expectations.[6]

The non-price effects in international transmission of inflation are demand effects and liquidity effects. Excess demand for goods and services for the world as a whole can be measured by the differences between the expected normal level of output and the actual level of output. Note that excess demand is obverse of deficits in supply and, hence, can be measured from output levels. The normal level of output is estimated by regressing the log of actual real world income (output), termed as RGWP, on a time trend variable and a constant, thus obtaining the fitted values of output (RGWP*).[7] The gap between RGWP and RGWP* is used as an indicator of excess demand for goods and services.

Liquidity effects refer to the excessive supply of money or to the excess of real money balances held by economic agents. Like other channels, the excess supply of money can be represented by the difference between the actual level of money supply and the normal level of money supply (WMS*). The latter is estimated by regressing the log of WMS on a time trend and a constant.[8] The discrepancies between WMS and WMS* are taken as unanticipated changes in world money supply. Liquidity effects in terms of normal level of real money balances can be estimated in the same manner by regressing the log of real money supply (RWMS) on a time trend and a constant and obtaining RWMS* and unanticipated changes in real money supply.

Empirical Evidence on Channels

The empirical evidence on the international transmission of inflation is presented in Table XII. The coefficients of both the price channels are significant at 5% level, although the size of the coefficient of the international inflationary expectations channel is larger than that of the prices of internationally traded goods channel. This implies that the worldwide inflation is due more to the general upward trend in prices around the world and less to the importation of goods from other countries. However, the latter remains a significant factor in worldwide inflation. The imported inflation is one of the various factors that causes an upward movement in world prices. Further, the international inflationary expectations are generated by several cyclical variables and the unanticipated changes in the prices of internationally traded goods represent one of such cyclical variables that feed the international inflationary expectations. Thus, the larger coefficient of the international inflationary expectations channel compared to that of the price channel of internationally traded goods is understandable.

The empirical results on non-price channels are presented in Table XII. They show that the current and one period lagged values of measures of excess demand and liquidity effects explain about 77% of the variations in the rate of inflation. In case of excess demand effects, both the current and the previous (one period lagged) demands affect prices and have expected positive signs. But the excess demand in the previous period has a relatively larger influence as indicated by the size of the coefficients. It is not difficult to seek an explanation in this regard. Excess demand for goods and services in the current period

TABLE XII

EMPIRICAL EVIDENCE ON CHANNELS OF INTERNATIONAL TRANSMISSION OF INFLATION

Price Channels

$$\ln WPI_t \; WPI_{t-1} = \underset{(3.879)}{.067} + \underset{(2.597)}{.078}\,(\ln CPI_t - \ln CPI^*_t) + \underset{(2.468)}{.198}\,(\ln WPI_t - \ln WPI^*_t) \qquad (1)$$

$R^2 = .868$ D.W. = 2.066 SSE = .015 $\rho = \underset{(6.468)}{.809}$ F = 62.428

Non-price Channels

$$\ln WPI_t - \ln WPI_{t-1} = \underset{(16.534)}{.058} + \underset{(2.476)}{.212}\,(\ln RGWP_t - \ln RGWP^*_t) + \underset{(3.412)}{.337}\,(\ln RGWP_{t-1} - \ln RGWP^*_{t-1}) + \underset{(8.305)}{.787}\,(\ln WMS_t - \ln WMS^*_t) - \underset{(-4.038)}{.382}\,(\ln WMS_{t-1} - \ln WMS^*_{t-1}) \qquad (2)$$

$R^2 = .769$ D.W. = 2.029 SSE = .018 F = 14.121

$$\ln WPI_t - \ln WPI_{t-1} = \underset{(15.006)}{.061} + \underset{(2.540)}{.235}\,(\ln RGWP_t - \ln RGWP^*_t) + \underset{(3.112)}{.333}\,(\ln RGWP_{t-1} - \ln RGWP^*_{t-1}) + \underset{(7.585)}{3.213}\,(\ln RWMS_t - \ln RWMS^*_t) - \underset{(-3.802)}{1.546}\,(\ln RWMS_{t-1} - \ln RWMS^*_{t-1}) \qquad (3)$$

$R^2 = .742$ D.W. = 2.019 SSE = .019 F = 12.222

TABLE XII (Continued)

Note: 1. Figures in parentheses are t-statistics.

2. When Equation (1) is estimated with different but the identical specifications, the results are consistent, i.e., the trend or expected/ estimated variables are not significant.

$$\ln WPI_t - \ln WPI_{t-1} = .55 + .05 \ln CPT + .09 WPI - .001 t$$
$$(5.0)\ (2.4)\qquad (1.9)\qquad (-.3)$$

$R^2 = .91$ D.W. = 1.97 SSE = .01 F = 65.7

$$\ln WPI_t - \ln WPI_{t-1} = .49 + .05 \ln CPI + .08 \ln WPI - .006 (\ln WPI^* + \ln CPI^*)$$
$$(9.0)\ (2.3)\qquad (4.0)\qquad (-.3)$$

$R^2 = .91$ D.W. = 1.97 SSE = .01 F - 65.7

tends to be viewed by economic agents as temporary resulting from either the maladjustment of supplies of goods in the various segments of the world market or from the temporary as against permanent changes in the income levels. As the year passes by, economic agents begin to perceive the permanent shift in demand for goods and services which further results in increases in prices. Thus, it is the inability of economic agents to distinguish between the two types of demand changes that causes fluctuations in the rate of world inflation.

The coefficients of excess money supply of current and the previous period are significant. However, they have opposite signs. The result has the following interpretation. Inasmuch as these variables are expressed in logarithms, the coefficients are elasticities of demand prices with respect to the unanticipated changes in nominal money supply in case of Equation (2) of Table XII. In Equation (3), note that the nominal money supply variable has been replaced by real money supply. Using a Patinkin (1965) type argument in Equation (1), absence of money illusion implies that the above elasticity coefficient should be unity in the long run because the increased money supply lead to the proportionate changes in prices and, hence, would leave demand unchanged. However, as stated earlier, economic agents are unable to distinguish between the temporary changes as against permanent changes. Therefore, the excess supply of money in the current period is likely to induce to the demand for goods and services resulting in an increase in price level. The estimated coefficient of price elasticity with respect to money supply is less than unity and positive. However, the increase in prices in the current period as a result of excess of money supply reduces the real balances of economic agents. As the latter becomes

evident, economic agents begin to see the operation of money illusion. As the real balances decrease, excess demand dwindles and the latter slows down the rate of increase in prices. Owing to these factors, the lagged value of excess money supply has a negative sign. The less than unity coefficient value of the excess money supply variable indicates that a given change in money supply does not lead to equiproportionate changes in prices.

It may be noted that in the specification of the price channel relationships, price expectations of internationally traded goods and international inflationary expectations are assumed to be contemporaneous to the rate of change of world prices because these two variables pertained to prices themselves and, hence, are considered to have a direct and immediate impact on a change in world inflation rates. Therefore, the independent variables do not involve lag values. However, the effects of non-price variables are not direct. It takes time for excess demand effects or liquidity effects to spill over into the world price level and, hence, the independent variables in non-price equations are lagged.

When the nominal world money supply is replaced by the real world money supply as in Equation (3) of Table XII, more or less simlilar results follow. The unanticipated changes in the current real money supply cause more than proportionate changes in the world rate of inflation as the relevant elasticity coefficient is greater than unity. As the rate of inflation accelerates, economic agents begin to realize that their real money balances have decreased and, thus, begin to perceive the operation of money illusion, or further adjust themselves in view of the increased level of prices. That is, as prices go up, the excess

demand generated by the initial disturbance is reduced and that decelerates the rate of inflation. Note that the explanation presented in this section is only a tentative one. In order to determine the exact nature of the adjustment processes, a complete model is needed.

In order to determine the relative importance of the price and non-price channels in influencing the rate of world inflation, all the channels are used in the specification of a single equation and the results obtained are reported below:

All Channels

$$\ln WPI_t - \ln WPI_{t-1} = \underset{(11.637)}{.062} + \underset{(1.976)}{.206}\,(\ln RGWP_t - \ln RGWP^*_t) + \underset{(2.441)}{.317}\,(\ln RGWP_{t-1} - \ln RGWP^*_{t-1}) + \underset{(6.069)}{.795}\,(\ln WMS_t - \ln WMS^*_t) - \underset{(-3.057)}{4.36}\,(\ln WMS_{t-1} - \ln WMS^*_{t-1}) + \underset{(1.291)}{.059}\,(\ln WPI_t - WPI^*_t) - \underset{(-.463)}{.054}\,(\ln CPI_t - \ln CPI^*_t)$$

$R^2 = .829$ D.W. = 1.991 SSE = .019 F = 12.599

The results indicate that both the non-price channels - excess demand effects and liquidity effects, remain significant. If the size of these coefficients is compared to the estimates of Equation (2) in Table XII, it is approximately the same; 0.2 and 0.3 for the excess demand channel and 0.8 and 0.4 for the liquidity channel for the current and the previous periods, respectively. However, both the price channels become insignificant as the coefficients corresponding to the international price expectations channel and the prices of internationally traded goods channel have the poor t-statistics. The implication of this result is that the unanticipated changes in the world money supply

and aggregate demand are responsible for accelerating the rate of world inflation. It is important to refer back to the money-income transmission mechanism illustrated in the international framework in Chapter IV where this study emphasizes the money market disturbance that affects the price level and nominal activity through various channels. It is also emphasized in that chapter how a change in the real income on the demand side causes a disturbance in the money market (through affecting the money demand function) which sets in motion a process of adjustments that influences the price level and the nominal activity. Thus, the non-price channels have the dominant influence on the rate of world inflation. The insignificance of price channels may mean that either their influence is meager such that it may not be captured in this kind of estimation or that one needs to have an elaborate mechanism of generation and adjustment of international price expectations in order to capture that influence which has not been done in this study.

Output-Inflation Tradeoffs

The monetary models of a closed economy advocated the hypothesis that only unanticipated movements in money affect real economic variables like the unemployment rate and the level of output. The rational expectations model of, for example, Lucas (1972, 1973) and Barro (1976, 1977) employed the above hypothesis. Lucas (1973) examined empirically the question whether the terms of the output-inflation tradeoffs vary across countries and concluded affirmatively. He found that in a stable price country like the U.S., there are short-term tradeoffs but in a volatile price country like Argentina, there are no discernible tradeoffs. Arak (1977) found the Lucas approach defective in the sense

that the latter assumed nominal GNP as an exogenous variable, Arak formulated a modified model and its empirical results showed that there were no discernible tradeoffs in case of the U.S.

This study attempts to examine whether there are discernible tradeoffs between output and inflation for the world economy as a whole. In earlier sections of this chapter, relationships between the level of world money supply and level of world output have been established. The rate of growth of world prices has been linked to unanticipated changes in money supply and output. An examination of output-inflation tradeoffs for the world economy would further throw light on the relationships between the world aggregates. Measures of unanticipated inflation and unanticipated output have been developed earlier in this chapter. The same variables can be used in the empirical examination of output-inflation tradeoffs for the world economy as a whole.

In order to examine the output-inflation tradeoffs, the following two hypotheses are considered:

1. The unanticipated movements in the real world output depend on its lagged value and some exogenous shift variable that embodies the impact of world inflation. Let this exogenous variable be considered as equal to the rate of growth of nominal world output.
2. The rate of world inflation depends on the lagged value of unanticipated movements in the real world output and on the contemporaneous and the past values of exogenous variable such as nominal world output.

The reasoning underlying the hypotheses is as follows. The validity of the first hypothesis would establish whether some exogenous factor

representing the impact of world inflation does affect the unanticipated changes in the real world output. That is, the real world output is very sensitive to the rate of growth of nominal world income because the latter could be considered as representing the unanticipated changes in the world aggregate demand. If the first hypothesis on the demand side were valid, then an excess of aggregate world supply would slow down the rate of world inflation. Hence, the second hypothesis that the unanticipated changes in the real world output create pressures on the rate of inflation should be valid. Inasmuch as both hypotheses have the unanticipated changes in real world output as one of the independent variables, the entire argument boils down to a question of a natural or normal level of output for the world economy as a whole.

The empirical results for both the hypotheses are presented in Equations (1) and (2), respectively, of Table XIII. The first equation suggests that the coefficients of both the independent variables are not significant. Further, Equation (1) does not perform well in terms of goodness-of-fit statistics of R^2 and F-statistics. Although the variable representing unanticipated changes in real world output in Equation (2) has an appropriate sign, the coefficient itself is not significantly different from zero in view of a poor t-statistic. The goodness-of-fit statistics of R^2 and F-statistic are better in Equation (2) than in the first one, the variable of major interest is not significant. Hence, the relations as specified in the above two hypotheses do not seem to be valid.

As mentioned earlier, the use of a nominal output variable as an exogenous shift variable has been attacked by Arak (1977) because the

TABLE XIII

EMPIRICAL EVIDENCE ON OUTPUT-INFLATION TRADEOFFS

$$\ln RGWP_t - \ln RGWP^*_t = .004 + .323\ (\ln RGWP_{t-1} - \ln RGWP^*_{t-1}) \quad (1)$$
$$(.112)\ (1.491)$$
$$+ .069\ (\ln GWP_t - \ln GWP_{t-1}$$
$$(.178)$$

$R^2 = .39$ D.W. = 1.93 $\rho = .37$ SSE = .05 F = 6.11

$$\ln WPI_t - \ln WPI_{t-1} = .058 + .386\ (\ln GWP_t - \ln GWP_{t-1} - \quad (2)$$
$$(1.451)\ (2.487)$$
$$+ .847\ (\ln GWP_{t-1} - \ln GWP_{t-2}) - .121$$
$$(2.042) \qquad (-1.374)$$
$$(\ln RGWP_{t-1} - \ln RGWP^*_{t-1})$$

$R^2 = .81$ D.W. = 1.98 $\rho = .89$ SSE = .02 F = 24.82

$$\ln RGWP_t - \ln RGWP^*_t = .652\ (\ln RGWP_{t-1} - \ln RGWP^*_{t-1}) + R1 \quad (3)$$
$$(4.961)$$

$R^2 = .43$ D.W. = 1.82 SSE = .04

$$\ln WPI_t - \ln WPI_{t-1} = .138 + .922\ (\ln RGWP_{t-1} - \ln RGWP^*_{t-1}) + R2$$
$$(1.670)\ (.984) \quad (4)$$

$R^2 = .74$ D.W. = 2.43 $\rho = .94$ SSE = .02 F = 55.94
(14.03)

Note: Figures in parentheses are t-statistics.

nominal output might be affected by various stochastic elements and, thus, may tend to make results less reliable. In view of poor results in Equations (1) and (2), the exogenous shift variable is eliminated and the results are displayed in Equations (3) and (4). R1 and R2 are estimated residuals from Equations (3) and (4), respectively. Further, R1 is regressed on R2 with an objective to examine whether there have been any systematic variations in error terms of both equations. Any evidence of systematic variations would reflect the impact of some exogenous variable that might cause changes in the output and inflation variables. A statistically significant coefficient of R2 with an appropriate sign would mean that there have been output-inflation tradeoffs for the world economy as a whole.

$$R1 = \underset{(-.253)}{-.019\ R2} \qquad (5)$$

$$R^2 = .01 \quad D.W. = 1.96 \quad SSE = .04$$

However, as Equation (5) above suggests, the coefficient of R2 is not significantly different from zero and the estimation performs extremely poor in terms of R^2 implying that there seem to be no discernible output-inflation tradeoffs. This alternative procedure does not alter the results that were derived using an exogenous shift variable in terms of nominal world output. The only difference is that the coefficient of lagged unanticipated real output becomes significant in (3) unlike in (1). However, it simply indicates that the unanticipated variations in output are explained by its past observations and does not establish any relationship with the price movements.

Summary

The purpose of this study is to relate the three world aggregates of money supply, output, and prices. The preceding chapter relates the two world aggregates of money supply and output. This chapter attempts to link the two to a third one - a measure of world inflation. The DGP weighted average of individual country consumer price indices is used as the measure of world price level. This chapter demonstrates that the rate of world inflation is satisfactorily explained by factors such as the unanticipated changes in the world money supply and output. The other channels of international transmission of inflation such as the unexpected movements in the prices of internationally traded goods and international inflationary expectations in general seem to be important but their importance is not clearly established in the simple framework of relations envisaged in this study. A complete model of generation and adjustment of expectations in the international context is needed to ascertain their impact. Further, there seem to be no discernible tradeoffs between the two world aggregates of output and inflation, at least in the way these tradeoffs are explained and modeled in the relevant literature and in this study.

FOOTNOTES

[1]Using the principal components analysis, Genberg (1977) has shown that the price variables across countries are interrelated. The same technique is used in Chapter III to show that money variables across countries are interrelated.

[2]The computation of error free aggregates can be an interesting aspect of the empirical studies in future. However, before such measure measures are computed, it needs to be established as to what extent the principal components method yields an error free measure. Moreover, the empirical usefulness can only determine the validity of such measures. As far as this study goes, the empirical measures employed do yield some useful results.

[3]Note that the consumer price indices used in this study are from IFS. First, the data have been transformed by IFS. "The index series are usually compiled from reported versions of national indexes by linking them together using the ratio of the first annual overlap and by shifting the linked indexes to the comparison base 1975 (IFS, 1979, p. 7). Second, this study attaches GDP weights to each index of consumer prices, thus further transforming the data. Alternative transformation that can be done as suggested by Genberg. But is not clear how the error component might be systematically affecting the world price level. Hence, the present study employs the weighted index rather than one derived from the principal components. The latter brings about a further transformation of data, the impact of which is not predictable. However, the use of a weighted (GDP weights) index is understandable in view of the express purpose of this study to establish relationships among the world money, output, and prices.

[4]Genberg (1977) suggested to use the GNP weights. Since the data for GNP are not available for each country in the sample, GDP weights are used.

[5]The estimated equation is

$$\log CPI = 2.544 + .096\ t$$
$$(2.168)\ (1.983)$$
$$R^2 = .734 \quad F = 57.90 \quad \text{Period } 1953\text{-}76$$

The unanticipated changes in the prices of internationally traded goods are calculated as the differences between the actual and predicted price level for those goods.

[6]The estimated equation is

$$\log WPI = 3.528 + .039\ t$$
$$(79.119)\ (12.398)$$
$$R^2 = .87 \quad F = 153.843 \quad \text{Period } 1953\text{-}76$$

The unanticipated changes for this variable are obtained in the same manner as in footnote 5.

[7]The estimated equation is

$$\log TGWP = 6.866 + .056\ t$$
$$(243.0)\ \ (28.6)$$
$$R^2 = .97 \quad F = 816.2 \quad \text{Period } 1953\text{-}76$$

[8]The estimated question is

$$\log WMS = 5.964 + .084\ t$$
$$(139.4)\ (27.9)$$
$$R^2 = .97 \quad F = 780.1 \quad \text{Period } 1953\text{-}76$$

CHAPTER VII

MAIN RESULTS AND IMPLICATIONS

Main Results

This study deals with an empirical approach to three world aggregates of world money supply, world output, and world price level. It does not develop a rigorous and a formal theoretical integration of these three aggregates; rather, it alludes to the lines of causal relationships which are consistent with the monetary approach to the balance of payments, and the global monetarism. The linkages that have been delineated among the three aggregates are tested and are not rejected empirically.

The measure of the world money supply used in this study is the summation of the SDR values of the aggregates of domestic money supplies, foreign exchange reserves and eurocurrency holdings. SDR rates are used as the conversion measure which provide a constant and convenient reference point in time and across countries. They are not merely a convenient measure, they also represent a good weighting scheme. The results of the principal components analysis suggest that the domestic money supplies, foreign exchange reserves as distinguished from the international reserves, and eurocurrency holdings need to be incorporated into the concept of world money supply. The principal components method also shows that the concept of world monetary base needs to incorporate

the domestic monetary base variables and foreign exchange reserves. Empirical relationships are established between WMS and WMB. The study also establishes the importance of the domestic and foreign components of the world monetary base in explaining the variations in the world money supply.

The money-income transmission mechanism is delineated for the world economy. The empirical evidence presented in this study suggests the money-income nexus for the world economy as a whole and the direction of causality that has been established runs from money to income. However, the evidence of this unidirectional causation is weak and the possibility of bidirectional or simultaneous causality is not ruled out. The empirical evidence presented in this study suggests money-income nexus for the world economy as a whole and the direction of causation that has been established runs from money to income. The most important determinant of global nominal activity is the contemporaneous world money supply, followed by one and two period lags of money supply variable.

The seemingly unrelated regressions and the log likelihood ratio test suggests that the slope coefficients of money supply variables of developed, developing, and oil-exporting countries in the determination of global nominal activity are not equal. This necessitated the disaggregation of the global variables. An important feature of money-income relationships among disaggregated variables is the importance of U.S. money aggregates. The U.S. monetary base is unambiguously a major determinant of world nominal activity and this is true for all the three country groups (developed, oil-exporting, and less developed countries) considered in this study. The overriding importance of U.S.

money supply is due to the fact that the U.S. is the largest constituent of the world economy and that the dollar occupies a unique position, being both a reserve currency and a widely used currency for international transactions.

This study maintains that an explanation of the mechanism for the international transmission of inflation is an indispensable link in the broader money-income transmission mechanism. The GDP weighted average of the individual country consumer price indices is used as the measure of the world price level. Unanticipated changes in the world money supply, output and prices are represented by the residuals that are obtained by regressing the log values of these variables on a time trend variable. The results derived in the study indicate that unanticipated changes in the world money supply and unanticipated changes in the world output satisfactorily account for the variations in the rate of world inflation. Similarly, international inflationary expectations as measured by the unanticipated changes in the world price level also contribute to the world inflation.

There are no output-inflation tradeoffs for the world economy, at least in the way these tradeoffs are modeled for specific countries in the relevant literature. Hence the argument that the higher inflation rates lead to either higher or lower unemployment, and consequently, less output does not seem to be valid on the empirical grounds for the world economy as a whole.

Implications

The modern world is characterized by growing international economic interdependence. This is reflected, among other changes, in the rise of

regional integration efforts, multinational corporations, and international banking institutions. On the one hand, this increased international interdependence has enhanced the capability of the world economy to provide a better standard of living for all. On the other hand, it has led to increasing vulnerability of both large and small national economies to international monetary impulses or changes.

This study shows that the level of nominal global activity is affected by the level of world money supply. However, it also demonstrates that the unanticipated changes in global money supply, unanticipated changes in the prices of internationally traded goods, and international inflationary price expectations could aggravate the problem of world inflation. The latter could endanger the standard of living for all, particularly for those poor living in Africa, Asia, and Latin America whose standard of living is far from satisfactory. The implication of output-inflation tradeoffs analysis is that the problem of world inflation is serious not because of the possibility that inflation can reduce output and thereby generate unemployment; rather world inflation could erode the standard of living (and could possibly bring about redistribution of income) even without creating higher unemployment or lesser output.

In view of the above, the U.S. economy, the international economic institutions, and multinational corporations have an important role to play because of their unique position in the world economy. As discussed in this study, the U.S. money supply and monetary base are significantly related to nominal activity of developed, developing, and oil-exporting countries. Unanticipated changes in these variables could accelerate the pace of inflation. Multinational corporations whose commerce and

trade transcend national boundaries and international economic institutions like the World Bank and IMF whose prime concerns are to enhance the standard of living through generating greater global activity and promote an orderly international monetary system, respectively, can also help in smoothing out unanticipated changes in aggregate demand, money supply, the prices of internationally traded goods, and international inflationary price expectations.

In summary, the results of this study are important for both theoretical and policy purposes. More meaningful theoretical models of open economies need to incorporate the impact of world aggregates on national economies. Similarly, awareness of the fact that international markets are integrated would facilitate the policy formulations of individual countries and of international economic institutions.

REFERENCES

Arak, M. 1977. "Some International Evidence on Output-Inflation Tradeoffs: Comment." American Economic Review, 67, September, 728-730.

Anderson, L. and J. Jordon. 1968. "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization." Federal Reserve Bank of St. Louis Review, 50, November, 11-24.

Aukrust, O. 1970. "PRIM I: A Model of Price and Income Distribution Mechanism of an Open Economy." Review of Income and Wealth, 16, March, 51-78.

Balassa, B. 1964. "The Purchasing Power Parity Doctrine: A Reappraisal." Journal of Political Economy, 72, December, 584-596.

Barro, R. J. 1977. "Unanticipated Money Growth and Unemployment in the United States." American Economic Review, 67, March, 101-115.

_____. 1978. "A Stochastic Equilibrium Model of an Open Economy Under Flexible Exchange Rates." Quarterly Journal of Economics, 92, February, 149-164.

Bell, G. L. 1964. "Credit Creation Through Eurodollar?" The Banker, 114, August, 494-502.

Bergsten, C. F. and W. R. Cline. 1976. "Increasing International Economic Interdependence: The Implications for Reserach." American Economic Review, 66, May, 155-161.

Bilson, J. F. O. 1978. "The Monetary Approach to the Exchange Rate: Some Empirical Evidence." IMF Staff Papers, 25, March, 48-75.

_____. 1979. "Recent Developments in the Monetary Models of Exchange Rate Determination." IMF Staff Papers, 26, June, 201-223.

Bisignano, J. 1975. "The Interdependence of National Monetary Policies." Federal Reserve Bank of San Francisco, Business Review, Spring, 41-48.

Black, S. 1972. "The Use of Rational Expectations in Models of Speculation." Review of Economics and Statistics, 54, May, 161-165.

_____. 1973. International Money Markets and Flexible Exchange Rates. Princeton Studies in International Finance, No. 32. Princeton, N. J.: Princeton University Press.

Brunner, K. and A. H. Meltzer. 1977. "The Explanation of Inflation: Some International Evidence." American Economic Review, 67, February, 148-154.

Calvo, G. A. and C. A. Rodriguez. 1977. "A Model of Exchange Rate Determination Under Currency Substitution and Rational Expectations." Journal of Political Economy, 85, June, 617-625.

Caves, R. E. 1963. "Flexible Exchange Rates." American Economic Review, 53, May, 120-129.

Chrystal, K. A. 1977. "Demand for International Media of Exchange." American Economic Review, 67, September, 732-740.

Claassen, E. 1976. "World Inflation Under Flexible Exchange Rates." Scandinavian Journal of Economics, 78, 346-365.

Cordon, W. M. 1976. "Inflation and the Exchange Rate Regime." Scandinavian Journal of Economics, 78, 370-383.

_____. 1977. Inflation, Exchange Rates and the World Economy, Lectures on International Monetary Economics, University of Chicago Press, Chicago.

Crockett, A. D. and M. Goldstein. 1976. "Inflation Under Fixed and Flexible Exchange Rates," IMF Staff Papers, 23, November, 509-544.

Day, W. H. L. and R. Heller, 1977. "The World Money Supply: Concept and Measurement." Weltwirtsch Archiv, 113, 693-718.

Dornbusch, R. 1976. "The Theory of Flexible Exchange Rates Regimes and Macroeconomic Policy." Scandinavian Journal of Economics, 78, 255-275.

Fisher, I. 1912. "Will the Present Upward Trend of World Prices Continue?" American Economic Review, 2, September, 531-558.

Frenkel, J. A. 1976. "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence." Scandinavian Journal of Economics, 78, 200-224.

_____. 1978. "International Reserves: Pegged Exchange Rates and Managed Float," Journal of Monetary Economics, 9, 111-140.

_____ and H. G. Johnson, eds. 1976. The Monetary Approach to the Balance of Payments. Toronto: University of Toronto Press.

_____. 1978. The Economics of Exchange Rates: Selected Studies. Reading, Mass.: Addison-Wesley.

Friedman, M. 1953. "The Case for Flexible Exchange Rates," In his Essays in Positive Economics, Chicago: University of Chicago Press, 157-203.

_____. 1969. "The Eurodollar Market: Some First Principles." Morgan Guarantee Survey, October, 4-14.

_____ and D. Meiselman. 1963. "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958." Commission on Money and Credit, Stabilization Policies, Prentice Hall, Inc., 165-268.

_____. and A. Schwartz. 1963. A Monetary History of the United States 1867-1960. National Bureau of Economic Research, Studies in Business Cycles, No. 12. Princeton, N.J.: Princeton University Press.

Frisch, H. 1977. "Inflation Theory 1963-1975: A 'Second Generation' Survey." Journal of Economic Literature, 15, December, 1289-1317.

Gaillot, H. J. 1970. "Purchasing Power Parity as an Explanation of Long-Term Changes in Exchange Rates." Journal of Money, Credit, and Banking, 2, August, 348-357.

Genberg, H. 1976a. "A Note on Inflation Rates Under Fixed Exchange Rates." In Parkin and Zis, eds., Inflation in the World Economy, Manchester: Manchester University Press, 183-187.

_____. 1976b. "Aspects of the Monetary Approach to Balance of Payments Theory: An Empirical Study of Sweden." In Frenkel and Johnson, eds., The Monetary Approach to the Balance of Payments. Toronto: Toronto University Press, 298-325.

_____. 1977. "The Concept and Measurement of the World Price Level and the Rate of Inflation." Journal of Monetary Economics, 3, April, 231-252.

Grubel, H. 1976. Domestic Origins of the Monetary Approach to the Balance of Payments. Essays in International Finance. Princeton, N.J.: Princeton University Press, 117.

Gupta, S., A. Schwartz, and R. Padulla. 1978. The Global Model Behind the World Development Report of the World Bank. Mimeo. The World Bank, December.

Haberler, G. 1977. "How Important Is Control Over International Reserves?" In the New International Monetary System, edited by R. A. Mundell and J. J. Polak. Columbia: Columbia University Press, 111-132.

Harman, H. H. 1967. Modern Factor Analysis. Chicago: University of Chicago Press.

Heller, H. R. 1976. "International Reserves and Worldwide Inflation." IMF Staff Papers, 23, 61-87.

_____ and M. S. Khan, 1978. "The Demand for International Reserves Under Fixed and Flexible Exchange Rates." IMF Staff Papers, 25, December, 623-649.

Hewson, J. and E. Sakakibara. 1975. The Eurocurrency Markets and Their Implications. Lexington, Mass.: Lexington Books.

Hinshaw, R. 1972. Inflation As A Global Problem. Baltimore: The John Hopkins University Press.

International Monetary Fund. 1974. Annual Report, 1974. Washington, D.C.

_____. 1977. The Monetary Approach to the Balance of Payments. Washington, D. C.

_____. 1978. Annual Report, 1978. Washington, D. C.

_____. International Financial Statistics. Washington, D. C. Various issues used for data.

Isard, P. 1977. "How Far Can We Push the Law of One Price?" American Economic Review, 67, December, 942-948.

Johnson, H. G. 1972. "The Monetary Approach to Balance of Payments Theory." Journal of Financial and Quantitative Analysis, 7, March, 1555-1572.

_____. 1973. "The Case for Flexible Exchange Rates," Chapter in his Further Essays in Monetary Economics, Harvard University Press, 198-222.

_____. 1975. "World Inflation and International Monetary System." The Three Banks Review, 107, September, 3-22.

Kenen, P. B. 1978. "New Views of Exchange Rates and Old Views of Policy." American Economic Review, 68, May, 398-405.

Keran, M. W. 1975. "Towards an Explanation of Simultaneous Inflation-Recession." Federal Reserve Bank of San Francisco, Business Review, Spring, 18-30.

Klopstock, F. H. 1968. "The Euro-Dollar Market: Some Unresolved Issues." Essays in International Finance, 65, March, Princeton University.

Kouri, P. J. K. 1976. "The Exchange Rate and the Balance of Payments in the Short-Run and Long-Run: A Monetary Approach," Scandinavian Journal of Economics, 78, 280-304.

Kravis, I. B. and R. E. Lipsey. 1977. "Export Prices and Transmission of Inflation," American Economic Review, 67, February, 155-163.

_____. 1978. "Price Behavior in the Light of Balance of Payments Theories," Journal of International Economics, 8, May, 193-246.

Kreinin, M. E. and L. H. Officer. 1978. The Monetary Approach to the Balance of Payments: A Survey, Princeton Studies in International Finance, 43, Princeton, N. J.: Princeton University Press.

Kriz, M. A. 1967. Gold: Barbarous Relic or Useful Instrument?, Essays in International Finance, 60, June, Princeton, N. J.: Princeton University Press.

Laffer, A. B. 1973. "Do Devaluations Really Help Trade?" Wall Street Journal, February, 5, 10.

_____. 1974. "The Bitter Fruits of Devaluation," Wall Street Journal, January, 10, 14.

_____. 1975. "The Phenomenon of Worldwide Inflation: A Study in International Market Integration." In The Phenomena of Worldwide Inflation, American Enterprise Institute for Public Policy Research, Washington, D. C. 27-47.

Lee, B. E. 1973. "The Eurodollar Multiplier," Journal of Finance, 28 867-874.

Lee, M. H. 1976. Purchasing Power Parity. New York: Marcel Dekker, Inc.

Logue, D. E. and R. E. Sweeney. 1978. "Aspects of International Monetary Influences." Journal of Financial and Quantitative Analysis, 13, March, 143-156.

Lucas, R. E. 1972. "Expectations and the Neutrality of Money," Journal of Economic Theory, 4, April, 103-124.

_____. 1973. "Some International Evidence on Output-Inflation Tradeoffs." American Economic Review, 63, June, 326-334.

Machlup, F. 1972. "The Eurodollar System and Its Control," In International Monetary Problems. American Enterprise Institute for Public Policy Research, 3-36.

_____. 1975. "How Inflation is Transmitted and Imported," Euromoney, September, 58-63.

Makin, J. H. 1972. "Demand and Supply Functions for Stocks of Eurodollar Deposits: An Empirical Study," Review of Economics and Statistics, 54, November, 381-391.

McKinnon, R. T. 1977. The Eurocurrency Market. Princeton Essays, 125, December.

Meade, J. E. 1955. "The Case for Variable Exchange Rates," The Three Banks Review, 27, September, 3-27.

Meiselman, D. I. 1975. "Worldwide Inflation: A Monetarist View," In The Phenomena of Worldwide Inflation, American Enterprise Institute for Public Policy Research, Washington, D. C., 69-112.

Miles, M. 1978. "Currency Substitution, Flexible Exchange Rates and Monetary Independence," American Economic Review, 68, June, 428-436.

Mills, T. C. and G. E. Woods. 1978. "Money-Income Relationships and the Exchange Rate Regime," Federal Reserve Bank of St. Louis Review, 60, August, 22-27.

Modigliani, F. and R. J. Shiller. 1973. "Inflation, Rational Expectations and the Term Structure of Interest Rates," Economica, 40, February, 12-43.

Mundell, R. A. 1968. International Economics, New York: Macmillan Company.

Mussa, M. 1976. "A Monetary Approach to Balance of Payments Analysis." Journal of Money, Credit and Banking, 3, 333-351.

_____. 1978. "The Exchange Rate, the Balance of Payments and Monetary and Fiscal Policy Under a Regime of Controlled Floating." In Frenkel and Johnson, The Economics of Exchange Rates: Selected Studies, 1978, 47-65.

Muth, J. F. 1961. "Rational Expectations and the Theory of Price Movements." Econometrica, 29, July, 315-335.

OECD. 197-3. "The International Transmission of Inflation," OECD Economic Outlook, Special section, July, 81-96.

Parkin, M. 1977. "A 'Monetarist' Analysis of the Generation and Transmission of World Inflation: 1958-1971." American Economic Review, 67, 164-171.

Parkin, M., I. Richards, and G. Zis. 1975. "The Determinants and Control of World Money Supply Under Fixed Exchange Rates, 1961-1971." Manchester School Economics and Social Studies, 43, September, 293-316.

Parkin, M. and G. Zis. 1976a. Inflation in Open Economy. Tortonto: University of Toronto Press.

_____. 1976b. Inflation in the World Economy. Tortonto: University of Toronto Press.

Patinkin, D. 1965. Money, Interest, and Prices. New York: Harper and Row, Publishers.

Rummel, R. J. 1970. Applied Factor Analysis. Chicago: Northwestern University Press.

Sargent, T. J. 1973. "Rational Expectations, Real Rate of Interest and the Natural Rate of Unemployment." Brookings Papers on Economic Activity, 2, Brooking Institution, Washington, D. C.

_____ and N. Wallace. 1973. "Rational Expectations and the Dynamics of Hyperinflation." International Economic Review, 14, June, 328-350.

Shaw, E. S. 1975. "International Money International Inflation: 1958-73." Federal Reserve Bank of San Francisco, Business Review, Spring, 5-17.

Sims, C. A. 1972. "Money, Income and Causality," American Economic Review, 62, September, 540-552.

Swoboda, A. K. 1976. "Monetary Approach to Balance of Payments Theory," In Recent Issues in International Monetary Economics, edited by E. M. Claassen and P. Salin, North Holland, Amsterdam.

_____. 1978. "Gold, Dollars, Eurodollars, and the World Money Stock Under Fixed Exchange Rates," American Economic Review, 68, September, 625-642.

Time. 1979. "Clash Over Stateless Cash." November, 5, 82,

Tobin, J. 1970. "Money and Income: Post Hoc Ergo Propter Hoc?" Quarterly Journal of Economics, 84, May, 301-317.

Waelbroeck, J. L. 1976. The Models of Project Link. North Holland, Amsterdam.

Wanniski, J. 1974. "The Case for Fixed Exchange Rates," Wall Street Journal, June 14, 1974, 10.

_____. 1975. "The Mundell-Laffer Hypothesis - A New View of the World Economy." Public Interest, 39, Spring, 31-52.

Whitman, M. N. 1975. "Global Monetarism and the Monetary Approach to the Balance of Payments." Brookings Paper on Economic Activity, 3, 491-536.

Williams, D., C. A. E. Goodhart, and D. H. Gowland. 1976. "Money, Income, and Causality: The U. K. Experience," American Economic Review, 66, June, 417-423.

Williamson, J. 1974. "Exchange Rate Flexibility and Reserve Use." Unpublished, International Monetary Fund, August.

Zellner, A. 1962. "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias," Journal of American Statistical Association, 57, June, 348-68.

_____. 1979. "Causality and Econometrics," In Three Aspects of Policy and Policymaking: Knowledge, Data and Institutions, Carnegie-Rochester Conference Series on Public Policy, North Holland, 9-54.

APPENDIX

MEASURES OF MONEY SUPPLY, OUTPUT AND PRICES, 1953-1976
(in billion SDRs)

Year	WMS	WMB	WPI Base 1975=100	GWP	DGDP
1953	518.964	112.427	40.5071	664.990	583.330
1954	536.862	112.107	40.8015	667.490	607.320
1955	555.614	114.294	40.9839	740.020	664.800
1956	580.979	120.627	41.8242	801.130	713.990
1957	592.018	120.640	43.1638	840.280	749.660
1958	628.069	123.259	44.2822	880.150	788.300
1959	646.892	125.322	44.8989	940.280	831.570
1960	692.913	134.179	45.7110	1007.91	888.350
1961	748.230	130.947	46.4250	1071.45	945.000
1962	804.357	136.530	47.6064	1151.16	1023.14
1963	887.016	148.417	47.4572	1251.89	1101.53
1964	974.432	158.437	48.6963	1360.14	1200.29
1965	1060.93	168.773	50.1112	1470.93	1295.30
1966	1140.66	180.998	52.0285	1605.85	1416.65
1967	1253.36	190.746	53.6531	1692.85	1496.42
1968	1392.18	206.474	57.6244	1854.66	1641.66
1969	1488.55	216.825	60.6151	2040.12	1798.18
1970	1682.63	246.411	64.1876	2219.11	1959.41
1971	1880.98	286.617	67.5468	2360.62	2095.04
1972	2211.09	333.224	70.8133	2616.14	2305.46
1973	2394.90	378.284	76.9090	2853.98	2473.77
1974	2805.93	444.460	88.2593	3305.47	2765.83
1975	2993.07	463.819	98.9999	3607.18	3085.54
1976	3293.57	509.063	113.200	4115.91	3535.65

MEASURES OF MONEY SUPPLY, OUTPUT AND PRICES (Continued)

OGDP	LGDP	DMS	OMS	LMS	USMS
9,15000	52,5100	271,250	1,79100	20.6970	173,300
10.0700	50.1000	287,482	1,96800	17.2230	180,600
11.0900	64.1300	300.333	1.76900	15.6610	185.300
12.5600	74,5800	314.455	2.07800	17.7270	188.900
13.8500	76.7700	325.812	2.63800	18.5570	193.300
14.1900	77.6600	351.795	3.11900	18.2050	206.600
19.1100	89.6000	361.626	3.30200	20.0000	210.500
20.6200	98.9400	339.635	3.78100	22.7120	217.00
21.3200	105.130	425.582	3.94000	23.9310	231.400
26.6100	101.410	467.279	4.38800	23.4760	250,400
25.6900	124,670	516.799	5.99100	27.5240	268.900
28,1500	131,700	570.613	6.71500	28.9220	290.000
31.1300	144.500	625.821	6.81900	32,4660	318.100
34,7400	154,460	675.616	7.75300	37.4080	334.700
38.3300	158.100	751,718	9.96400	34.7660	371,800
44.4200	168.580	838,501	11.7370	39.1590	409.500
51.3500	190.590	885,688	12.5530	45.0510	405.300
59.0000	200.700	1002.74	14,2690	50,7410	451,900
65.0900	200.490	1118.12	16.0700	52.6880	469,700
76.7700	233.910	1316.69	20.0890	61.0090	526.900
98.6600	281.550	1420.33	25.7230	76.8820	528.300
165,990	373.650	1684.36	35.4280	94.7800	568.600
190,880	330.760	1797.49	50.9670	83.1090	631.600
231,580	348.680	1892.29	68.0550	94.8720	687,000

MEASURES OF MONEY SUPPLY, OUTPUT AND PRICES (Concluded)

DMB	OMB	LMB	USMB	WRGDP
92.0170	3.17500	17.2350	51.0000	1091.79
93.9440	2.58000	15.5830	49.3000	1123.86
98.4780	2.60600	13.2100	50.2000	1198.95
102.991	3.15900	14.4770	50.8000	1211.56
104.215	3.81200	12.6130	50.9000	1244.86
107.743	3.67700	11.8390	50.7000	1258.98
109.371	3.33100	12.6200	50.8000	1353.10
116.496	3.67900	14.0040	49.9000	1462.86
113.477	3.23200	14.2380	51.4000	1515.04
119.781	3.15100	13.5980	53.9000	1599.34
128.160	3.94100	16.3160	54.9000	1751.88
137.197	4.72000	16.5200	57.9000	1859.98
144.922	5.02600	18.8250	61.3000	1905.72
154.635	5.61600	20.7470	65.7000	2028.79
165.345	6.26900	19.1320	70.5000	2117.43
178.675	6.86200	20.9370	76.4000	2299.06
185.670	7.96800	23.1870	78.8000	2415.03
211.076	9.62600	25.7090	81.8000	2556.80
246.827	13.3540	26.4360	83.3000	3261.87
282.704	16.9230	33.5970	84.7000	3355.16
298.527	21.5140	58.2430	83.8000	3343.51
321.727	50.4040	72.3300	88.6000	3421.54
346.897	65.1200	51.8020	96.3000	3470.66
370.246	79.3870	59.4310	102.800	3647.62

VITA[2]

Jayanti L. Jain

Candidate for the Degree of

Doctor of Philosophy

Thesis: WORLD MONEY SUPPLY, OUTPUT AND INFLATION: AN EMPIRICAL STUDY

Major Field: Economics

Biographical:

Personal Data: Born in Galiakot, Rajasthan, India, March 1, 1949, the son of Mr. and Mrs. Chagan Lal Jain.

Education: Received Bachelor of Arts degree in Economics, Political Science and English Literature from University of Udaipur, Udaipur, India, in 1969; received Master of Arts degree in Economics from University of Udaipur in 1971; received Master of Arts degree in Economics from Wichita State University in 1976; completed requirements for the Doctor of Philosophy degree at Oklahoma State University in May, 1980.

Professional Experience: Lecturer in Economics, Hans Raj College, Delhi, 1971-72; Lecturer in Economics, Bhagat Singh College, New Delhi, 1972-75; Research Assistant, Wichita State University, 1975-76; Teaching Assistant, Oklahoma State University, 1977; Graduate Instructor, 1978; Research Assistant, the World Bank, 1978-79; Teaching Associate, Oklahoma State University, 1979-80.