NBER WORKING PAPER SERIES

THE LONG-RUN BEHAVIOR OF VELOCITY: THE INSTITUTIONAL APPROACH REVISITED

Michael D. Bordo

Lars Jonung

Working Paper No. 3204

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 1989

This paper was prepared for the conference "Understanding Velocity: New Approaches and Their Policy Relevance" at the Federal Reserve Bank of Cleveland, September 24-25, 1989. This paper is part of NBER's research program in Financial Markets and Monetary Economics. Any opinions expressed are those of the authors not those of the National Bureau of Economic Research.

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ABSTRACT

In this paper we provide evidence using annual data for the period 1880 to 1986 that institutional variables are significant determinants of velocity in the United States, United Kingdom, Canada, Sweden and Norway. This evidence supplements our earlier findings (Bordo and Jonung, Cambridge University Press, 1987) for annual data ending in the early 1970's. We present evidence that several proxies for institutional change in the financial sector are significant determinants of the long-run velocity function; that for the majority of countries the long-run velocity function incorporating institutional determinants has not undergone significant change over the last 10 to 15 years; and that out of sample forecasts over the last 10 to 15 years based on our institutional hypothesis are superior to those based on a benchmark long-run velocity function for a number of countries. These results suggests that failure to account for institutional change in the financial sector such as may be captured by our proxy variables may well be one factor behind the recently documented instability and decline in predictive power of short-run velocity models incorporating dynamic adjustment and higher frequency data.

Michael D. Bordo
Department of Economics
Rutgers University
New Brunswick, NJ 08903

Lars Jonung
Stockholm School of Economics
Box 6501
Stockholm, Sweden
11383

I. Introduction

Recently, professional economists and policy makers, particularly in the U. S., have expressed considerable interest, in the behavior of the velocity of circulation. The reason is that the velocity of narrow money (M1) apparently has become unstable and unpredictable after nearly 30 years of exhibiting a steadily rising trend (B. Friedman, 1988).[1] Researchers discussed "The Case of the Missing Money," Goldfeld (1976) - the tendency, beginning in 1972, of conventional short-run money demand functions (using monthly and quarterly data) to systematically over-predict real money balances or, alternatively, of M1 velocity to rise faster than predicted. Economists have since been concerned that the velocity of M1 and several other monetary aggregates from 1981 to at least 1986 declined to an unpredicted extent. They have questioned the continued pursuit by central banks of monetary targets. Unpredictability of velocity is the reason policy makers in the United States and elsewhere have given for abandoning targeting since 1982.

In both episodes, researchers have attributed the alleged "unusual" behavior of velocity,[2] in large part, to financial innovation. In the 1970's, they emphasized the development of new payments techniques and new instruments to economize on cash holding, both a consequence of deregulation of the financial system and inflation (Laidler, 1985). In the 1980's, financial innovation in response to deregulation and disinflation led to the redefinition of traditional monetary aggregates. Financial innovation may also have led to an increase in the interest elasticity of demand for real balances (Stone and Thornton, 1977, Poole, 1988).

Much of the recent literature has treated financial innovation and its effects on velocity as if it were a phenomenon of the 1970's. We believe that such a short-run perspective is misleading. The events of the past 15 to 20 years may fruitfully be understood within the context of a longer-run picture. In our book, (Bordo and Jonung, 1987) and several articles,[3] we make the case that financial development and more generally, institutional factors have been important determinants of the long-run behavior of velocity for as far back in history as data can be found.[4]

In our book we developed a hypothesis to explain the behavior of velocity covering a century of annual data for 12 advanced countries. For the majority of these countries velocity of broad money (M_2) displays a U-shaped pattern that declines from the late nineteenth century to just after World War II, when it begins a secular rise. Our explanation for the U-shaped secular behavior of velocity, inspired by the work of Knut Wicksell, stresses the influence of institutional factors in addition to the traditional determinants, real income and an interest rate. According to our approach, the process of monetization accounts for the downward trend in velocity. This process reflects the spread of the money economy, and the proliferation of commercial banking. Financial sophistication and improved economic stability account for the upward trend. Financial sophistication refers both to the emergence of money substitutes and to the development of methods of economizing on cash balances. Improved economic stability encompasses many aspects of the modern welfare state as well as stabilization policies.

Institutional developments produce changes in the quality of the service flows yielded by money and other assets that induce a series of substitutions between assets yielding monetary and nonmonetary services. Thus in the process of economic development there is substitution into money in the form of bank notes and deposits, replacing earlier arrangements for payments and for storing wealth. Eventually, new substitutes for money develop, inducing portfolio holders over time to switch out of money into the new assets.

According to our approach, velocity is influenced by both sets of institutional variables, but the monetization effect first dominates, causing velocity to fall. Later the influence of financial development and improved stability is stronger than the monetization process, causing velocity to rise. The relative strength of these two sets of forces determines the dating of the turning point of velocity. Finally, we argue that these institutional explanatory variables are additional to or supersede the standard determinants of velocity, including real income and interest rates.

In our book, we tested this approach to the long-run behavior of velocity on the basis of annual data for approximately 100 years for five countries: the United States, Canada, the United Kingdom, Sweden, and Norway. For each country we added empirical counterparts for the institutional variables to a standard regression of velocity on permanent income and interest rates.

Our results showed that for virtually every country inclusion of the institutional variables significantly improves the benchmark regression. In addition, in the majority of cases the institutional variables are correctly signed and statistically significant. Further evidence was provided by: pooling the data for the five countries and performing regressions similar to those for each country taken in isolation; a case study of the monetization process in Sweden during the pre World War I period; and a cross section time series analysis of data for over 80 countries in the post-World War II period which produced results consistent with a global U-shaped velocity curve.

In this paper we present new empirical evidence for the long-run institutional approach for our sample of five advanced countries by extending to 1986 our data, which originally ended in the early 1970's. Our hypothesis is about the long-run or equilibrium behavior of velocity while the recent discussion relates to unpredictability in the short-run velocity (money demand) function which incorporates dynamic adjustment to disturbances and which uses higher frequency (typically quarterly) data. Nevertheless, our approach may have some relevance for the recent discussion. The results we present show that several proxies for institutional change in the financial sector are significant determinants of the long-run velocity function from the 1870s to the late 1980s in all five countries; that for the majority of countries the long run velocity function incorporating institutional determinants has not undergone significant change over the last ten to fifteen years; and that out of sample forecasts over the last 10 to 15 years based on our institutional hypothesis are superior to those based on a benchmark long-run velocity function for a number of countries. This suggests that failure to account for institutional change in the financial sector such as may be captured by our proxy variables may well be one factor behind the recently documented instability and decline in predictive power of short run velocity models incorporating dynamic adjustment.

Section II discusses the secular pattern of velocity from 1870 to 1986 for the United States, Canada, United Kingdom, Sweden, and Norway. Section III presents the empirical counterparts to the institutional hypothesis. We present econometric estimates using the best available data both for the time span covered in the book and for the period ending in 1986. Section IV presents the results of an alternative econometric specification of our model using log differences. Finally, Section V concludes with a discussion of the policy implications of our work.

II. The Secular Picture Revisited

In Bordo and Jonung (1987) we present charts showing the long-run pattern of the income velocity of money from the 1870's to the 1970's in the United States, Canada, the United Kingdom, Sweden, and Norway. The velocity curves were calculated using a broad definition of money, M_2, where M_2 is defined as the sum of currency, demand, and time deposits. M_2 is the only monetary aggregate available over the entire data period for each of the five countries.[5] National income was measured by NNP at market prices for the United States and the United Kingdom, by GNP at market prices for Canada, and by GDP at market prices for Sweden and Norway.

In charts 1 to 5 we show V_2 curves for the five countries up to 1986. The updated data is defined the same way as in the earlier study for all countries except the United States and United Kingdom. For the United States we used Gordon's (1985a) GNP series, and for the United Kingdom we used Capie and Webber's (1985) M_2/M_3 series.[6]

The five charts show, at least up to the early 1970's, that velocity has exhibited a secular U-shaped pattern over the past century in the five countries, most prominently in Sweden, Norway, Canada, and the United States. However, the downward portion of the U is considerably more pronounced then the upward portion. Also, the dating of the turnaround differs across countries. Finally, there are marked cyclical fluctuations in the velocity curves; specifically the depressions of the 1920's and 1930's are commonly reflected in substantial declines in velocity.[7]

Velocity was falling in the United States prior to the mid-1940's when the turnaround occurred (chart 1). It displayed a clear upward trend for about 15 years and subsequently seems to have levelled off. Adding on fourteen more years of data may have turned the U into a ladle. The post-1981 downturn in velocity seems small in a long-run perspective by comparison not only to the 1940's turnaround but also to the declines associated with the two World Wars and the Great Depression.

The Canadian curve (chart 2) has great similarities with the American one, with a turnaround in the 1940's after a sharp cyclical downturn around 1930. One interesting contrast is the 1982-86 period when Canadian V_2 rose sharply while that in the United States fell.[8] The extra twelve years of data for Canada however seems to confirm the U-shaped pattern.

For the United Kingdom, velocity falls from around 1910 onward, with a turnaround occurring in the mid 1940's (chart 3). The additional data accentuate the upward portion of the V_2 curve. For the recent period, three exceptional patterns deserve attention: a sharp decline in velocity 1971 to 1973 which presumably reflects the bank credit explosion following institutional changes due to Competition and Credit Control (1971); a sharp rise in velocity from 1973-79 similar to that occurring in the United States, likely reflecting rapid inflation; and a sharp decline from 1979 on, reflecting disinflation and increased competition in the financial sector (Bank of England, 1984).

The U-shaped pattern with the bottom in 1922, is clearest for Sweden (chart 4) at least up to 1970. Since 1970, Sweden may also be experiencing the ladle effect of a flattening out in V observed for the United States. Norway (chart 5) and Sweden exhibit similar patterns until 1939, when World War II interrupted the data series for the former, allowing the conjecture (see dotted line) that had Norway not been involved in the war, its velocity would have continued to behave in the Swedish mode. For Norway, the extra twelve years of data seem to conform more to the U-shaped pattern than do the data for Sweden, with the noted exception of a downturn in V 1981 to 1986.[9]

To sum up, the U-shaped pattern of velocity for the five countries observed until the early 1970's generally holds up, at least through 1982, with the noted exceptions of the United States and Sweden where the upper part of the U may be turning into the handle of a ladle. In terms of our hypothesis, the flattening out effect may reflect the effects of deregulation that increased competition within the banking system. By paying competitive interest on deposits and expanding the menu of banking services, banks make the holding of bank money more desirable. This factor tends to raise the demand for money and lower velocity thereby offsetting the effect on velocity of financial sophistication. The recent downturn in V_2 in the United States, United Kingdom and Norway seems to be consistent with earlier cyclical downturns and as has been argued may also reflect disinflation [(Friedman, 1987) (Rasche, 1989)].

III. The Institutionalist Hypothesis Revisited

According to the institutional hypothesis, the process of monetization -- the spread of the money economy and the expansion of commercial banking accounts for the downward secular trend in velocity. These two developments might be expected to promote a more rapid growth in the demand for money than in nominal income and to dominate other secular influences on velocity. Increasing financial sophistication -- the emergence of a large number of close money substitutes and the development of methods of economizing on money balances -- and improved economic security and stability explain the upward trend in velocity.

In Bordo and Jonung (1987) in chapter 4, we test our approach to the long run behavior of velocity by adding proxy variables to account for these institutional forces to a standard regression of velocity on permanent income and interest rates.[10] Here we update the proxy variables to 1986 and repeat the regressions of our earlier work. As a measure of the monetization process, we use the share of the labor force in non agricultural pursuits. As a measure of the spread of commercial banking, we use the currency-money ratio. We proxy financial development by the ratio of total nonbank financial assets to total financial assets. Finally, we use two measures of improved stability and security: a six-year moving standard deviation of the annual percentage change in real per capita income; and total government expenditures, both including and excluding defence expenditures, as shares of national income.

These proxies, especially the currency-money ratio and the ratio of total nonbank financial assets to total financial assets may be, in part, endogenous variables, i.e. they reflect movements in some of the basic forces (e.g. real income and interest rates) that determine velocity. Ideally, according to this view, we should have included as measures of institutional forces the actual technological changes in financial arrangements and in economic structure that affected velocity in each country. We attempted to capture some of these basic determinants in Sweden before 1914 (Chapter 5 of our book) by a detailed analysis of the monetization process and of the effect of measures of monetization on velocity. In the absence of comparable measures of these 'deep structural' factors across countries, we use more general proxies which are available for all five countries, acknowledging that in a sense they are endogenous and hence should be regarded as proximate determinants of the institutional forces affecting velocity.

(i) The Earlier Sample Revisited

Table 1 repeats some of the regressions for the period 1870-1975 shown in Table (4.1) in our book. Two notable changes in the data underlying the table are the Capie-Webber (1985) M_2/M_3 series for the U.K. from 1870 to 1890 and Gordon's (1985) GNP series for the U.S. A number of minor data errors were also corrected. We used the RATS computer program in place of TSP (for data sources see Appendix 1). Equation (1) is the benchmark velocity function:

$$\log V = B_0 + B_1 \log (Y/PN)^p + B_2 i + B_3 \log \text{cycle} + e$$

where log stands for natural logarithm; $V=(Y/M)$ is nominal GNP divided by M_2; $(Y/PN)^p$ represents real per capita permanent income; and i is an appropriate rate of interest representing the opportunity cost of holding money balances. Equation (1) is derived from a standard permanent income long-run money demand function (Laidler, 1985). $(Y/PN)^p$ is an extension of the Friedman (1957) and Darby (1972) measures. Preferably, i should be a short-term interest rate, which we used for the United States and United Kingdom, but for Canada, Norway and Sweden only the long-term bond yield was available for most of the period examined.[11] Cycle stands for the ratio of measured per capita real income to permanent per capita real income. This variable, which measures the influence of transitory income, should have a coefficient of one in the regression. A coefficient that is positive but less than one would reflect the fact that velocity moves procyclically and would be consistent with Friedman's (1957) permanent income hypothesis. Over the cycle, transitory income would increase the demand for money, since cash balances serve as a buffer stock [Darby, (1972); Carr and Darby (1981); Laidler (1984)]. Over the long run these transitory balances would then be worked off, returning the coefficient to unity.

In addition, the expected rate of inflation (p^e) should be included in the velocity function, at least in periods of rapid change in the price level or in countries where interest rates are not free to respond to market forces. For the United States, Canada, and the United Kingdom, at least until the late 1960's, inflation was relatively mild and interest rates adjusted freely to market forces - with the exception of the 1939-51 period for the United Kingdom and Canada, and 1941-51 for the United States -- so that expected price change should not be an important variable in the demand for money for these countries. Before the late 1960's there is not much evidence for its significance. This is not the case for Sweden and Norway, where government regulation of securities markets has been in effect since World War II. For these countries the measured long-term bond rate would not be a proper measure of the opportunity cost of holding money. Consequently, we generated the expected inflation rate by regressing the annual rate of change in the price level on successive past rates of change using an F-test criterion to choose the lag length.[12] The predicted change in the price level from this regression served as a measure of p^e.

To account for the influence of institutional factors we added the institutional proxies to the benchmark equation (1). The expanded velocity function follows:

$$\log V = B_0 + B_1 \log (Y/PN)^P + B_2 i + B_3 \log \text{cycle} + B_4 \log (LNA/L) + B_5 \log (C/M) + B_6 \log (TNBFA/TFA) + B_7 \log S_y + e' \quad (2)$$

(LNA/L), the share of the labor force in nonagricultural pursuits, is our proxy for monetization. We expect this ratio to be positively correlated with the spread of the monetary economy and hence it should enter the equation with a negative sign. The demand for money should rise as structural change leads to a relative decline in importance of the primary sector.

As a proxy for the spread of commercial banking we use the currency-money ratio (C/M). We expect this variable to be negatively correlated with the spread of the money economy and to enter the velocity function with a positive sign.[13]

We expect our proxy for financial development, the ratio of total nonbank financial assets to total financial assets (TNBFA/TFA), to enter the velocity function with a positive sign. This should also be the case for the ratio of total private nonbank financial assets to total private financial assets (TPNBFA/TPFA) that we use for the United States.[14]

Finally, we expect a six-year moving standard deviation of the annual percent change in real income per head (S_y), representing the influence of economic stability, to be negatively correlated with velocity. A decline in certainty about the future, reflected by an increase in S_y, should raise the precautionary demand for money and hence should lower velocity.

Table 1 presents OLS regressions of equations (1) and (2) for the five countries over the entire period. Although data suitable to construct an annual velocity series for each country were available from 1870 to 1975, other data, required to represent the independent variables, were not. Hence we show the results for the earliest starting date for each country; for the majority of countries this was the period beginning in 1880. We use the Cochrane - Orcutt procedure to correct for severe autocorrelation in the residuals observed in preliminary testing, Norway is an exception. Because of a break in the data we use a maximum likelihood procedure. Also, for Sweden and Norway we incorporate the expected rate of inflation in regression equations (1A) and (2A).[15]

The benchmark velocity regression equation (1) performs close to our theoretical expectations for most of the countries. The permanent income elasticity of velocity is not significantly different from zero for the United States and United Kingdom. This suggests a unitary permanent income elasticity of money demand. For the other three countries, the income elasticity of velocity is positive and significant. This finding implies permanent income elasticities of the demand for money considerably less than one, in agreement with other studies [Goldfeld (1973), Laidler (1985)] as well as with the view that there are economies of scale in cash management [Baumol (1952), Tobin (1956)].

The interest rate variable is positive and significant in every country except Sweden and the implied negative interest elasticity of the demand for money agrees with traditional monetary theory. The negative and nonsignificant coefficient for Sweden suggests that the long-term bond rate may not be the appropriate opportunity cost variable. The significant expected price change coefficient for that country supports this conclusion.

The cycle variable is not significantly different from one in Canada, Sweden and Norway but is less than one for the United States and the United Kingdom. The latter result suggests that cyclical behavior, in the 1929-46 period, may be a key determinant of the long-run pattern of velocity for these countries especially so for the United States.

Inclusion of the four institutional variables in regression equations (2) (2A) significantly improves the regression for every country. This improvement is observable in the significant sequential F-statistics reported following regression equations (2) (2A) as well as in a higher adjusted R^2.

Moreover, introduction of these variables raises the income elasticity of velocity and hence lowers the income elasticity of the demand for money for three of the five countries. One explanation for these results is that two of these variables are highly correlated with permanent income.[16] Running the regression with income alone, omitting these variables, yields downward-biased income elasticities of velocity (upward-biased income elasticities of the demand for money) to the extent that the omitted variables represent a true influence on velocity. Alternatively, since income itself is a vector of characteristics of economic development, that includes institutional factors, introducing the institutional variables explicitly into the regression would per se reduce the influence of income on velocity. It is not possible to separate the specification bias from the simultaneous equation bias.

Examining each of the institutional coefficients in regression equations (2) and (2A) in turn, we observe that LNA/L has the correct negative sign for all countries and is significant at the five percent level for the United States, Canada, and the United Kingdom. Second, C/M our proxy for the spread of commercial banking, is significant at the ten percent level or higher with the correct positive sign for all countries except for the United States. Third, TNBFA/TFA is significant at the five percent level and exhibits the correct sign in all five countries except Norway. Finally, the proxy for economic stabilization, S_y, is significant at the ten percent level in only one country - the United Kingdom.[17]

In sum, except for the measure of economic stability, the suggested institutional variables represent important determinants of the long-run velocity function for the majority of the countries examined over the period ending in the early 1970's.

(ii) The Results Updated

Table 2 presents the same regressions as Table 1 updated through 1986 for all countries except the United Kingdom where the data end in 1985. These extra years provide a check on the robustness of our institutional hypothesis. In addition, since they have been regarded as years during which the velocity function deteriorated, it is of interest to see if our institutional proxies remain as significant determinants.

Initially we present the benchmark regression (1) for each country and the benchmark (1A) including p^e for Sweden and Norway. The result with p^e in the regressions for the other countries was always insignificant. Equation (1) remains quite similar to the earlier one for the United States, United Kingdom and Sweden but not for Canada and Norway. For both countries the interest rate becomes insignificant.[18] However, for Norway the long-term rate becomes significant when the regression includes our measure of price expectations.

The full institutional hypothesis also performs about as well as it does with the earlier data. LNA/L and TNBFA/TFA both are correctly signed and significant at the 10 percent level or higher in all countries except Norway, as is C/M in all countries except the United States. With the additional years S_y becomes insignificant in all countries. As for the earlier period, the price expectations variable is significant for Sweden and Norway in the institutional regressions.

Table 3 presents the results of Chow tests to test for the stability of the regressions between the earlier period underlying Table 1 and the additional 10-15 years. The benchmark equations are not statistically different from each other at the 5 percent level for the United States and Sweden, but are statistically different for the other three countries. In both the Norwegian and Canadian cases, shifts in the interest rate coefficient (based on t-tests on interactive dummy variables) are observable.[19] In the case of the United Kingdom, shifts occur both in the intercept of the regression and the interest rate coefficient.[20]

For the full institutional hypothesis we observe no significant difference in the regressions between the earlier and later data for all the countries except the United Kingdom. In the case of the United

Kingdom, shifts occur in the intercept, interest rate, and TNBFA coefficients.[21] Apparently the dramatic changes in financial structure in that country, outlined in Section II above, may not be fully captured by our proxy variables. Thus, with the exception of the United Kingdom, our institutional hypothesis is stable during the recent period.

A closer look at the secular behavior of the three significant proxy variables for institutional change from the regression in Tables 1 and 2 is useful. Charts 6 to 7 plot LNA/L, C/M and TNBFA/TFA for each of the five countries over the entire period.

Compare chart 6 for the United States to chart 1, the V_2 curve. The ratio of total private nonbank financial assets to total financial assets mirrors movements in V_2 quite closely, especially so after 1964 when annual data became available instead of interpolations between quinquennial benchmarks. The turning point in this variable occurs in 1945, while that in V_2 occurs in 1946. The peak in TPNBFA/TFA occurs in the mid 1960's about the time the V_2 curve stops rising and becomes a ladle handle. The C/M ratio moves parallel to V_2 in the period of falling V and opposite in the period of rising V. However annual movements in it are only roughly related closely to annual movements in V_2. LNA/L displays a virtually steady rising trend throughout the period, levelling off in recent years. The movement in LNA/L is too smooth to explain the choppy movements in V_2.

The picture for Canada in chart 7 is very similar to that of the United States for all three variables. However, the Canadian data for TNBFA/TFA over the whole period are annual so that movements in this ratio, as early as 1900, seem even more closely related to those in V_2 than is the case for the United States.

For the United Kingdom, the pattern of the three proxies resembles that of the United States and Canada. TNBFA/TFA becomes closely related to V_2 after World War II with a turning point in 1947 and a decline beginning in the mid-1960's. A key difference between the United Kingdom and the other two countries is the precipitous drop in the TNBFA/TFA ratio in the early 1970's. This drop likely reflects the enormous growth in the banking sector that accompanied the bank credit fueled monetary explosion in these years. This drop is partly mirrored in the erratic behavior of V_3 discussed above.

For Sweden and Norway, both TNBFA/TFA and C/M seem to mimic the movements of V_2 over the entire period, with the former proxy more closely related to V_2 in the last decade.

In sum, the charts flesh out the story told by the regression coefficients in Tables 1 and 2. Movements in TNBFA/TFA and to a lesser extent C/M are closely related to those in the V_2. To the extent they capture the processes of the spread of commercial banking and financial sophistication they merit attention in discussions of the long-run behavior of velocity and the demand for money.

IV. First Difference Results

In this section we report results of regressions using first differences. We do this because of evidence that the log velocity series for each of the five countries contains a unit root (is differenced stationary) for the period ending in the 1970's (Bordo and Jonung 1987, Chapter 7, Raj and Siklos, 1988), and that regressions using non-stationary data in levels may produce spurious results (Granger and Newbold, 1974). However, since the estimated rhos from the Cochrane-Orcutt regressions in Tables 1 and 2 are close to one the levels specifications used there is tantamount to first differences. Thus we do not expect much of a change in the results. For the first difference regressions covering the extended period, see Table 4.

The benchmark equation (1) yields results similar to those using the Cochrane-Orcutt procedure with the exception of Norway for which the interest rate becomes insignificant. When we add the institutional variables to the benchmark regression one notable change in equation (2) is that LNA/L becomes insignificant in every country. This result is not surprising since LNA/L is largely dominated by trend, as can be seen in charts 6 to 10. Also, since these advanced countries had reached a stage of virtually complete monetization in the late 20th century, this variable would be expected to decline in importance. Including p^e in the regression for Sweden and Norway does not change the results.

The first difference data for the period ending in 1986 suggest that a slightly modified version of our institutional hypothesis including only C/M and TNBFA/TFA may be in order. This modification is shown in equations (3) and (3A) that also incorporates p^e. Both institutional variables seem to be robust to the new sample. C/M according to the hypothesis captures the spread of commercial banking, a process which recent deregulation of the banking sector has stimulated, while TNBFA/TFA captures financial sophistication, a process recently responsive to new technology and deregulation.

The first difference results are relevant for a hypothesis explaining the rate of change of velocity, whereas our institutional approach is primarily an explanation for the long-run or equilibrium behavior of the levels of velocity. Thus, the first difference specification does not yield a long-run equilibrium solution. A topic for further research is to use tests for cointegration to determine whether the institutional hypothesis is an equilibrium relationship. In other words if both velocity and its determinants are integrated of order one (require first differences to make them stationary) then velocity and its determinants may contain a common unit root. If that is the case then the first difference specification should be amended to include an error correction term (Engle and Granger, 1987).[22]

V. Conclusions and Implications

This paper has provided evidence for the period from 1880 to 1986 that institutional variables are significant determinants of velocity in five advanced countries. This evidence supplements our earlier findings for annual data ending in the early 1970's. The extra 12 to 14 years of data are important not only because they expand the period covered but also because they encompass years when it has been argued that financial innovation has made the velocity function unstable and unpredictable in the short run.

The econometric evidence from the Chow tests in Table 3 suggests that while the benchmark equation is stable through the 1980's only for the United States and Sweden, our institutional hypothesis is stable for all the countries except the United Kingdom. Furthermore, although our hypothesis is directed towards capturing broad historical changes, it is still of interest to see how our model fares at predicting annual movements in velocity over the past decade--a period during which financial innovation has been regarded as important. Consequently as an experiment we generated dynamic out of sample forecasts for both the benchmark and the institutional hypotheses. Using the coefficients and coefficients of serial correlation (rhos) from Table 1 for the period ending in the mid 1970's we predicted velocity over the subsequent 10 to 15 years. Table 5 displays the root mean square errors from the forecasts. As can be seen from Table 5 the institutional hypothesis yields a better prediction of velocity than does the benchmark equation for Canada, Sweden and Norway. However, the opposite prevails for the United Kingdom. This result is fully consistent with the evidence presented earlier for that country of instability in the institutional hypothesis since 1975. For the United States, there is not much difference in predicted velocity between the two specifications.

In sum, our results in Tables 1, 2, and 4 suggest that the long-run velocity (money demand) function should include at least two of our institutional variables. These results combined with the mixed results based on the Chow tests in Table 3 and the dynamic forecasts in Table 5 suggest that institutional change in the financial sector, such as may be captured by our proxy variables, may well be part of the explanation of the recently documented instability and unpredictability of short-run velocity functions. However to make the case for the United States and the United Kingdom further research would be required, perhaps using alternative measures of financial innovation.

Our results that institutional factors are significant determinants of long-run velocity behavior may have an implication for policy. (Friedman, 1960), has made a strong case for adopting a monetary rule that would set the growth of some monetary aggregate equal to the growth of real output adjusting for the trend growth of velocity. Such a rule would require that account be taken of major institutional changes, such as occurred in the mid 1940's in a number of countries, that producing a permanent change in the trend of velocity. The problem is that when a turning point occurs it is not transparent whether it is permanent or will be reversed in the not too distant future. Thus the recent decline in V, though marked compared to the experience of the previous three decades, is not that unusual compared to the cyclical declines of the two world wars and the 1930's. It is too soon to tell whether it is permanent.

To put the matter another way, institutional change in the financial sector is an ongoing process. It reflects in part purely technological factors independent of the money supply process and in part a reaction by individuals and financial institutions to the monetary framework, neither of which is fully predictable. Thus adopting a constant money growth rule without taking into account fundamental changes in the trend of velocity due to institutional change may lead to departures from long-run price level stability.[23]

However, one difficulty of responding to every change in velocity as if it were permanent and following a fine-tuning policy, is that it may create more instability than it is supposed to offset. Such a proposal is a possible implication of evidence that V contains a unit root (for the United States, Gould and Nelson 1974, Nelson and Plosser, 1982; for other countries, Bordo and Jonung 1987-Chapter 8) and that changes in velocity are permanent. That would lead the policy maker to offset every change in V to prevent permanent effects on nominal income (Gordon, 1985b). Two problems with this view however are that the power of the unit root tests is not great (McCallum, 1986) and that the fraction of the variance of the time series accounted for by the unit root may be small (Cochrane, 1988).

Though our results and other evidence on financial innovation (Laidler, 1985) may weaken somewhat the case for a (Friedman, 1960) constant money growth rule, they would be compatible with the case for some other type of macro policy rule such as rules for targeting GNP growth that McCallum (1989) and Meltzer (1987) have recently advocated. McCallum's rule circumvents the problem of accounting for institutional change in the financial sector by having the monetary authorities set the monetary base in such a way as to achieve a target growth path of nominal GNP equal to the long-run real growth rate of the economy. This rule encompasses an adjustment for past changes in velocity and deviations of GNP from its long-run path.

Alternatively, a price level rule such as has been recently proposed by e.g. Haraf(1987) could also avoid the problem of institutional change in the financial sector. Since price indexes are better understood by the public, are published more often and are less subject to revision than GNP, a price level rule may be superior to a GNP rule. In this regard Wicksell's (1898) own rule of stabilizing the price level by offsetting changes in the central bank's discount rate may be an apt Wicksellian counterpart to the Wicksellian approach to velocity.

Footnotes

* We extend our thanks for research assistance to Alvaro Aguiar, Gunnar Dahlfors, Peter Jansson, Oscar Kaumets and Ann Enshagen. For helpful comments we thank John Huizinga, Jan Tore Klovland, David Laidler, Peter Rappoport, Hugh Rockoff, Anna Schwartz and Neil Wallace. Financial support from the Jan Wallander Foundation is gratefully acknowledged.

1. Although Rasche (1987) has argued for the U.S. that for V_1 the only evidence of instability is a one time shift in early 1982 in the drift term of an AR(1) regression. For V_2, Rasche(1988) finds no evidence of instability.

2. Alleged "unusual" since we are unaware that anyone has tested the predictability of the short-run velocity function in earlier periods such as the 1890's, 1920's and 1930's.

3. Bordo and Jonung (1981), Jonung (1978), (1983).

4. The link between financial development and the demand for money or velocity has a long history in monetary economics with major contributions by Wicksell, Fisher, and more recently by Gurley and Shaw, Hicks, Clower, and Friedman and Schwartz. For a survey see Bordo and Jonung (1987), Chapter 2.

5. For the U.K. after 1967, we used M_3 as an M_2 series was no longer available.

6. For sources of the data used in the book see Bordo and Jonung (1987), Appendix IB, for sources of the updated series, see Appendix I.

7. One explanation (Friedman (1959)) for the procyclical behavior of velocity is that real money demand -- a function of real permanent income -- does not fully adjust to changes in measured income. Alternatively, it reflects money's role as a buffer stock (Laidler 1984) in response to monetary shocks -- people hold cash balances before reallocating their portfolios. Thus acceleration in money growth initially produces a decline in velocity, then a rise as portfolios are readjusted.

8. According to one interpretation, the rise in V reflected a lagged response to the disinflation policies of the Bank of Canada (Howitt, 1987).

9. This decline, like that in the U.S. and Sweden, may be explained by cyclical phenomena but also, as in those countries, by deregulation of the banking system that allowed commercial banks to pay competitive interest on savings deposits.

10. The index number approach of Barnett (1989) may be an alternative to the use of proxy variables to capture changes in the quality of the flow of services from money and other financial assets.

11. Klein (1974) and subsequent writers have argued that a proper specification of the demand for money should include the own rate of return on money, since including a cross rate such as the long-term bond yield, while not including the own rate, will produce a downward biased interest elasticity. Lacking the data on the rate of return on deposits for all five countries we omitted this variable from our specification. However, as a proxy for this variable we included in the benchmark equation Klein's measure of the own rate of return on money (^{r}m) (which can be measured for the U.S. and the U.K. over the whole period and for Canada from 1934). The results including (^{r}m) were only marginally different from those reported here. See Bordo and Jonung (1987) p. 33.

12. For both countries we selected a two-year lag.

13. There are two problems with the use of this proxy to capture the spread of commercial banking. First, the C/M ratio is also a proximate determinant of the money supply so including it as an independent variable may entangle money supply with money demand. Second, the C/M ratio may be capturing factors other than the spread of commercial banking such as income tax evasion. To avoid these problems, in Bordo and Jonung, (1981), as alternative proxies, we used the number of bank offices and the number of bank offices per capita. For the five countries, neither variable was more than marginally significant in regressions similar to those reported in Table 1. However for Sweden 1875-1913 the number of commercial bank accounts

per capita is a significant determinant of velocity (Bordo and Jonung, 1987, Chapter 5).

14. We also tried TPNBFA/TPFA for Canada but found that TNBFA/TFA yielded stronger results.

15. We included a similar measure of p^e in all the regressions for the other 3 countries, but the p^e variable was always insignificant.

16. The correlation coefficients with log $(Y/PN)^p$ by country for each of log (LNA/L) and log (TNBFA/TFA) are:

	log (LNA/L)	log(TNBFA/TFA)
1. U.S.	.977	.760
2. Canada	.977	.767
3. U.K.	.922	.779
4. Sweden	.992	.954
5. Norway	.951	.961

17. Experiments with our alternative measure of economic stability, government's share in national income, also yielded insignificant results in every country.

18. Similar results for Canada obtain with a short term interest rate. The explanation given by McPhail and Caramazza (1989) is that, beginning in 1967, the chartered banks began paying competitive interest rates on savings deposits. Their regressions show that

including a savings deposit rate in a standard money demand regression restores the opportunity cost variable to significance.

19. The t-statistic on the interest rate coefficient for equation (1) for Canada is 2.92 and for Norway from equation (1A), 1.91.

20. The t-statistic on the interest rate coefficient from equation (1) for the United Kingdom is 1.63.

21. The t-statistic on the interest rate coefficient from equation (2) for the United Kingdom is 2.50, on TNBFA/TFA, it is 1.69.

22. In this vein, Hoffman and Rasche (1989) fit a cointegrating vector to real cash balances, real income and an interest rate for postwar U.S. monthly data. Evidence for a unitary income elasticity of real money demand allows them to view the cointegrating regression as an equilibrium liquidity preference relationship. Also, Siklos (1989) presents preliminary results of a cointegrating vector between the logs of velocity, the interest rate, real income, a measure of inflationary expectations and three of our institutional variables: the logs of LNA/L, C/M and TNBFA/TFA for the U.S., U.K., and Canada using our data extended through 1986. He also incorporates an error correction term into a dynamic specification of the hypothesis.

23. See Laidler (1982, 1985) for a similar emphasis.

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Chart 1

VELOCITY OF CIRCULATION OF M2

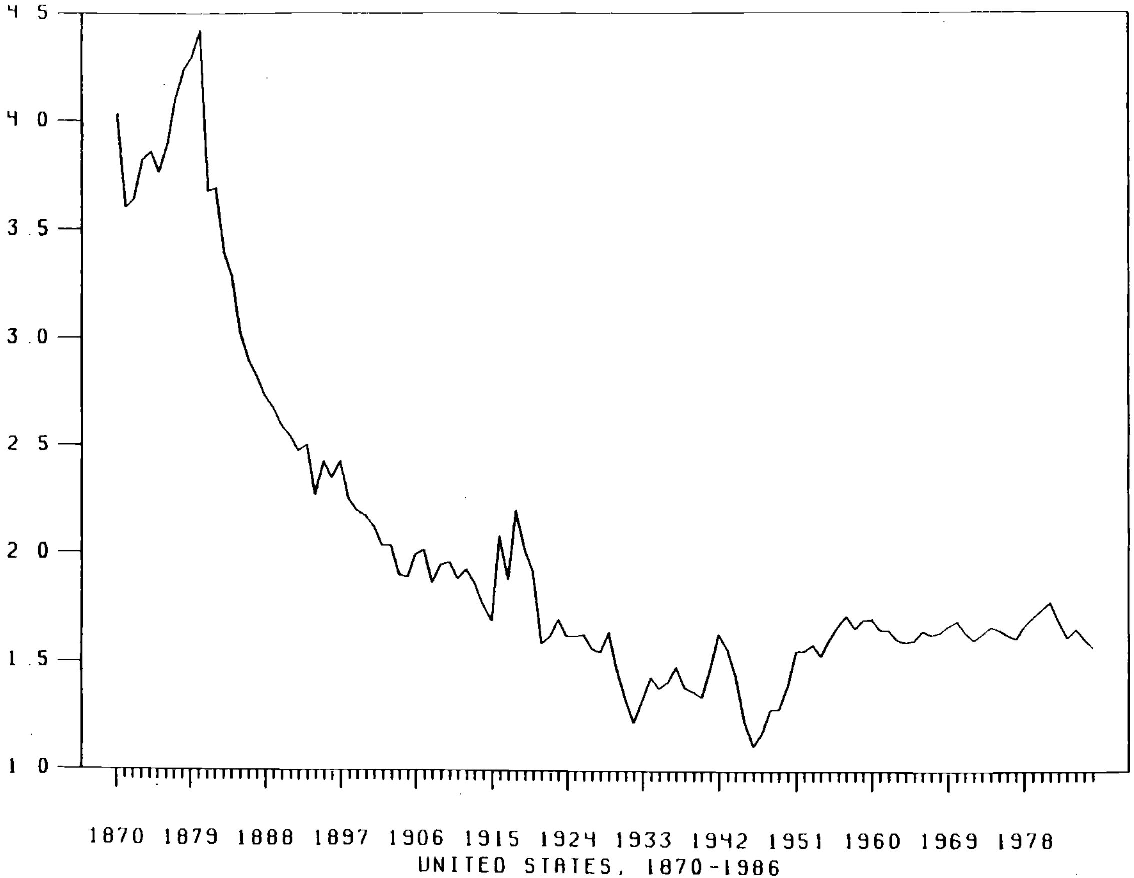


Chart 2

VELOCITY OF CIRCULATION OF M2

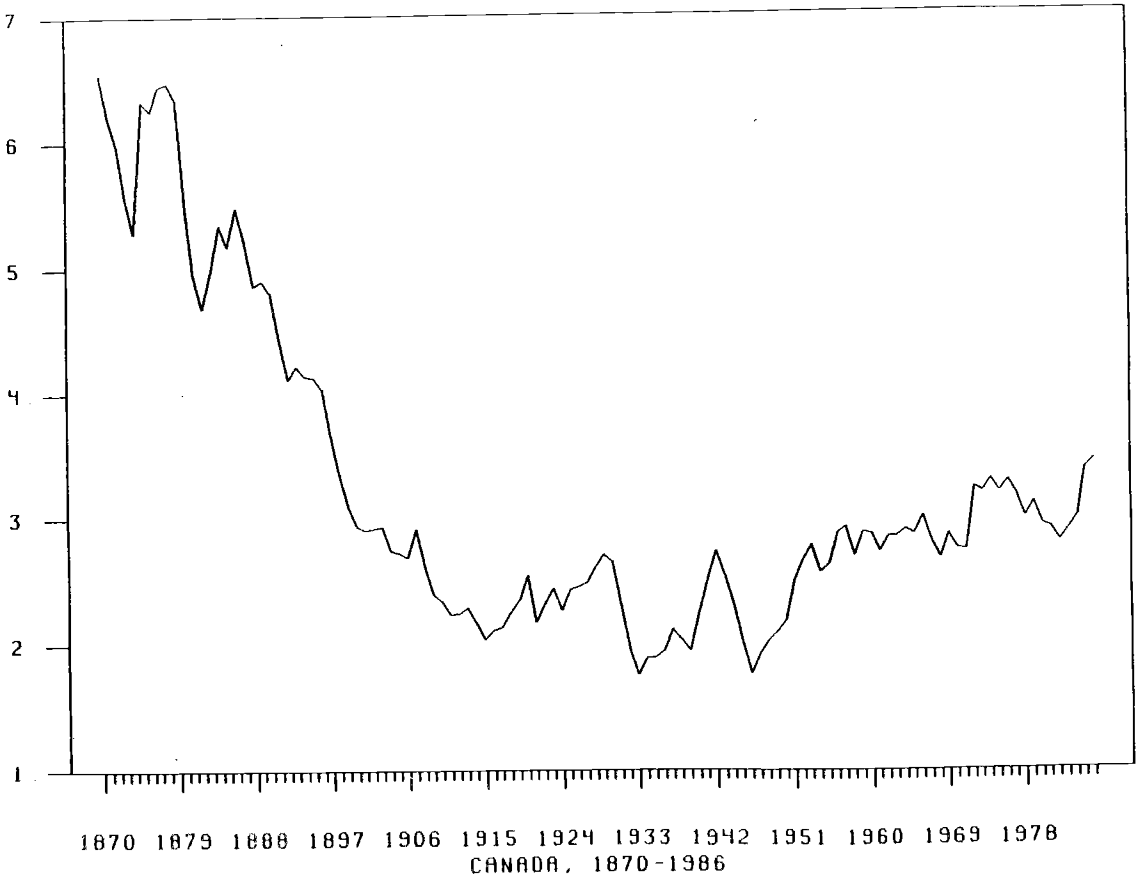
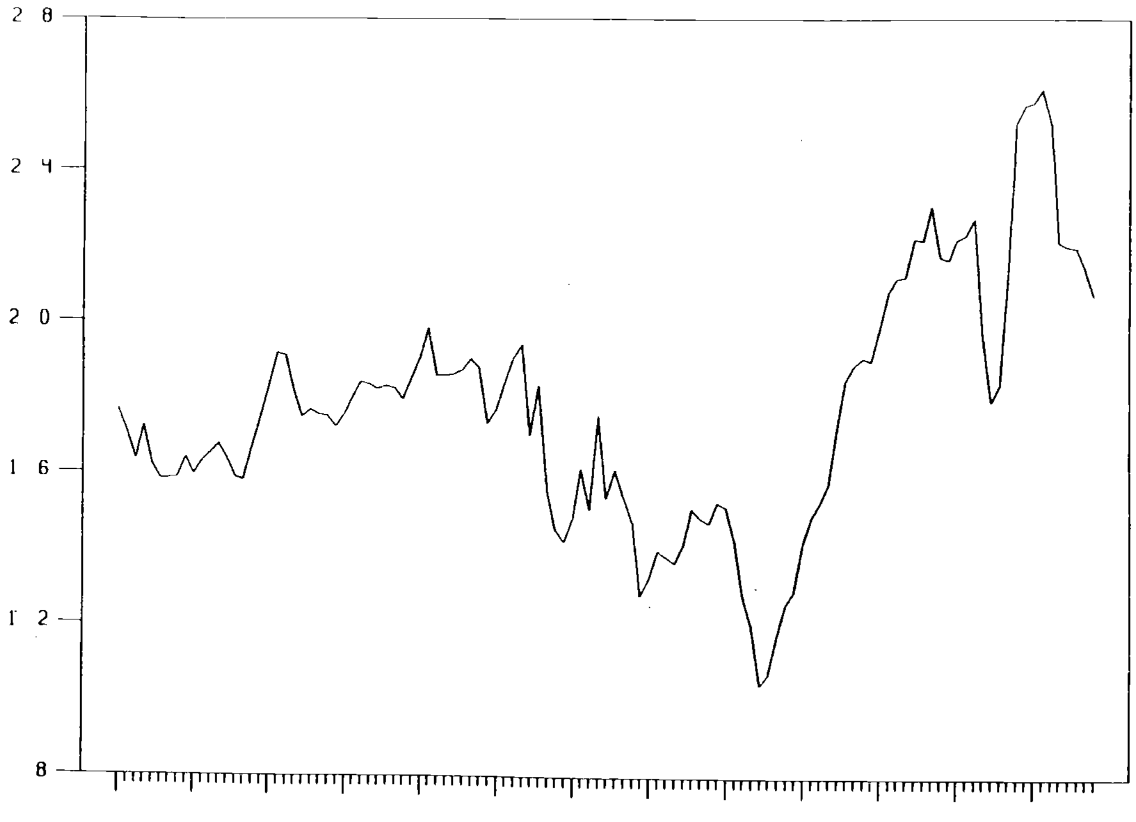


Chart 3

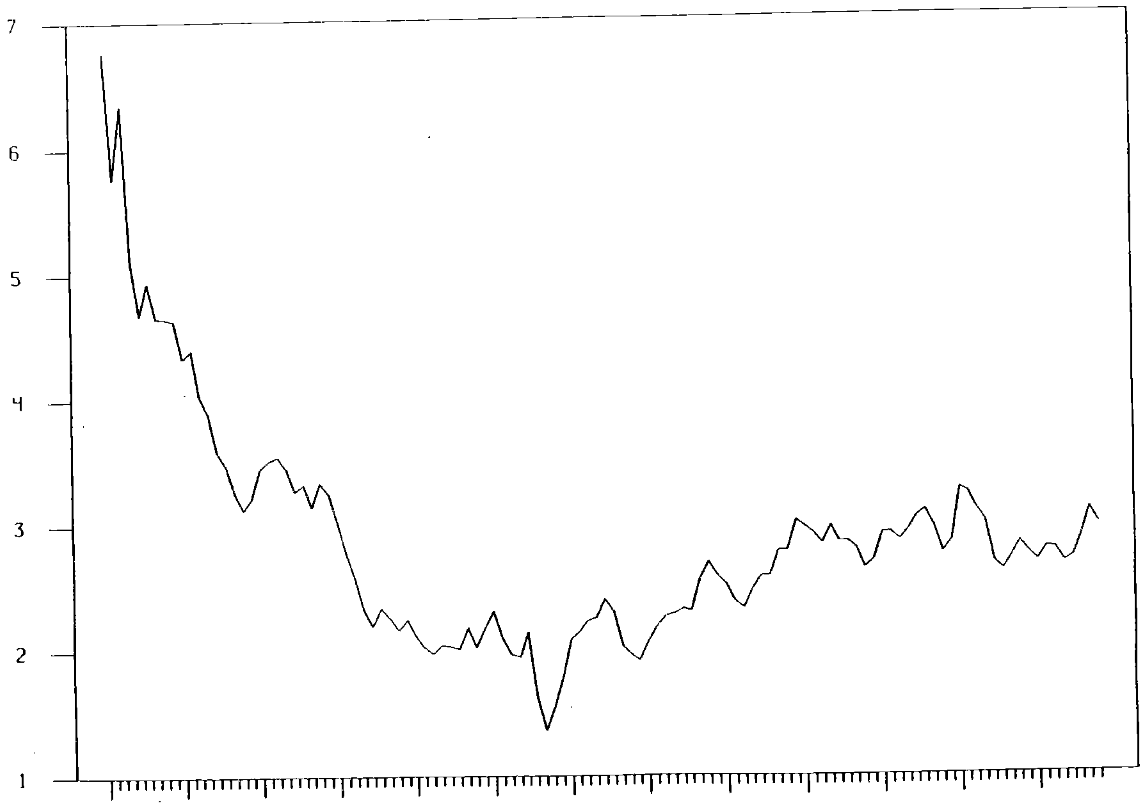
VELOCITY OF CIRCULATION OF M2



UNITED KINGDOM, 1870-1985

Chart 4

VELOCITY OF CIRCULATION OF M2



SWEDEN, 1871-1986

Chart 5

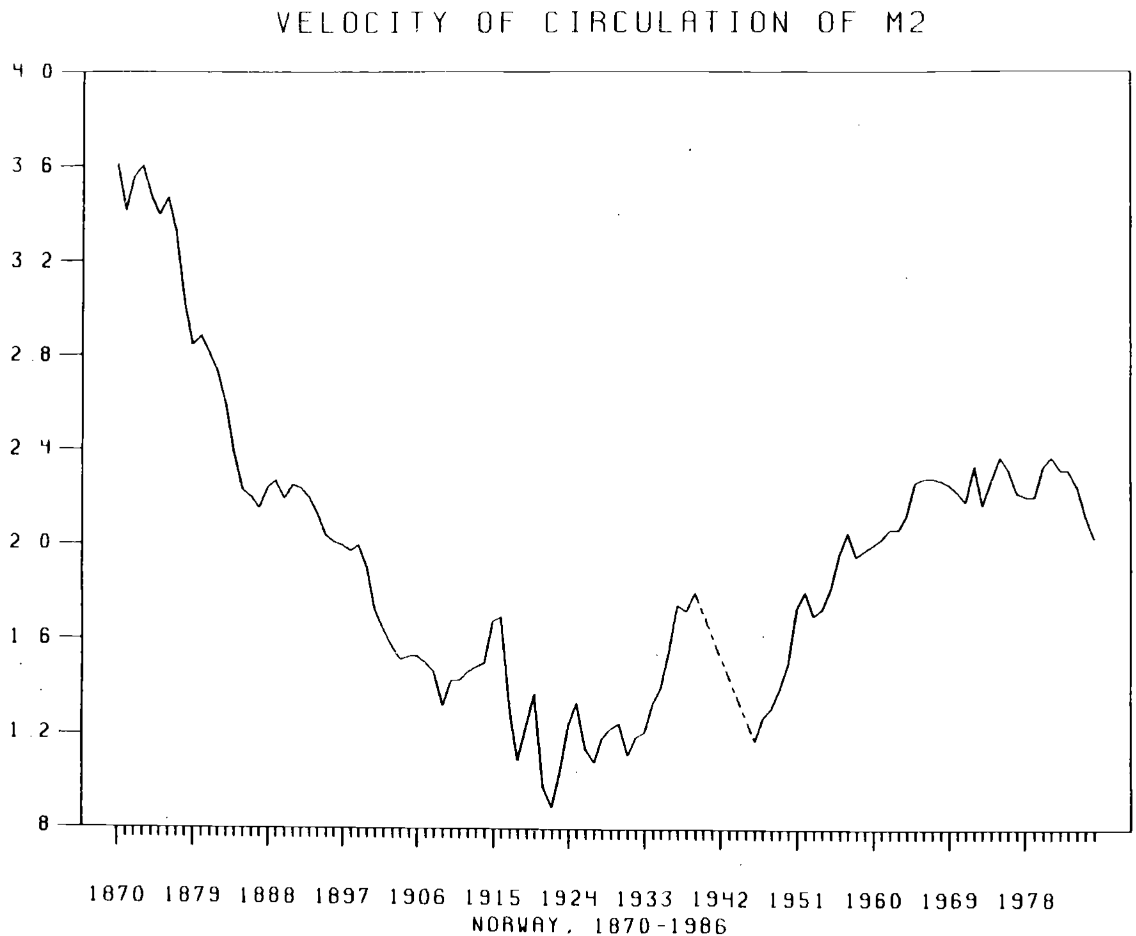

VELOCITY OF CIRCULATION OF M2
4 0
3 6
3 2
2 8
2 4
2 0
1 6
1 2
8
1870 1879 1888 1897 1906 1915 1924 1933 1942 1951 1960 1969 1978
NORWAY, 1870-1986

Chart 6

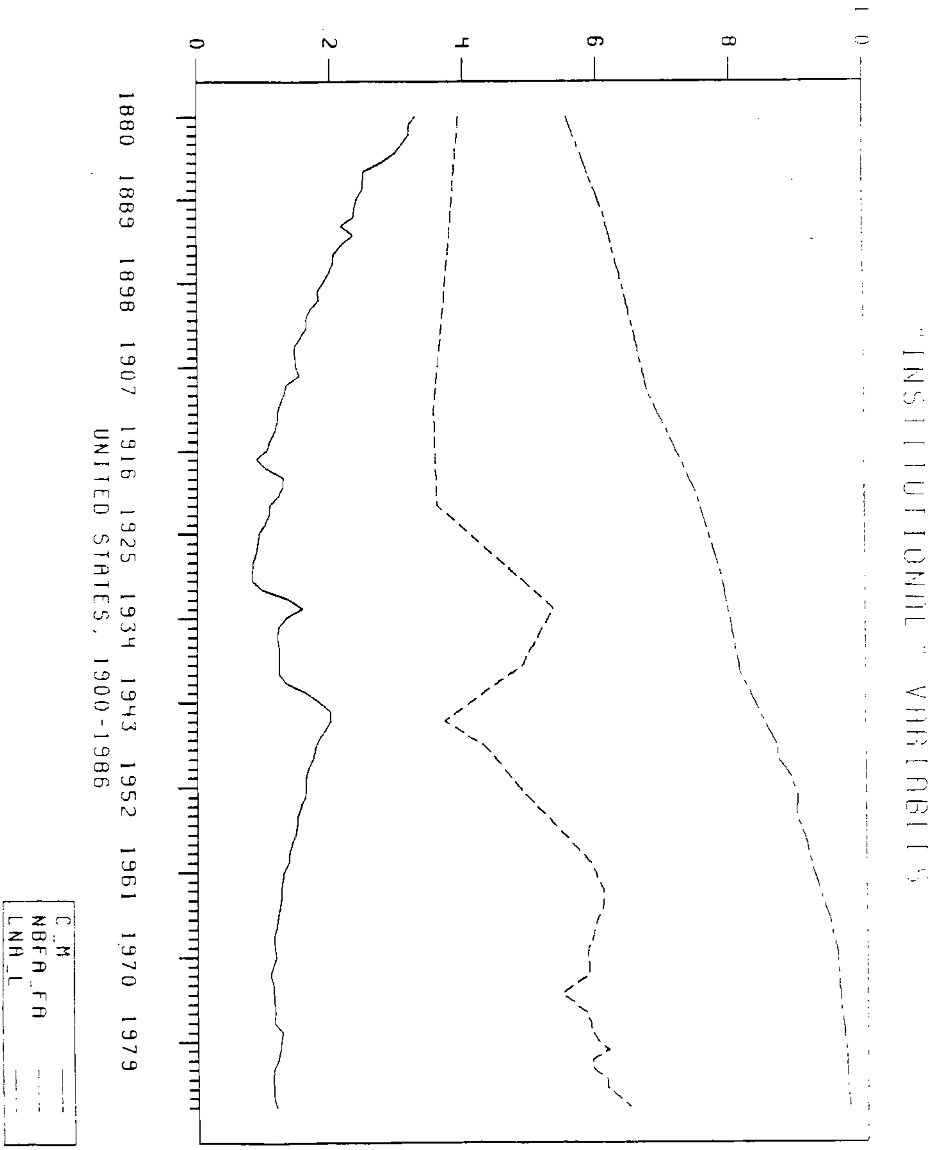

INSTITUTIONAL VARIABLES
0
2
4
6
8
10
1880 1889 1898 1907 1916 1925 1934 1943 1952 1961 1970 1979
UNITED STATES, 1900-1986
C_M
NBFA_FA
LNA_L

Chart 7

"INSTITUTIONAL" VARIABLES

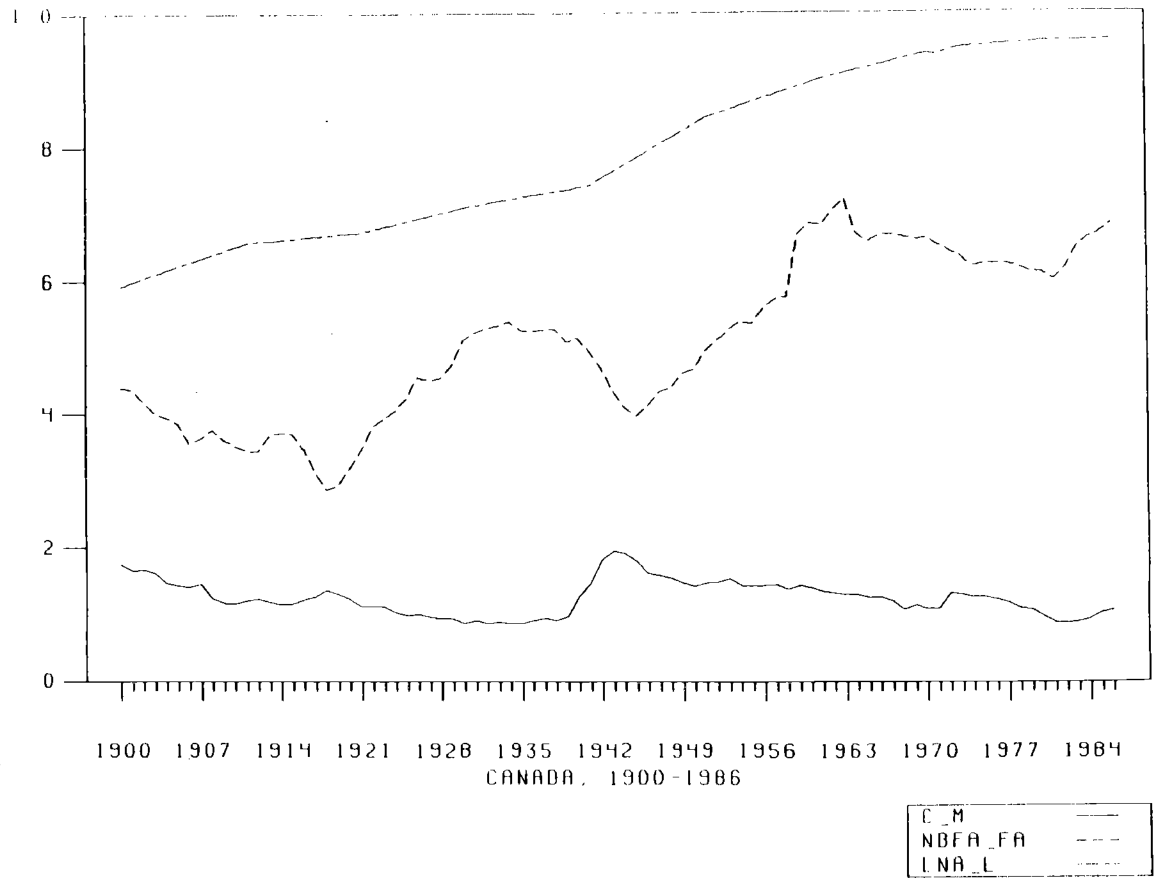


Chart 8

"INSTITUTIONAL" VARIABLES

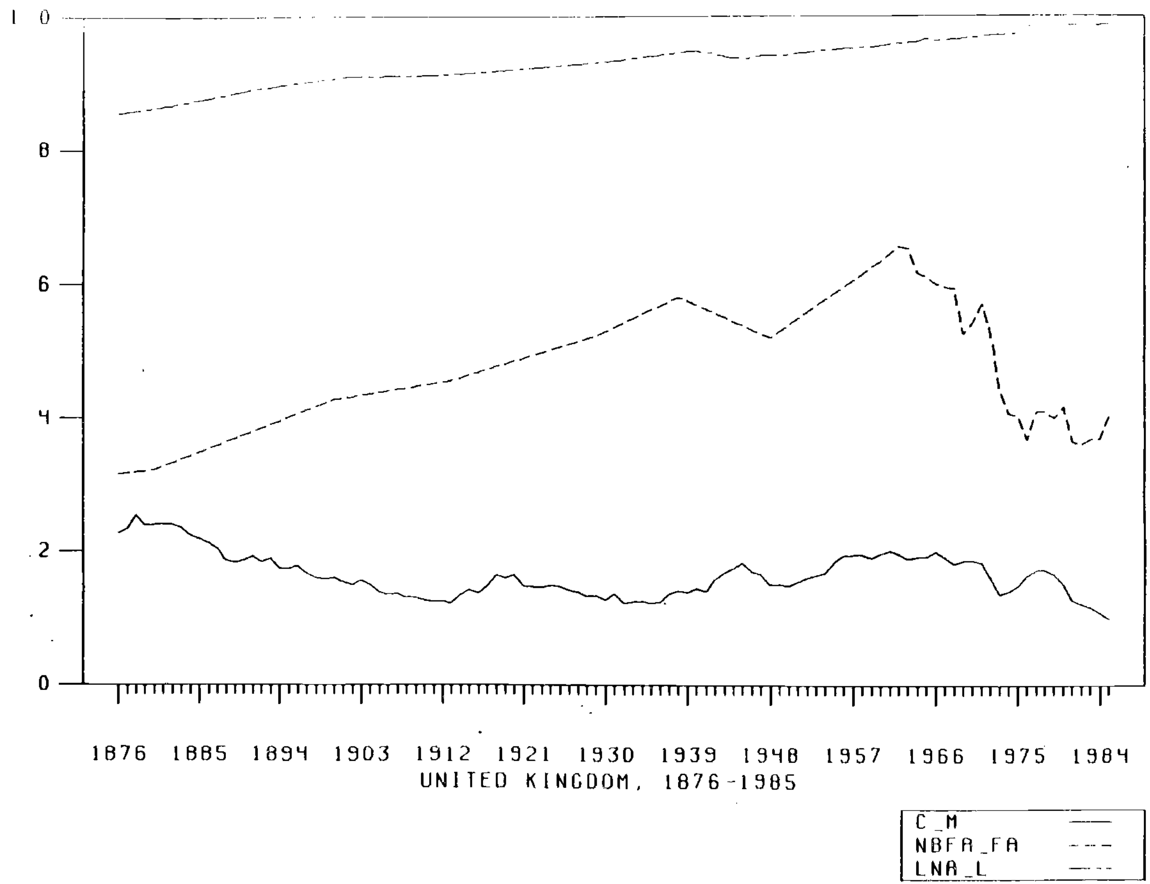


Chart 9

"INSTITUTIONAL" VARIABLES

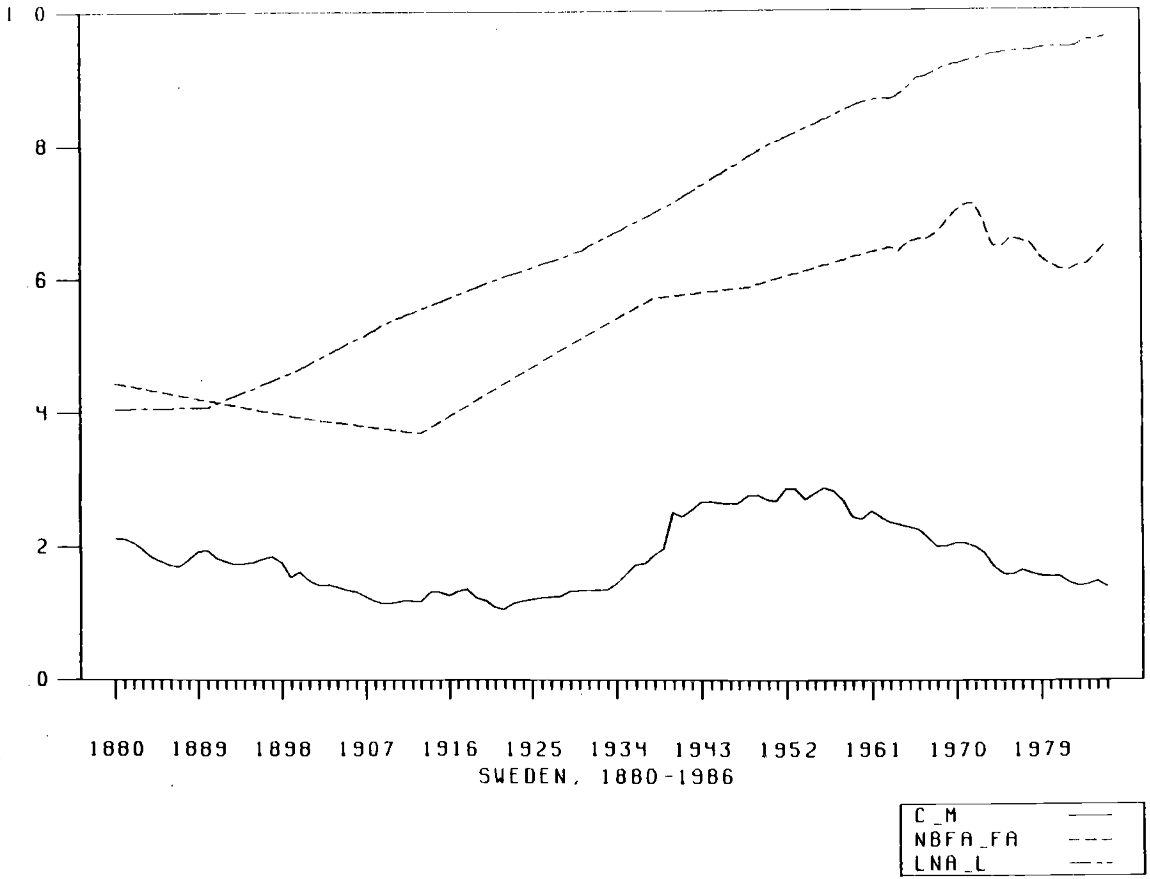


Chart 10

"INSTITUTIONAL" VARIABLES

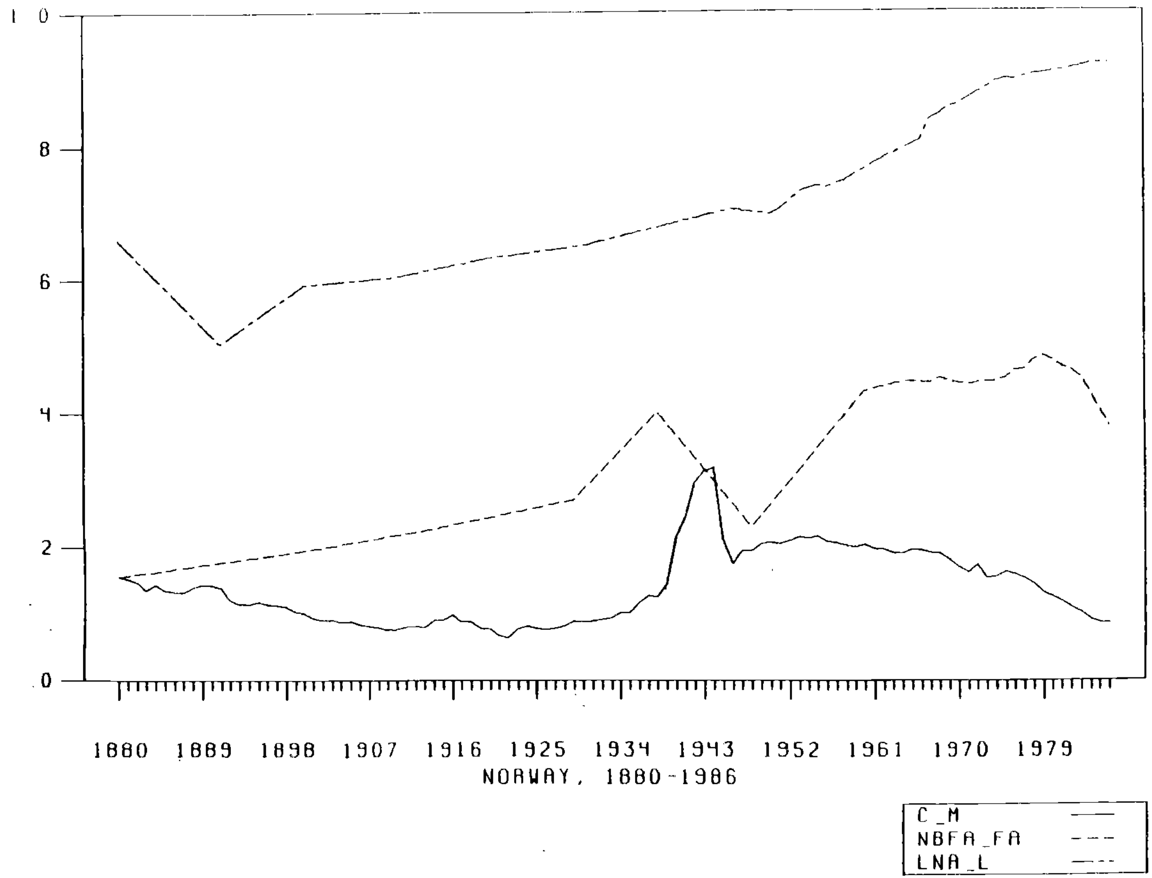


Table 1 INSTITUTIONAL VARIABLES IN THE LONG-RUN VELOCITY FUNCTION: FIVE COUNTRIES 1870–1974 (Cochrane–Orcutt Technique)

COEFFICIENTS OF INDEPENDENT VARIABLES (t - VALUES IN PARENTHESES)

Eq No	constant	$\ln(Y/PN)^{P}$	i	cycle	ln(LNA/L)	ln(C/M)	$\ln(\frac{TNBFA}{TFA})$	$\ln s_{\hat{y}}$	p^{e}	$\bar{R}^2$	SEE	DW	ρ	F^{b}
A. U.S., 1880–1972														
(1)	0.679	-0.018	1.81	0.78						0.969	0.046	2	0.925	
	(.924)	(-.062)	(3.71)*	(7.57)#										
(2)	-1.05	0.298	1.82	0.845[a]	-2.12	0.077	0.746	0.028		0.972	0.043	1.81	0.875	4.09*
	(-.885)	(1.771)#	(3.709)*	(8.023)*	(-3.416)*	(1.235)	(3.572)*	(1.418)						
B. Canada, 1900–75														
(1)	-0.479	0.182	3.926	0.959[a]						0.885	0.053	1.74	0.869	
	(.656)	(1.749)#	(2.494)*	(6.331)*										
(2)	-1.867	0.478	3.783	0.717	-2.34	0.437	0.59	-0.007		0.934	0.042	1.44	0.878	10.61*
	(-1.115)	(2.31)*	(2.853)*	(5.413)*	(-2.968)*	(5.098)*	(4.712)	(-.608)						
C. U.K., 1876–1974														
(1)	-0.909	0.226	1.53	0.592						0.906	0.051	1.84	0.953	
	(-.647)	(1.01)	(3.016)*	(2.29)*										
(2)	-2.387	0.502	2.42	.643	0.312	0.189	0.742	-0.028		0.932	0.043	2.27	0.987	10*
	(-1.23)	(1.88)#	(4.86)*	(3.49)*	(.085)	(1.91)#	(3.65)*	(-1.712)#						

Table 1 (con't)

Eq No	constant	$\ln(Y/PN)^P$	i	cycle	ln(LNA/L)	ln(C/M)	$\ln(\frac{TNBFA}{TFA})$	$\ln s_{\hat{y}}$	p^e	$\bar{R}^2$	SEE	DW	ρ	F^b
D. Sweden, 1880–1974														
(1)	−9.137	0.983	0.81	0.919[a]						0.949	0.049	1.18	0.991	
	(−3.329)*	(3.5)*	(−.327)	(6.5)*										
(1A)	−7.3	0.869	0.331	0.902[a]					0.375	0.956	0.046	1.52	0.987	
	(−3.29)*	(3.55)*	(.143)	(6.9)*					(3.39)*					
(2)	−3.02	0.589	2.981	0.987[a]	−2.2	0.501	0.43	0.009		0.971	0.038	1.36	0.756	45.77*
	(2.466)*	(3.911)*	(1.766)#	(8.59)*	(−6.73)*	(6.52)*	(2.03)*	(.585)						
(2A)	−2.987	0.578	2.42	0.959[a]	−2.19	0.457	0.502	0	0.322	0.975	0.035	1.61	0.752	51.39*
	(−2.646)	(4.17)	(1.54)	(8.97)	(−6.21)	(6.35)	(2.57)	(.031)	(3.86)					
E. Norway, 1880–1974 (excluding 1939–45)														
(1)	−3.777	0.514	4.879	1.275[a]						0.921	0.075	1.503	0.996	
	(−1.537)#	(1.91)#	(2.2687)*	(4.321)*										
(1A)	−0.392	0.13	5.065	1.768					.567	.948	.061	1.97	.99	
	(−0.206)	(.608)	(3.39)*	(6.817)*					(4.476)*					
(2)	5.634	−0.363	4.18	1.45	0.45	0.584	0.425	−0.025		0.963	0.055	1.65	0.976	9.015*
	(2.17)	(−1.45)	(3)	(6.05)	(.87)	(5.45)	(1.39)	(1.36)						
(2A)	5.833	−0.399	4.74	1.68	0.47	0.506	0.452	−0.028	0.475	0.97	0.047	2.02	0.983	103.54*
	(2.542)*	(−1.78)	(3.96)*	(7.97)*	(1.06)	(5.42)*	(1.72)#	(−1.77)#	(4.69)*					

Notes: *: statistically significant at 5% level
#: stastically significant at the 10% level
a: not significantly different from one at 5% level
b: sequential F–test: eq (2) vs. eq (1), eq (2a) vs. eq (1a)

Table 2 INSTITUTIONAL VARIABLES IN THE LONG-RUN VELOCITY FUNCTION: FIVE COUNTRIES 1870–1986 (Cochrane–Orcutt Technique)

COEFFICIENTS OF INDEPENDENT VARIABLES (t-VALUES IN PARENTHESES)

Eq No	constant	ln(Y/PN)[f]	i	cycle	ln(LNA/L)	ln(C/M)	$\ln(\frac{TNBFA}{TFA})$	$\ln s_{\varsigma}$	p[e]	$\bar{R}^2$	SEE	DW	ρ	F[b]
A. U.S., 1880–1986														
(1)	0.645	-0.012	1.46	0.775[a]						0.969	0.043	1.96	0.928	
	(1.034)	(-1.36)	(4.28)*	(8.11)*										
(2)	-0.52	0.21	1.601	0.836[a]	-1.959	0.075	0.65	0.016		0.973	0.041	1.82	0.875	4.48*
	(-.525)	(1.534)	(4.715)*	(8.541)*	(-3.519)*	(1.298)	(3.698)*	(.986)						
B. Canada, 1900–1986														
(1)	-1.67	0.371	-0.069	0.874[a]						0.891	0.054	1.78	0.901	
	(-2.26)*	(3.672)*	(-.076)	(5.919)*										
(2)	-2.927	0.641	1.3	0.632	-2.745	0.472	0.638	-0.011		0.934	0.042	1.48	0.898	14.142*
	(-2.116)*	(3.867)*	(1.748)#	(5.058)*	(-3.622)*	(5.9)*	(5.354)*	(.932)						
C. U.K., 1876–1985														
(1)	-0.953	0.244	0.922	0.652						0.917	0.054	1.66	0.936	
	(-.875)	(1.41)	(2.16)*	(3.468)*										
(2)	-1.497	0.459	0.921	0.546	5.538	0.378	0.292	-0.962		0.935	0.047	1.9	0.963	8.83*
	(-.814)	(1.75)#	(2.406)*	(3.034)*	(1.7)#	(4.256)*	(1.83)#	(-.586)						

Table 2 (con't)

Eq No	constant	ln(Y/PN)	i	cycle	ln(LNA/L)	ln(C/M)	ln(TNBFA/TFA)	ln $s_{\hat{y}}$	p[c]	$\bar{R}^2$	SEE	DW	ρ	F[b]
D. Sweden, 1880–1986														
(1)	-7.606	0.91	1.553	0.916[a]						0.947	0.048	1.24	0.988	
	(-3.315)*	(3.604)*	(1.223)	(6.73)*										
(1A)	-6.183	0.783	1.22	0.901[a]					0.366	0.953	0.045	1.57	0.985	
	(-3.242)*	(3.604)*	(1.025)	(7.126)*					(3.962)*					
(2)	-3.338	0.632	1.968	0.977[a]	-2.324	0.473	0.507	0.008		0.969	0.036	1.36	0.761	49.07*
	(3.314)*	(5.117)*	(2.201)*	(8.961)*	(7.26)*	(7.736)*	(2.668)*	(.553)						
(2A)	-3.181	0.605	1.724	0.951[a]	-2.277	0.441	0.554	-0.0008	0.316	0.974	0.034	1.62	0.758	54.51*
	(3.413)*	(5.3)*	(2.072)*	(9.361)*	(7.696)*	(7.723)*	(3.154)*	(-.059)	(4.042)*					
E. Norway, 1880–1986 (excluding 1939–45)														
(1)	-2.335	0.343	2.635	1.238[a]						.915	.077	1.61	.995	
	(-1.002)	(1.375)	(1.867)#	(4.149)*										
(1A)	.974	-0.224	2.692	1.746					0.521	0.944	0.062	2.07	0.983	
	(.625)	(-.14)	(2.35)*	(6.687)*					(4.163)*					
(2)	3.74	-0.159	3.163	1.387[a]	0.402	0.551	0.306	-0.022		0.956	0.056	1.67	0.983	9.76*
	(1.831)#	(-.789)	(2.989)*	(5.843)*	(.773)	(5.552)*	(1.24)	(-1.195)						
(2A)	4.086	-0.207	3.241	1.613	0.456	0.492	0.316	-0.025	0.435	0.965	0.05	2.03	0.986	10.09*
	(2.184)*	(-1.115)	(3.429)*	(7.368)*	(.979)	(5.435)*	(1.429)	(-1.537)	(4.145)*					

Notes: see notes to Table 1.

Table 3. Chow Tests (F-tests) for the equality of coefficients between the sample underlying Table 1 and that underlying Table 2
(Degrees of Freedom in Parentheses)

	F-Values		
Equation Number	a) Intercept	b) Slope	c) Intercept and Slopes
A. United States, 1880-1972, 1973-86			
(1)	.238	.562	.481
	(1,101)	(3,98)	(4,98)
(2)	.229	.473	.442
	(1,97)	(7,90)	(8,90)
B. Canada, 1900-1975, 1976-86			
(1)	.065	4.58*	3.46*
	(1,81)	(3,78)	(4,78)
(2)	.606	1.43	1.33
	(1,77)	(7,70)	(8,70)
C. United Kingdom, 1876-1974, 1975-85			
(1)	12.45*	4.14*	6.50*
	(1,104)	(3,101)	(4,101)
(2)	18.60*	2.10*	4.35*
	(1,100)	(7,93)	(8,93)
D. Sweden, 1880-1974, 1975-86			
(1)	.999	.813	.858
	(1,101)	(3,98)	(4,98)
(1A)	1.33	.770	.785
	(1,100)	(4,96)	(5,96)
(2)	.678	.770	.757
	(1,97)	(7,90)	(8,90)
(2A)	1.01	.715	.746
	(1,96)	(8,88)	(9,88)
E. Norway, 1880-1974, 1975-86			
(1)	.219	6.01*	4.58*
	(1,95)	(3,92)	(4,92)
(1A)	1.52*	3.96*	3.51*
	(1,91)	(4,87)	(5,87)
(2)	1.63	1.97#	1.94#
	(1,85)	(7,78)	(8,78)
(2a)	2.40	2.65*	2.67*
	(1,84)	(8,76)	(9,76)

Notes: * Statistically significant at the 5% level.
Statistically significant at the 10% level.

Table 4 INSTITUTIONAL VARIABLES IN THE LONG-RUN VELOCITY FUNCTION: FIVE COUNTRIES 1870–1986 (FIRST DIFFERENCES)
COEFFICIENTS OF INDEPENDENT VARIABLES (t-VALUES IN PARENTHESES)

Eq No	constant	Δln(Y/PN)	ΔI	Δ cycle	Δln(LNA/L)	Δln(C/M)	Δln(TNBFA/TFA)	ln s_v	ρ[a]	$\bar{R}^2$	SEE	DW	F[b]
A. U.S., 1880–1986													
(1)	−0.014	0.374	1.257	0.672						0.413	0.047	1.91	
	(−2.81)*	(3.328)*	(3.486)*	(7.439)*									
(2)	−0.018	0.405	1.491	0.876[a]	−0.04	0.125	0.971	0.021		0.568	0.042	1.79	6.027*
	(−2.055)*	(2.287)*	(4.487)*	(9.235)*	(−.031)	(2.094)*	(4.641)*	(1.379)					
(3)	−0.17	0.359	1.468	0.858[a]		0.121	0.931			0.537	0.042	1.84	11.11*
	(−3.2)*	(2.069)*	(4.425)*	(9.162)*		(2.032)*	(4.509)*						
B. Canada, 1900–86													
(1)	−0.009	0.556	0.074	0.863[a]						0.358	0.056	1.8	
	(−1.073)	(2.396)*	(−.082)	(5.642)*									
(2)	−0.005	0.612	1.189	0.651	−1.223	0.483	0.615	−0.007		0.623	0.043	1.55	
	(−.509)	(2.965)*	(1.619)#	(5.271)*	(.931)	(6.096)*	(5.164)*	(.661)					
(3)	−0.009	0.539	1.313	0.678		0.497	0.615			0.626	0.042	1.54	30.43*
	(−1.509)	(2.765)*	(1.619)#	(5.627)*		(6.369)*	(5.178)*						
C. U.K., 1876–1985													
(1)	−0.005	0.542	0.859	0.599						0.16	0.064	1.73	
	(−.742)	(1.659)#	(2.051)*	(3.155)*									
(2)	−0.009	0.53	0.918	0.542	5.104	0.379	0.264	−0.011		0.352	0.048	1.69	8.76*
	(1.154)	(1.731)#	(2.409)*	(2.861)*	(1.621)	(4.232)*	(1.746)*	(−.69)					
(3)	−0.004	0.378	0.941	0.666		0.41	0.282			0.342	0.048	1.72	15.54*
	(−.07)	(1.274)	(2.433)*	(3.963)*		(4.621)*	(1.804)*						

Eq No	constant	Δ ln(Y/PN)	Δ i	Δcycle	Δln(LNA/L)	Δln(C/M)	Δln(TNBFA/TFA)	ln s	ρ	R^2	SEE	DW	F^b
D. Sweden, 1880–1986													
(1)	0.033	1.131	2.221	0.868						0.449	0.048	1.2	
	(-3.601)*	(3.534)*	(1.742)#	(6.105)*									
(1A)	-0.031	1.055	1.98	0.843					0.353	0.513	0.046	1.48	
	(-3.62)*	(3.498)*	(1.648)#	(6.305)*					(3.789)*				
(2)	-0.02	0.948	2.562	0.92	-1.245	0.499	0.822	0.006		0.66	0.038	1.52	16.83*
	(-2.087)*	(3.665)*	(2.509)*	(8.176)*	(1.465)	(6.435)*	(2.727)*	(.392)					
(2A)	-0.02	0.891	2.387	0.9	-1.076	0.469	0.848	0	0.291	0.704	0.036	1.75	17.29*
	(-2.279)*	(3.674)*	(2.502)*	(8.564)*	(-1.355)	(6.452)*	(3.014)*	(-.03)	(3.94)*				
(3A)	-0.027	0.828	2.579	0.912		0.468	0.82		2.94	0.704	0.036	1.7	30.3*
	(-3.915)*	(3.487)*	(2.733)*	(8.721)*		(6.531)*	(2.932)*		(4.007)*				
E. Norway, 1880–1986 (excluding 1939–45)													
(1)	-0.44	1.658	1.934	1.136						0.398	0.059	1.55	
	(-4.141)*	(4.758)*	(1.777)#	(4.84)*									
(1A)	-0.045	1.667	1.939	1.409					0.477	0.503	0.054	1.67	
	(-4.032)*	(4.131)*	(1.919)#	(6.005)*					(4.43)*				
(2)	-0.036	1.188	2.565	1.196	-0.03	0.494	0.441	-0.008		0.567	0.05	1.75	9.73*
	(-3.087)*	(2.766)*	(2.626)*	(5.459)*	(-.066)	(5.147)*	(1.736)#	(-.52)					
(2A)	-0.036	0.991	2.788	1.431	0.097	0.431	0.474	-0.016	0.433	0.654	0.044	2.17	10.48*
	(-3.169)*	(2.567)*	(3.189)*	(7.085)*	(.23)	(4.971)*	(2.099)*	(-1.136)	(4.734)*				
(3A)	-0.039	1.232	2.681	1.413		0.434	0.583		0.406	0.654	0.044	2.11	23.34*
	(-3.941)*	(3.587)*	(3.09)*	(7.121)*		(5.127)*	(2.74)*		(4.495)*				

Notes: see notes to table 1.

Table 5. Dynamic Forecast Errors from Out of Sample Predictions mid 1970's to 1980's using the coefficients from the regressions estimated in Table 1. Five Countries. Cochrane Orcutt.

Equation Number	Root Mean Square Error (%)	Equation Number	Root Mean Square Error (%)
A. United States, 1973 to 1986		D. Sweden, 1975 to 1986	
(1)	2.16	(1)	4.03
(2)	2.78	(1A)	4.21
B. Canada, 1976 to 1986		(2)	3.09
(1)	9.50	(2A)	2.97
(2)	6.15		
		E. Norway, 1975 to 1986	
C. United Kingdom, 1975 to 1985			
(1)	8.09	(1)	8.24
(2)	10.65	(1A)	7.94
		(2)	5.13
		(2A)	5.69

Note: The dynamic forecasts were generated using the coefficients and rhos estimated in Table 1 and data for the independent variables from the subsequent period.

Appendix 1: Data Sources

The data used in this article are an update of the data used in Bordo and Jonung (1987). All the sources are reported in Appendices 1A and 1B. However, we made a number of changes in the data and these we list below.

United States

National Income 1870-1986. We used GNP in current market prices from Gordon (1985a).

United Kingdom

Money Supply 1870-1985. We used M_2/M_3 from Capie and Webber (1985).

Sweden

Long-term interest rate, 1870-1960, see Bordo and Jonung (1987) Appendix 1B, 1961-1986. Central Government Bonds, 10 years. Source, Sveriges Riksbank Annual Report, various issues.