# AN ANALYSIS OF MONETARY VELOCITY IN AN OPEN ECONOMY

by

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# CHAPTER I

## INTRODUCTION

Over the past twenty years the focus of modern monetary theory has been on the relationship between the supply of money and other economic aggregates. Some agreement, though far from conclusive, seems to be emerging regarding the proper role of money in a closed economy. Perimeters of discussion appear to be well demarcated, given widely accepted theoretical and empirical results.[1]

Discussion of the role of money in an open economy, on the other hand, has proceeded at a much slower pace. Over the past few years, however, there has emerged an increasing interest in applying the quantity theory to monetary relationships among the trading countries of the world.

Though large gains have been made on theoretical grounds, empirical results remain scarce. The paucity of quantity-theory results in international monetary relations can be attributed to the fact that recent

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[1]For an authoritative statement, see Milton Friedman, "The Quantity Theory of Money," in Studies in the Quantity Theory of Money, ed. M. Friedman (Chicago: University of Chicago Press, 1952), pp. 3-21.

[2]Arnold Collery, International Adjustments, Open Economies and the Quantity Theory ("Princeton Studies in International Finance," No. 28; Princeton, N. J.: Princeton University Press, 1971); and Robert A. Mundell, Monetary Theory: Inflation, Interest and Growth in the World Economy (Pacific Palisades, Calif.: Goodyear Publishing Co., Inc.) 1971.

developments in the theory of money, with some exceptions, have been the work of United States economists. From the American position, the closed economy has not only served as a simplifying assumption, but has provided a necessary analytical structure on the basis of which almost all empirical and theoretical results have been obtained.

The emergent interest in applying the quantity theory to monetary relationships among countries appears to have been precipitated by the growing integration of world markets and the attending accelerated worldwide inflation. Although fruitful results have been obtained, research efforts continue to be mainly directed toward measurement of the impact of domestic money stock changes on national income. As a consequence, major research efforts aimed at analyzing the effects of international forces on income and the nature of velocity in an open economy, per se, are virtually non-existent.

## 1.1 The quantity theory

Several theories have been advanced in an attempt to explain the recent round of inflation. Of the many theories that have been suggested, few enjoy the long-established tradition and recognition of the quantity theory.

In its simplest and most familiar formulation, the relationship between money, prices, and real income is defined in terms of the Fisherine equation of exchange in the form:

$$MV = PY \qquad (1.1)$$

where M is money stock, V is velocity of money per unit of output, P is the average price level, and y is real income. In this statement, the role of money is crystalized. The quantity of money is recognized as the important determinant of the level of prices and nominal income. The recognition of the importance of money is in conformity with a preponderance of evidence accumulated over centuries. Anna Schwartz has recently shown that, without exception, price changes have tended to be the mirror image of monetary changes over the last two-and-a-half millennia.[1]

Viewed superficially, the quantity theory is just a tautology and a pure ex-post accounting identity. When certain assumptions are made about the behavior of velocity, however, the equation of exchange states an exact testable proposition based on an accurate portrayal of the relationship between money and national income. The validity of this proposition depends on the stability of velocity. Clearly if velocity is not stable under a broad range of circumstances, as will be shown, then the quantity theory is not capable of prediction. This possibility not withstanding, quantity theorists have always assumed velocity to be stable, albeit varying slowly.

The stability assumption is tantamount to an assertion that there exists a proportionate relationship, or a tendancy toward proportionality, between the price level and the stock of money per unit of output:

$$P = V\ (M/y) \qquad (1.2)$$

where P is the average level of prices and V is velocity of circulation of money, M, per unit of real output, y. These relationships and assertions are assumed to be true on the supposition that the quantity theory is a

[1] Anna J. Schwartz, "Secular Price Changes in Historical Perspective," Journal of Money, Credit, and Banking, V (September, 1973), pp. 243-269.

theory of money demand rather than a theory of national income or price. A moment's reflection suggests that these assertions are violated when money demand is assumed to depend on expenditure. If international forces are permitted to influence the demand for money, then the stability hypothesis becomes tenuous.

In an open economy, money demand may be expenditure-constrained and thus may not be a stable function of income as traditionally hypothesized. An elaboration of this notion is the subject of this volume.

## 1.2 The quantity theory in the open economy

The characteristic themes of the open-economy based quantity theory are derived from monetarism which places heavy emphasis on the quantity of money demanded and supplied as the prime factor motivating spending and, therefore, changes in nominal income and prices. Friedman and others have repeateadly explained that monetary authorities can change the nominal quantity of money, but that it is money holders who determine the velocity with which the stock of money is used, and who ultimately determine the stock of real balances through effects of spending decisions on prices. As Friedman puts it, "The key insight of the quantity approach is that such a discrepancy (between the demand for and supply of money) will be manifested in attempted spending, thence in changes in nominal income."[1]

For a world economy, this model is summarized by the income-constrained money-demand function in the velocity equation form:

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[1] Milton Friedman, "A Theoretical Framework for Monetary Analysis," *Journal of Political Economy*, LXXVIII (March/April, 1970), p. 225.

$$V = Y_\omega / M_\omega \tag{1.3}$$

or, in real terms,

$$V = \frac{Y_\omega \; (1/P_\omega)}{M_\omega \; (1/P_\omega)} \tag{1.4}$$

where V, $Y_\omega$, and $M_\omega$ are velocity of circulation per unit of output, world nominal income, and narrowly defined world money stock, respectively, and $P_\omega$ is the average of world price level.

In principle, this analytical structure is standard whether a closed, open, or world economy is the unit of interest. A world economy is indistinguishable from a closed economy. In the aggregate, it is not possible for the money holders of the world (world public) to change the nominal quantity of money. A distinction must be made between closed and open economies, however. An open economy is subject to the basic laws of inter-regional trade. This is in direct contrast to the traditional notion which assumes that economic developments in a political unit are explained by factors endogenous to that unit. Available evidence suggests that major trading countries are linked together in a chain of highly integrated markets and, until recently, by a system of fixed exchange rates.

## 1.3 The need for further research

If fixed exchange rates continue to be held as a panacea for such evils as economic stagnation and unemployment (and, in spite of protestations to this effect, it is doubtful that fixed exchange rates are the necessary remedy), then we are not over the apex of high inflationary pressures. There is a real danger that flexible exchange rates may be abandoned.[1] Monetary authorities will then resort to control of monetary aggregates as a possible cure for external disturbances. In spite of all of this, available evidence suggests that monetary authorities may not be able to sterilize external disturbances.

In recent years, particularly after the mid-sixties, the growing integration of world markets, working through large increases in the supply of money, has made wide-spread, persistent, and variable inflation possible. In country after country, these developments have caused concern and have tended to crystalize the degree of monetary interdependence among trading countries of the world. For example, the weighted average of prices for nine major countries of the Organization for Economic Cooperation and Development (OECD countries), including the United States, increased by 22.7 percent between 1965 and 1970, and by 17.8 percent between 1970 and 1973. This is equal to an increase of over 4.2 and 5.6 percent, respectively, in the average annual rate of inflation, or an increase of 64.3 percent for the fifteen year period (1960-1973).[2]

Monetary theorists have attributed these developments to the rapid world-wide increase in money made possible by the Bretton Woods Agreement,

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[1] On February 9, 1976, Spain devalued the Spanish peso by 10 percent. This action was accompanied by many European countries' attempts to shore up their currencies in the face of the sagging U. S. dollar. The latter was precipitated by fluctuations in gold prices.

[2] David I. Meiselman, Worldwide Inflation: A Monetarist View, presented at the Conference on The Phenomenon of Worldwide Inflation, May 6, 1974, at the American Enterprise Institute for Public Policy, Washington, D. C., pp. 20-22. Reprinted in David I. Meiselman and Arthur B. Laffer (eds.), The Phenomenon of Worldwide Inflation (Washington, D. C.: American Enterprise Institute for Public Policy, 1975), pp. 90-91.

International Monetary Fund arrangements, and the system of fixed exchange rates. The latter has served as an important transmission mechanism for world-wide dispersal of excess money. While predictions following the Smithsonian Agreement in the first quarter of 1973 suggested a decrease in the rate of money growth, it appears that a sustained slower rate of growth may not be realized. There is no guarantee that national governments will refrain from political pressures to maintain exchange rates at artificial levels.

Therefore understanding the nature of velocity in an open economy may provide information that might be used to pursue an enlightened monetary policy and to ensure that effects of irresponsible monetary policies of some countries are not borne by innocent ones.

One approach that has been employed in applying the quantity theory to relationships among countries has proceeded on the basis of closed-economy assumptions and has thus failed to take account of open-economy linkages. It assumes that a world velocity equation can be obtained if economic aggregates for all trading countries are lumped together.[1] Results about the relationship between money demand and income secured on the basis of this approach correspond to closed-economy results; long-term relationships are given preference over policy considerations. Necessarily, velocity has tended to be a rather colorless concept. Consequently, analysis of velocity in an open economy has been discouraged.

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[1]Donald S. Kemp, "A Monetary View of the Balance of Payments," Review--Federal Reserve Bank of St. Louis, LVII (April, 1975), pp. 14-22.

While these results are useful, more information can be acquired by focusing attention on associations among trading countries. In an open economy, these associations are summarized by balance-of-payments changes which reflect money demand adjustments following a money stock change and expenditure changes. Aggregate expenditures will invariably diverge from income by the difference between exports and imports. Therefore, when foreign expenditure patterns and governmental budgetary activity are brought into the purview of analysis, and when it is simultaneously recognized that exports depend on expenditure patterns abroad and that domestic expenditures include imports, as well, the notion that velocity is a stable function only of income becomes questionable.

The fraction of income held in the form of money balances may not be a constant proportion of income. Instead, this fraction may vary with changes in anticipated expenditures and with the relative distribution of cash among countries. This follows from the principle that the immediate impact of a money stock change, domestic or world, is on expenditures.

These observations indicate the need for further research in the theory of money. Presumably, incorporation of capital flows in the estimated money-demand function will yield more concrete results. In the first place, use of capital flows might enable a determination of the degree of variation in velocity for a given portfolio adjustment. In addition, it may permit a broadening of the money supply definition to include different types of assets and allow measurement of the relative variability of alternative velocity functions. Although quite useful for focusing attention on important macroeconomic relationships, such an exercise is beyond the confines of this study.

## 1.4 The objective of the study

In this dissertation, we develop an alternative money-demand framework. We investigate the effects of international forces on income. The theoretical framework to be employed is derived from extensions of the quantity theory to analysis of monetary relationships among countries.[1]

Two general functional forms are considered. They are the income approach associated with Fisher and Marshall, et al, and the expenditure approach developed here. The expenditure approach hypothesizes that an increase in exports, domestic money and total private expenditures remaining constant, increases income and causes income velocity to rise.

In contrast, with domestic money and private expenditures still remaining constant, the income approach says that an increase in exports can only occur at the expense of imports and expenditures on domestic goods and services. Imports and private expenditures are components of total expenditures by residents of a country. Thus, unless the domestic stock of money increases, nominal income cannot increase because of the inherent crowding-out effect implicit in the income approach. As exports increase, residents will tend to buy less from abroad and from themselves; the total value of imports and domestic purchases will fall. Exports thus occur at the expense of the two components of total private expenditures. A temporary increase in income occurs, but this is a mirage. After adjustment, both income and velocity will be unchanged. Hence, international forces play no role.

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[1]For a discussion of attempts to apply the quantity theory to monetary relationships among countries, see Harry G. Johnson, Further Essays in Monetary Theory (Cambridge, Ma.: Harvard University Press, 1973) pp. 229-49.

Discussion proceeds on the proposition that properties of an open-economy based money-demand function are derived from assumptions made about the money-supply process and expenditure patterns. We assume that relationships among countries are summarized by existing international monetary arrangements. World and domestic money stocks are defined in terms of base money which is made up of international reserve and domestic reserve components. We employ only the narrow definition of money, $M_1$. All values are nominal.

A major proposition is that open-economy properties can be differentiated from those associated with a closed economy. Consequently, the fraction of nominal income held in the form of cash balances may vary in accordance with changes in expenditures. Thus, it may be possible to define the demand for money with respect to planned expenditures instead of income. A priori, income is the proper money-demand constraint in three cases only, namely: (1) when world and domestic money grow at the same rate, (2) when domestic money grows at the same rate as real output, and (3) when the balance of payments registers a zero sum. Otherwise, money demand will generally be expenditure-constrained whenever expenditures dominate income.

There are three specific issues discussed in this dissertation. These are: (1) the nature of the specified model, (2) the properties of the estimated equation, and (3) the relative performance of the two alternative models.

The first problem deals with how trade relationships among countries can usefully be incorporated into the standard velocity function and whether results obtained from estimating the derived equation would be significantly different from those obtained from estimating the standard velocity equation. Open-economy-based models are specified and discussed in chapter II where their theoretical foundations are developed and reduced-form equations derived. For all countries included in the sample, we were able to distinguish the expenditure version from the income version both theoretically and statistically. Test results reported in chapter III suggest that expenditure changes are important.

The second problem deals with whether or not the reduced-form equation derived from the model developed in chapter II is valid. In the final form, this equation includes open-economy arguments specified in monetary terms. Testing could not proceed on the basis of this form, however. It was apparent at the outset that velocity would be subject to trend effects and other factors not included in the model. Because money demand had to be estimated, elimination of this variable removed attending identification difficulties and thus resulted in a respecification of the model for empirical testing. Procedures are discussed in chapter III. Regression results generally supported the view that changes in the composition of expenditures are a major explanation of velocity, and that nominal-income changes can be explained by world money-stock and government-expenditure changes, as well. These results and test procedures can be found in chapter III. While trend effects are important, their significance serves to support rather than refute the basic thesis.

The third problem, as indicated, addresses the issue of the relative performance of the expenditure formulation. Results reported in chapter III suggest that modification of the standard quantity equation to allow for changes in expenditures produces a function, the results of which are, for most countries, both quantitatively and qualitatively superior to those obtained from testing the income formulation. This evidence indicates that the expenditure version is the proper structure for analyzing velocity in an open economy.

Finally, chapter IV presents the summary of findings and conclusion on the study.

## CHAPTER II

## SPECIFICATION OF ALTERNATIVE MONEY DEMAND FUNCTIONS

In this chapter we review some preliminary evidence and develop an alternative money-demand framework. We assume that money demand is a function of expenditures rather than income as hypothesized by traditional theory. The theoretical framework developed here is derived from an extension of the quantity theory to monetary relations among countries.

Two general functional forms are considered. They are the expenditure approach, to be developed subsequently, and the income approach associated with Fisher and Marshall, et al. The former hypothesizes that money balances held depend not so much on income, but on expenditures by residents of a country in general. The latter hypothesizes that money demand is a constant proportion of income and assumes that velocity is relatively stable.

### 2.1 Some preliminary evidence

The previous chapter established that a number of money-demand functions have been estimated over the past twenty years. Almost all of these studies include income or wealth as a money-demand constraint.[1] In

[1]For example, see Karl Brunner and Allen H. Meltzer, "Predicting Velocity: Implications for Theory and Policy," Journal of Finance XVIII (May, 1963), pp. 319-59; Milton M. Friedman, "The Demand for Money: Some Theoretical and Empirical Results," The Journal of Political Economy, LXVII (June, 1959), pp. 327-51; M. J. Kavanagh and A. A. Walters,

other studies prices and rates of interest are also included. Money-demand functions of this general type have been applied exhaustively to time-series data for various periods. With but a few exceptions, results obtained are in general agreement. The quantity of money demanded is estimated to be a positive but stable function of income or wealth and to be a negative function of the rate of interest.[1]

These studies, however, overlook a large body of potentially contradictory evidence: effects of international forces on the quantity of money demanded and the implications of these forces on the behavior of income and velocity. From the viewpoint of an individual country, a balance-of-payments deficit represents attempts by residents to get rid of unwanted cash by spending it, while a balance-of-payments surplus represents attempts to replenish cash holdings by disposing of unwanted goods or securities. Consequently, open-economy forces are monetary phenomena. They reflect excess demand or supply of cash. These are effected through expenditure changes because money-stock changes accompanying a disequilibrium in the external balance have their initial impact on expenditures. Therefore, the fraction of income held in the form of cash balances may not be in a stable relationship to income. For a given

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"The Demand for Money in the United Kingdom, 1877-1966: Some Preliminary Findings," reprinted from The Oxford Bulletin of Economics and Statistics, XXVIII (1966) in Money and Banking, ed. A. A. Walters (Harmondsworth: Middlesex, England: Penguin Education, 1973), p. 183; Allen H. Meltzer "Demand for Money: Evidence from Time Series," The Journal of Political Economy, LXXI (June, 1963), pp. 219-246.

[1]The most notable exception is Friedman, who does not find interest rates to be significant in his statistical estimates, see Milton Friedman, "The Demand for Money: Some Theoretical and Empirical Results," op cit., p. 329.

distribution of money among countries, the quantity of money demanded by residents of any one country will invariably change with anticipated variations in expenditures, regardless of the level of income. That is, money demand will generally tend to be expenditure-constrained when an open economy is assumed. In spite of this evidence, international studies of the money-demand function seem to persistently assume that these forces are not sufficiently important to necessitate their incorporation in the final functional forms estimated.

Illustrative of contemporary research in the application of the quantity theory to international relationships is Professor David Meiselman's study of world-wide inflation. In conjunction with other recent work, this study has provided an open-economy-based quantity equation similar to the Cambridge specification, except for the substitution of a world economy in the place of a closed economy. Results obtained by estimating this version of the quantity equation on the basis of weighted-average time-series data from nine OECD countries show that velocity in "the rest of the world" has been highly stable albeit falling very gradually at an average annual rate of -0.8 for the period between 1960 and 1973.[1] Meiselman has therefore concluded that this particular round of inflation is primarily due to excessive money creation.

There is no disputing this evidence. The association between output and prices is good, given the $R^2$ of 0.98. In addition, the $R^2$ between the stock of money and income, 0.99, is also exceptionally good.

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[1]David Meiselman, op.cit., table 4. Meiselman defines "the rest of the world" as the nine major OECD countries, excluding The United States: Belgium, Canada, France, Germany, Japan, Italy, The Netherlands, The United Kingdom, and Switzerland.

On the basis of these results, Meiselman has concluded that the large increase in nominal expenditures in "the rest of the world" were the result of large increases in the quantity of money rather than in velocity.[1]

Other international studies have also come to the same general conclusion. For example, Yong Chul Park has estimated adjusted coefficients of variation in velocity on the basis of lagged and non-lagged money demand function of the Friedman type for countries at different stages of development.[2] On the basis of results obtained which show that velocity is much more variable in less-developed countries than in advanced ones, Park concludes that money demand in the latter group of countries is relatively stable. International studies by George Kaufman and Cynthia Latta, and by Joseph Adekunle, also support the general view that money demand is a stable function of income.[3]

While these studies have enhanced our understanding of the relationship between the demand for money and income, they, too, overlook the effects of international forces on income. Meiselman seems to have recognized the importance of these forces, however, though the aggregative nature of the final functional form estimated makes it exceedingly diffi-

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[1]Extensions to these conclusions can be found in William Rule, "Money, Income and Prices: The Velocity of Money in Nine OECD Economies" (unpublished Ph.D. dissertation, Department of Economics, Virginia Polytechnic Institute and State University, 1975).

[2]Yong Chul Park, "The Variability of Velocity: An International Comparison," International Monetary Fund Staff Papers (November, 1970), pp. 620-39; see also, J. Melitz and H. Correo, "International Differences in Income Velocity," Review of Economics and Statistics, LII (1970), pp. 12-7.

[3]George G. Kaufman and Cynthia Latta, "The Demand for Money: Preliminary Evidence from Industrialized Countries," Journal of Finance and Quantitative Analysis, I (September, 1966), pp. 78-89; and Joseph O. Adekunle, "The Demand for Money: An International Comparison," The Indian Economic Journal, XVI (July-September, 1968), pp. 23-43.

cult to isolate the specific relationships between international forces and a country's income.

In this study we correct this oversight by formulating the specific relationship between international forces and a country's income. A theoretical distinction is then made between this structure and the income approach.

## 2.2 Specification of alternative theoretical frameworks

In the subsequent derivation of competing analytical structures and discussion, it is assumed that all prices, including exchange and interest rates, are determined by world forces. Capital flows are a function of international interest rate differentials and of the relative distribution of cash among trading countries of the world. Therefore they do not enter into the analytical structures to be developed. It is argued, however, that their exclusion will not bias results so significantly as to affect the validity of conclusions obtained.

In order to compare the relative predictive capabilities of the two functional forms, it is necessary to derive both formulations from the same set of conditions. This is done in the section dealing with the specification of the two alternative functional structures. For ease of exposition and reference, the expenditure and income approaches will hereafter be referred to as models I and II, respectively.

## 2.3 The expenditure approach: model I

Hitherto, it has been argued that existing money-demand formulations have failed to include variables to represent international forces in the final money-demand functions estimated. A more precise formulation of the money-demand function, defined to include open-economy effects, necessitates specification of the following framework. Consider the open-economy equilibrium condition:

$$Y_i = E_i^i + E_i^\omega + G_i^i \tag{2.1}$$

where $Y_i$ is the open-economy nominal gross national product, or income, and where $E_i^i$ and $E_i^\omega$ and $G_i^i$ are domestic private expenditures, exports, and government expenditures, respectively. Here domestic private expenditures are defined to include consumption and investment expenditures on a country's own gross product.[1] Exports are defined as the current-account export variable excluding official transfers. The government expenditure variable, $G_i^i$, is autonomous, and it represents purchases of domestic goods and services by the public sector. The subscript, i, refers to the source of goods for any individual country, i. Superscripts refer to the destination of goods, country i or the rest of the world, ω. In the preceeding equation, for example, $E_i^i$ refers to goods from country i to country i, and $E_i^\omega$ refers to goods from country i to the rest of the world, ω.

Equation (2.1) says that equilibrium, for any open economy, i, is obtained when the value of all domestic expenditures and exports is equal to the total value of goods and services produced by that economy. Throughout the remainder of this section, gross national product (GNP) is used synonymously with income. Because of the assumption that prices are determined by world forces, only nominal values are employed.

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[1]Domestic private expenditures are presumed to be all private expenditures excluding expenditures by government.

The sum of expenditures by a country's residents are not restricted to expenditures by nationals on goods produced by country i alone, however. Expenditures on imported goods by the private sector and government also constitute an integral part of national expenditures. To focus attention on the effects of trade, a composite expenditure variable is introduced. It is assumed that part of expenditures goes toward acquiring goods produced abroad while another part is devoted to domestic goods. Clearly the proportion of expenditures between imports and domestic goods depends on tastes, relative prices, and a few other choice variables, as well as on budgetary considerations.

Total expenditures by country i's residents can be defined rather simply as

$$E_i = E_i^i + E_\omega^i \tag{2.2}$$

where $E_i$ is total expenditures by country i's residents on domestic goods as well as on imports. The variable $E_\omega^i$ is the import variable.

Substituting equation (2.2) into equation (2.1), we obtain

$$Y_i = (E_i - E_\omega^i) + E_i^\omega + G_i^i \tag{2.3}$$

This equation is one normally found in macroeconomic models which include the foreign sector, except that here emphasis is on net expenditures rather than on net exports as is usually the case.[1] Note also

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[1]The open economy equilibrium condition is traditionally specified as $Y_i = E_i^i + (E_i^\omega - E_\omega^i) + G_i^i = C + I + (X - M) + G$, where C is consumption, I is investment expenditures, and (X - M) is net exports, for X defined to be exports and M defined to be imports, and G is government expenditure.

that this formulation is but a variant formulation of the open-economy equilibrium condition specified by equation (2.1), given equation (2.2).

From the American vantage point, as articulated by U. S.-based economists, $E_{\omega}^{i}$ and $E_{i}^{\omega}$ are not large enough to make any difference in the money-demand functions estimated, hence the simplifying assumption of a closed economy characteristic of almost all money-demand functions that have been estimated. From the viewpoint of most trading countries of the western world (the western world being taken to include LDCs), however, exports and imports make up a relatively large proportion of national income in these countries. Therefore they can not be ignored when formulating and estimating money-demand functions for these countries.

There are two possible conditions an open economy must face regarding external balance. On the one hand, exports and imports are always equal, such that $E_{i}^{\omega} - E_{\omega}^{i} = 0$, or near zero, in which case international forces can not influence national income. On the other hand, the external balance may be in perpetual disequilibrium, such that $E_{i}^{\omega} - E_{\omega}^{i} \neq 0$, in which case international forces obviously can not be ignored. If exports and imports always balance, then, in any country, i, income can always be explained by expenditure patterns at home alone. The money-demand function would then take on only relevant domestic arguments as constraints. If, on the other hand, exports and imports very frequently are unequal, then they can not be ignored. Any simplifying assumption of the closed-economy variety can not be justified. Changes in the import and export balance will affect income considerably. That is, the behavior of nominal income can also be explained by what happens abroad.

External disequilibria are monetary phenomena and reflect excess demand for cash by either nationals of foreigners effected through expenditure changes. Thus, for example, an increase in the stock of money in country i, all other things remaining equal, will be dissipated elsewhere as residents adjust to the larger stock of money by substituting goods for money and expanding import expenditures or capital exports. Conversely, a decrease in the quantity of money in country i, all other things remaining equal, results in accumulation of cash as residents adjust to new circumstances by decumulating goods and expanding exports or capital imports. As a consequence, the demand for money will vary with changes in anticipated expenditure following a current-account-induced cash re-distribution among trading countries of the world.

The preceding discussion suggests that the volume of a country's exports, $E_i^{\omega}$, is a positive function of world money. An increase in the stock of world money affects world expenditures directly by stimulating import demand. Since net world imports are country i's net exports, exports are exogenously determined. Hence, exports may be defined in terms of world money such that

$$E_i^{\omega} = \gamma_{\omega} M_{\omega} \qquad (2.4)$$

where $E_i^{\omega}$ is as previously defined and $M_{\omega}$ is the world stock of money.[1]

[1]World money stock $M_{\omega}$ is defined to be the sum of money stocks of the rest of the world, $M_j$, weighted by the rate of exchange or conversion factor such that $M_{\omega} = \sum_{j=2}^{N} \lambda M_j$, $i \neq j$, $j = 2, 3, \ldots, N$, where $M_j$ is the money stock of country j and $\lambda$ is average dollar price of foreign currency or the dollar rate. Use of this conversion factor is convenient. Furthermore, there is no evidence to suggest that a conversion factor weighted to reflect devaluations or revaluations is better.

Parameter $\gamma_\omega$ specifies the relationship between country i's exports and the stock of world money. From equation (2.4), it is quite clear that an increase in world money stock necessarily causes an increase in exports as foreigners decumulate cash balances and acquire country i's goods, exports.

Although the functional dependence of imports on domestic money stock is clearly suggested by the preceding analysis, another relationship, perhaps a more useful one, is also indicated. It was proposed earlier that residents choose to spend a fraction of total expenditures on imports, depending on tastes, relative prices, and a few other important choice variables. Consider the following:

$$E_\omega^i = \pi_i E_i \qquad (2.5)$$

where $E_\omega^i$ is import expenditures as previously defined. Variable $E_i$ is total private expenditures by country i's residents, inclusive of imports. Parameter $\pi_i$ takes on a value between zero and unity, such that $0 < \pi_i < 1$. This is self-explanatory, since expenditures on imports can only be as large as the total volume of expenditures. A zero import-expenditure coefficient is unlikely in a world in which international markets are considerably interdependent. Clearly, an increase in planned total expenditures, $E_i$, necessarily increases both domestic expenditures and imports. An increase in imports, however, will tend to be accompanied by cash decumulations as residents direct excess cash holdings toward expenditures on imports.

There is another more subtle variable not previously included in the model. Budgetary activity, government expenditures in particular, is composed of expenditures on domestic goods as well as expenditures on imports. Since government expenditures enter the income stream autonomously, their treatment requires caution. It is rather simple to postulate the following relationship. Suppose total government expenditures to be composed of expenditures on domestic goods and services, $G_i^i$, and expenditures on imported goods. Now consider the following equation:

$$G_i = G_i^i + G_\omega^i \tag{2.6}$$

where $G_i$ is total government expenditures, $G_i^i$ is government expenditure on domestic goods as previously defined, and $G_\omega^i$ is government expenditure on imported goods. As usual, subscripts mean goods from country i or the rest of the world, $\omega$, and superscripts mean goods to country i or to $\omega$, according to the convention previously established. Now assume government expenditures on imports are a fixed proportion of total government expenditures, such that:

$$G_\omega^i = z_i G_i \tag{2.7}$$

where $z_i$ has some value between zero and unity: that is, $0 < z_i < 1$. The parameter $z_i$ specifies a constant proportionate relationship between import and total expenditures. Thus, increases in government expenditures have implications for changes in income and expenditures abroad. Clearly government expenditures in country i on goods from some country j, or from the rest of the world, can be summarized by the current-account balance of payments. Hence these expenditures may also explain how nationals and foreigners react to money-stock changes.

The monetary nature of international effects and their transmission through changes in excess demand for cash clearly suggest that the money-demand function be defined in terms of expenditures. Following the monetarist specification, suppose money demand to be proportionate to total expenditures for any country i such that

$$M_i^d = \theta_{i1} E_i \qquad (2.8)$$

where $M_i^d$ is demand for nominal balances by country i's residents. Variable $E_i$ is total expenditures, including expenditures on imports as previously defined, and endogenous to the system. Parameter $\theta_{i1}$ is some constant which relates money demand to total planned expenditures. Note that parameter $\theta_{i1}$ is a Cambridge-k variant specified for expenditure changes. This parameter has a value greater than zero. Subscripts i and 1 refer to country i and to the fact that attention is on model I. Equation (2.8) states that cash balances demanded are explained by the volume of planned expenditures. For a given set of payment arrangements summarized by $\theta_{i1}$, an increase in import demand for a constant $E_i$ does not affect the quantity of money balances demanded. Residents will substitute imports for domestic goods. The converse is also true. If, however, both import demand and expenditures on domestic goods increase such that planned total expenditures increase, then the quantity of money demanded will also increase.

Now suppose monetary authorities do indeed make the quantity of money in circulation any amount they choose. Further, consider the money creation process in any country. An increase in either government borrowing financed by the monetary authority or international reserve holdings at the central bank increases base money which, subject to the money multiplier, increases money stock. The reserve bank can pursue a prudent money-management policy, however, by neutralizing external effects and deficit-financing repercussions. The historical record suggests otherwise, though. Monetary authorities can not be trusted to effect timely brakes on either money-stock growth or contraction. Therefore we assume that both domestic and world money are exogenously determined.

For an individual economy and the world, consider the following money-supply specifications:

$$M_i^s = M_i^0 \tag{2.9}$$

$$M_\omega = M_\omega^0 \tag{2.10}$$

where $M_i^s$ is the money supply in country i and $M_i^0$ specifies exogeneity of money-stock determination. The superscript 0 indicates exogeneity. The variable, $M_\omega$, is world money stock as previously defined. If, for one country, the domestic money stock is exogenous, then the world money stock is also exogenous to that country, assuming complete sterilization.

In equilibrium, the nominal quantity of money demanded by residents must equal the nominal, albeit exogenously determined, money supply. The equilibrium money market condition for an open economy is

$$M_i^d = M_i^0 \tag{2.11}$$

## 2.4 The expenditure-approach estimate of the money-demand income relationship

From equation (2.2) can be obtained the following respecifications of the relationship between total expenditure components, viz:

$$E_i^i = E_i - \pi_i E_i \tag{2.12}$$

or

$$E_i^i = (1 - \pi_i)\, E_i \tag{2.13}$$

Equations (2.12) and (2.13) say that expenditures on domestic goods are equal to the difference between total expenditures by residents of country i and imported goods and services. Substituting equations (2.6), (2.7), (2.12), and (2.13) into equation (2.1), we have:

$$Y_i = (1 - \pi_i)\ E_i + E_i^{\omega} + (1 - z_i)\ G_i \tag{2.14}$$

Further substituting equations (2.4) and (2.11), including all money market properties, into equation (2.14) and solving for velocity, we obtain:

$$V_i = (1 - \pi_i)\ /\ \theta_{i1} + \gamma_{\omega}\ (M_{\omega}/M_i) + (1 - z_i)(G_i/M_i) \tag{2.15}$$

Equation (2.15) is the reduced form of the expenditure approach.

Consider the first term in equation (2.15). If imports and exports always have a zero sum,

$$\frac{\pi_i M_i}{\theta_{i1}} - \gamma_{\omega} M_{\omega} = 0 \text{ [1]} \tag{2.16}$$

for $\pi_i$ and $\gamma_{\omega} > 0$, then a simple closed-economy model may be the proper analytical structure. Money demand will then tend to be a constant proportion of income. Thus, external forces may not affect national income, except indirectly, as summarized by the income version. If, on the other hand, exports and imports do not balance, then income will be affected by what happens aborad. Money demand will not be a stable function of income except, maybe, in the long run. As Keynes said, however, "In the long run, we are dead." Supposedly, it will not make any difference whether money

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[1]See equation (2.15).

demand is a stable function of income or not. More immediately, though, money demand may not be a stable function of income. The quantity of money the public desires to hold will vary with changes in the distribution of private and government expenditures between domestic goods and imports and with trade-induced relative distribution of cash among trading countries of the world.

Budgetary changes may also be expected to influence the amount of cash held by the public. A proportionate increase in tax rates, for example, can be expected to increase the amount of cash demanded as individuals accumulate money balances in order to meet tax assessments. Further, for $z_i > 0$, income will be less if it is assumed that total government expenditures are financed solely by taxes. Thus, it is quite evident that changes in budgetary activity, for a given stock of money, will affect velocity. Therefore the assumed stability property must be questioned.

In this formulation, an attempt has been made to link developments abroad to income changes at home. As specified, our model has ten unknowns, $Y_i$, $E_i$, $E_i^i$, $E_\omega^i$, $E_i^\omega$, $G_i^i$, $G_\omega^i$, $M_d^i$, $M_i^s$, and $M_\omega$, in ten equations, (2.1), (2.2), and (2.4) through (2.11). The reduced form equation obtained incorporates open-economy properties which conventional formulations do not. Global forces have been permitted to influence both income and velocity. Unlike the Meiselman framework, effects of world forces can be isolated for each country by the expenditure approach.

Price effects, including the effects of interest-rate differentials among countries, and the effects of currency devaluation or revaluation on expenditure patterns at home or abroad, have not been analyzed. There is no price equation in this model. This is in conformity with the object of this dissertation, which is the comparison of two alternative money-demand formulations.

Equation (2.15) has important implications for the behavior of velocity. Before these implications are discussed, note that the ratios $(M_\omega/M_i)$ and $(G_i/M_i)$ are monetary- and fiscal-policy variables. A change in these ratios will cause velocity to change regardless of whether or not a balanced budget is maintained and regardless of whether or not monetary authorities successfully neutralize external effects or maintain steady money growth.

To appreciate this, suppose that, for any reason, either world money or government expenditures increase, and domestic money and private expenditures remain constant. Then exports will increase as foreigners buy more of country i's goods and services. The increase in exports and government expenditures will raise income, thereby causing velocity to rise.

If monetary authorities do not neutralize the monetary effects of the increase in exports, domestic money will rise. The increase in domestic money causes the world-domestic money ratio to fall. Thus, velocity must fall. Other things being equal, an increase in domestic money causes expenditures and the level of money balances held to rise as residents adjust to the larger stock of money. As a consequence, velocity will fall.

The expenditure approach has now been fully specified and its derivation discussed at sufficiently great length. In the next section, we develop the income approach from exactly the same open-economy conditions, after which we contrast and compare the two alternative formulations.

## 2.5 The income approach: model II

While historical accuracy requires that a distinction be made among several income-constrained money-demand versions, ease of exposition necessitates that the Cambridge version be considered adequately representative of the income approach. For example, although Fisher and Marshall follow distinctly different paths, their final money-demand formulations are quite similar. Further, once prices are assumed to be determined by world forces, as is done in this paper, then the Cambridge version appears indistinguishable from subsequent formulations.[1]

The substance of the income approach is that, if one looks at the problem of money demand, one must conclude that the holding of cash has an opportunity cost associated with it. When made more explicit, as Pigou did, the volume of transaction demand and income are found to be in stable relationship to each other.[2] This does not mean that the demand for money is invariant, however. Sharp rises in prices during periods of hyperinflation are consistent with the notion of stable money demand, since that function normally includes variables referring to expected price changes. That is, the public tends to discount the inflation rate, once it comes to be expected, in their calculations of the amount of cash

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[1] Harry G. Johnson, "Monetary Theory and Policy," The American Economic Review, LII (June, 1962), p. 344.

[2] A. C. Pigou, "The Value of Money," reprinted from the Quarterly Journal of Economics, XXXII (1917), in Readings in Monetary Theory, AEA Series (Homewood, Ill.: Richard D. Irwin, 1951), pp. 173-180.

balances to hold.

But instead of incorporating open-economy repurcussions into the standard velocity equation as we have tried to do, the income version and variations to this standard formulation have generally been concerned with difficulties surrounding the proper definition of money, income, and the cost of holding cash; that is, whether money ought to be defined to be inclusive or exclusive of savings deposits, $M_2$ and $M_1$. The problem of choosing the proper income definition has been reduced to a problem of distinguishing income, as ordinarily understood, from permanent income or wealth. On the whole, choice of $M_1$ has been accompanied by a choice of long-term rates, while that of $M_2$ has been associated with short-term rates.[1]

In an open economy, prices are determined by world and not by domestic markets. Hence, interest rate differentials are endogenous. This means that capital flows are also endogenous, since these are a function of interest-rate differentials. Further, since both wealth and permanent income require discounting, these are also determined by the model. Hence, our use of the simple Fisherine income version.

The simple income-constrained money-demand function is reproduced here so as to highlight similarities and differences between it and the expenditure approach. It is a simple matter to show that, while the two approaches start from the same place, their implications are quite different.

Consider the open-economy equilibrium condition:

$$Y_i = E_i^i + E_i^{\omega} + G_i^i$$

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[1]See Meltzer, "The Demand for Money: The Evidence from Time Series," op. cit., p. 240.

Equation (2.17) says that the total value of goods and services produced by any country, i, is equal to the sum of all domestic expenditures and exports to the rest of the world, and expenditures by government on domestic goods and services. Variable $Y_i$ represents gross national product, $E_i^i$ is domestic expenditures, $E_i^\omega$ represents total exports, and $G_i^i$ represents government expenditures. Subscripts and superscripts mean goods from country i to country i or the rest of the world, $\omega$, respectively.

Country i's exports depend on expenditure patterns abroad. The latter are a function of the relative abundance of cash. Since the total amount of the circulating medium abroad is exogenous, exports can be defined in terms of total world money such that:

$$E_i^\omega = \gamma_\omega M_\omega \tag{2.18}$$

where $M_\omega$ is the total world money stock as previously defined. The parameter $\gamma_\omega$ relates exports to total world money stock and has some range such that $0 < \gamma_\omega$.

Substituting equation (2.18) into equation (2.17), obtain a generalized commodity market equilibrium condition:

$$Y_i = E_i^i + \gamma_\omega M_\omega + G_i^i \tag{2.19}$$

Equation (2.19) says that income in any country i can be explained by domestic expenditures $E_i^i$ and world expenditure patterns such that an increase in world money or in domestic expenditure components will cause income to increase.

Domestic expenditures, $E_i^i$, and expenditures by government on domestic goods, $G_i^i$, can be specified in terms of total private expenditures, $E_i$, and total government expenditures, $G_i$, such that:

$$E_i = E_i^i + E_\omega^i \tag{2.20}$$

$$E_\omega^i = \pi_i E_i \tag{2.21}$$

$$G_\omega^i = z_i G_i \tag{2.22}$$

$$G_i^i = (1 - z_i)\ G_i \tag{2.23}$$

where $\pi_i$ and $z_i$ are parameters which specify the proportionate relationships between import expenditures by the private sector and government sector and total expenditures by each of these sectors.

Substituting equations (2.20) through (2.23) into equation (2.19), obtain $Y_i$ expressed in terms of all open-economy effects:

$$Y_i = (1 - \pi_i)\ E_i + \gamma_\omega M_\omega + (1 - z)\ G_i \tag{2.24}$$

Now consider the money market. The relationship between the demand for money in any country, i, and income can be specified as

$$M_i^d = \theta_{i2}\ Y_i \tag{2.25}$$

where $M_i^d$ is demand for nominal balances in country i and $Y_i$ is nominal income in country i. The parameter $\theta_{i2}$ is the Cambridge k and its value is greater than zero. The subscript 2 draws attention to the income specification of the money-demand function. Equation (2.25) says that the quantity of money demanded will be in stable relationship to income.

For exogenously determined domestic and world money stocks, we have

$$M_i^s = M_1^0 \tag{2.26}$$

and

$$M_\omega = M_\omega^0 \tag{2.27}$$

where $M_i^s$ is domestic money supply and where $M_\omega$ is world money stock. The superscript 0 indicates exogeneity of money-supply determination for country i and the rest of the world, $\omega$.

Money market equilibrium for any country, i, is obtained when the quantity of the circulating medium supplied is equal to the quantity of that medium demanded.

$$M_i^d = M_i^0 \qquad (2.28)$$

## 2.6 The reduced form equation for the income approach

Substituting the money-market equilibrium condition, equation (2.28), into the generalized commodity-market equilibrium condition, equation (2.17), we obtain:

$$M_i^0 = \theta_{i2} [(1 - \pi_i) E_i + \gamma_\omega M_\omega + (1 - z) G_i] \qquad (2.29)$$

or

$$M_i^0 = \theta_{i2} Y_i \qquad (2.30)$$

Solving for monetary velocity, $V_i$, obtain

$$V_i = (1/\theta_{i2}) \qquad (2.31)$$

the reduced form equation of the income approach. In equation (2.31) we observe velocity to be a constant and to be dependent on the fixed proportionality between money demand and income. This property suggests that the reciprocal of velocity, $\theta_{i2}$, or money demand, is also a stable function of income. As previously noted, the parameter, $\theta_{i2}$, is the Cambridge k. As specified, the income approach structure has 10 unknowns, $Y_i$, $E_i$, $E_i^i$, $G_i^i$, $G^i$, $E_\omega^i$, $E_i^\omega$, $M_i^d$, $M_i^s$, and $M_\omega$, in 10 equations, (2.17), (2.18), (2.20) through (2.23), and (2.25) through (2.28).

The income approach as approximated by the reduced-form equation, equation (2.31), says that an increase in exports, with domestic money constant, occurs at the expense of imports and purchases by residents of a country from themselves. These are components of total expenditures by residents of a country. What this says is that, unless the domestic stock of money increases, nominal income can not increase because of the inherent crowding-out effect implicit in the income approach.

As exports increase, residents will tend to buy less from abroad and from themselves. The total value of imports and domestic purchases by a country's residents falls. Exports thus occur at the expense of the two components of total private expenditures by a country's residents. A temporary increase in income occurs following the increase in exports. This is an illusion, however. After adjustment, both income and velocity will be unchanged.

In this formulation, world forces play no role. Income is explained solely by domestic expenditures. World demand patterns and international distribution of cash are not important. Clearly the income approach comes perilously close to the simplifying assumption of a closed economy in which world forces are assumed to be either unimportant or insignificant in influencing income changes.

## 2.7 Comparison of the alternative functional forms

The commodity and money-market propositions, identities, and equilibrium conditions associated with the alternative analytical structures have now been discussed. From the two structural formulations, it is quite clear that, though both forms start from the same place, the final equations are distinctly different.

The differences between the two formulations are summarized by the treatment of the expenditure variable, $E_i$, and by the final set of reduced-form equations. In the expenditure version, total expenditures are defined to include imports. Following the monetarist money-demand specification, the demand for money is expressed as a function of total private expenditures. This formulation supposes that the residents of a country hold money balances in order to execute planned expenditures. A major proposition underlying this formulation is that an increase in the quantity of money affects private expenditures first. Individuals are assumed to react to changes in circumstances, following a money-stock change, by increasing expenditures or by decumulating goods or services so as to return to some desired combination of goods and cash.

The final reduced-form equations obtained by simultaneous solution of each structure forces attention to the directional cause of changes in money demand; that is, whether money demand is a function of income or expenditure alone, or of both, in the expenditure approach, external effects are permitted to influence the behavior of income through changes in the quantity of money demanded. The latter, as previously shown, is a function of total expenditures defined to include imports. In addition to the $(G/M_i)$ ratio, the expenditure-approach reduced-form equation emphasizes the relative distribution of cash among countries. Clearly, a change in this ratio has important policy implications for any country for which the foreign sector is relatively large.

In contrast, the influences of international forces on income drop out in the final reduced-form equation obtained for the income version. This formulation supposes that changes in external forces are summarized by income changes such that there is no need to include them in the money-demand function. Consequently, money demand is assumed to be a stable function of income. As previously shown, this will be the case only when either the ratio of world to domestic money or the ratio of government expenditures to domestic money remain constant.

It is rather easy, however, to show that expenditures are not equal to income under open-economy conditions. Divergence between exports and imports reflect two forces at work. The first has to do with the money creation process and the second has to do with how the public adjusts to a given money stock change.

An import or export deficit or surplus means a loss or gain of international reserves. The latter constitutes an important component of the money base.[1] For a given money multiplier and a given world stock of money, therefore, a deficit or surplus means a reduction or an increase in the stock of money. In order to adjust to the change in money stock, the public decumulates goods, exports, gets rid of excess cash, imports, and acquires securities denominated in foreign currency. In this process, increases in money stock in one country are dissipated to the rest of the N-1 trading countries. Hence, a balance-of-payments disequilibrium means $Y_i \neq E_i$ and $\theta_{i1} \neq \theta_{i2}$. For $E_i > Y_i$ or for $E_i < Y_i$, expenditures will determine the amount of cash the non-bank public plans to hold. In general, however, income is an important determinant of mone-

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[1]Leonal C. Anderson and Jerry L. Jordan, "The Monetary Base: Explanation and Analytic Use," Review (St. Louis: Federal Reserve Bank of St. Louis, 1968) pp. 7-11; Albert E. Burger, The Money Supply Process (Belmont, Calif.: Wadsworth Publishing Co., 1971), p. 38.

tary velocity whenever $Y_i = E_i^i + G_i^i$. This means that income will be an important determinant of velocity when either one of the following three conditions is satisfied: (1) when world and domestic money grow at the same rate or when the ratio of government expenditures to domestic money is maintained, (2) when domestic money grows at the same rate as real output, or (3) when the balance of payments registers a zero sum. Otherwise, velocity will be expenditure-constrained whenever $E_\omega^i - E_i^\omega \neq 0$ and whenever the government expenditure-domestic money ratio changes.

## 2.7 Summary

In this chapter, we have shown that it is theoretically possible to modify the traditional quantity equation so that external forces are permitted to play a role in the final money-demand estimating equation. The result is a dichotomized analytical structure specified according to the expenditure and income approaches. The former suggests that international forces are an important determinant of income, while the latter suggests that they are not. Which of the two functional forms is the appropriate structure for analyzing money demand and income in an open economy is clearly an empirical question. We take up this question in chapter III.

# CHAPTER III

## ESTIMATION PROCEDURES AND TEST RESULTS

We have shown that there are two competing theoretical models which can be derived to explain the effects of international forces on income and velocity. While the two formulations were shown to be theoretically distinguishable, determination of their relative predictive powers is an empirical problem. This chapter analyzes the properties of the reduced-form estimation equation, specifies data properties and limitations, and reports test results.

### 3.1 The nature and properties of the estimated equation

In this section, we analyze the effects of changes in the composition of expenditures on the level of income and velocity. As a by-product of this analysis, it may also be possible to obtain some notion about the influences of the relative distribution of money among countries on nominal income, and to test the hypothesis that velocity is a stable function of income.

There are two major tests undertaken. First the expenditure-approach reduced-form equation suggests that changes in the composition of expenditures might also be an explanation of changes in velocity. Second, given that velocity could be defined in terms of both income and expenditures by residents of a country, the two functional forms now have competing claim in explaining velocity. A corollary to these is that nominal income might not depend on domestic nominal money alone, but that it might depend on money-stock changes occuring in the rest of the world. Our specification also suggests that budgetary activities may be another important factor in explaining the level of income.

The results and discussion which follow are based on the reduced-form equation obtained for the expenditure approach outlined in chapter II. As in all other reduced-form equation models, the equation estimated is part of a simultaneous system of equations. The single equation estimated may, therefore, be biased. Corrections have not been made. From results obtained by others on the basis of reduced-form equations, it would appear that coefficients obtained are best-linear and unbiased.[1]

Equation (2.15) is the reduced-form estimation equation and the basis of the statistical results reported in this chapter. As specified, however, some of its properties must be estimated. This is so for a number of reasons. In the first place, $V_i$ is clearly subject to changes in the two arguments included in the model and to trend effects not explained in this specification.

In order to capture other influences on $V_i$, we suppose that $\theta_{i1}$ is subject to some trend. Time serves as a proxy for this purpose. If it is now assumed that $\theta_{i1}$ is a function of trend effects as well as those arguments included in the model, then $\theta_{i1}$ can be expressed as

$$\theta_{i1} = Q_{i1} + Q_{i2(t)}, \quad \text{for } t = 1, 2, 3, \ldots, T \tag{3.1}$$

so that

$$(1/\theta_{i1}) = 1/[Q_{i1} + Q_{i1(t)}] \tag{3.2}$$

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[1]See studies by the Federal Reserve Bank of St. Louis on analysis of monetary aggregates.

where $Q_{i2(t)}$ is the trend factor. Substituting equation (3.2) into equation (2.15), we have

$$V_{i(t)} = [(1 - \pi_i)_t/Q_{i1} + Q_{i2(t)}] + \gamma_\omega(M_\omega/M_i)_{(t)} + (1 - z_i)(G_i/M_i)_{(t)}, \quad \text{for } i = 1, 2, 3, \ldots, N; \; t = 1, 2, 3, \ldots, T \tag{3.3}$$

Equation (3.3) expresses $V_i$ in terms of variables of interest as well as in terms of other variables and effects we are not interested in investigating, but which we know affect $V_i$. Equation (3.3) is not operational, however. The parameter $\theta_{i1}$ must be estimated by the model. For this reason, the operational equation must be

$$V_{i(t)} = (1 - \pi_i)_{(t)} + \gamma_\omega(M_\omega/M_i)_{(t)} + [(1 - z_i)(G_i/M_i)]_{(t)} \tag{3.4}$$

or

$$V_{i(t)} = \hat{\alpha}_{10} + \hat{\beta}_{11}(M_\omega/M_i)_{(t)} + \hat{\beta}_{12}(G_i/M_i)_{(t)} + U_{(t)}, \quad \text{for } i = 1, 2, 3, \ldots, N; \; t = 1, 2, 3, \ldots, T \tag{3.5}$$

where $\hat{\alpha}_{10}$ estimates $(1 - \pi_i)$, $\hat{\beta}_{11}$ estimates $\gamma_\omega$, and $\hat{\beta}_{12}$ estimates $(1 - z_i)$.

Parameters $(1 - \pi_i)$, $\gamma_\omega$, and $(1 - z_i)$ are fixed proportions which must be estimated by the model. The first term in equation (3.5) is the constant term and must be less than one, since the proportion of expenditures by a country's residents on goods and services produced by residents can not equal total private expenditures except in the singular case where imports equal zero. In additicn, this parameter can not equal zero except when residents specialize in export production only.

The parameter $\gamma_\omega$ measures the change in a country's exports for a given change in world money. This conforms to the specification of the export function discussed in chapter II. It will be recalled that exports were defined to be some constant proportion of world money and to be exogenous to the system.

Similarly, the parameter $(1 - z_i)$ is the proportion of total expenditures by the public sector on goods and services produced by residents. A ten-billion-dollar increase in total expenditures by the public sector, for example, causes expenditures by the public sector on domestic goods to increase by $(1 - z_i)$ times ten-billion dollars.

Here we have taken the liberty of employing a convention that will be maintained throughout the course of this discussion. Coefficients $\alpha$ and $\beta$ are adopted for convenience of expression and their subscripts take on the number of the estimating equation. The estimating equation number is written first, followed by the coefficient number.

A maintainable hypothesis associated with equation (3.5) is that the coefficients $\beta_{11}$ and $\beta_{12}$ are equal to zero. That is, velocity is stable along trend and not influenced by the world-domestic money ratio or by the government expenditure-domestic money ratio. Should we assume that equation (3.5) is the appropriate equation for an open economy, then the distribution of least-squares estimates must be centered around the true parameter values.

However, the maintainable hypothesis agrees with the competing model which also assumes that $\beta_{11}$ and $\beta_{12}$ are both equal to zero. The income approach hypothesizes that

$$V_{i(t)} = \alpha_{20} \qquad (3.6)$$

On the assumption that the least-squares estimates are centered around the true values of the population, then model II must be the appropriate equation for an open economy, as well. Equation (3.6) asserts that

$V_i$ is a stable function of $Y_i$; that is, money demand is a constant proportion of income. This outcome is plausible only when highly restrictive assumptions are made.[1]

Aside from these statistical difficulties, it is clear that there are differences in monetary and budgetary institutions among countries. For example, in France, monetary and fiscal policies are carried out by the same agency. The existance of systematic differences in monetary and budgetary institutions among countries is not a random phenomenon. Such differences cause the model to be misspecified so that estimates obtained would be biased. Thus, suppose the correct specification of equation (3.5) to be

$$V_{i(t)} = \alpha_{10} + \beta_{11}(M_\omega/M_i) + \beta_{12}(G_i/M_i) + \beta_{13}Q_{i(t)} \qquad (3.7)$$

Now assume $Q_{i(t)}$ is not observable and we use $(M_\omega/M_i)^*$. Then for $(M_\omega/M_i)$ defined as

$$(M_\omega/M_i)_{(t)} = (M_\omega/M_i)^*_{(t)} + Q_{i(t)} \qquad (3.8)$$

where $Q_{i(t)}$ is some non-stochastic and unmeasurable variable, misspecification error will occur. Indeed this situation is very likely to arise, particularly in international monetary relationships. World-wide changes in financial and monetary institutions and differences in these among countries may cause differences in money-demand structures to occur. For exam-

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[1]The traditional velocity function specification makes three rather strong assumptions, namely: (1) that the average number of transactions (as products pass through various stages of production and distribution), each requiring payments between separate units, remains constant over time; (2) that aggregate demand for cash for all other reasons mover proportionately to that of meeting the flow of payments associated with current output; and (3) that the volume of transactions, in existing assets, is also proportionate to the money value of current output. See George Garvy and Martin R. Blynn, The Velocity of Money (New York: Federal Reserve Bank of New York, October, 1969), p. 49.

ple, a number of innovations occuring in the United States over the last twenty years have been identified as having influenced the demand for cash balances.[1] In addition, other influences such as the structure of output and interest rates, expected rates of inflation, and income distribution, though difficult to measure or unmeasurable, could also be treated as explanatory variables. Yet the relationship specified in this model is linear with respect to the world money-domestic money ratio and government expenditure-domestic money ratio. This tends to be one of the major problems encountered by the researcher using a reduced-form model for analyzing international data. Subsequently, it will be shown that this problem has definite implications for the estimates obtained.

## 3.2 Least squares and relationships containing autocorrelation

Earlier we supposed the expenditure model might be subject to trend effects. On this supposition, the parameter $\theta_{i1}$ was respecified in order to account for these effects. Another problem is manifest in the reduced-form equation of model I; existence of serial correlation among the disturbance terms.[1] There are several causes of this problem. It was mentioned that time-series data generally tend to be conditioned by business cycles, institutional changes, and other non-stochastic effects. These effects may render one of the classical least-squares assumptions invalid. Disturbance terms thus may not be obtained independently of one

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[1] Garvy and Blyn, op. cit., p. 83.

[2] Autocorrelation violates one of the basic least-squares assumptions: serial independence of disturbance terms. See J. Johnston, Econometric Methods (2nd ed.; New York: McGraw Hill, 1960), chap. 8.

another. In our particular instance, we felt that the error term may have been correlated with its own past value of values such that it could be expressed as a transformation of these values.

This problem is generally attributed to omission of variables or misspecification of the functional form estimated. It is therefore quite possible that the specified model may be subject to this defect. Repairs were thus suggested. Autocorrelation coefficients are estimated for the expenditure model and its implied income equation for each sample member, and repairs are undertaken. To appreciate this problem, suppose that we specify the relationship between $V_i$ and $(M_\omega/M_i)$ or $(G_i/M_i)$ in linear form as suggested by equation (3.4). If the true relationship should include $(M_\omega/M_i)^2$ or $(G_i/M_i)^2$, the error term will contain a factor in these variables. For example, if we specify

$$V_{i(t)} = \alpha + \beta_1(M_\omega/M_i)_{(t)} + \beta_2(G_i/M_i)_{(t)} + U_{(t)}, \quad \text{for } i = 1, 2, 3, \ldots, N; \; t = 1, 2, 3, \ldots, T \tag{3.9}$$

where $U_{(t)}$, the error term, is a function of $U_{(t-1)}$.

$$U_{(t)} = \rho U_{(t-1)} + \varepsilon_{(t)} \tag{3.10}$$

Then it can be shown that the covariance of $U_{(t)}$ and $U_{(t-1)}$ does not in fact equal zero so that the disturbance terms are not independent of each other.

$$E(U_t U_{t-1}) = E(e_t + \rho e_{t-1} + \rho^2 e_{t-2} + \rho^3 e_{t-3} + \ldots)$$

$$= \rho E(e_t + e_{t-1} + e_{t-2} + e_{t-3} + \ldots)$$

$$= \rho\delta^2$$

$$\neq 0$$

where e and ρ are residual and autocorrelation coefficient, respectively.

This suggests that the transformed relationships for the basic model are

$$V_{i(t)} - \rho V_{i(t-1)} = \alpha(1 - \rho) + \beta_1[(M_\omega/M_i)_{(t)} - \rho(M_\omega/M_i)_{(t)}] \quad (3.11)$$
$$+ \beta_2[(G_i/M_i)_{(t)} - \rho(G_i/M_i)_{(t-1)}] + \varepsilon_{(t)}$$

and

$$Y_{i(t)} - \rho Y_{i(t-1)} = \alpha(1 - \rho) + \beta_1[M_{i(t)} - \rho M_{i(t-1)}] \quad (3.12)$$
$$+ \beta_2[M_{\omega(t)} - \rho M_{\omega(t-1)}]$$
$$+ \beta_3[G_{i(t)} - \rho G_{i(t-1)}] + \varepsilon_{(t)},$$
$$\text{for } i = 1, 2, 3, \ldots, N$$
$$t = 1, 2, 3, \ldots, T$$

Minimizing the sum of squared residuals leads to non-linear equations so that analytical expressions of $\hat{\alpha}$s, $\hat{\beta}$s, and $\hat{\rho}$s can not be obtained. One method of approximating these estimates is the Cochrane-Orcutt itarative process.[1] Starting with an arbitrary value for ρ, say $\rho_1$, this proceedure requires minimization of the sum of squared residuals with respect to parameters. Keeping the new set fixed, minimizing the sum of squared residuals with respect to the value of ρ previously obtained, and once again keeping this new value fixed, a different set of parameters α and β is obtained. This process is continued until successive estimates differ by arbitrary small amounts. We assume that, in the limit, these coefficients converge to some limit.

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[1] D. Cochrane and G. H. Orcutt, "Application of Least-squares Regressions to Relationships Containing Auto-correlated Terms," Journal of the American Statistical Association, XLIV (1948), pp. 32-61.

## 3.3 The nature and limitations of the data

Computations for this dissertation were performed on an IBM/370 system operated by the Virginia Polytechnic Institute and State University Computing Center, via the Time Series Processor regression package.[1] The test results reported in this chapter were obtained by applying equations (3.11) and (3.12) to annual time-series data of twenty-two industrialized countries for the period 1954-1973.

Choice of countries included in the sample was made on the basis of availability and reliability of the data. While inclusion of less-developed countries in the sample could have led to more fruitful results, lack of data required that these be excluded from the sample.

Because of gaps, neither monthly nor quarterly data were used. Employed are unadjusted annual time-series data. Estimates were obtained from and are based on the International Monetary Fund magnetic tape, IFS, serial number 213900/SL/01/07/75/unit M786, and can also be found in International Financial Statistics, published by the IMF. Only nominal values are used in estimation.

No attempt is made to include price-level and interest-rates data. There is no price equation in the model. As a consequence, currency devaluation and revaluation effects, as well as price level changes between domestic and foreign goods and services, are not discussed. Given the nominal nature of the data, we assume that prices and interest rates are endogenous to both systems.

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[1]For a discussion and usage of this package, see Robert E. Hall, Time Series Processor (Technical Paper Number 12; Cambridge, Mass.: Harvard Institute of Economic Research, Harvard University, May, 1973).

Gross world money-stock data are based on money stocks of sample members for the sample period. That is, for each time period, (t), world money stock estimates were computed as follows: The average annual rate of exchange, defined as national currency units per U.S. dollar, appearing at the head of country tables, was applied in order to convert each sample member's money stock into U. S. dollars. The total of all sample member's money stocks represents a gross world money total and must be distinguished from "world money" as employed in this dissertation. Only the narrow definition of money, $M_1$, is used.

The narrow definition of money was chosen because it has certain obvious advantages. In the first place, $M_1$ focuses on the medium-of-exchange definition of money. Since we wished to show the relationship between expenditures by residents of a country and money balances held, $M_1$ provides a simple definition of these balances. Further, given different definitions of $M_2$ among countries, use fo $M_1$ avoids a number of complications associated with a broader definition of money.

Note that gross world money total is defined as

$$\sum_{i=1}^{N} \lambda M_i, \text{ for } i = 1, 2, 3, \ldots, N \tag{3.13}$$

where $\lambda$ is the conversion factor and $M_i$ is some country, i's, money stock, narrowly defined. World money, as employed in this dissertation, is defined as

$$M_\omega = \sum_{j=2}^{N} \lambda M_j, \text{ for } j = 2, 3, 4, \ldots, N \tag{3.14}$$

where $\lambda$ is the conversion factor and $M_j$ is some country, j's, stock of money, narrowly defined, for $i \neq j$. The variable, N, denotes the total number of countries studied.

The parameter, $\lambda$, is the dollar rate of exchange used to convert sample members' money stocks into U. S. dollars in order to obtain the gross world money total. The sum of other countries' money stocks, or world money, $M_\omega$, is obtained by subtracting a country's money stock from the gross world money total. This figure is then reconverted into a given country's own currency before estimation.

The dollar rate used in conversion, $\lambda$, is a time-series variable defined as an annual average. Consequently, there is no distinction made between fixed and flexible exchange rates.

The conversion factor used biases estimated results for the United States, however. A devaluation of the U. S. dollar, for example, increases world money in dollars. Since $M_1$ in the United States will be unchanged, the world-domestic money ratio, in the United States, will rise, thereby causing an increase in the level of velocity. For the rest of the world, this problem does not arise.

### 3.4 Some evidence from international time series

The expenditure-approach reduced-form equation in the velocity form, (3.11), and in terms of income, equation (3.12), were applied to time-series data as specified. Estimates are reported by country according to the International Monetary Fund country code listing.

Table 3.1 reports the estimates obtained from testing the stability hypothesis, and whether the world-domestic money and government expenditure-domestic money ratios, $(M_\omega/M_1)$ and $(G/M_1)$, can explain changes in velocity. The second set of estimates, table 3.2, are results obtained from estimat-

Table 3.1

Regression Estimates of the Effects of Changes in the Composition of Expenditures on Velocity, Annual Data, 1954-1973[a]

| Country | Dependent Variable: $V_t$ $(M_\omega/M_1)_t$ | $(G/M_1)_t$ | Constant | $R^2$ | $R^2$ for Differences | F-ratio |
|---|---|---|---|---|---|---|
| The United States | 0.472<br>(4.062) | 2.311<br>(7.655) | 1.467<br>(9.632) | 0.983 | 0.471 | 465.371 |
| The United Kingdom | 0.114<br>(5.305) | 0.173<br>(0.876)† | 2.553<br>(6.112) | 0.943 | 0.431 | 133.376 |
| Austria | 0.004<br>(0.100)† | 3.184<br>(6.160) | 2.089<br>(3.629) | 0.807 | 0.856 | 33.478 |
| Belgium | 0.033<br>(2.473) | -0.408<br>(0.829)† | 1.407<br>(1.777) | 0.900 | 0.293 | 72.270 |
| Denmark | 0.006<br>(3.907) | 1.356<br>(5.765) | 2.193<br>(5.893) | 0.739 | 0.729 | 22.625 |
| France | -0.004<br>(1.244)† | 5.373<br>(5.430) | 1.073<br>(2.585) | 0.885 | 0.712 | 61.365 |
| Germany | 0.090<br>(3.988) | 3.596<br>(7.058) | 1.107)<br>(1.290) | 0.787 | 0.819 | 29.518 |
| Italy | 0.102<br>(4.097) | 1.613<br>(2.045) | 0.477<br>(0.461) | 0.734 | 0.700 | 22.067 |

Table 3.1--Continued

| Country | Dependent Variable: $V_t$ $(M_\omega/M_1)_t$ | $(G/M_1)_t$ | Constant | $R^2$ | $R^2$ for Differences | F-ratio |
|---|---|---|---|---|---|---|
| The Netherlands | 0.011<br>(2.234) | 4.529<br>(11.294) | 0.394<br>(0.747) | 0.965 | 0.879 | 219.724 |
| Norway | 0.004<br>(2.576) | 2.826<br>(11.240) | 1.676<br>(4.643) | 0.942 | 0.791 | 128.749 |
| Sweden | 0.00001<br>(0.002)† | 2.524<br>(12.517) | 4.089<br>(5.647) | 0.974 | 0.737 | 300.267 |
| Switzerland | 0.008<br>(1.857)† | 5.883<br>(6.102) | 0.271<br>(0.787) | 0.774 | 0.699 | 27.431 |
| Canada | 0.037<br>(2.408) | 17.122<br>(5.673) | -0.190<br>(1.707) | 0.915 | 0.803 | 85.640 |
| Japan | 0.078<br>(6.424) | 3.484<br>(3.855) | 0.202<br>(1.223) | 0.994 | 0.752 | 1232.08 |
| Finland | 0.00001<br>(2.250) | 4.670<br>(6.515) | 2.193<br>(5.893) | 0.940 | 0.788 | 126.223 |
| Greece | 0.006<br>(7.375) | 3.804<br>(4.382) | 0.914<br>(2.421) | 0.989 | 0.856 | 708.486 |
| Ireland | 0.003<br>(3.708) | 2.644<br>(6.862) | 0.939<br>(3.751) | 0.971 | 0.859 | 264.934 |

Table 3.1--Continued

| Country | Dependent Variable: $V_t$ $(M_\omega/M_1)_t$ | $(G/M_1)_t$ | Constant | $R^2$ | $R^2$ for Differences | F-ratio |
|---|---|---|---|---|---|---|
| Spain | 0.009<br>(3.203) | 2.093<br>(2.108)† | 1.860<br>(5.081) | 0.518 | 0.533 | 8.589 |
| Turkey | 0.003<br>(1.547)† | 6.755<br>(7.397) | 0.768)<br>(1.060) | 0.931 | 0.810 | 107.412 |
| Australia | -0.007<br>(0.890)† | 5.709<br>(6.189) | 1.949<br>(4.535) | 0.979 | 0.668 | 365.992 |
| New Zealand | -0.001<br>(0.232)† | 5.108<br>(9.957) | 1.302<br>(5.527) | 0.986 | 0.848 | 555.976 |
| South Africa | 0.001<br>(0.688)† | 2.924<br>(3.685) | 3.196<br>(8.297) | 0.873 | 0.685 | 55.168 |

†not significant at the 0.05 level.

ing the effects of changes in the composition of expenditures on income. The latter is a test of levels. The first line in each table represents regression coefficients and the second line represents the t-statistics in parentheses.

In many discussions about velocity, the constant proportionate relationship between the demand for money and a country's income is mentioned as a causal factor for the stability of velocity over time. In chapter II, we argued that it is not income, but expenditures by residents of a country that are controlling.

The hypothesis tested is that for any open economy, i, velocity is a linear function of the ratio of world money to domestic money and of the government expenditure-domestic money ratio. This test also corresponds to a test of the stability hypothesis. If it can be shown that coefficients of $M_{\omega}/M_1$ and $G/M_1$ are not significantly different from zero, then velocity will have been shown to be a stable function of income and only subject to trend effects.

The first overall impression is that the $R^2$s are large. The F-ratios are statistically significant, too. The estimated coefficients possess the appropriate sign and are also statistically significant at the five-percent level for most countries.

There are a total of only eight countries for which the world-domestic money ratio is not statistically significant. These are Austria, France, Sweden, Switzerland, Turkey, Australia, New Zealand, and South Africa. The government expenditure-domestic money ratio is not important as an explanation of velocity changes when Belgian, British, or Spanish time-series data are used. There are a total of ten countries for which both world-domestic money and government expenditures-domestic money ratios explain changes in velocity. In other countries, velocity is a function of either the world-domestic money ratio or of the government expenditure-domestic money ratio. In every country, at least one of these arguments is important.

The highest coefficient on $M_\omega/M_1$ is registered for the United States, 0.472, and the lowest coefficient was obtained for Norway, 0.004. Canada has the highest coefficient of the $G/M_1$ ratio at 17.122, and Denmark has the lowest, 1.356.

In general, the coefficient on $G/M_1$ dominates changes in velocity. This does not suggest that the world-domestic money ratio is not important, however. Evidence suggests that this variable is influential in a relatively large number of countries.

The $R^2$s for levels range between 0.734 and 0.989, and between 0.293 and 0.829 for changes. The F-ratios obtained from this test are statistically significant.

This evidence is impressive enough to warrant the conclusion that world forces and budgetary activity are, for a given level of domestic money, an important explanation of velocity. Quite clearly, this evidence questions the stability hypothesis and suggests that velocity can not be stable in many instances. If either the world or government expenditures grow at a rate different from the growth rate of domestic money, velocity will change. Velocity will rise whenever world money or government expenditures grow at a faster rate than domestic money. It will fall whenever either world money or government expenditures grow at a slower rate than the growth rate of domestic money. In general, therefore, an increase in either exports or government expenditures raises income. If domestic money and private expenditures remain constant, velocity will necessarily rise. However, should domestic money increase, world money and government expenditures remaining constant, the increase in money balances will cause velocity to fall.

This evidence suggests that velocity will almost always be variable. Unlike the income approach, in which changes in exports have no effect on either income or velocity, with domestic money and private expenditures remaining constant, our approach suggests that expenditures are the proper constraint on the demand for money in an open economy and that income can be explained by changes in the composition of these expenditures.

While these results are impressive, the inconsistency of estimates is cause for concern. As previously indicated, we find that velocity is always a function of one or the other of the arguments, or of both. We suppose that differences in money-creation and budgetary institutions may explain the differential impact of these arguments on velocity in different countries. In some countries, especially those for which only one variable is dominant, there is an implied correlation between the number of transformations. In different log-linear and log-linear in first-differences forms, including or excluding a time variable to account for trend effects, elasticity and percent change estimates were obtained.[1]

These estimates then served as the basis for testing the stability hypothesis. Results can be found in the appendix.

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[1]The first difference in logarithms is a percent operator and records arithmetic changes occuring in $V_i$ per unit of time, operationally and notationally, for some variable $x_{(t)}*$. The first difference of $x_{(t)}*$ is $x_{(t)}* = x_{(t)} - x_{(t-1)}$, so that the log transformation in first differences is $\log x_{(t)}* = \log [x_{(t)}/x_{(t-1)}]$.

In terms of both elasticity and percent-change measures, we find the ratios of world to domestic money and government expenditure to domestic money to be differentially important among countries. Velocity is relatively elastic with respect to changes in the government expenditure-domestic money ratio in most countries. When percent changes are used, the world-domestic money ratio is important for very few countries. In general, results differ depending on whether a two- or three-variable model is used. On the whole, the fit is quite good, given high $R^2$s and statistically significant F-ratios.

Equation (3.12) was applied to the time-series data of the sample countries in order to determine the effect of changes in the composition of expenditures on income. Test results obtained suggest something about monetary and fiscal policy effects at home and abroad.

Regression results obtained from estimation of this equation can be found in table 3.2. Estimated coefficients possess the appropriate sign. In all regressions, $R^2$s for levels range between 0.990 and 0.999, and between 0.473 and 0.957 for changes. The F-ratios are statistically significant and suggest good fit for all sample members.

In general, changes in nominal income are a function of changes in domestic money, $M_1$, world money, $M_\omega$, government expenditures, G, or some combination of these arguments.

As a combination, world money and government expenditures explain nominal income changes in three countries only. These are the United States, Australia, and Turkey. World money dominates nominal income changes in four countries: Belgium, Canada, Greece, and Italy. In only one country, the United Kingdom, do we find nominal income to depend on nominal

Table 3.2

Regression Estimates of the Effects of Domestic and World Money and Government Expenditures on Income, Annual Data, 1954-1973

| Country | $M_{1(t)}$ | $M_{\omega(t)}$ | $G_{(t)}$ | Constant | $R^2$ | $R^2$ for Differences | F-ratio |
|---|---|---|---|---|---|---|---|
| | Dependent Variable: $Y_t$ | | | | | | |
| The United States | 0.530<br>(0.456) | 0.567<br>(3.278)* | 2.743<br>(4.833)* | 86.443<br>(0.823) | 0.998 | 0.858 | 2466.91 |
| The United Kingdom | 3.453<br>(2.205)* | 0.095<br>(2.134)* | 0.440<br>(1.853) | -6.341<br>(0.872) | 0.990 | 0.473 | 501.382 |
| Austria | 1.680<br>(3.091)* | -0.002<br>(0.734) | 4.685<br>(7.466)* | 9.959<br>(2.223)* | 0.999 | 0.941 | 4251.14 |
| Belgium | 1.065<br>(1.143) | 0.043<br>(2.649)* | -0.468<br>(1.370) | 176.604<br>(4.516)* | 0.996 | 0.797 | 1383.75 |
| Denmark | 2.549<br>(6.933)* | -0.004<br>(0.785) | 2.126<br>(5.751)* | 0.227<br>(2.246)* | 0.999 | 0.940 | 4765.88 |
| France | (0.128<br>(0.755) | 0.003<br>(0.869) | 8.032<br>(19.185)* | 32.087<br>(5.971)* | 0.999 | 0.947 | 6459.57 |
| Germany | 1.356<br>(1.012) | 0.040<br>(0.583) | 3.793<br>(6.630)* | 34.155<br>(1.112) | 0.998 | 0.816 | 1979.87 |
| Italy | 0.341<br>(1.892) | 0.114<br>(3.242)* | -0.287<br>(0.235) | 22503.0<br>(3.202)* | 0.998 | 0.863 | 2210.58 |

Table 3.2--Continued

| Country | $M_{1(t)}$ | $M_{\omega(t)}$ | $G_{(t)}$ | Constant | $R^2$ | $R^2$ for Differences | F-ratio |
|---|---|---|---|---|---|---|---|
| | Dependent Variable: $Y_t$ | | | | | | |
| The Netherlands | -0.824 | 0.019 | 5.473 | 0.263 | 0.999 | 0.949 | 5432.50 |
| | (1.215) | (1.567) | (12.532)* | (0.052) | | | |
| Norway | 1.463 | 0.003 | 3.074 | 0.780 | 0.998 | 0.897 | 2985.96 |
| | (4.459)* | (1.481) | (5.426)* | (0.414) | | | |
| Sweden | 0.680 | 0.011 | 2.319 | 49.062 | 0.998 | 0.772 | 2955.53 |
| | (0.656) | (1.111) | (3.715)* | (2.995)* | | | |
| Switzerland | -0.100 | 0.011 | 7.434 | 5.316 | 0.998 | 0.913 | 2983.49 |
| | (0.420) | (1.815) | (11.384)* | (1.107) | | | |
| Canada | 0.038 | 0.130 | 0.803 | 1.415 | 0.993 | 0.624 | 745.613 |
| | (0.042) | (4.106)* | (1.828) | (0.336) | | | |
| Japan | 1.084 | 0.020 | -18.764 | -4632.77 | 0.999 | 0.965 | 4961.70 |
| | (4.110)* | (0.378) | (1.128) | (1.128) | | | |
| Finland | 1.587 | 0.000005 | 4.745 | 3.554 | 0.998 | 0.938 | 3162.06 |
| | (1.637) | (0.298) | (9.359)* | (4.681)* | | | |
| Greece | 1.425 | 0.011 | 1.717 | -17.022 | 0.994 | 0.880 | 876.450 |
| | (1.479) | (2.928)* | (1.564) | (1.058) | | | |
| Ireland | 1.170 | 00.001 | 3.696 | 44.893 | 0.999 | 0.958 | 3285.88 |
| | (3.446)* | (1.071) | (6.316)* | (1.216) | | | |

Table 3.2--Continued

Dependent Variable: $Y_t$

| Country | $M_{1(t)}$ | $M_{\omega(t)}$ | $G_{(t)}$ | Constant | $R^2$ | $R^2$ for Differences | F-ratio |
|---|---|---|---|---|---|---|---|
| Spain | 0.832 | -0.009 | 5.600 | 707.972 | 0.999 | 0.957 | 5174.82 |
| | (3.280)* | (1.285) | (4.787)* | (3.046)* | | | |
| Turkey | 3.474 | -0.013 | 3.457 | 80.705 | 0.991 | 0.819 | 862.972 |
| | (5.472)* | (2.875)* | (3.486)* | (2.863)* | | | |
| Australia | 0.650 | -0.007 | 6.195 | 5.350 | 0.998 | 0.866 | 2058.81 |
| | (1.064) | (2.147)* | (6.810)* | (3.208)* | | | |
| New Zealand | 1.995 | -0.0002 | 4.745 | 345.099 | 0.996 | 0.905 | 1139.49 |
| | (4.821)* | (0.269) | (7.483)* | (2.040) | | | |
| South Africa | 2.855 | 0.001 | 3.438 | 164.410 | 0.998 | 0.912 | 1971.87 |
| | (5.398)* | (0.284) | (4.378)* | (0.612) | | | |

*significant at the 0.05 level

domestic and world money. The domestic money-government expenditure combination dominates income in Austria, Denmark, Ireland, New Zealand, Norway, and South Africa, while government expenditures, alone, explain all variations in nominal income in six countries: Finland, Germany, the Netherlands, Sweden, and Switzerland. Domestic money is dominant only in Japan.

The highest coefficients on $M_1$ were obtained when British and Turkish data were used; 3.453 and 3.474, respectively. The lowest coefficient was registered for Ireland, 0.832. The coefficient on world money ranges between 0.007, registered for Australia, and 0.567, registered for the United States. The highest coefficient on government expenditure was obtained when French time-series data were used and the lowest, 2.126, was obtained for Denmark.

The differential importance of one variable or combination of variables in different countries is hard to explain. In the case of the United Kingdom, on the one hand, government expenditures can not explain income changes. On the other hand, nominal income changes are explained by government expenditures in the cases of France, Germany, and the Netherlands, for example.

The immediate explanation in the first case is that the United Kingdom has relied on borrowings from the International Monetary Fund in order to finance deficit spending.[1] As a result, nominal income in the United Kingdom has tended to be more responsive to world and domestic

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[1]This view was articulated by Professor A. A. Walters of the London School of Economics, in a series of seminars sponsored by the Economics Department at Virginia Polytechnic Institute and State University, Spring Term, 1974.

monetary aggregates. There is also the implication that domestic and world money may be correlated.

In the second case, particularly in France, the relatively dominant role of government expenditures may be due to the fact that monetary and fiscal policy are under the control of the same government agency. Therefore, it may not be possible to isolate purely fiscal activity from monetary activity: money supply and government expenditures may be closely correlated.

These results are strong evidence. They support the hypothesis that changes in the composition of expenditures are an important explanation of nominal income changes. These changes have a differential impact on nominal income, depending on the monetary and budgetary institutions of the country in question.

The fact that no single variable or combination of variables consistently explains nominal income changes in all countries suggests that fiscal policy and monetary policy, at home or abroad, have differential impacts. Nominal income changes may require not only changes in $M_1$, but changes in $M_\omega$ or G, as well.

The hypothesis that nominal income is a stable function of domestic money alone is clearly rejected. Both world money and deficit spending are also important.

In spite of the strong results obtained from this test, it was necessary that possible collinearity be explained. This required the variation of equation (2.15). Ordinary log-linear and first-differenced log-linear forms were estimated in order to ameliorate or mitigate possible collinearity among the independent variables. These functional forms are not immediately derivable from the expenditure-version and implied-income equation.

We chose this particular functional form because it corresponds to a measure of elasticity between the dependent and independent variables and because of the further advantage that it produces a direct estimate of that elasticity. The log-linear in first-differences form was used in estimating percentage changes and it corresponds to a test of the stability hypothesis.

Test results obtained suggest that nominal income is not universally elastic with respect to $M_1$ changes. In only six countries (Austria, Denmark, Finland, New Zealand, Norway, and South Africa), is $M_1$ the sole explanation of changes in nominal income. Government expenditures are not important in three countries: United Kingdom, Belgium, and Japan. In nine countries, the most important of which are the United States, Japan, the United Kingdom, and Italy, we find $M_\omega$ is an important explanation of nominal income changes. On the whole, results differ, depending on whether we regress nominal income on each argument separately or on some combination of these arguments, and depending on whether or not we include time. These results are in general agreement with results obtained when we estimated the log-linear in first-differences form. (See appendix.)

## 3.5 Summary

Estimates presented in this chapter can be viewed as an exercise in appraising the effects of world forces on national income and velocity. These results were obtained on the basis of two alternative money-demand formulations.

The first of these hypothesized that nominal income is subject to international forces and that, to the extent that these forces are monetary in nature, money demand is not a stable function of income as hypothesized by traditional theory. The functional relationship between money demand and expenditures, defined so as to include import expenditures and budgetary activity, was recognized. Accordingly, modification of the quantity equation to allow for changes in these variables produces an expenditure-constrained money-demand function.

Test results obtained support the thesis that expenditure changes are a significant explanation of velocity changes for all countries included in the sample studied. World forces do affect income and velocity in a manner overlooked by traditional theory. That is, velocity is not a stable function of income, but varies with changes in money demand, given changes in anticipated expenditures.

It was not sufficient to obtain results on the basis of which the expenditure hypothesis could not be rejected, however. Distinguishing the expenditure version from the income approach both theoretically and statistically for each sample member was necessary. Empirical results obtained on the basis of a relatively large sample of countries (see appendix) show that the expenditure version is to be preferred. The expenditure approach results are distinctly superior.

In choosing the reduced-form equation for empirical testing, we were aware, at the outset, that economic time series have a tendency to move together. In particular, arguments $M_1$, $M_\omega$, and G tended to be collinear. The problem was not limited to these arguments alone. Both velocity and the world-domestic money ratio are subject to trend so that the independent variable appeared to be collinear with respect to magnitudes not represented in the reduced form. Consequently, the reduced form did not insure either absence or negation of time-induced multicollinearity.

In the results presented, we assume matter-of-factly that economic time series data are generally conditioned by business cycles, institutional changes, and by other non-stochastic effects. While trend effects can generally be eliminated, we assumed these were important enough that their effects on velocity had to be estimated. Consequently, we allowed trend effects to influence some estimated coefficients.[1] A numerical description of the passage of time was assumed to be representative of the combined effects of otherwise unmeasurable factors. This series of magnitudes was then treated as any other independent variable or argument in a set of multiple regression equations. Coefficients obtained then indicated the relationship of velocity to this trend and to the other variable in the equation estimated.[2]

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[1]See Ragnar Frisch and Frederick V. Waugh, "Partial Time Regression as Compared with Individual Trends," in Selected Readings in Econometrics from Econometrica, ed. John Hooper and Marc Nerlove (Cambridge, Mass.: MIT Press, 1970) pp. 17-31.

[2]Bradford Smith, "The Error of Eliminating Secular Trends and Seasonal Variations before Correlating Time Series," Journal of the American Statistical Association (December, 1925). Estimates tended to be quite sensitive when we included or excluded the time variable. Essentially the same degree of sensitivity of estimated coefficients was encountered when we regressed both M and $M_1$ on nominal income as separate arguments. These results can be found in the appendix.

# CHAPTER IV

## SUMMARY AND CONCLUSION

This concludes our attempt to produce evidence which would bear upon the expenditure-constrained money-demand function. This study was confined to the special case in which money demand was assumed to be a function of total private expenditures on goods and services only. It would seem likely that inclusion of other effects such as changes in the capital account in the money-demand function estimated would yield stronger and more conclusive evidence. Inclusion of capital flows in the money-demand function may enable us to determine the degree of variability of velocity in the face of portfolio adjustment. In addition, this may permit a broadening of the definition of money to include different types of assets and measure the relative variability of velocity, alternatively defined.

No attempt has been made to link percent changes in velocity in one country to percent changes in import or export relationships with another country. Undoubtedly, such analysis would make it possible to link percentage changes in velocity to specific relationships among countries taken two at a time. Estimates obtained would then serve as a basis for prediction and informed monetary policy.

In the preceding discussion, however, we were able to show that nominal income changes in any country do not depend on domestic money-stock changes, alone, as hypothesized by traditional theory. Evidence indicates that world forces and governmental budgetary activities are equally important. Changes in these, the latter in particular, exert a strong influence on nominal income. In addition, estimates obtained by testing the reduced form equation of the expenditure approach suggests that velocity is not a constant proportion of income, but that it varies with changes in world money and government expenditure for some given level of domestic money stock. This evidence has strong implications for macro-economic theory and policy.

On both theoretical and empirical grounds, our results question the stability hypothesis. At best, the hypothesis that the stability of velocity corresponds to stability in the relationship between nominal income and nominal money is weak. In country after country, our results assign considerable importance to changes in either the world-domestic money ratio or the government expenditure to domestic money ratio. When we look at the relationships between nominal income and domestic money, world money or government expenditures, we find a confirmation of these results. In only one country, Japan, is $M_1$ alone important after repairs for autocorrelation. In all other countries, we find nominal income to be a positive function in some combination of these three arguments.

This evidence does not contradict the old and noble tradition in economics that assigns to money the central role in the analysis and determination of prices, especially circular changes in prices. World expenditure patterns, deficit budgetary activities, and domestic expenditure patterns reflect money stock changes. Here it is suggested only that these patterns be isolated and their effects on income analyzed. On these grounds alone, we can not find evidence which would support the stability hypothesis. Thus, we conclude, as other economists have done, that the quantity theory in the form M = kY holds only in the long run, if at all. The ratio of income to nominal money, or its reciprocal, is subject to substantial short-run fluctuations.[1]

As previously shown, the behavior of velocity is conditioned by one consideration: the relative world and domestic money-growth rates for some inwardly-directed and exogenous government expenditure level. If world and domestic money grow at the same rate, this is tantamount to saying that the relative cash distribution among trading countries of the world remains unchanged. All external and budgetary effects are neutralized and the simple quantity theory comes of age. Model II, the income version, is now the proper analytical structure.

If, however, world and domestic money grow at different rates and if government expenditures are not restricted to domestic purchases, the stability hypothesis does not hold. Private expenditure patterns and budgetary activities will ensure that velocity and money demand will not be stable functions of income. In this instance, the expenditure model is the appropriate analytical structure.

Some may argue against the inclusion of government expenditures. We submit that budgetary activities affect money demand. Deficit financing, for example, has spillover effects and has a tendency to increase the quantity of money elsewhere. These effects have implications for expenditure patterns abroad as world money increases.

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[1]Brunner and Meltzer, op. cit., p. 285.

The converse is also true. Purchases of United States goods and services by foreign governments, for example, are reflected by an increase in domestic money stock. The implications of this increase have already been discussed in chapter II.

Suppose, instead, that government purchases are financed by taxes. In this instance, the demand for money will also be affected. Money demand will increase as individuals anticipate tax assessments. Therefore budgetary activities can hardly be considered neutral unless the monetary authority always successfully offsets these effects. But monetary authorities can not be trusted to implement measures which ensure timely expansion and growth of money. Although money-stock control is technically possible, both budgetary activity and the money creation process are highly politicized.[1]

In conclusion, recognition of the possibility that money demand might be a function of total private expenditures rather than dependent on income, per se, and the modification of the quantity equation to allow for changes in expenditures, produced an expenditure-constrained money-demand function for almost all sample members. To the extent that expenditures were shown to be an important argument, the assumption of a stable, income-constrained money-demand function must be questioned. Further, the notion that monetary authorities stand ready and are able to effectively neutralize all external money effects suggests further reappraisal.

A residual conclusion remains. Velocity will be a stable function of income when balance-of-payments changes are permitted no role and when

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[1]As witnessed by recent U. S. Congressional debates regarding the control of monetary policy.

all payments to foreigners and receipts from foreigners are equal. Otherwise, surpluses or deficits on the balance of payments will affect expenditures. The latter is a dominant constraint on money balances held. Therefore, the implications of scarcity or abundance of the means of payment have been verified.

Estimates obtained are good enough to warrant the conclusion that the analytical structure tested is the appropriate one. In an open economy, excess demands for cash are cleared through accumulation or decumulation of goods and services. The consequential transfer precipitates a redistribution of cash among trading countries. This is a continuous process and may not be abated except for relatively short periods. As transfer proceeds, velocity adjusts and cushions the impact of cash redistribution. To the extent that desired cash balances are never revealed to the monetary authority, any decreases or increases in domestic monetary aggregates have short-lived effects when there are no accompanying changes in world monetary aggregates.

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APPENDIX

# RESULTS OBTAINED FROM ESTIMATION OF VARIATIONS OF THE EXPENDITURE-APPROACH REDUCED-FORM EQUATION

Since the assumptions of either approach discussed in this dissertation are competing, verification, rejection, or acceptance of either structure requires simultaneous testing of each on the basis of the assumptions of the other structure. This necessitates testing the set of hypotheses associated with each model.

This was done by hypothesizing that money demand is a function of both income and expenditures by residents. A further assumption was made regarding the relationship between expenditures by residetns on their own goods and on imports; that is, $E^i_\omega = \phi E^i_i$.[1] By substituting these restrictions into the expenditure-approach commodity and money-market equilibrium conditions and solving for $Y_i$ and $V_i$, the following set of equations was obtained.

$$Y_i = [\frac{1}{\theta_{i1}(1 + \phi) + \theta_{i2}}] M_i + [1 - \frac{\theta_{i2}}{\theta_{i1}(1 + \phi) + \theta_{i2}}] Y_\omega M_\omega$$

$$+ [1 - \frac{\theta_{i2}}{\theta_{i1}(1 + \phi) + \theta_{i2}}] (1 - z_i) G_i$$

[1]Note that the assumption that imports, $E^i_\omega$, are a constant proportion of total expenditures by a country's residents is the same thing as saying that imports are a constant proportion of purchases by residents from themselves. All parameters and variables are defined exactly as in chapter II.

and

$$V_i = [\frac{1}{\theta_{i1}(1 - \phi) + \theta_{i2}}] + [1 - \frac{\theta_{i2}}{\theta_{i1}(1 + \phi) + \theta_{i2}}] (\frac{\gamma_\omega M_\omega}{M_i})$$

$$+ [1 - \frac{\theta_{i1}}{\theta_{i1}(1 + \phi) + \theta_{i2}}] (1 - z_i) (\frac{G_i}{M_i}),$$

for $i = 1, 2, 3, \ldots, N$

These equations are not operational, however. Their verification depends on the behavior of parameters $\theta_{i1}$, $\theta_{i2}$, and $\phi$. For $\theta_{i1} > 0$ and $\theta_{i2} = 0$, these equations specify the expenditure approach, model I.

A similar process, but with no restrictions on expenditures by residents of a country on their own goods, after solution for $Y_i$ and $V_i$, gives the following set of equations:

$$Y_i = [\frac{1}{\theta_{i1} + \theta_{i2}}] M_i - [\frac{\theta_{i1}}{\theta_{i1} + \theta_{i2}}] E^i_\omega + [1 - \frac{\theta_{i2}}{\theta_{i1} + \theta_{i2}}] \gamma_\omega M_\omega$$

$$+ [1 - \frac{\theta_{i2}}{\theta_{i1} + \theta_{i2}}] (1 - z_i) G_i$$

and

$$V_i = [\frac{1}{\theta_{i1} + \theta_{i2}}] - [\frac{\theta_{i1}}{\theta_{i1} + \theta_{i2}}] (\frac{E^i_\omega}{M_i}) + [1 - \frac{\theta_{i2}}{\theta_{i1} + \theta_{i2}}] (\frac{\gamma_\omega M_\omega}{M_i})$$

$$+ [1 - \frac{\theta_{i2}}{\theta_{i1} + \theta_{i2}}] (1 - z_i) (\frac{G_i}{M_i}), \quad \text{for } i = 1, 2, 3, \ldots, N$$

This set of equations is also inoperational unless some assumptions are made about the behavior of $\theta_{i1}$ and $\theta_{i2}$. Thus, for $\theta_{i1} = 0$ and $\theta_{i2} > 0$, velocity is equal to a constant, $1/\theta_{i2}$. This set of equations specifies model II, the income approach. The constant corresponds to the stability hypothesis. Note that all other variables except the constant term drop out.

A log-linear form was used to estimate the expenditure approach, model I. A log-linear in first-differences form was used to estimate the income approach, model II. In the latter case, percentage changes in velocity were assumed to be some constant explained by trend effects, only, and it was hypothesized that all other coefficients would not be significantly different from zero. These equations, including variations of these, are summarized by the accompanying tables, and were estimated using the least-squares method. Results are reported by country according to the International Monetary Fund listing.

Restrictions on $\theta_{i1}$ and $\theta_{i3}$, combined with restrictions on parameters, express the statistical null hypothesis tested. The results of this exercise have been discussed and need no further elaboration. Note that the F-ratio takes on the number of the equation estimated and that an asterisk on it refers to significance at the five percent level.

Table 1

Regression Results Obtained from Estimating Velocity, Model I, for The United States, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 1.423 (11.820) | . . | . . | . . | . . | . . | 2.410 (18.369) | 0.877 | 0.443 |
| 2. | $\log V_t$ | . . | 0.151 (3.490) | . . | . . | 0.477 (5.873) | . . | 1.442 (77.842) | 0.978 | 1.529 |
| 3. | $\log V_t$ | . . | 0.391 (15.951) | . . | . . | . . | . . | 1.338 (137.527) | 0.932 | 0.680 |
| 4. | $\log V_t$ | . . | . . | 0.026 (25.081) | . . | . . | . . | 0.867 (47.123) | 0.972 | 1.034 |
| 5. | $\log V_t$ | . . | -0.004 (0.048) | 0.027 (4.934) | . . | . . | . . | 0.863 (8.956) | 0.972 | 1.035 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.286 (0.925) | . . | 1.215 (1.731) | 0.051 (1.459) | 0.166 | 2.574 |

Note: F(2) = 372.222*; F(3) = 248.144*; F(4) = 629.184*; F(5) = 297.156*; F(6) = 1.697

Table 2

Regression Results Obtained from Estimating Velocity, Model II, for the United States, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log\left(\frac{M_\omega}{M_1}\right)_t$ | $\Delta\log\left(\frac{G}{M_1}\right)_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.094 (0.848) | 0.246 (1.773) | . . | 0.014 (1.291) | 0.173 | 2.566 |
| 8. | $\Delta\log V_t$ | 0.070 (0.600) | . . | . . | 0.208 (2.034) | 0.020 | 2.558 |
| 9. | $\Delta\log V_t$ | . . | . . | -0.011 (0.526) | 0.263 (1.537) | 0.0002 | 2.580 |
| 10. | $\Delta\log V_t$ | 0.074 (0.593) | . . | 0.027 (0.177) | 0.018 (0.859) | 0.020 | 2.562 |

Note: F(7) = 1.774; F(8) = 0.363; F(9) = 0.003; F(10) = 0.177.

Table 3

Regression Results Obtained from Estimating Income, Model I, for The United States, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.237<br>(1.663) | . . | 0.182<br>(3.416) | . . | 0.503<br>(5.895) | 1.856<br>(4.444) | 0.996 | 1.615 |
| 12. | $\log Y_{(t)}$ | . . | 0.707<br>(3.469) | . . | 0.356<br>(4.643) | . . | . . | 1.010<br>(1.490) | 0.989 | 0.668 |
| 13. | $\log Y_{(t)}$ | . . | 1.632<br>(25.947) | . . | . . | . . | . . | -1.963<br>(6.033) | 0.974 | 0.380 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 0.616<br>(29.998) | . . | . . | 3.345<br>(31.868) | 0.980 | 0.599 |
| 15. | $\Delta Y_{(t)}$ | 0.483<br>(0.384) | . . | 0.689<br>(3.026) | . . | 1.578<br>(2.307) | . . | 11.704<br>(1.935) | 0.805 | 2.120 |

Note: F(11) = 1468.11*; F(12) = 731.843*; F(13) = 673.280*; F(14) = 899.924*; F(15) = 22.047*.

Table 4

Regression Results Obtained from Estimating Income, Model II, for The United States, 1954-1973

| Eq. No. | Dependent Variable | $\Delta \log M_{1(t)}$ | $\Delta \log M_{\omega(t)}$ | $\Delta \log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta \log Y_{(t)}$ | 0.191 (0.678) | 0.082 (0.807) | 0.194 (1.508) | -0.036 (2.505 | 0.241 | 2.363 |
| 17. | $\Delta \log Y_{(t)}$ | 0.333 (1.208) | 0.062 (0.593) | . . | 0.044 (3.264) | 0.134 | 2.249 |
| 18. | $\Delta \log Y_{(t)}$ | 0.389 (1.534) | . . | . . | 0.049 (4.298) | 0.116 | 2.220 |
| 19. | $\Delta \log Y_{(t)}$ | . . | 0.105 (1.065) | . . | 0.052 (4.378) | 0.059 | 1.790 |

Note: F(16) = 1.698; F(17) = 1.311; F(18) = 2.355; F(19) = 1.134.

Table 5

Regression Results Obtained from Estimating Velocity,
Model I, for the United Kingdom, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.158 (11.084) | . . | . . | . . | . . | . . | 2.115 (7.685) | 0.875 | 0.615 |
| 2. | $\log V_t$ | . . | 0.666 (11.317) | . . | . . | 0.027 (1.456) | . . | -0.354 (2.227) | 0.887 | 0.860 |
| 3. | $\log V_t$ | . . | 0.638 (11.124) | . . | . . | . . | . . | -0.295 (1.862) | 0.873 | 0.542 |
| 4. | $\log V_t$ | . . | . . | 0.028 (14.839) | . . | . . | . . | 0.988 (29.376) | 0.924 | 0.976 |
| 5. | $\log V_t$ | . . | -0.099 (0.452) | 0.033 (3.452) | . . | . . | . . | 1.190 (2.657) | 0.925 | 1.096 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.046 (0.908) | . . | 0.323 (1.373) | 0.096 (1.677) | 0.233 | 2.705 |

Note: F(2) = 66.783*; F(3) = 123.746*; F(4) = 220.239*; F(5) = 105.359*; F(6) = 2.585.

Table 7

Regression Results Obtained from Estimating Income, Model I, for The United Kingdom, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | log $M_{1(t)}$ | $\Delta M_{\omega(t)}$ | log $M_{\omega(t)}$ | $\Delta G_{(t)}$ | log $G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | log $Y_{(t)}$ | . . | -0.240<br>(0.566) | . . | 0.924<br>(4.479) | . . | 0.002<br>(0.071) | 1.726<br>(1.078) | 0.981 | 0.716 |
| 12. | log $Y_{(t)}$ | . . | -0.260<br>(0.839) | . . | 0.934<br>(6.043) | . . | . . | -5.100<br>(4.884) | 0.981 | 0.736 |
| 13. | log $Y_{(t)}$ | . . | 1.582<br>(17.750) | . . | . . | . . | . . | -10.664<br>(12.600) | 0.940 | 0.604 |
| 14. | log $Y_{(t)}$ | . . | . . | . . | 0.806<br>(29.742) | . . | . . | -5.931<br>(18.676) | 0.980 | 0.620 |
| 15. | $\Delta Y_{(t)}$ | -0.361<br>(0.406) | . . | 0.118<br>(4.554) | . . | -0.255<br>(1.685) | . . | 1282.66<br>(3.912) | 0.761 | 1.919 |

Note: F(11) = 273.327*; F(12) = 435.445*; F(13) = 280.601*; F(14) = 884.716*; F(15) = 16.962*.

Table 6

Regression Results Obtained from Estimating Velocity, Model II, for the United Kingdom, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.335<br>(1.561) | 0.004<br>(0.264) | . . | 0.017<br>(1.232) | 0.181 | 2.097 |
| 8. | $\Delta\log V_t$ | 0.362<br>(1.971) | . . | . . | 0.016<br>(1.249) | 0.178 | 2.021 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.338<br>(1.016) | 0.006<br>(0.220) | 0.054 | 2.365 |
| 10. | $\Delta\log V_t$ | 0.436<br>(2.418) | . . | 0.515<br>(1.694) | -0.025<br>(0.936) | 0.296 | 2.366 |

Note: F(7) = 1.877; F(8) = 3.885; F(9) = 1.032; F(10) = 3.579*.

Table 8

Regression Results Obtained from Estimating Income, Model II, for The United Kingdom, 1954-1973

| Eq. No. | Dependent Variable | $\Delta \log M_{1(t)}$ | $\Delta \log M_{\omega(t)}$ | $\Delta \log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta \log Y_{(t)}$ | 0.095 (0.816) | 0.124 (1.234) | -0.003 (0.501) | 0.058 (7.238) | 0.268 | 1.180 |
| 17. | $\Delta \log Y_{(t)}$ | 0.120 (1.154) | 0.103 (1.154) | . . | 0.058 (7.633) | 0.257 | 1.236 |
| 18. | $\Delta \log Y_{(t)}$ | 0.186 (2.113) | . . | . . | 0.064 (11.021) | 0.199 | 1.009 |
| 19. | $\Delta \log Y_{(t)}$ | . . | 0.159 (2.113) | . . | 0.059 (7.605) | 0.199 | 1.154 |

Note: F(16) = 1.957; F(17) = 2.939; F(18) = 4.465*; F(19) = 4.463*.

Table 9

Regression Results Obtained from Estimating Velocity,
Model I, for Austria, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | -0.922 (2.451) | ... | . . | . . | . . | . . | 7.962 (9.124) | 0.071 | 1.172 |
| 2. | $\log V_t$ | . . | 0.060 (0.619) | . . | . . | 0.530 (5.688) | . . | 1.480 (3.059) | 0.753 | 1.027 |
| 3. | $\log V_t$ | . . | -0.314 (2.646) | . . | . . | . . | . . | 3.214 (5.167) | 0.282 | 1.136 |
| 4. | $\log V_t$ | . . | . . | 0.007 (4.123) | . . | . . | . . | 1.446 (45.954) | 0.486 | 1.177 |
| 5. | $\log V_t$ | . . | 0.286 (1.290) | 0.012 (3.022) | . . | . . | . . | -0.129 (0.106) | 0.533 | 1.047 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.006 (1.584) | . . | 4.453 (4.175) | 0.038 (0.943) | 0.712 | 1.022 |

Note: F(2) = 25.854*; F(3) = 7.061*; F(4) = 17.084*; F(5) = 9.691*; F(6) = 21.034*

Table 10

Regression Results Obtained from Estimating Velocity, Model II, for Austria, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta\log$ Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.254 (1.551) | 0.625 (4.278) | . . | 0.008 (0.975) | 0.722 | 1.076 |
| 8. | $\Delta\log V_t$ | 0.669 (3.622) | . . | . . | 0.028 (2.617) | 0.422 | 1.442 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.133 (0.349) | -0.774 (0.025) | 0.007 | 2.073 |
| 10. | $\Delta\log V_t$ | 0.743 (4.014) | . . | 0.441 (1.509) | -0.002 (0.094) | 0.490 | 1.565 |

Note: F(7) = 22.022*; F(8) = 13.124*; F(9) = 0.122; F(10) = 8.167*.

Table 11

Regression Results Obtained from Estimating Income, Model I, for Austria, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.432<br>(2.508) | . . | -0.150<br>(0.783) | . . | 0.645<br>(5.000) | 2.906<br>(2.383) | 0.997 | 1.203 |
| 12. | $\log Y_{(t)}$ | . . | 0.925<br>(4.222) | . . | 0.204<br>(0.740) | . . | . . | 0.008<br>(0.005) | 0.991 | 1.066 |
| 13. | $\log Y_{(t)}$ | .... | 1.086<br>(44.081) | . . | . . | . . | . . . | 1.240<br>(13.081) | 0.991 | 1.142 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 1.359<br>(31.150) | . . | . . | -6.925<br>(17.505) | 0.982 | 0.631 |
| 15. | $\Delta Y_{(t)}$ | 0.909<br>(1.521) | . . | -0.0003<br>(0.096) | . . | 5.300<br>(7.348) | . . | 1.218<br>(0.548) | 0.921 | 1.336 |

Note: F(11) = 1531.88*; F(12) = 947.491*; F(13) = 1943.21*; F(14) = 970.356*; F(15) = 62.524*.

Table 12

Regression Results Obtained from Estimating Income,
Model II, for Austria, 1954-1973

| Eq. No. | Dependent Variable | $\Delta \log M_{1(t)}$ | $\Delta \log M_{\omega(t)}$ | $\Delta \log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta \log Y_{(t)}$ | 0.075<br>(0.556) | 0.009<br>(0.042) | 0.346<br>(1.635) | 0.054<br>(1.980) | 0.165 | 0.957 |
| 17. | $\Delta \log Y_{(t)}$ | 0.056<br>(0.408) | 0.017<br>(0.887) | . . | -0.062<br>(0.367) | 0.063 | 0.946 |
| 18. | $\Delta \log Y_{(t)}$ | 0.081<br>(0.606) | . . | . . | 0.087<br>(6.687) | 0.020 | 0.967 |
| 19. | $\Delta \log Y_{(t)}$ | . . | 0.018<br>(1.015) | . . | -0.071<br>(0.437) | 0.054 | 0.843 |

Note: F(16) = 1.056; F(17) = 0.575; F(18) = 0.367; F(19) = 1.031.

Table 13

Regression Results Obtained from Estimating Velocity,
Model I, for Belgium, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.074<br>(18.799) | . . | . . | . . | . . | . . | -2.237<br>(6.589) | 0.823 | 0.945 |
| 2. | $\log V_t$ | . . | 1.174<br>(2.165) | . . | . . | 0.271<br>(2.350) | . . | -3.445<br>(1.518) | 0.650 | 0.827 |
| 3. | $\log V_t$ | . . | 2.038<br>(4.567) | . . | . . | . . | . . | -7.214<br>(4.019) | 0.537 | 0.568 |
| 4. | $\log V_t$ | . . | . . | 0.014<br>(11.235) | . . | . . | . . | 0.750<br>(34.088) | 0.875 | 1.010 |
| 5. | $\log V_t$ | . . | 0.425<br>(1.340) | 0.013<br>(7.263) | . . | . . | . . | -0.933<br>(0.742) | 0.887 | 0.862 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.031<br>(2.525) | . . | -0.323<br>(0.690) | 0.035<br>(2.026) | 0.276 | 2.263 |

Note: F(2) = 15.815*; F(3) = 20.865*; F(4) = 126.244*; F(5) = 66.805*; F(6) = 3.232.

Table 14

Regression Results Obtained from Estimating Velocity, Model II, for Belgium, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_{\omega}}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.656<br>(2.536) | -0.037<br>(0.595) | . . | 0.013<br>(2.056) | 0.275 | 2.257 |
| 8. | $\Delta\log V_t$ | 0.630<br>(2.518) | . . | . . | 0.013<br>(2.110) | 0.260 | 2.260 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.049<br>(0.215) | 0.012<br>(0.642) | 0.003 | 2.296 |
| 10. | $\Delta\log V_t$ | 0.629<br>(2.435) | . . | 0.010<br>(0.052) | 0.013<br>(0.780) | 0.260 | 2.260 |

Note: F(7) = 3.232*; F(8) = 6.338*; F(9) = 0.046; F(10) = 2.994.

Table 15

Regression Results Obtained from Estimating Income,
Model I, for Belgium, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.565<br>(1.756) | . . | 0.582<br>(1.771) | . . | 0.040<br>(0.515) | -2.375<br>(1.796) | 0.996 | 1.110 |
| 12. | $\log Y_{(t)}$ | . . | 0.545<br>(1.744) | . . | 0.650<br>(2.209) | . . | . . | -2.740<br>(2.507) | 0.995 | 1.045 |
| 13. | $\log Y_{(t)}$ | . . | 1.233<br>(54.885) | . . | . . | . . | . . | -0.339<br>(2.650) | 0.994 | 1.180 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 1.163<br>(57.360) | . . | . . | -4.619<br>(23.459) | 0.995 | 0.958 |
| 15. | $\Delta Y_{(t)}$ | 1.150<br>(1.424) | ... | 0.031<br>(2.041) | . . | -0.646<br>(2.088) | . . | 13.679<br>(1.377) | 0.791 | 2.003 |

Note: F(11) = 1169.70*; F(12) = 1833.62*; F(13) = 3012.81*; F(14) = 3290.69*; F(15) = 20.231*.

Table 16

Regression Results Obtained from Estimating Income,
Model II, for Belgium, 1954-1973

| Eq. No. | Dependent Variable | $\Delta \log M_{1(t)}$ | $\Delta \log M_{\omega(t)}$ | $\Delta \log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta \log Y_{(t)}$ | 0.220<br>(0.930) | 0.344<br>(1.302) | -0.062<br>(1.116) | 0.043<br>(3.127) | 0.343 | 1.586 |
| 17. | $\Delta \log Y_{(t)}$ | 0.216<br>(0.907) | 0.330<br>(1.244) | . . | 0.041<br>(2.964) | 0.291 | 1.597 |
| 18. | $\Delta \log Y_{(t)}$ | 0.414<br>(2.299) | . . | . . | 0.049<br>(4.126) | 0.227 | 1.536 |
| 19. | $\Delta \log Y_{(t)}$ | . . | 0.491<br>(2.496) | . . | 0.043<br>(3.257) | 0.257 | 1.371 |

Note: F(16) = 2.779; F(17) = 3.496; F(18) = 5.284*; F(19) = 6.231*.

Table 17

Regression Results Obtained from Estimating Velocity,
Model I, for Denmark, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.002 (1.039) | . . | . . | . . | . . | . . | 5.152 (16.200) | 0.088 | 1.196 |
| 2. | $\log V_t$ | . . | 0.224 (4.405) | . . | . . | 0.225 (6.290) | . . | 0.377 (1.535) | 0.702 | 1.404 |
| 3. | $\log V_t$ | . . | -0.013 (0.216) | . . | . . | . . | . . | 1.473 (4.813) | 0.007 | 1.007 |
| 4. | $\log V_t$ | . . | . . | 0.002 (1.559) | . . | . . | . . | 1.368 (53.342) | 0.123 | 1.104 |
| 5. | $\log V_t$ | . . | 0.531 (5.457) | 0.015 (5.997) | . . | . . | . . | -1.534 (2.883) | 0.681 | 1.801 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.007 (1.983) | . . | 1.799 (2.477) | 0.009 (0.251) | 0.616 | 2.272 |

Note: F(2) = 19.980*; F(3) = 0.125; F(4) = 2.521; F(5) = 18.168*; F(6) = 13.605*

Table 18

Regression Results Obtained from Estimating Velocity, Model II, for Denmark, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta\log$ Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.195 (1.293) | 0.398 (3.095) | . . | -0.003 (0.356) | 0.655 | 2.220 |
| 8. | $\Delta\log V_t$ | 0.518 (3.918) | . . | . . | 0.018 (2.410) | 0.460 | 2.389 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.176 (0.607) | -0.005 (0.196) | 0.020 | 2.113 |
| 10. | $\Delta\log V_t$ | 0.512 (3.751) | . . | 0.075 (0.338) | 0.012 (0.657) | 0.464 | 2.400 |

Note: F(7) = 16.120*; F(8) = 15.349*; F(9) = 0.037; F(10) = 7.354*.

Table 19

Regression Results Obtained from Estimating Income, Model I, for Denmark, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.505 | . . | -0.093 | . . | 0.432 | 2.499 | 0.999 | 1.423 |
| | | | (6.192) | | (0.484) | | (3.419) | (1.965) | | |
| 12. | $\log Y_{(t)}$ | . . | 0.659 | . . | 0.488 | . . | . . | -1.465 | 0.998 | 1.522 |
| | | | (7.602) | | (4.226) | | | (2.200) | | |
| 13. | $\log Y_{(t)}$ | . . | 1.022 | . . | . . | . . | . . | 1.347 | 0.996 | 1.115 |
| | | | (64.950) | | | | | (30.981) | | |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 1.359 | . . | . . | -6.449 | 0.991 | 0.806 |
| | | | | | (44.234) | | | (26.969) | | |
| 15. | $\Delta Y_{(t)}$ | 2.171 | . . | -0.006 | . . | 2.437 | . . | 0.709 | 0.924 | 2.516 |
| | | (5.367) | | (1.316) | | (5.719) | | (1.100) | | |

Note: F(11) = 4449.61*; F(12) = 494.200*; F(13) = 4219.11*; F(14) = 1956.96*; F(15) = 64.490*.

Table 20

Regression Results Obtained from Estimating Income,
Model II, for Denmark, 1954-1973

| Eq. No. | Dependent Variable | $\Delta \log M_{1(t)}$ | $\Delta \log M_{\omega(t)}$ | $\Delta \log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta \log Y_{(t)}$ | 0.262 (2.248) | -0.038 (0.229) | 0.355 (3.065) | 0.029 (1.835) | 0.538 | 2.338 |
| 17. | $\Delta \log Y_{(t)}$ | 0.298 (2.098) | 0.194 (1.072) | . . | 0.054 (3.205) | 0.267 | 2.104 |
| 18. | $\Delta \log Y_{(t)}$ | 0.316 (2.235) | . . | . . | 0.065 (4.908) | 0.217 | 1.786 |
| 19. | $\Delta \log Y_{(t)}$ | . . | 0.240 (1.225) | . . | 0.076 (5.230) | 0.077 | 1.637 |

Note: F(16) = 6.211*; F(17) = 3.092; F(18) = 4.994*; F(19) = 1.501.

Table 21

Regression Results Obtained from Estimating Velocity, Model I, for France, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | -0.006 (1.001) | . . | . . | . . | . . | . . | 3.527 (29.907) | -0.613 | 0.335 |
| 2. | $\log V_t$ | . . | -0.004 (0.403) | . . | . . | 0.833 (6.653) | . . | 1.909 (16.884) | 0.745 | 0.570 |
| 3. | $\log V_t$ | . . | -0.025 (1.267) | . . | . . | . . | . . | 1.178 (24.047) | 0.082 | 0.375 |
| 4. | $\log V_t$ | . . | . . | 0.005 (1.986) | . . | . . | . . | 1.027 (20.719) | 0.180 | 0.484 |
| 5. | $\log V_t$ | . . | -0.020 (1.043) | 0.005 (1.802) | . . | . . | . . | 1.080 (15.175) | 0.229 | 0.437 |
| 6. | $\Delta V_t$ | . . | . . | . . | -0.005 (1.615) | . . | 4.089 (5.592) | 0.017 (0.757) | 0.683 | 1.973 |

Note: F(2) = 24.876*; F(3) = 1.614; F(4) = 3.955; F(5) = 2.531; F(6) = 18.293*.

Table 22

Regression Results Obtained from Estimating Velocity, Model II, for France, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | -0.012<br>(1.640) | 0.538<br>(5.690) | . . | 0.007<br>(0.947) | 0.697 | 2.055 |
| 8. | $\Delta\log V_t$ | -0.200<br>(1.663) | . | . . | 0.002<br>(0.119) | 0.133 | 1.380 |
| 9. | $\Delta\log V_t$ | . . | . . | -0.532<br>(1.499) | 0.042<br>(1.469) | 0.111 | 1.485 |
| 10. | $\Delta\log V_t$ | -0.023<br>(1.996) | . . | -0.616<br>(1.860) | 0.046<br>(1.755) | 0.280 | 1.659 |

Note: F(7) = 19.584*; F(8) = 2.766; F(9) = 2.247; F(10) = 3.302.

Table 23

Regression Results Obtained from Estimating Income, Model I, for France, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.163 (2.009) | . . | 0.002 (0.283) | . . | 0.891 (11.181) | 1.673 (19.773) | 0.998 | 1.803 |
| 12. | $\log Y_{(t)}$ | . . | 1.060 (31.122) | . . | -0.021 (1.095) | . . | . . | 0.979 (5.914) | 0.986 | 0.426 |
| 13. | $\log Y_{(t)}$ | . . | 1.044 (33.994) | . . | . . | . . | . . | 0.905 (5.952) | 0.985 | 0.472 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 0.248 (1.916) | . . | . . | 4.242 (4.480) | 0.170 | 0.235 |
| 15. | $\Delta Y_{(t)}$ | 0.206 (0.556) | . . | -0.009 (0.176) | . . | 7.660 (8.733) | . . | 2.716 (0.527) | 0.899 | 1.830 |

Note: F(11) = 3276.09*; F(12) = 584.860*; F(13) = 1155.74*; F(14) = 3.673; (F(15) = 47.479*.

Table 24

Regression Results Obtained from Estimating Income, Model II, for France, 1954-1973

| Eq. No. | Dependent Variable | $\Delta \log M_{1(t)}$ | $\Delta \log M_{\omega(t)}$ | $\Delta \log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta \log Y_{(t)}$ | -0.065<br>(0.630) | -0.005<br>(1.276) | 0.249<br>(3.485) | 0.085<br>(6.346) | 0.508 | 1.394 |
| 17. | $\Delta \log Y_{(t)}$ | -0.125<br>(0.946) | -0.005<br>(0.910) | . . | 0.113<br>(8.206) | 0.134 | 0.810 |
| 18. | $\Delta \log Y_{(t)}$ | -0.166<br>(1.350) | . . | . . | 0.117<br>(8.981) | 0.092 | 0.794 |
| 19. | $\Delta \log Y_{(t)}$ | . . | -0.007<br>(1.323) | . . | 0.101<br>(20.462) | 0.089 | 0.975 |

Note: F(16) = 5.502*; F(17) = 1.317; F(18) = 1.822; F(19) = 1.751.

Table 25

Regression Results Obtained from Estimating Velocity,
Model I, for Germany, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | -0.039 (2.319) | . . | . . | . . | . . | . . | 8.231 (19.787) | -0.064 | 1.328 |
| 2. | $\log V_t$ | . . | 0.109 (2.012) | . . | . . | 0.396 (5.017) | . . | 1.535 (9.664) | 0.682 | 1.698 |
| 3. | $\log V_t$ | . . | -0.108 (2.160) | . . | . . | . . | . . | 2.160 (19.329) | 0.212 | 1.560 |
| 4. | $\log V_t$ | ... | . . | 0.005 (3.179) | . . | . . | . . | 1.754 (64.572) | 0.364 | 1.765 |
| 5. | $\log V_t$ | . . | 0.206 (1.699) | 0.012 (2.768) | . . | . . | . . | 1.024 (2.380) | 0.457 | 1.810 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.034 (0.700) | . . | 4.071 (4.196) | -0.007 (0.878) | 0.626 | 1.776 |

Note: F(2) = 18.247*; F(3) = 4.831*; F(4) = 10.314*; F(5) = 7.142*; F(6) = 14.251*.

Table 26

Regression Results Obtained from Estimating Velocity,
Model II, for Germany, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.152 (0.832) | 0.630 (4.422) | . . | 0.0008 (0.065) | 0.639 | 1.724 |
| 8. | $\Delta\log V_t$ | 0.526 (2.275) | . . | . . | 0.026 (1.826) | 0.223 | 2.024 |
| 9. | $\Delta\log V_t$ | . . | . . | -0.332 (0.877) | 0.029 (0.967) | 0.041 | 2.316 |
| 10. | $\Delta\log V_t$ | 0.532 (1.998) | . . | 0.020 (0.053) | 0.025 (0.890) | 0.223 | 2.023 |

Note: F(7) = 15.034*; F(8) = 5.175*; F(9) = 0.077; F(10) = 2.446.

Table 27

Regression Results Obtained from Estimating Income, Model I, for Germany, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.409 (2.980) | . . | -0.070 (0.511) | . . | 0.549 (4.139) | 2.549 (3.473) | 0.998 | 1.632 |
| 12. | $\log Y_{(t)}$ | . . | 0.899 (9.287) | . . | 0.257 (1.642) | . . | . . | 0.417 (0.572) | 0.995 | 1.917 |
| 13. | $\log Y_{(t)}$ | . . | 1.055 (55.563) | . . | . . | . . | . . | 1.609 (20.398) | 0.994 | 1.750 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 1.686 (23.965) | . . | . . | -6.073 (12.083) | 0.970 | 0.707 |
| 15. | $\Delta Y_{(t)}$ | -0.785 (0.617) | . . | 0.042 (0.709) | . . | 3.827 (7.212) | . . | 12.631 (2.399) | 0.809 | 2.028 |

F(11) = 2201.89*; F(12) = 1690.40*; F(13) = 3087.05*; F(14) = 574.315*; F(15) = 22.6711*.

Table 28

Regression Results Obtained from Estimating Income, Model II, for Germany, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log M_{1(t)}$ | $\Delta\log M_{\omega(t)}$ | $\Delta\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta\log Y_{(t)}$ | -0.061 (0.296) | 0.013 (0.070) | 0.430 (2.675) | 0.052 (1.963) | 0.328 | 1.729 |
| 17. | $\Delta\log Y_{(t)}$ | -0.154 (0.654) | 0.075 (0.360) | . . | 0.102 (4.604) | 0.027 | 1.477 |
| 18. | $\Delta\log Y_{(t)}$ | -0.135 (0.602) | . . | . . | 0.104 (4.928) | 0.020 | 1.557 |
| 19. | $\Delta\log Y_{(t)}$ | . . | 0.044 (0.219) | . . | 0.090 (7.350) | 0.003 | 1.675 |

Note: F(16) = 2.601; F(17) = 0.237; F(18) = 0.362; F(19) = 0.048.

Table 29

Regression Results Obtained from Estimating Velocity,
Model I, for Italy, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.081 (12.772) | . . | . . | . . | . . | . . | 1.385 (10.428) | 0.918 | 0.262 |
| 2. | $\log V_t$ | . . | 0.278 (5.056) | . . | . . | 0.725 (6.238) | . . | 0.976 (3.514) | 0.983 | 0.820 |
| 3. | $\log V_t$ | . . | 0.598 (17.466) | . . | . . | . . | . . | -0.723 (7.579) | 0.944 | 0.264 |
| 4. | $\log V_t$ | . . | . . | -0.043 (13.762) | . . | . . | . . | 1.633 (29.942) | 0.913 | 0.316 |
| 5. | $\log V_t$ | . . | 1.490 (4.656) | 0.065 (2.798) | . . | . . | . . | -4.257 (3.364) | 0.962 | 0.782 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.014 (1.103) | . . | 4.183 (4.073) | -0.042 (1.356) | 0.561 | 1.679 |

Note: F(2) = 493.275*; F(3) = 305.090*; F(4) = 189.389*; F(5) = 214.321*; F(6) = 10.868*.

Table 30

Regression Results Obtained from Estimating Velocity, Model II, for Italy, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.366<br>(1.682) | 0.398<br>(2.346) | . . | -0.044<br>(0.322) | 0.611 | 1.300 |
| 8. | $\Delta\log V_t$ | 0.721<br>(4.116) | . . | . . | 0.008<br>(0.586) | 0.485 | 0.794 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.703<br>(2.591) | -0.092<br>(4.246) | 0.272 | 1.628 |
| 10. | $\Delta\log V_t$ | 0.650<br>(4.353) | . . | 0.562<br>(2.902) | 0.038<br>(1.925) | 0.656 | 1.219 |

Note: F(7) = 13.342*; F(8) = 16.944*; F(9) = 6.716*; F(10) = 16.178*.

Table 31

Regression Results Obtained from Estimating Income, Model I, for Italy, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | log $M_{1(t)}$ | $\Delta M_{\omega(t)}$ | log $M_{\omega(t)}$ | $\Delta G_{(t)}$ | log $G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | log $Y_{(t)}$ | . . | 0.402 (3.919) | . . | -0.412 (2.575) | . . | 0.611 (7.246) | 6.516 (5.157) | 0.998 | 1.586 |
| 12. | log $Y_{(t)}$ | . . | 0.914 (6.105) | . . | 0.512 (1.560) | . . | . . | 7.987 (3.190) | 0.992 | 0.755 |
| 13. | log $Y_{(t)}$ | . . | 0.676 (44.814) | . . | . . | . . | . . | 3.988 (27.915) | 0.991 | 0.390 |
| 14. | log $Y_{(t)}$ | . . | . . | . . | 1.434 (26.687) | . . | . . | -7.123 (10.863) | 0.975 | 0.340 |
| 15. | $\Delta Y_{(t)}$ | 0.272 (1.691) | . . | 0.119 (3.794) | . . | -0.805 (0.716) | . . | 1231.782 (3.782) | 0.885 | 1.465 |

Note: F(11) = 2952.20*; F(12) = 1092.40*; F(13) = 2008.22*; F(14) = 712.194*; F(15) = 42.889*.

Table 32

Regression Results Obtained from Estimating Income, Model II, for Italy, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log M_{1(t)}$ | $\Delta\log M_{\omega(t)}$ | $\Delta\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta\log Y_{(t)}$ | 0.052<br>(0.433) | 0.238<br>(1.503) | 0.121<br>(0.880) | 0.057<br>(3.246) | 0.372 | 1.710 |
| 17. | $\Delta\log Y_{(t)}$ | 0.044<br>(0.366) | 0.308<br>(2.271) | . . | 0.066<br>(4.699) | 0.341 | 1.512 |
| 18. | $\Delta\log Y_{(t)}$ | 0.191<br>(1.722) | . . | . . | 0.067<br>(4.262) | 0.141 | 1.338 |
| 19. | $\Delta\log Y_{(t)}$ | . . | 0.335<br>(3.018) | . . | 0.070<br>(8.251) | 0.336 | 1.557 |

Note: F(16) = 3.154; F(17) = 4.402*; F(18) = 2.963; F(19) = 9.107*.

Table 33

Regression Results Obtained from Estimating Velocity, Model I, for The Netherlands, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | -0.038 (4.064) | ... | .. | .. | .. | .. | 10.896 (9.358) | 0.423 | 1.623 |
| 2. | $\log V_t$ | .. | 0.153 (1.246) | .. | .. | 0.697 (9.401) | .. | 1.066 (2.133) | 0.940 | 0.677 |
| 3. | $\log V_t$ | .. | -0.837 (5.483) | .. | .. | .. | .. | 4.994 (7.530) | 0.626 | 1.252 |
| 4. | $\log V_t$ | .. | .. | 0.018 (9.800) | .. | .. | .. | 1.066 (33.787) | 0.842 | 1.408 |
| 5. | $\log V_t$ | .. | 1.035 (4.388) | 0.036 (8.309) | .. | .. | .. | -3.727 (3.411) | 0.926 | 1.277 |
| 6. | $\Delta V_t$ | .. | .. | .. | 0.017 (1.828) | .. | 4.226 (5.950) | 0.032 (1.045) | 0.846 | 1.641 |

Note: F(2) = 132.231*; F(3) = 30.077*; F(4) = 96.084*; F(5) = 106.400*; F(6) = 46.727*

Table 33 continued

Regression Results Obtained from Estimating Velocity,
Model I, for The Netherlands, 1954-1973

Beta Coefficients

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ |
|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.796 | . . | . . | . . | . . | . . |
| 2. | $\log V_t$ | . . | 0.439 | . . | . . | 0.548 | . . |

Table 34

Regression Results Obtained from Estimating Velocity, Model II, for The Netherlands, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.435 (2.048) | 0.579 (5.207) | . . | 0.012 (1.422) | 0.836 | 1.857 |
| 8. | $\Delta\log V_t$ | 1.194 (4.933) | . . | . . | 0.044 (4.914) | 0.575 | 2.407 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.291 (0.771) | 0.003 (0.098) | 0.032 | 2.113 |
| 10. | $\Delta\log V_t$ | 1.177 (4.724) | . . | 0.134 (0.520) | 0.034 (1.582) | 0.582 | 2.433 |

Note: F(7) = 43.374*; F(8) = 24.332*; F(9) = 0.594; F(10) = 11.809*.

Table 35

Regression Results Obtained from Estimating Income, Model I, for The Netherlands, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | -0.155 (0.555) | . . | 0.815 (1.731) | . . | 0.549 (4.401) | -2.462 (0.994) | 0.998 | 0.988 |
| 12. | $\log Y_{(t)}$ | . . | -0.471 (1.208) | . . | 2.195 (4.334) | . . | . . | -10.168 (4.030) | 0.995 | 1.840 |
| 13. | $\log Y_{(t)}$ | . . | 1.216 (41.598) | . . | . . | . . | . . | 0.764 (9.368) | 0.990 | 1.218 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 1.584 (58.063) | . . | . . | -7.129 (36.774) | 0.995 | 1.459 |
| 15. | $\Delta Y_{(t)}$ | -0.904 (1.405) | . . | 0.021 (1.617) | . . | 5.381 (11.609) | . . | 0.251 (0.432) | 0.937 | 1.476 |

Note: F(11) = 2405.26*; F(12) = 1729.55*; F(13) = 1730.54*; F(14) = 3371.59*; F(15) = 79.506*.

Table 36

Regression Results Obtained from Estimating Income, Model II, for The Netherlands, 1954-1973

| Eq. No. | Dependent Variable | $\Delta \log M_{1(t)}$ | $\Delta \log M_{\omega(t)}$ | $\Delta \log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta \log Y_{(t)}$ | -0.032 (0.222) | 0.230 (1.044) | 0.489 (4.390) | 0.034 (2.543) | 0.646 | 1.727 |
| 17. | $\Delta \log Y_{(t)}$ | -1.177 (0.862) | 0.593 (2.016) | . . | 0.076 (5.605) | 0.219 | 1.572 |
| 18. | $\Delta \log Y_{(t)}$ | 0.120 (6.774) | . . | . . | 0.088 (6.579) | 0.032 | 1.425 |
| 19. | $\Delta \log Y_{(t)}$ | . . | 0.411 (2.020) | . . | 0.074 (5.593) | 0.185 | 1.620 |

Note: F(16) = 9.721*; F(17) = 2.383; F(18) = 0.600; F(19) = 4.081*.

Table 37

Regression Results Obtained from Estimating Velocity,
Model I, for Norway, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.003 (0.468) | . . | . . | . . | . . | . . | 5.100 (2.793) | -0.015 | 0.243 |
| 2. | $\log V_t$ | . . | 0.192 (2.445) | . . | . . | 0.481 (14.396) | . . | 0.631 (1.487) | 0.925 | 1.192 |
| 3. | $\log V_t$ | . . | 0.146 (0.529) | . . | . . | . . | . . | 0.669 (0.446) | 0.016 | 0.193 |
| 4. | $\log V_t$ | . . | . . | 0.011 (4.406) | . . | . . | . . | 1.280 (29.620) | 0.519 | 0.393 |
| 5. | $\log V_t$ | . . | 0.800 (6.193) | 0.016 (9.813) | . . | . . | . . | -3.119 (4.387) | 0.852 | 1.328 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.003 (0.904) | . . | 2.803 (3.774) | 0.019 (0.618) | 0.549 | 1.728 |

Note: F(2) = 105.480*; F(3) = 0.297; F(4) = 19.446*; F(5) = 49.079*; F(6) = 10.339*.

Table 38

Regression Results Obtained from Estimating Velocity, Model II, for Norway, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.146 (0.819) | 0.459 (3.696) | . . | 0.004 (0.525) | 0.531 | 1.565 |
| 8. | $\Delta\log V_t$ | 0.390 (1.811) | . . | . . | 0.016 (1.884) | 0.154 | 1.917 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.651 (2.748) | -0.036 (1.887) | 0.295 | 2.130 |
| 10. | $\Delta\log V_t$ | 0.203 (0.939) | . . | 0.551 (2.113) | -0.026 (1.209) | 0.330 | 2.740 |

Note: F(7) = 9.626*; F(8) = 3.280; F(9) = 7.545*; F(10) = 4.188*.

Table 39

Regression Results Obtained from Estimating Income, Model I, for Norway, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.379<br>(3.556) | . . | 0.021<br>(0.097) | . . | 0.555<br>(5.923) | 1.693<br>(1.272) | 0.998 | 1.238 |
| 12. | $\log Y_{(t)}$ | . . | 0.118<br>(0.702) | . . | 1.132<br>(5.968) | . . | . . | -5.266<br>(4.858) | 0.992 | 1.265 |
| 13. | $\log Y_{(t)}$ | . . | 1.112<br>(27.015) | . . | . . | . . | . . | 1.194)<br>(12.092) | 0.976 | 0.320 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 1.264<br>(47.240) | . . | . . | -6.013<br>(28.848) | 0.992 | 1.379 |
| 15. | $\Delta Y_{(t)}$ | 2.081<br>(4.534) | . . | -0.002<br>(0.688) | . . | 2.063<br>(3.189) | . . | 1.068<br>(2.270) | 0.880 | 1.872 |

Note: F(11) = 2184.94*; F(12) = 1084.77*; F(13) = 729.909*; F(14) = 2231.95*; F(15) = 39.218*.

Table 40

Regression Results Obtained from Estimating Income, Model II, for Norway, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log M_{1(t)}$ | $\Delta\log M_{\omega(t)}$ | $\Delta\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta\log Y_{(t)}$ | 0.324<br>(2.058) | -0.117<br>(0.610) | 0.276<br>(2.061) | 0.041<br>(2.438) | 0.392 | 1.677 |
| 17. | $\Delta\log Y_{(t)}$ | 0.375<br>(2.209) | -0.147<br>(0.705) | . . | 0.065<br>(4.718) | 0.230 | 1.883 |
| 18. | $\Delta\log Y_{(t)}$ | 0.316<br>(2.169) | . . | . . | 0.060<br>(5.042) | 0.207 | 1.958 |
| 19. | $\Delta\log Y_{(t)}$ | . . | 0.079<br>(0.399) | . . | 0.078<br>(5.693) | 0.008 | 1.479 |

Note: F(16) = 3.430*; F(17) = 2.537; F(18) = 4.708*; F(19) = 0.159.

Table 41

Regression Results Obtained from Estimating Velocity,
Model I, for Sweden, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.037 (2.067) | . . | . . | . . | . . | . . | 3.255 (1.061) | 0.185 | 0.081 |
| 2. | $\log V_t$ | . . | -0.065 (0.893) | . . | . . | 0.526 (22.229) | . . | 2.179 (6.097) | 0.971 | 1.280 |
| 3. | $\log V_t$ | . . | 0.572 (1.598) | ... | . . | . . | . . | -0.784 (0.444) | 0.125 | 0.083 |
| 4. | $\log V_t$ | . . | . . | 0.022 (11.072) | . . | . . | . . | 1.681 (49.086) | 0.872 | 0.674 |
| 5. | $\log V_t$ | . . | 0.431 (4.504) | 0.021 (14.428) | . . | . . | . . | -0.432 (0.920) | 0.942 | 0.953 |
| 6. | $\Delta V_t$ | ... | . . | . . | 0.012 (1.035) | . . | 2.693 (2.995) | 0.001 (0.021) | 0.623 | 1.657 |

Note: F(2) = 283.599*; F(3) = 2.573; F(4) = 122.719*; F(5) = 137.243*; F(6) = 158.619*.

Table 42

Regression Results Obtained from Estimating Velocity, Model II, for Sweden, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.231 (1.231) | 0.531 (3.342) | . . | 0.005 (0.060) | 0.637 | 1.739 |
| 8. | $\Delta\log V_t$ | 0.626 (3.451) | . . | . . | 0.019 (2.711) | 0.398 | 1.521 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.248 (0.869) | 0.005 (0.232) | 0.040 | 1.569 |
| 10. | $\Delta\log V_t$ | 0.694 (4.034) | . . | 0.422 (1.965) | -0.011 (0.659) | 0.509 | 1.878 |

Note: F(7) = 14.909*; F(8) = 11.909*; F(9) = 0.755; F(10) = 8.834*.

Table 43

Regression Results Obtained from Estimating Income,
Model I, for Sweden, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.513<br>(6.697) | . . | -0.146<br>(1.136) | . . | 0.591<br>(6.720) | 2.661<br>(3.668) | 0.998 | 1.285 |
| 12. | $\log Y_{(t)}$ | . . | 0.729<br>(5.524) | . . | 0.587<br>(4.548) | . . | . . | -1.652<br>(2.576) | 0.992 | 0.819 |
| 13. | $\log Y_{(t)}$ | . . | 1.314<br>(31.758) | . . | . . | . . | . . | 1.246<br>(11.792) | 0.983 | 0.614 |
| 14. | $\log Y_{(t)}$ | . . . | . . | . . | 1.283<br>(28.216) | . . | . . | -5.002<br>(14.732) | 0.978 | 0.322 |
| 15. | $\Delta Y_{(t)}$ | 0.570<br>(0.614) | . . | 0.010<br>(1.108) | . . | 1.907<br>(3.181) | . . | 2.754<br>(3.076) | 0.808 | 2.207 |

Note: F(11) = 2571.99*; F(12) = 1066.01*; F(13) = 1008.62*; F(14) = 796.193*; F(15) = 22.476*.

Table 44

Regression Results Obtained from Estimating Income, Model II, for Sweden, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log M_{1(t)}$ | $\Delta\log M_{\omega(t)}$ | $\Delta\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta\log Y_{(t)}$ | 0.158<br>(1.324) | -0.025<br>(0.156) | 0.172<br>(1.071) | 0.057<br>(3.285) | 0.184 | 2.033 |
| 17. | $\Delta\log Y_{(t)}$ | 0.168<br>(1.407) | 0.000<br>(0.000) | . . | 0.072<br>(6.763) | 0.126 | 1.887 |
| 18. | $\Delta\log Y_{(t)}$ | 0.168<br>(1.609) | . . | . . | 0.072<br>(9.602) | 0.126 | 1.887 |
| 19. | $\Delta\log Y_{(t)}$ | . . | 0.099<br>(0.663) | . . | 0.076<br>(7.091) | 0.024 | 1.757 |

Note: F(16) = 1.203; F(17) = 1.222; F(18) = 2.587; F(19) = 0.439.

Table 45

Regression Results Obtained from Estimating Velocity, Model I, for Switzerland, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | -0.008 (1.844) | . . | . . | . . | . . | . . | 3.240 (9.943) | -0.011 | 1.153 |
| 2. | $\log V_t$ | . . | 0.151 (2.310) | . . | . . | 0.605 (6.327) | . . | 0.996 (4.365) | 0.706 | 1.115 |
| 3. | $\log V_t$ | . . | -0.488 (0.478) | . . | . . | . . | . . | 0.878 (2.170) | 0.013 | 0.823 |
| 4. | $\log V_t$ | . . | . . | 0.003 (1.646) | . . | . . | . . | 0.631 (18.210) | 0.131 | 0.873 |
| 5. | $\log V_t$ | . . | 0.951 (4.832) | 0.022 (5.371) | . . | . . | . . | -3.451 (4.084) | 0.634 | 1.091 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.026 (4.280) | . . | 4.042 (4.498) | 0.036 (2.770) | 0.757 | 1.514 |

Note: F(2) = 20.383*; F(3) = 0.231; F(4) = 2.714; F(5) = 14.717*; F(6) = 26.530*.

Table 46

Regression Results Obtained from Estimating Velocity, Model II, for Switzerland, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta\log$ Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.687 (4.280) | 0.402 (3.803) | . . | 0.018 (2.723) | 0.726 | 1.616 |
| 8. | $\Delta\log V_t$ | 0.854 (4.183) | . . | . . | 0.026 (3.068) | 0.493 | 1.447 |
| 9. | $\Delta\log V_t$ | . . | . . | -0.092 (0.280) | 0.017 (0.655) | 0.004 | 1.238 |
| 10. | $\Delta\log V_t$ | 0.855 (4.093) | . . | -0.105 (0.433) | 0.033 (1.696) | 0.498 | 1.463 |

Note: F(7) = 22.526*; F(8) = 17.501*; F(9) = 0.785; F(10) = 8.449*.

Table 47

Regression Results Obtained from Estimating Income,
Model I, for Switzerland, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.055<br>(0.391) | . . | 0.635<br>(3.259) | . . | 0.451<br>(4.433) | -1.619<br>(1.577) | 0.998 | 1.161 |
| 12. | $\log Y_{(t)}$ | . . | 0.263<br>(1.369) | . . | 1.018<br>(4.027) | . . | . . | -4.279<br>(3.548) | 0.994 | 1.179 |
| 13. | $\log Y_{(t)}$ | . . | 1.034<br>(41.960) | . . | . . | . . | . . | 0.571<br>(6.992) | 0.989 | 0.886 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 1.362<br>(55.792) | . . | . . | -5.913<br>(33.384) | 0.994 | 1.202 |
| 15. | $\Delta Y_{(t)}$ | -0.116<br>(0.504) | . . | 0.013<br>(2.021) | . . | 7.342<br>(10.281) | . . | -0.017<br>(0.029) | 0.903 | 1.218 |

Note: F(11) = 2289.70*; F(12) = 1633.19*; F(13) = 1760.99*; F(14) = 3113.35*; F(15) = 49.734*.

Table 48

Regression Results Obtained from Estimating Income, Model II, for Switzerland, 1954-1973

| Eq. No. | Dependent Variable | $\Delta \log M_{1(t)}$ | $\Delta \log M_{\omega(t)}$ | $\Delta \log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta \log Y_{(t)}$ | -0.096<br>(0.609) | 0.411<br>(1.888) | 0.299<br>(2.596) | 0.043<br>(2.793) | 0.381 | 1.183 |
| 17. | $\Delta \log Y_{(t)}$ | 0.030<br>(0.175) | 0.300<br>(1.214) | . . | 0.066<br>(4.467) | 0.120 | 0.757 |
| 18. | $\Delta \log Y_{(t)}$ | 0.136<br>(0.905) | . . | . . | 0.075<br>(5.801) | 0.043 | 0.590 |
| 19. | $\Delta \log Y_{(t)}$ | . . | 0.321<br>(1.553) | . . | 0.066<br>(5.070) | 0.118 | 0.772 |

Note: F(16) = 3.279*; F(17) = 1.157; F(18) = 0.818; F(19) = 2.412.

Table 49

Regression Results Obtained from Estimating Velocity, Model I, for Canada, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.074 (3.049) | . . | . . | . . | . . | . . | 3.592 (3.179) | 0.474 | 1.027 |
| 2. | $\log V_t$ | . . | 0.613 (4.847) | . . | . . | 0.227 (1.964) | . . | -0.453 (0.982) | 0.601 | 0.782 |
| 3. | $\log V_t$ | . . | 0.586 (4.332) | . . | . . | . . | . . | -0.376 (0.761) | 0.551 | 0.865 |
| 4. | $\log V_t$ | . . | . . | -0.007 (2.252) | . . | . . | . . | 1.873 (36.234) | 0.220 | 1.006 |
| 5. | $\log V_t$ | . . | 0.569 (3.182) | -0.001 (0.152) | . . | . . | . . | -0.306 (0.446) | 0.512 | 0.877 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.104 (3.389) | . . | 2.031 (2.426) | 0.020 (0.304) | 0.623 | 1.422 |

Note: F(2) = 12.821*; F(3) = 18.798*; F(4) = 5.093*; F(5) = 8.901*; F(6) = 14.056*.

Table 50

Regression Results Obtained from Estimating Velocity, Model II, for Canada, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.721 (3.696) | 0.291 (2.238) | . . | 0.004 (1.336) | 0.629 | 1.406 |
| 8. | $\Delta\log V_t$ | 0.883 (4.418) | . . | . . | 0.004 (0.195) | 0.520 | 1.533 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.367 (0.685) | -0.034 (0.799) | 0.025 | 2.229 |
| 10. | $\Delta\log V_t$ | 0.874 (4.297) | . . | 0.258 (0.676) | -0.015 (0.500) | 0.533 | 1.596 |

Note: F(7) = 14.437*; F(8) = 19.520*; F(9) = 0.469; F(10) = 9.695*.

Table 51

Regression Results Obtained from Estimating Income, Model I, for Canada, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | log $M_{1(t)}$ | $\Delta M_{\omega(t)}$ | log $M_{\omega(t)}$ | $\Delta G_{(t)}$ | log $G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | log $Y_{(t)}$ | . . | 0.260<br>(1.579) | . . | 0.288<br>(1.634) | . . | 0.389<br>(3.092) | 0.950<br>(1.330) | 0.990 | 1.150 |
| 12. | log $Y_{(t)}$ | . . | 0.508<br>(2.885) | . . | 0.555<br>(2.216) | . . | . . | 0.180<br>(0.220) | 0.984 | 0.938 |
| 13. | log $Y_{(t)}$ | . . | 0.894<br>(28.136) | . . | . . . | . . | . . | 1.992<br>(28.968) | 0.979 | 1.075 |
| 14. | log $Y_{(t)}$ | . . | . . | . . | 1.040<br>(27.057) | . . | . . | -2.121<br>(9.432) | 0.976 | 0.594 |
| 15. | $\Delta Y_{(t)}$ | -0.034<br>(0.040) | . . | 0.103<br>(3.052) | . . . . | -0.642<br>(0.124) | . . | 1.682<br>(1.979) | 0.674 | 1.239 |

Note: F(11) = 523.597*; F(12) = 519.187*; F(13) = 849.097*; F(14) = 732.210*; F(15) = 11.008*.

Table 52

Regression Results Obtained from Estimating Income, Model II, for Canada, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log M_{1(t)}$ | $\Delta\log M_{\omega(t)}$ | $\Delta\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta\log Y_{(t)}$ | -0.005<br>(0.037) | 0.114<br>(0.555) | -0.023<br>(0.189) | 0.070<br>(3.854) | 0.030 | 1.181 |
| 17. | $\Delta\log Y_{(t)}$ | -0.011<br>(0.088) | 0.024<br>(0.645) | . . | 0.068<br>(4.689) | 0.028 | 1.175 |
| 18. | $\Delta\log Y_{(t)}$ | 0.031<br>(0.283) | . . | . . | 0.074<br>(2.214) | 0.004 | 1.175 |
| 19. | $\Delta\log Y_{(t)}$ | . . | 0.166<br>(0.717) | . . | 0.068<br>(4.978) | 0.028 | 1.198 |

Note: F(16) = 0.167; F(17) = 0.025; F(18) = 0.797; F(19) = 0.514.

Table 53

Regression Results Obtained from Estimating Velocity, Model I, for Japan, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.035<br>(6.537) | . . | . . | . . | . . | . . | 3.074<br>(27.965) | 0.662 | 1.125 |
| 2. | $\log V_t$ | . . | 0.063<br>(0.778) | . . | . . | 0.407<br>(1.243) | . . | 1.535<br>(2.570) | 0.796 | 1.030 |
| 3. | $\log V_t$ | . . | 0.160<br>(7.934) | . . | . . | . . | . . | 0.796<br>(14.643) | 0.778 | 1.350 |
| 4. | $\log V_t$ | . . | . . | -0.016<br>(6.526) | . . | . . | . . | 1.480<br>(34.428) | 0.703 | 1.264 |
| 5. | $\log V_t$ | . . | 0.850<br>(7.155) | 0.073<br>(5.835) | . . | . . | . . | -2.216<br>(4.285) | 0.926 | 1.650 |
| 6. | $\Delta V_t$ | . . | . . | . . | -0.078<br>(1.151) | . . | 14.843<br>(3.264) | -0.048<br>(0.574) | 0.609 | 1.613 |

Note: F(2) = 33.223*; F(3) = 62.994*; F(4) = 42.634*; F(5) = 106.345*; F(6) = 13.251*.

Table 54

Regression Results Obtained from Estimating Velocity, Model II, for Japan, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.626<br>(2.578) | 0.502<br>(1.800) | . . | 0.065<br>(2.950) | 0.755 | 2.369 |
| 8. | $\Delta\log V_t$ | 0.983<br>(6.618) | . . | . . | 0.087<br>(4.957) | 0.708 | 2.473 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.385<br>(0.759) | -0.042<br>(1.024) | 0.031 | 2.190 |
| 10. | $\Delta\log V_t$ | 1.045<br>(6.591) | . . | -0.320<br>(1.082) | 0.117<br>(3.585) | 0.738 | 2.676 |

Note: F(7) = 26.243*; F(8) = 43.801*; F(9) = 0.577; F(10) 22.692*.

Table 55

Regression Results Obtained from Estimating Income, Model I, for Japan, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | log $M_{1(t)}$ | $\Delta M_{\omega(t)}$ | log $M_{\omega(t)}$ | $\Delta G_{(t)}$ | log $G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | log $Y_{(t)}$ | . . | 0.442<br>(2.052) | . . | 1.498<br>(2.827) | . . | -0.060<br>(0.183) | -10.694<br>(2.374) | 0.998 | 1.550 |
| 12. | log $Y_{(t)}$ | . . | 0.412<br>(3.040) | . . | 1.438<br>(3.581) | . . | . . | -10.187<br>(2.953) | 0.998 | 1.480 |
| 13. | log $Y_{(t)}$ | . . | 0.900<br>(63.606) | . . | . . | . . | . . | 2.160<br>(16.984) | 0.996 | 1.344 |
| 14. | log $Y_{(t)}$ | . . | . . | . . | 2.654<br>(67.822) | . . | . . | -20.612<br>(45.345) | 0.996 | 1.513 |
| 15. | $\Delta Y_{(t)}$ | -1.842<br>(4.757) | . . | -0.059<br>(0.710) | . . | 18.819<br>(9.937) | . . | 530.345<br>(1.159) | 0.961 | 1.660 |

Note: F(11) = 2111.24*; F(12) = 3357.69*; F(13) = 4045.74*; F(14) = 4599.88*; F(15) = 131.760*.

Table 56

Regression Results Obtained from Estimating Income,
Model II, for Japan, 1954-1973

| Eq. No. | Dependent Variable | $\Delta \log M_{1(t)}$ | $\Delta \log M_{\omega(t)}$ | $\Delta \log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta \log Y_{(t)}$ | -0.167<br>(1.005) | 0.322<br>(0.820) | 0.513<br>(1.837) | 0.083<br>(2.835) | 0.335 | 2.150 |
| 17. | $\Delta \log Y_{(t)}$ | -0.129<br>(0.772) | -0.038<br>(2.239) | . . | 0.264<br>(4.158) | 0.230 | 1.770 |
| 18. | $\Delta \log Y_{(t)}$ | 0.040<br>(0.245) | . . | . . | 0.132<br>(4.946) | 0.003 | 1.573 |
| 19. | $\Delta \log Y_{(t)}$ | . . | -0.032<br>(2.143) | . . | 0.228<br>(5.359) | 0.203 | 1.844 |

Note: F(16) = 2.680; F(17) = 2.543; F(18) = 0.060; F(19) = 4.593*.

Table 57

Regression Results Obtained from Estimating Velocity,
Model I, for Finland, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.000 (4.714) | . . | . . | . . | . . | . . | 14.918 (38.663) | 0.441 | 1.148 |
| 2. | $\log V_t$ | . . | 0.014 (1.536) | . . | . . | 0.562 (7.435) | . . | -0.903 (1.902) | 0.901 | 0.650 |
| 3. | $\log V_t$ | . . | -0.039 (4.736) | . . | . . | . . | . . | 2.722 (38.225) | 0.555 | 1.034 |
| 4. | $\log V_t$ | . . | . . | 0.015 (4.913) | . . | . . | . . | 2.145 (39.546) | 0.574 | 0.534 |
| 5. | $\log V_t$ | . . | -0.019 (1.254) | 0.008 (1.536) | . . | . . | . . | 2.407 (11.135) | 0.609 | 0.799 |
| 6. | $\Delta V_t$ | . . | . . | . . | -0.001 (1.933) | . . | 4.440 (6.137) | 0.000 (0.407) | 0.727 | 1.837 |

Note: F(2) = 77.446*; F(3) = 22.485*; F(4) = 24.200*; F(5) = 13.270*; F(6) = 22.581*.

Table 58

Regression Results Obtained from Estimating Velocity, Model II, for Finland, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.015<br>(1.660) | 0.617<br>(5.130) | . . | -0.003<br>(0.350) | 0.646 | 1.876 |
| 8. | $\Delta\log V_t$ | 0.194<br>(1.639) | . . | . . | 0.014<br>(1.136) | 0.129 | 1.572 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.451<br>(1.152) | -0.023<br>(0.746) | 0.068 | 2.105 |
| 10. | $\Delta\log V_t$ | 0.018<br>(1.570) | . . | 0.410<br>(1.809) | -0.016<br>(0.531) | 0.186 | 1.705 |

Note: F(7) = 15.507*; F(8) = 2.688; F(9) = 1.329; F(10) = 1.951.

Table 59

Regression Results Obtained from Estimating Income,
Model I, for Finland, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.218 (3.650) | . . | 0.001 (0.733) | . . | 0.675 (13.685) | 0.662 (1.667) | 0.999 | 1.554 |
| 12. | $\log Y_{(t)}$ | . . | 1.043 (20.182) | . . | -0.038 (2.715) | . . | . . | 2.711 (17.356) | 0.982 | 1.023 |
| 13. | $\log Y_{(t)}$ | . . | 1.131 (26.105) | . . | . . | . . | . . | 2.296 (60.198) | 0.974 | 0.473 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | -0.232 (4.709) | . . | . . | 5.224 (11.414) | 0.552 | 0.418 |
| 15. | $\Delta Y_{(t)}$ | 0.004 (2.935) | . . | 0.0001 (1.296) | . . | 3.053 (3.576) | . . | 0.442 (1.740) | 0.933 | 2.090 |

Note: F(11) = 3976.19*; F(12) = 465.032*; F(13) = 681.545*; F(14) = 22.176*; F(15) = 74.447*.

## Table 60

Regression Results Obtained from Estimating Income,
Model II, for Finland, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log M_{1(t)}$ | $\Delta\log M_{\omega(t)}$ | $\Delta\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta\log Y_{(t)}$ | 0.247<br>(2.887) | 0.003<br>(1.411) | 0.670<br>(0.469) | 0.075<br>(4.231) | 0.399 | 1.814 |
| 17. | $\Delta\log Y_{(t)}$ | 0.259<br>(3.209) | 0.007<br>(1.412) | . . | 0.081<br>(8.813) | 0.392 | 1.755 |
| 18. | $\Delta\log Y_{(t)}$ | 0.237<br>(2.914) | . . | . . | 0.082<br>(8.725) | 0.321 | 1.866 |
| 19. | $\Delta\log Y_{(t)}$ | . . | 0.004<br>(0.657) | . . | 0.105<br>(16.212) | 0.023 | 1.064 |

Note: F(16) = 3.537*; F(17) = 5.476*; F(18) = 8.491*; F(19) = 0.432.

Table 61

Regression Results Obtained from Estimating Velocity, Model I, for Greece, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.008 (17.821) | . . | . . | . . | . . | . . | 3.439 (13.379) | 0.949 | 0.845 |
| 2. | $\log V_t$ | . . | 0.385 (7.832) | . . | . . | 0.422 (4.223) | . . | -0.344 (1.061) | 0.980 | 1.094 |
| 3. | $\log V_t$ | . . | 0.575 (20.809) | . . | . . | . . | . . | -1.618 (9.699) | 0.960 | 0.896 |
| 4. | $\log V_t$ | . . | . . | 0.038 (10.192) | . . | . . | . . | 2.468 (38.106) | 0.852 | 0.374 |
| 5. | $\log V_t$ | . . | 0.737 (7.539) | 0.012 (1.719) | . . | . . | . . | -2.786 (3.993) | 0.966 | 1.078 |
| 6. | $\Delta V_t$ | . . | . . | . . | -0.001 (2.116) | . . | 5.760 (6.846) | -0.107 (1.948) | 0.737 | 1.437 |

Note: F(2) = 428.014*; F(3) = 433.106*; F(4) = 103.903*; F(5) = 241.548*; F(6) = 23.799*.

Table 62

Regression Results Obtained from Estimating Velocity, Model II, for Greece, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | -0.007 (1.226) | 0.619 (4.939) | . . | -0.013 (1.379) | 0.591 | 1.515 |
| 8. | $\Delta\log V_t$ | 0.002 (0.225) | ... | . . | -0.034 (2.546) | 0.003 | 1.907 |
| 9. | $\Delta\log V_t$ | . . | . . | -0.428 (1.086) | -0.002 (0.057) | 0.061 | 2.062 |
| 10. | $\Delta\log V_t$ | 0.010 (1.012) | . . | -0.696 (1.466) | 0.015 (0.422) | 0.115 | 2.084 |

Note: F(7) = 12.255*; F(8) = 0.508; F(9) = 1.179; F(10) = 1.509.

Table 63

Regression Results Obtained from Estimating Income, Model I, for Greece, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.182 (2.859) | . . | 0.438 (3.595) | . . | 0.403 (3.678) | -0.744 (0.825) | 0.997 | 1.129 |
| 12. | $\log Y_{(t)}$ | . . | 0.345 (5.698) | . . | 0.743 (6.313) | . . | . . | -2.913 (3.241) | 0.994 | 1.056 |
| 13. | $\log Y_{(t)}$ | . . | 0.717 (29.372) | . . | . . | . . | . . | 2.754 (34.077) | 0.980 | 0.370 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 1.397 (31.531) | . . | . . | -7.837 (19.142) | 0.982 | 0.607 |
| 15. | $\Delta Y_{(t)}$ | 3.238 (3.668) | . . | 0.0004 (0.272) | . . | 4.627 (2.592) | . . | -4.533 (1.380) | 0.885 | 1.716 |

Note: F(11) = 1605.15*; F(12) = 1382.39*; F(13) = 862.717*; F(14) = 994.183*; F(15) = 40.964*.

Table 64

Regression Results Obtained from Estimating Income, Model II, for Greece, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log M_{1(t)}$ | $\Delta\log M_{\omega(t)}$ | $\Delta\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta\log Y_{(t)}$ | 0.331 (1.698) | -0.005 (0.922) | 0.571 (3.170) | -0.002 (0.005) | 0.454 | 1.368 |
| 17. | $\Delta\log Y_{(t)}$ | 0.288 (1.194) | 0.004 (0.628) | . . | 0.067 (1.865) | 0.110 | 1.075 |
| 18. | $\Delta\log Y_{(t)}$ | 0.311 (1.329) | . . | . . | 0.065 (1.859) | 0.089 | 1.086 |
| 19. | $\Delta\log Y_{(t)}$ | . . | 0.005 (0.812) | . . | 0.108 (9.029) | 0.035 | 0.829 |

Note: F(16) = 4.425*; F(17) = 1.050; F(18) = 1.765; F(19) = 0.659.

Table 65

Regression Results Obtained from Estimating Velocity, Model I, for Ireland, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.008 (10.194) | . . | . . | . . | . . | . . | -0.131 (0.253) | 0.860 | 1.160 |
| 2. | $\log V_t$ | . . | 0.097 (2.304) | . . | . . | 0.556 (16.911) | . . | 1.630 (42.769) | 0.946 | 0.807 |
| 3. | $\log V_t$ | . . | 1.021 (10.077) | . . | . . | . . | . . | -5.033 (8.044) | 0.850 | 1.176 |
| 4. | $\log V_t$ | . . | . . | 0.012 (3.280) | . . | . . | . . | 1.080 (17.564) | 0.374 | 0.359 |
| 5. | $\log V_t$ | . . | 0.895 (10.034) | 0.005 (3.364) | . . | . . | . . | -4.335 (8.024) | 0.910 | 1.700 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.135 (1.103) | . . | 4.287 (5.376) | -0.007 (0.277) | 0.804 | 1.765 |

Note: F(2) = 147.935*; F(3) = 101.576*; F(4) = 10.773*; F(5) = 85.559*; F(6) = 34.963*.

Table 66

Regression Results Obtained from Estimating Velocity, Model II, for Ireland, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta\log$ Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.042<br>(0.621) | 0.640<br>(6.386) | . . | -0.003<br>(0.518) | 0.821 | 1.879 |
| 8. | $\Delta\log V_t$ | 0.615<br>(3.406) | . . | . . | 0.007<br>(0.696) | 0.392 | 2.403 |
| 9. | $\Delta\log V_t$ | . . | . . | -0.588<br>(1.620) | 0.057<br>(1.965) | 0.127 | 2.283 |
| 10. | $\Delta\log V_t$ | 0.560<br>(3.004) | . . | -0.333<br>(1.063) | 0.032<br>(1.250) | 0.430 | 2.528 |

Note: F(7) = 38.855*; F(8) = 11.604*; F(9) = 2.625; F(10) = 6.409*.

Table 67

Regression Results Obtained from Estimating Income, Model I, for Ireland, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.267<br>(5.248) | . . | -0.131<br>(2.110) | . . | 0.725<br>(15.560) | 2.735<br>(10.313) | 0.999 | 1.625 |
| 12. | $\log Y_{(t)}$ | . . | 0.168<br>(1.649) | . . | 0.900<br>(9.881) | . . | . . | -4.192<br>(7.300) | 0.995 | 1.736 |
| 13. | $\log Y_{(t)}$ | . . | 1.156<br>(23.778) | . . | . . | . . | . . | 1.476<br>(21.984) | 0.969 | 0.428 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 1.047<br>(58.082) | . . | . . | -5.129<br>(38.316) | 0.995 | 1.700 |
| 15. | $\Delta Y_{(t)}$ | 0.113<br>(0.186) | . . | -0.128<br>(0.970) | . . | 5.189<br>(7.767) | . . | 17.138<br>(1.700) | 0.957 | 1.655 |

Note: F(11) = 4242.70*; F(12) = 1849.33*; F(13) = 565.401*; F(14) = 3373.51*; F(15) = 117.140*.

Table 68

Regression Results Obtained from Estimating Income, Model II, for Ireland, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log M_{1(t)}$ | $\Delta\log M_{\omega(t)}$ | $\Delta\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta\log Y_{(t)}$ | 0.059 (0.600) | -0.060 (0.968) | 0.643 (8.083) | 0.020 (2.322) | 0.865 | 1.960 |
| 17. | $\Delta\log Y_{(t)}$ | 0.081 (0.395) | 0.474 (2.774) | . . | 0.039 (2.428) | 0.421 | 1.518 |
| 18. | $\Delta\log Y_{(t)}$ | 0.378 (1.848) | . . | . . | 0.057 (3.272) | 0.160 | 0.813 |
| 19. | $\Delta\log Y_{(t)}$ | . . | 0.510 (3.582) | . . | 0.042 (2.945) | 0.416 | 1.475 |

Note: F(16) = 34.114*; F(17) = 6.191*; F(18) = 3.416; F(19) = 12.828*.

Table 69

Regression Results Obtained from Estimating Velocity, Model I, for Spain, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | -0.002<br>(0.464) | . . | . . | . . | . . | . . | 3.334<br>(15.189) | -0.411 | 0.803 |
| 2. | $\log V_t$ | . . | 0.181<br>(5.050) | . . | . . | 0.194<br>(2.562) | . . | 0.612<br>(5.005) | 0.602 | 1.230 |
| 3. | $\log V_t$ | . . | 0.132<br>(3.808) | . . | . . | . . | . . | 0.566<br>(4.691) | 0.448 | 1.213 |
| 4. | $\log V_t$ | . . | . . | -0.004<br>(3.165) | . . | . . | . . | 1.162<br>(49.419) | 0.359 | 1.334 |
| 5. | $\log V_t$ | . . | 0.113<br>(1.685) | -0.008<br>(0.320) | . . | . . | . . | 0.652<br>(2.147) | 0.451 | 1.247 |
| 6. | $\Delta V_t$ | . . | . . | . . | -0.003<br>(0.461) | . . | 10.722<br>(17.650) | -0.037<br>(0.841) | 0.949 | 2.254 |

Note: F(2) = 12.834*; F(3) = 14.592*; F(4) = 10.098*; F(5) = 6.984*; F(6) = 158.619*.

Table 70

Regression Results Obtained from Estimating Velocity, Model II, for Spain, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.385 (1.837) | -0.892 (12.913) | . . | 0.013 (0.588) | 0.908 | 2.234 |
| 8. | $\Delta\log V_t$ | -0.110 (0.167) | . . | . . | 0.044 (0.648) | 0.002 | 1.124 |
| 9. | $\Delta\log V_t$ | . . | . . | 4.608 (2.947) | -0.289 (2.310) | 0.326 | 1.423 |
| 10. | $\Delta\log V_t$ | -0.624 (0.112) | . . | 4.603 (2.860) | -0.291 (2.233) | 0.326 | 1.436 |

Note: F(7) = 83.518*; F(8) = 0.028; F(9) = 8.687*; F(10) = 4.111*.

Table 71

Regression Results Obtained from Estimating Income, Model I, for Spain, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | (0.643<br>(6.621) | . . | 0.104<br>(1.671) | . . | 0.226<br>(2.961) | 1.121<br>(3.084) | 0.999 | 1.333 |
| 12. | $\log Y_{(t)}$ | . . | 0.893<br>(15.643) | . . | 0.095<br>(1.256) | . . | . . | 0.785<br>(1.882) | 0.998 | 1.267 |
| 13. | $\log Y_{(t)}$ | . . | 0.964<br>(93.837) | . . | . . | . . | . . | 1.303<br>(21.479) | 0.998 | 1.338 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 1.254<br>(24.666) | . . | . . | -5.404<br>(10.770) | 0.981 | 0.644 |
| 15. | $\Delta Y_{(t)}$ | 0.364<br>(1.612) | . . | -0.023<br>(3.363) | . . | 7.445<br>(7.569) | . . | 47.405<br>(3.212) | 0.940 | 2.129 |

Note: F(11) = 4417.75*; F(12) = 4545.36*; F(13) = 8805.92*; F(14) = 608.458*; F(15) = 83.963*.

Table 72

Regression Results Obtained from Estimating Income,
Model II, for Spain, 1954-1973

| Eq. No. | Dependent Variable | $\Delta \log M_{1(t)}$ | $\Delta \log M_{\omega(t)}$ | $\Delta \log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta \log Y_{(t)}$ | 0.093 (0.224) | 0.297 (0.813) | 1.744 (55.424) | -0.152 (1.971) | 0.995 | 2.432 |
| 17. | $\Delta \log Y_{(t)}$ | -3.358 (0.604) | -5.628 (1.195) | . . | 1.348 (1.381) | 0.082 | 1.250 |
| 18. | $\Delta \log Y_{(t)}$ | -1.676 (0.308) | . . | . . | 0.631 (0.810) | 0.005 | 1.054 |
| 19. | $\Delta \log Y_{(t)}$ | . . | -4.909 (1.097) | . . | 0.839 (1.733) | 0.063 | 1.207 |

Note: F(16) = 1116.32*; F(17) = 0.763; F(18) = 0.095; F(19) = 1.204.

Table 73

Regression Results Obtained from Estimating Velocity, Model I, for Turkey, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.013<br>(4.945) | . . | . . | . . | . . | . . | 3.831<br>(4.340) | 0.594 | 1.098 |
| 2. | $\log V_t$ | . . | 0.136<br>(1.666) | . . | . . | 0.847<br>(7.530) | . . | 1.346<br>(2.829) | 0.902 | 1.043 |
| 3. | $\log V_t$ | . . | 0.574<br>(4.947) | . . | . . | . . | . . | -1.269<br>(1.928) | 0.576 | 1.085 |
| 4. | $\log V_t$ | . . | . . | -0.025<br>(2.590) | . . | . . | . . | 2.389<br>(14.282) | 0.272 | 0.480 |
| 5. | $\log V_t$ | . . | 0.507<br>(4.795) | -0.017<br>(2.503) | . . | . . | . . | -0.610<br>(0.960) | 0.690 | 1.317 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.002<br>(0.998) | . . | 6.004<br>(5.683) | -0.071<br>(0.500) | 0.701 | 1.854 |

Note: F(2) = 78.466*; F(3) = 24.482*; F(4) = 6.712*; F(5) = 18.955*; F(6) = 19.923*.

Table 74

Regression Results Obtained from Estimating Velocity, Model II, for Turkey, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.036 (0.450) | 0.746 (5.964) | . . | -0.009 (0.431) | 0.715 | 1.716 |
| 8. | $\Delta\log V_t$ | 0.199 (1.564) | . . | . . | -0.028 (0.785) | 0.120 | 2.347 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.708 (0.599) | -0.086 (0.914) | 0.019 | 2.997 |
| 10. | $\Delta\log V_t$ | 0.193 (1.479) | . . | 0.550 (0.479) | -0.069 (0.746) | 0.131 | 2.373 |

Note: F(7) = 21.357*; F(8) = 2.445; F(9) = 0.359; F(10) = 1.285.

Table 75

Regression Results Obtained from Estimating Income, Model I, for Turkey, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.098<br>(1.311) | . . | 0.149<br>(2.111) | . . | 0.690<br>(6.042) | 1.383<br>(3.363) | 0.992 | 1.372 |
| 12. | $\log Y_{(t)}$ | . . | 0.439)<br>(5.031) | . . | 0.424<br>(4.445) | . . | . . | -0.112<br>(0.195) | 0.974 | 1.349 |
| 13. | $\log Y_{(t)}$ | . . | 0.800<br>(17.261) | . . | . . | . . | . . | 2.430<br>(21.569) | 0.943 | 0.475 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 0.870<br>(16.015) | . . | . . | -2.649<br>(6.145) | 0.934 | 1.352 |
| 15. | $\Delta Y_{(t)}$ | 3.281<br>(5.640) | . . | -0.012<br>(3.077) | . . | 2.831<br>(2.796) | . . | 4.864<br>(2.203) | 0.825 | 1.670 |

Note: F(11) = 658.839*; F(12) = 314.097*; F(13) = 298.951*; F(14) = 256.489*; F(15) = 25.209*.

Table 76

Regression Results Obtained from Estimating Income, Model II, for Turkey, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log M_{1(t)}$ | $\Delta\log M_{\omega(t)}$ | $\Delta\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta\log Y_{(t)}$ | 0.103 (1.003) | 0.011 (0.181) | 0.171 (0.873) | 0.101 (2.752) | 0.122 | 1.496 |
| 17. | $\Delta\log Y_{(t)}$ | 0.111 (1.091) | 0.015 (0.246) | . . | 0.125 (4.036) | 0.080 | 1.641 |
| 18. | $\Delta\log Y_{(t)}$ | 0.117 (1.220) | . . | . . | 0.126 (5.327) | 0.076 | 1.550 |
| 19. | $\Delta\log Y_{(t)}$ | . . | 0.032 (0.528) | . . | 0.142 (7.527) | 0.015 | 1.551 |

Note: F(16) = 0.738; F(17) = 0.735; F(18) = 1.488; F(19) = 0.279.

Table 77

Regression Results Obtained from Estimating Velocity, Model I, for Australia, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.310 (7.645) | . . | . . | . . | . . | . . | 3.174 (11.950) | 0.786 | 0.809 |
| 2. | $\log V_t$ | . . | -0.187 (3.204) | . . | . . | 0.898 (10.771) | . . | 2.840 (9.975) | 0.973 | 0.720 |
| 3. | $\log V_t$ | . . | 0.410 (8.207) | . . | . . | . . | . . | -0.130 (0.678) | 0.789 | 0.662 |
| 4. | $\log V_t$ | . . | . . | 0.035 (14.853) | . . | . . | . . | 0.856 (20.676) | 0.925 | 0.606 |
| 5. | $\log V_t$ | . . | 0.032 (0.430) | 0.033 (5.572) | . . | . . | . . | 0.773 (3.856) | 0.925 | 0.616 |
| 6. | $\Delta V_t$ | . . | . . | . . | -0.008 (1.847) | . . | 5.907 (4.224) | 0.023 (0.549) | 0.513 | 1.298 |

Note: F(2) = 306.911*; F(3) = 67.363*; F(4) = 220.647*; F(5) = 105.424*; F(6) = 8.939*.

Table 78

Regression Results Obtained from Estimating Velocity, Model II, for Australia, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta\log$ Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | -0.075 (1.266) | 0.551 (3.320) | . . | 0.013 (1.239) | 0.394 | 1.283 |
| 8. | $\Delta\log V_t$ | 0.006 (0.085) | ... | . . | 0.032 (2.926) | 0.004 | 1.790 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.509 (1.644) | -0.005 (0.188) | 0.130 | 2.040 |
| 10. | $\Delta\log V_t$ | 0.011 (0.166) | . . | 0.511 (1.605) | -0.005 (0.207) | 0.132 | 2.090 |

Note: F(7) = 5.515*; F(8) = 0.007; F(9) = 2.702; F(10) = 1.292.

Table 79

Regression Results Obtained from Estimating Income, Model I, for Australia, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | -0.102<br>(1.416) | . . | -0.194<br>(5.577) | . . | 1.068<br>(18.418) | 3.322<br>(17.520) | 0.998 | 2.384 |
| 12. | $\log Y_{(t)}$ | . . | 0.819<br>(3.471) | . . | 0.337<br>(3.801) | . . | . . | -0.076<br>(0.379) | 0.955 | 0.593 |
| 13. | $\log Y_{(t)}$ | . . | 1.650<br>(14.095) | . . | . . | . . | . . | 0.506<br>(2.969) | 0.917 | 0.348 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 0.622<br>(14.716) | . . | . . | -0.403<br>(1.796) | 0.923 | 0.775 |
| 15. | $\Delta Y_{(t)}$ | 1.005<br>(1.885) | . . | -0.008<br>(2.695) | . . | 4.550<br>(4.855) | . . | 0.522<br>(3.180) | 0.877 | 1.909 |

Note: F(11) = 2631.45*; F(12) = 180.790*; F(13) = 198.718*; F(14) = 216.590*; F(15) = 38.121*.

Table 80

Regression Results Obtained from Estimating Income, Model II, for Australia, 1954-1973

| Eq. No. | Dependent Variable | $\Delta \log M_{1(t)}$ | $\Delta \log M_{\omega(t)}$ | $\Delta \log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta \log Y_{(t)}$ | 0.245 (2.163) | -0.072 (1.888) | 0.150 (1.113) | 0.062 (5.150) | 0.398 | 1.887 |
| 17. | $\Delta \log Y_{(t)}$ | 0.289 (2.705) | -0.058 (1.596) | . . | 0.072 (8.879) | 0.351 | 1.816 |
| 18. | $\Delta \log Y_{(t)}$ | 0.275 (2.477) | . . | . . | 0.067 (8.551) | 0.254 | 2.128 |
| 19. | $\Delta \log Y_{(t)}$ | . . | -0.050 (1.185) | . . | 0.084 (11.188) | 0.072 | 1.393 |

Note: F(16) = 3.526*; F(17) = 4.605*; F(18) = 6.134*; F(19) = 1.403.

Table 81

Regression Results Obtained from Estimating Velocity,
Model I, for New Zealand, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.008 (3.450) | . . | . . | . . | . . | . . | 1.951 (2.297) | -0.472 | 0.850 |
| 2. | $\log V_t$ | . . | -0.029 (1.170) | . . | . . | 0.800 (16.867) | . . | 2.028 (13.333) | 0.991 | 1.486 |
| 3. | $\log V_t$ | . . | 0.230 (1.606) | . . | . . | . . | . . | 0.170 (0.219) | 0.125 | 1.070 |
| 4. | $\log V_t$ | . . | . . | 0.014 (0.912) | . . | . . | . . | 1.168 (4.230) | 0.044 | 1.064 |
| 5. | $\log V_t$ | . . | 0.460 (1.568) | -0.028 (0.898) | . . | . . | . . | -0.602 (0.519) | 0.165 | 1.055 |
| 6. | $\Delta V_t$ | . . | . . | . . | -0.002 (0.285) | . . | 4.319 (7.505) | 0.046 (1.326) | 0.808 | 1.992 |

Note: F(2) = 933.614*; F(3) = 2.578; F(4) = 0.832; F(5) = 1.679; F(6) = 35.867*.

Table 82

Regression Results Obtained from Estimating Velocity, Model II, for New Zealand, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | -0.003 (0.086) | 0.641 (6.885) | . . | 0.009 (1.202) | 0.769 | 1.942 |
| 8. | $\Delta\log V_t$ | 0.606 (1.646) | . . | . . | -0.086 (0.978) | 0.130 | 1.092 |
| 9. | $\Delta\log V_t$ | . . | . . | 3.112 (1.115) | -0.282 (1.262) | 0.065 | 0.929 |
| 10. | $\Delta\log V_t$ | 0.650 (1.799) | . . | 3.549 (1.342) | -0.349 (1.632) | 0.214 | 1.236 |

Note: F(7) = 28.284*; F(8) = 2.712; F(9) = 1.243; F(10) = 2.318.

Table 83

Regression Results Obtained from Estimating Income, Model I, for New Zealand, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | $\log M_{1(t)}$ | $\Delta M_{\omega(t)}$ | $\log M_{\omega(t)}$ | $\Delta G_{(t)}$ | $\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | $\log Y_{(t)}$ | . . | 0.253 (4.276) | . . | -0.028 (1.115) | . . | 0.791 (15.012) | 1.912 (6.648) | 0.997 | 1.472 |
| 12. | $\log Y_{(t)}$ | . . | -1.353 (2.238) | . . | 0.626 (3.459) | . . | . . | -2.404 (2.283) | 0.429 | 1.395 |
| 13. | $\log Y_{(t)}$ | . . | 0.327 (0.715) | . . | . . | . . | . . | 1.215 (7.771) | 0.028 | 1.035 |
| 14. | $\log Y_{(t)}$ | . . | . . | . . | 0.301 (2.523) | . . | . . | -0.404 (0.656) | 0.261 | 1.267 |
| 15. | $\Delta Y_{(t)}$ | 2.305 (5.013) | . . | -0.0006 (0.815) | . . | 4.004 (4.284) | . . | 46.174 (0.862) | 0.864 | 2.177 |

Note: F(11) = 2034.87*; F(12) = 6.395*; F(13) = 0.511; F(14) = 6.366*; F(15) = 33.752*.

Table 84

Regression Results Obtained from Estimating Income, Model II, for New Zealand, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log M_{1(t)}$ | $\Delta\log M_{\omega(t)}$ | $\Delta\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta\log Y_{(t)}$ | 0.323<br>(3.533) | -0.018<br>(0.485) | 0.494<br>(3.055) | 0.026<br>(1.552) | 0.645 | 2.110 |
| 17. | $\Delta\log Y_{(t)}$ | -2.560<br>(2.182) | 0.103<br>(0.219) | . . | 0.092<br>(0.727) | 0.235 | 1.785 |
| 18. | $\Delta\log Y_{(t)}$ | -2.612<br>(2.336) | . . | . . | 0.105<br>(0.979) | 0.233 | 1.798 |
| 19. | $\Delta\log Y_{(t)}$ | . . | 0.312<br>(0.614) | . . | -0.058<br>(0.503) | 0.021 | 1.111 |

Note: F(16) = 9.675*; F(17) = 2.609; F(18) = 5.459*; F(19) = 0.377.

Table 85

Regression Results Obtained from Estimating Velocity, Model I, for South Africa, 1954-1973

| Eq. No. | Dependent Variable | $(\frac{M_\omega}{M_1})_t$ | $\log(\frac{M_\omega}{M_1})_t$ | log Time | $\Delta(\frac{M_\omega}{M_1})_t$ | $\log(\frac{G}{M_1})_t$ | $\Delta(\frac{G}{M_1})_t$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | $V_t$ | 0.007 (3.906) | . . | . . | . . | . . | . . | 4.923 (15.441) | 0.592 | 0.908 |
| 2. | $\log V_t$ | . . | 0.024 (0.531) | . . | . . | 0.478 (5.492) | . . | 1.756 (6.562) | 0.860 | 0.754 |
| 3. | $\log V_t$ | . . | 0.228 (5.312) | . . | . . | . . | . . | 0.469 (2.241) | 0.611 | 0.703 |
| 4. | $\log V_t$ | . . | . . | 0.015 (5.879) | . . | . . | . . | 1.325 (28.991) | 0.658 | 0.662 |
| 5. | $\log V_t$ | . . | 0.105 (1.597) | 0.010 (2.289) | . . | . . | . . | 0.904 (3.379) | 0.703 | 0.714 |
| 6. | $\Delta V_t$ | . . | . . | . . | 0.001 (0.423) | . . | 4.052 (3.427) | 0.026 (0.552) | 0.457 | 2.138 |

Note: F(2) = 52.094*; F(3) = 28.251*; F(4) = 34.612*; F(5) = 20.070*; F(6) = 7.147*.

Table 86

Regression Results Obtained from Estimating Velocity, Model II, for South Africa, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log(\frac{M_\omega}{M_1})_t$ | $\Delta\log(\frac{G}{M_1})_t$ | $\Delta$log Time | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 7. | $\Delta\log V_t$ | 0.019<br>(0.375) | 0.530<br>(4.028) | . . | 0.004<br>(0.409) | 0.528 | 2.046 |
| 8. | $\Delta\log V_t$ | 0.082<br>(1.238) | . . | . . | 0.018<br>(1.452) | 0.078 | 1.823 |
| 9. | $\Delta\log V_t$ | . . | . . | 0.574<br>(1.609) | -0.021<br>(0.743) | 0.126 | 2.182 |
| 10. | $\Delta\log V_t$ | 0.074<br>(1.134) | . . | 0.536<br>(1.508) | -0.021<br>(0.756) | 0.187 | 2.110 |

Note: F(7) = 9.525*; F(8) = 1.533; F(9) = 2.488; F(10) = 1.958.

Table 87

Regression Results Obtained from Estimating Income, Model I, for South Africa, 1954-1973

| Eq. No. | Dependent Variable | $\Delta M_{1(t)}$ | log $M_{1(t)}$ | $\Delta M_{\omega(t)}$ | log $M_{\omega(t)}$ | $\Delta G_{(t)}$ | log $G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|---|---|---|
| 11. | log $Y_{(t)}$ | . . | 0.150 (1.578) | . . | 0.019 (0.567) | . . | 0.701 (8.374) | 2.870 (8.529) | 0.996 | 1.425 |
| 12. | log $Y_{(t)}$ | . . | 0.852 (8.389) | . . | 0.195 (3.414) | . . | . . | 0.609 (2.293) | 0.980 | 0.714 |
| 13. | log $Y_{(t)}$ | . . | 1.169 (22.539) | . . | . . | . . | . . | 1.514 (53.067) | 0.966 | 0.527 |
| 14. | log $Y_{(t)}$ | . . | . . | . . | 0.634 (12.431) | . . | . . | -1.369 (5.063) | 0.896 | 0.561 |
| 15. | $\Delta Y_{(t)}$ | 2.519 (4.864) | . . | -0.001 (0.564) | . . | 3.429 (3.843) | . . | 128.716 (1.372) | 0.865 | 2.368 |

Note: F(11) = 1409.02*; F(12) = 410.249*; F(13) = 508.044*; F(14) = 154.541*; F(15) = 34.087*.

Table 88

Regression Results Obtained from Estimating Income, Model II, for South Africa, 1954-1973

| Eq. No. | Dependent Variable | $\Delta\log M_{1(t)}$ | $\Delta\log M_{\omega(t)}$ | $\Delta\log G_{(t)}$ | Constant | $R^2$ | DW |
|---|---|---|---|---|---|---|---|
| 16. | $\Delta\log Y_{(t)}$ | 0.274 (2.964) | -0.035 (0.947) | 0.082 (1.584) | 0.052 (4.305) | 0.537 | 1.879 |
| 17. | $\Delta\log Y_{(t)}$ | 0.330 (3.695) | -0.034 (0.881) | . . | 0.066 (7.166) | 0.465 | 1.677 |
| 18. | $\Delta\log Y_{(t)}$ | 0.333 (3.763) | . . | . . | 0.062 (7.637) | 0.440 | 1.589 |
| 19. | $\Delta\log Y_{(t)}$ | . . | -0.040 (0.808) | . . | 0.087 (9.245) | 0.035 | 0.664 |

Note: F(16) = 6.196*; F(17) = 7.383*; F(18) = 14.164*; F(19) = 0.653.

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AN ANALYSIS OF VELOCITY IN AN OPEN ECONOMY

by

Leonard L. Tsumba

(ABSTRACT)

In spite of widely accepted theoretical and empirical results regarding the relationship between the supply of money and other economic aggregates, the recent round of world-wide inflation has precipitated a growing interest in applying the quantity theory to monetary relationships among trading countries of the world. Though large gains have been made on theoretical grounds, empirical results remain scarce.

In this study, effects of international forces on nominal income and the income velocity of money are investigated for twenty-two industrialized countries for the period, 1954-1973. Two general functional forms are considered. They are the income approach associated with Fisher and Marshall, et al, and the expenditure approach developed in this study. The latter is derived from extension of the quantity theory to monetary relationships among trading countries. It includes the ratios of world to domestic money and government expenditures to domestic money as arguments in the final reduced-form equation estimated. The two functional forms are then compared in terms of their predictive abilities.

There are three areas of inquiry evolving from (1) the nature of the specified models, (2) properties of estimating equations, and (3) the relative performance of the two functional forms. A major emphasis is

placed on evidence which supports the expenditure approach as the appropriate structure for analyzing open-economy effects.

The estimates obtained question the stability hypothesis. Velocity will change in accordance with the growth rate in world money or government expenditures relative to domestic money. This is so whether or not steady money growth and a balanced budget are maintained. There is one instance in which velocity will be unchanged: when the growth rate of world money or government expenditures relative to domestic money remains unchanged.

All external effects drop out in the income approach. There is an inherent crowding-out effect in this formulation. Following an increase in exports, for example, income and velocity will not change, assuming private expenditure and domestic money remain constant. Exports occur at the expense of private expenditures.

Estimates are obtained after repairs for autocorrelation, using the least-squares method. Coefficients are unbiased and correspond to the test of the hypothesis that money demand is a constant proportion of income.