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The Long-Run Behavior of Velocity: The Institutional Approach Revisited

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In this article we provide evidence from annual data for the period 1880–1986 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, *The Long-run Behavior of the Velocity of Circulation,* Cambridge University Press, 1987) for annual data ending in the early 1970s. 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 10–15 years; and that out-of-sample forecasts over the last 10–15 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.

1. INTRODUCTION

Recently, professional economists and policymakers, particularly in the United States, 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 (Friedman, 1988).[1]

[1]Although Rasche (1987) has argued that for the United States the only evidence of instability of V1 is a one-time shift in early 1982 in the drift term of an AR(1) regression. For V2, Rasche (1988) finds no evidence of instability.

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Researchers have discussed "The Case of the Missing Money" (Goldfeld, 1976), the tendency, beginning in 1972, of conventional short-run money demand functions (derived from monthly and quarterly data) to systematically overpredict 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 policymakers 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 1970s, 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 1980s, 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 1970s. We believe that such a short-run perspective is misleading. The events of the past 15–20 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 (M2) 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

[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 1890s, 1920s, and 1930s.

[3]Bordo and Jonung (1981); Jonung (1978, 1983).

[4]Study of the link between financial development and the demand for money or velocity has a long history in monetary economics that includes 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.

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 those yielding 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 (a) pooling the data for the five countries and performing regressions similar to those for each country taken in isolation; (b) a case study of the monetization process in Sweden during the pre–

World War I period; and (c) a cross-section time series analysis of data for over 80 countries in the post–World War II period that produced results consistent with a global U-shaped velocity curve.

In this article 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 1970s. Our hypothesis is about the long-run or equilibrium behavior of velocity, whereas the recent discussion relates to unpredictability in the short-run velocity (money demand) function, which incorporates dynamic adjustment to disturbances and 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 10–15 years; and that out-of-sample forecasts over the last 10–15 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 2 discusses the secular pattern of velocity from 1870 to 1986 for the United States, Canada, United Kingdom, Sweden, and Norway. Section 3 presents the empirical counterparts to the institutional hypothesis. We present econometric estimates derived from the best available data both for the time span covered in the book and for the period ending in 1986. Section 4 presents the results of an alternative econometric specification of our model using log differences. Finally, Section 5 concludes with a discussion of the policy implications of our work.

2. 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 1870s to the 1970s in the United States, Canada, the United Kingdom, Sweden, and Norway. The velocity curves were calculated using a broad definition of money, M2, where M2 is defined as the sum of currency and demand and time deposits. M2 is the only monetary aggregate available over the entire data period for each of the five countries.[5] National income was measured by net national product (NNP) at market prices for the United States and the United Kingdom, by gross national product (GNP) at market prices for Canada, and by gross domestic product (GDP) at market prices for Sweden and Norway.

In Figures 1–5 we show V2 curves for the five countries up to 1986. The updated data are 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) M2/M3 series.[6]

Figures 1–5 show that, at least up to the early 1970s, 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 than 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 1920s and 1930s are commonly reflected in substantial declines in velocity.[7]

Velocity was falling in the United States prior to the mid-1940s, when the turnaround occurred (Figure 1). It displayed a clear upward trend for about 15 years and subsequently seems to have leveled off. Adding on 14 more years of data might have turned the U into a ladle. The post-1981 downturn in velocity seems small in a long-run perspective by comparison not only with the 1940s turnaround but also with the declines associated with the two World Wars and the Great Depression.

The Canadian curve (Figure 2) has great similarities with the U.S. curve, having a turnaround in the 1940s after a sharp cyclical downturn around 1930. One interesting contrast is the 1982–1986 period, when Canadian V_2 rose sharply while that in the United States fell.[8] The

[5]For the United Kingdom after 1967, we used M3, as an M2 series was no longer available.

[6]For sources of the data used in Bordo and Jonung (1987), see its Appendix IB; for sources of the updated series, see Appendix 1 below.

[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, 1986).

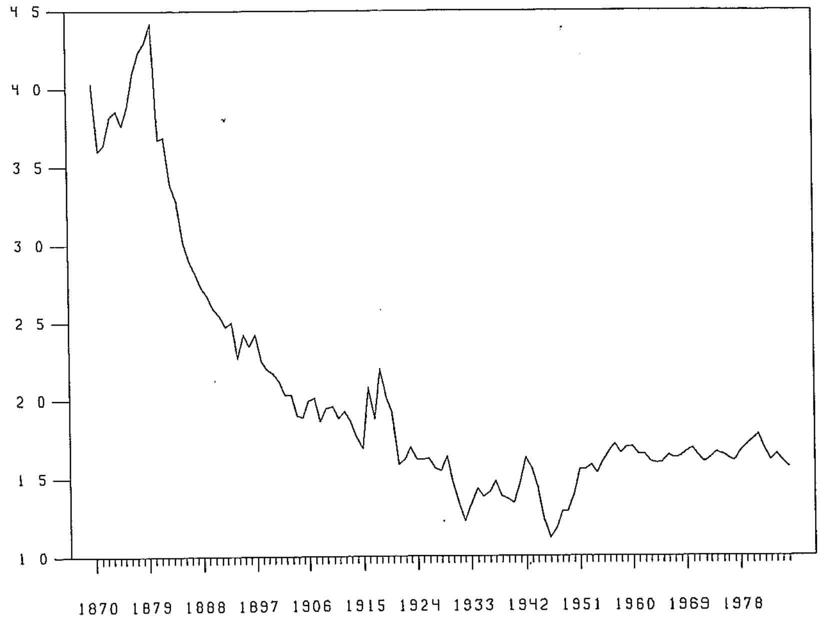

Figure 1. Velocity of circulation of M2. United States, 1870–1986.

extra 12 years of data for Canada, however, seem to confirm the U-shaped pattern.

For the United Kingdom, velocity falls from around 1910 onward, with a turnaround occurring in the mid 1940s (Figure 3). The additional data accentuate the upward portion of the V2 curve. For the recent period, three exceptional patterns deserve attention: a sharp decline in velocity from 1971 to 1973 that presumably reflects the bank credit explosion following institutional changes due to Competition and Credit Control (1971); a sharp rise in velocity from 1973 to 1979 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 (Figure 4), at least up to 1970. Since 1970, Sweden may also be experiencing the ladle effect of a flattening out in V, as is observed for the United States. Norway (Figure 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 12 years of data

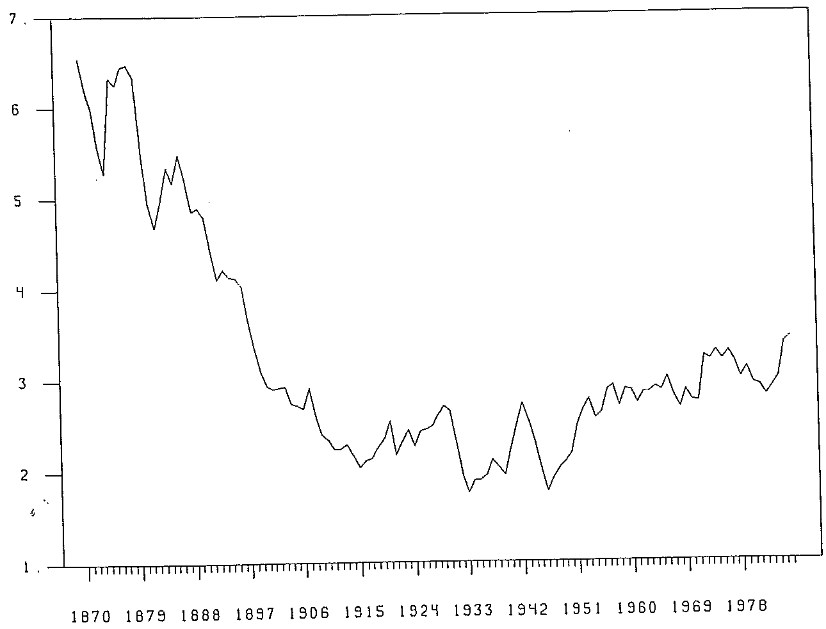

Figure 2. Velocity of circulation of M2. Canada, 1870–1986.

seem to conform more to the U-shaped pattern than do the data for Sweden, with the noted exception of a downturn in V in 1981–1986.[9]

To sum up, the U-shaped pattern of velocity for the five countries observed until the early 1970s 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 V2 in the United States, the United Kingdom, and Norway seems to be consistent with earlier cyclical downturns and, it has been argued, may also reflect disinflation (Friedman, 1987; Rasche, 1989).

[9]This decline, like that in the United States 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.

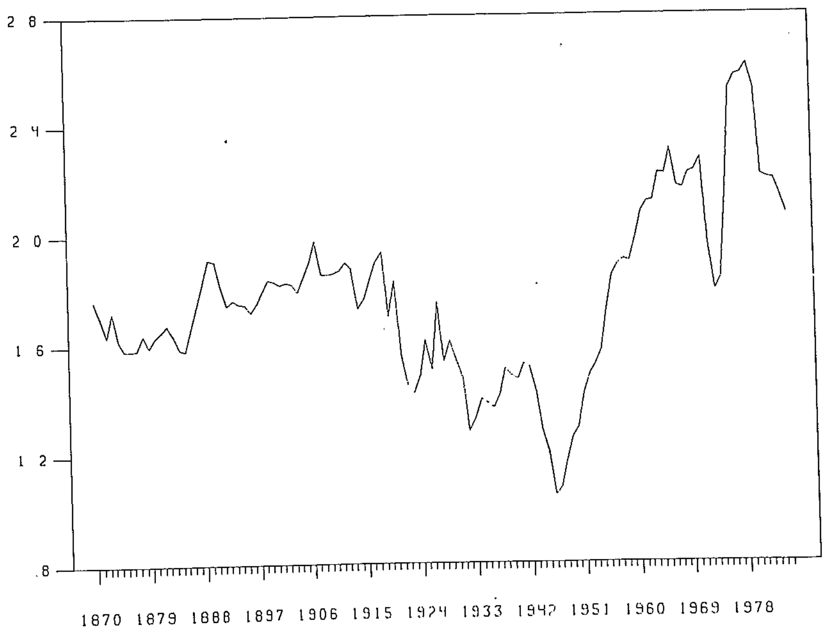

Figure 3. Velocity of circulation of M2. United Kingdom, 1870–1985.

3. 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 vari-

[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.

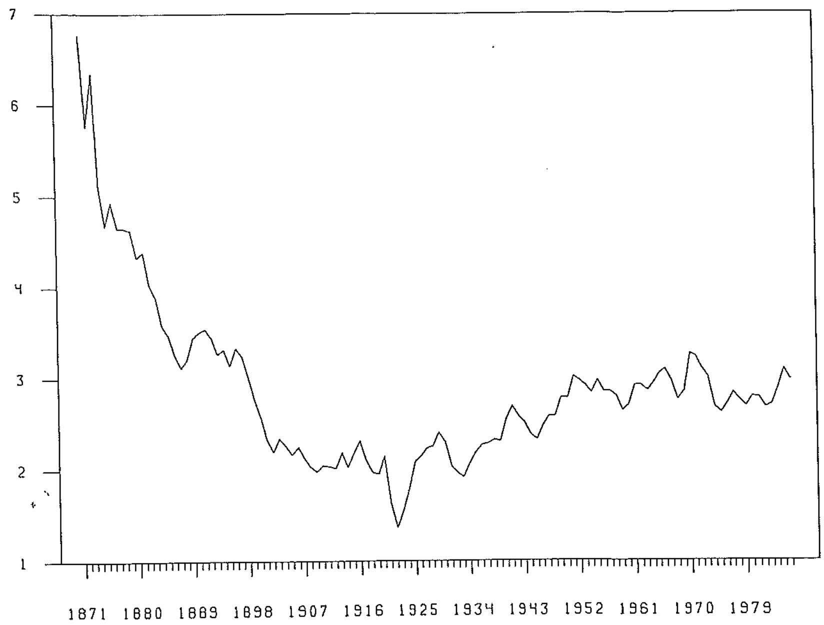

Figure 4. Velocity of circulation of M2. Sweden, 1871–1986.

ables 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 nonagricultural 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 6-year moving standard deviation of the annual percentage change in real per capita income; and total government expenditures, both including and excluding defense 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, that is, 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

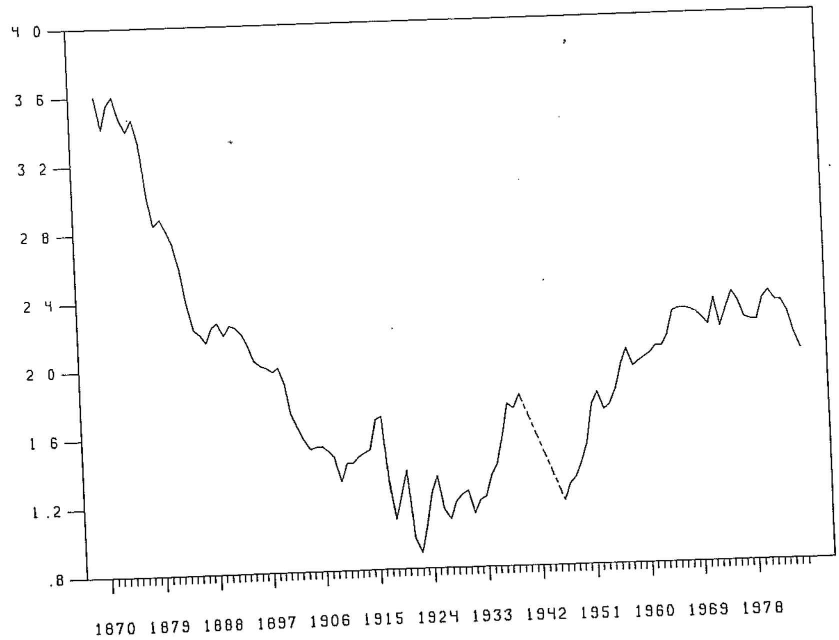

Figure 5. Velocity of circulation of M2. Norway, 1870–1986.

monetization on velocity. In the absence of comparable measures of these "deep structural" factors across countries, we use more general proxies that 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.

3A. 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) M2/M3 series for the United Kingdom from 1870 to 1890 and Gordon's (1985a) GNP series for the United States. 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:

$$\log V = B_0 + B_1 \log (Y/PN)^p + B_2 i + B_3 \log cycle + e, \tag{1}$$

where log stands for natural logarithm; $V = (Y/M)$ is nominal GNP divided by M2; $(Y/PN)^p$ represents real per capita permanent income; and i is an appropriate rate of interest representing the opportunity cost

Table 1: Institutional Variables in the Long-run Velocity Function: Five Countries, 1870–1974 (Cochrane–Orcutt Technique)

Eq. No.	Constant	In(Y/PN)[p]	i	Cycle	In(LNA/L)	In(C/M)	In[(TNBFA)/TFA]	InS_y	p^e	$\bar{R}^2$	SEE	DW	ρ	F^b
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)						
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	3.763	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)						
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 *(continued)*

Eq. No.	Constant	In$(Y/PN)^p$	i	*Cycle*	In(LNA/L)	In(C/M)	In$\left[\frac{(TNBFA)}{TFA}\right]$	InS_g	p^e	$\bar{R}^2$	*SEE*	*DW*	ρ	F^b
Sweden, 1880–1974														
(1)	−9.137 (−3.329)*	0.983 (3.5)*	0.81 (−.327)	0.919[a] (6.5)*						0.949	0.049	1.18	0.991	
(1A)	−7.3 (−3.29)*	0.869 (3.55)*	0.331 (.143)	0.902[a] (6.9)*					0.375 (3.39)*	0.956	0.046	1.52	0.987	
(2)	−3.02 (2.466)*	0.589 (3.911)*	2.981 (1.766)#	0.987[a] (8.59)*	−2.2 (−6.73)*	0.501 (6.52)*	0.43 (2.03)*	0.009 (.585)		0.971	0.038	1.36	0.756	45.77*
(2A)	−2.987 (−2.646)	0.578 (4.17)	2.42 (1.54)	0.959[a] (8.97)	−2.19 (−6.21)	0.457 (6.35)	0.502 (2.57)	0 (.031)	0.322 (3.86)	0.975	0.035	1.61	0.752	51.39*
Norway, 1880–1974 (excluding 1939–1945)														
(1)	−3.777 (−1.537)#	0.514 (1.91)#	4.879 (2.2687)*	1.275[a] (4.321)*						0.921	0.075	1.503	0.996	
(1A)	−0.392 (−0.206)	0.13 (.608)	5.065 (3.39)*	1.768 (6.817*					.557 (4.476)*	.948	.061	1.97	.99	
(2)	5.634 (2.17)	−0.363 (−1.45)	4.18 (3)	1.45 (6.05)	0.45 (.87)	0.584 (5.45)	0.425 (1.39)	−0.025 (1.36)		0.963	0.055	1.65	0.976	9.015*
(2A)	5.833 (2.542)*	−0.399 (−1.78)	4.74 (3.96)*	1.68 (7.97)*	0.47 (1.06)	0.506 (5.42)*	0.452 (1.72)#	−0.028 (−1.77)#	0.475 (4.69)*	0.97	0.047	2.02	0.983	103.54*

Note: Data are coefficients of independent variables (t values in parentheses).
[a]Not significantly different from one at 5% level.
[b]Sequential F test: Equation 2 vs. Equation 1; Equation 2a vs. Equation 1a.
*Statistically significant at 5% level.
#Statistically significant at the 10% level.

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] The term *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 1 in the regression. A coefficient that is positive but less than 1 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, because 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 1960s, inflation was relatively mild and interest rates adjusted freely to market forces—with the exception of the 1939–1951 period for the United Kingdom and Canada, and 1941–1951 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 1960s 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

[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 United States and the United Kingdom 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.

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:

$$\log V = B_0 + B_1 \log (Y/PN)^p + B_2 i + B_3 \log cycle + B_4 \log (LNA/L) + B_5 \log (C/M) + B_6 \log (TNBFA/TFA) + B_7 \log S_{\dot{y}} + e'. \qquad (2)$$

(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 ($TPNBFA/TPFA$), which we use for the United States.[14]

Finally, we expect a 6-year moving standard deviation of the annual percentage change in real income per head ($S_{\dot{y}}$), representing the influence of economic stability, to be negatively correlated with velocity. A decline in certainty about the future, reflected by an increase in $S_{\dot{y}}$, should raise the precautionary demand for money and hence should lower velocity.

[12]For both countries we selected a 2-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. In Bordo and Jonung (1981), to avoid these problems we used as alternative proxies 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 during the period 1875–1913 the number of commercial bank accounts per capita is a significant determinant of velocity (Bordo and Jonung, 1987, chap. 5).

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

Table 1 presents ordinary least squares (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, which were 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 the 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 unity, 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 1929–1946 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 and 2A significantly improves the regression for every country. This

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

improvement is observable in the significant sequential F statistics reported following regression Equations 2 and 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, which 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 5 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 10 percent level or higher with the correct positive sign for all countries except for the United States. Third, *TNBFA/TFA* is significant at the 5 percent level and exhibits the correct sign in all five countries except Norway. Finally, the proxy for economic stabilization, $S_{\hat{y}}$, is significant at the 10 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 1970s.

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

	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.

3B. The Results Updated

Table 2 presents the same regressions as Table 1, updated through 1986 for all countries except the United Kingdom, for which 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), which includes 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, the 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 $S_{\hat{y}}$ 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 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 they 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]

[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 is 1.91.

[20]The t statistic on the interest rate coefficient from Equation 1 for the United Kingdom is 1.63.

Table 2: Institutional Variables in the Long-run Velocity Function: Five Countries 1870–1986 (Cochrane-Orcutt Technique)

Eq. No.	Constant	In(Y/PN)[P]	i	*Cycle*	In(LNA/L)	In(C/M)	$\ln\left[\frac{(TNBFA)}{TFA}\right]$	$\ln S_{\hat{y}}$	p^e	$\bar{R}^2$	SEE	DW	ρ	F^b
U.S., 1880–1986														
(1)	0.645	−0.012	1.46	0.775[a]						0.969	0.043	1.98	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)						
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)						
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	0.983	8.83*
	(−.814)	(1.75)#	(2.406)*	(3.034)*	(1.7)#	(4.256)*	(1.83)#	(−.586)						

Sweden, 1880–1986														
(1)	−7.806	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)*					
Norway, 1880–1986 (excluding 1939–1945)														
(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)*					

Note: 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	**Intercept**	**Slope**	**Intercept and Slopes**
United States, 1880–1972, 1973–1986			
(1)	.238	.562	.481
	(1,101)	(3,98)	(4,98)
(2)	.229	.473	.442
	(1,97)	(7,90)	(8,90)
Canada, 1900–1975, 1976–1986			
(1)	.065	4.58*	3.46*
	(1,81)	(3,78)	(4,78)
(2)	.606	1.43	1.33
	(1,77)	(7,70)	(8,70)
United Kingdom, 1876–1974, 1975–1985			
(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)
Sweden, 1880–1974, 1975–1986			
(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)
Norway, 1880–1974, 1975–1986			
(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)

*Statistically significant at the 5% level.
#Statistically significant at the 10% level.

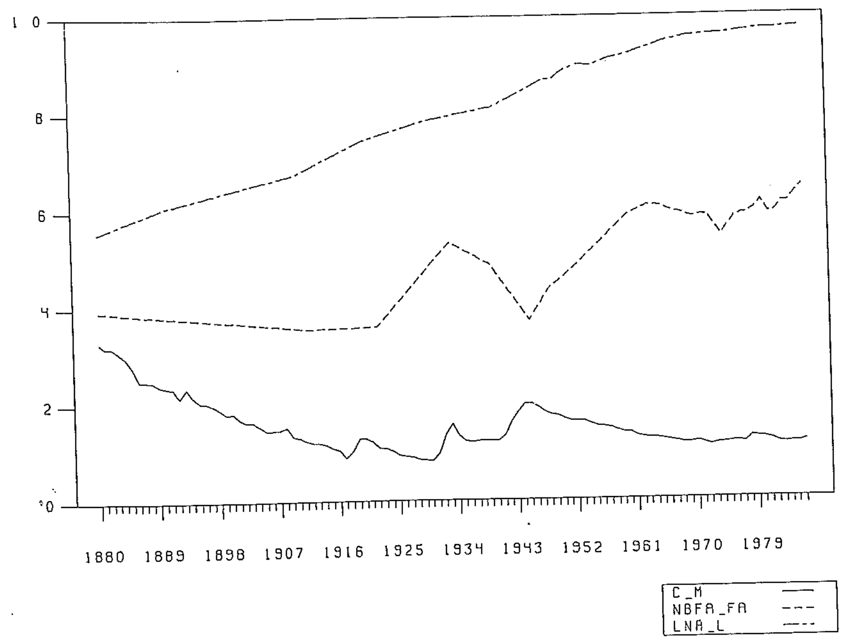

Figure 6. Institutional variables. United States, 1900–1986.

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 2 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. Figures 6 and 7 plot *LNA/L, C/M,* and *TNBFA/TFA* for each of the five countries over the entire period.

Compare Figure 6 for the United States with Figure 1, the V2 curve. The ratio of total private nonbank financial assets to total financial assets mirrors movements in V2 quite closely, especially so after 1964, when annual data became available instead of interpolations between

[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.

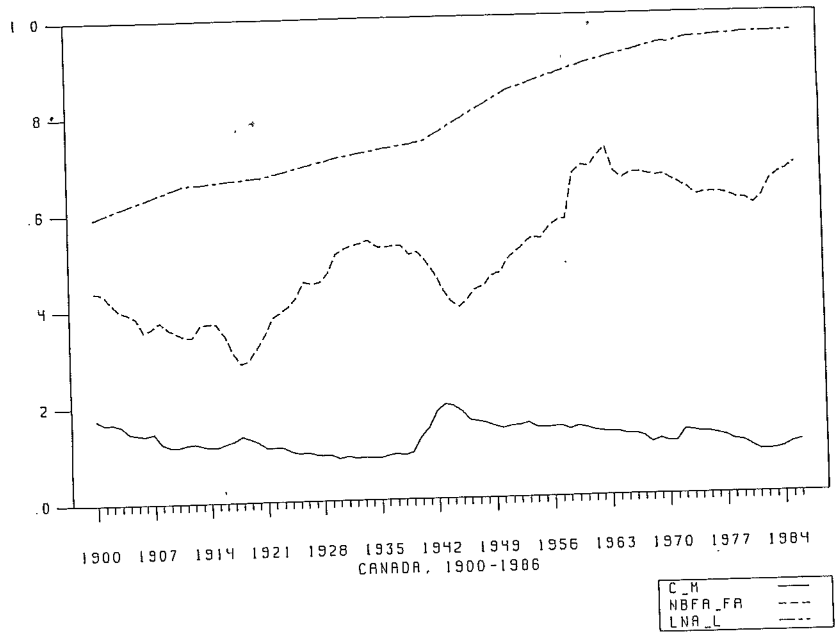

Figure 7. Institutional variables. Canada, 1900–1986.

quinquennial benchmarks. The turning point in this variable occurs in 1945, and that in V2 occurs in 1946. The peak in *TPNBFA/TFA* occurs in the mid 1960s about the time the V2 curve stops rising and becomes a ladle handle. The *C/M* ratio moves parallel to V2 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 V2. *LNA/L* displays a virtually steady rising trend throughout the period, leveling off in recent years. The movement in *LNA/L* is too smooth to explain the choppy movements in V2.

The picture for Canada in Figure 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 movements in this ratio, as early as 1900, seem even more closely related to those in V2 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 V2 after World War II, with a turning point in 1947 and a decline beginning in the mid-1960s. A key difference between the United Kingdom and the other two countries is the precipitous drop in the *TNBFA/TFA* ratio in the early 1970s. This drop likely reflects the enormous growth in the banking sector that accompanied the monetary explosion fueled in these years by bank credit. This drop is partly mirrored in the erratic behavior of V3 discussed above.

For Sweden and Norway, both *TNBFA/TFA* and *C/M* seem to mimic the movements of V2 over the entire period, the former proxy being more closely related to V2 in the last decade.

In sum, the figures 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 V2. 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.

4. FIRST-DIFFERENCE RESULTS

In this section we report results of regressions derived from 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 1970s (Bordo and Jonung, 1987, chap. 7; Raj and Siklos, 1989), and that regressions based on nonstationary 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 are 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 derived from 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 Figures 6–10. Also, since these advanced countries had reached a stage of virtually complete monetization in the late twentieth 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 that includes only *C/M* and *TNBFA/TFA* may be in order. This modification is shown in Equations 3 and 3A, which also incorporate p^e. Both institutional

Table 4: Institutional Variables in the Long-run Velocity Function: Five Countries 1870–1986 (First Differences)

Eq. No.	Constant	$\ln(Y/PN)^p$	i	*Cycle*	$\ln(LNA/L)$	$\ln(C/M)$	$\ln\left[\frac{(TNBFA)}{TFA}\right]$	$\ln S_y$	p^e	$\bar{R}^2$	*SEE*	*DW*	ρ	F^b
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″	−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″		0.121	0.931			0.537	0.042	1.84		11.11*
	(−3.2)*	(2.069)*	(4.425)*	(9.162)*		(2.032)*	(4.509)*							
Canada, 1900–1986														
(1)	−0.009	0.556	0.074	0.863″						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)*	(1.819)#	(5.627)*		(6.369)*	(5.178)*							
U.K., 1876–1985														
(1)	−0.005	0.542	0.859	0.599						0.16	0.054	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	1.89		8.76*
	(1.154)	(1.731)#	(2.409)*	(2.961)*	(1.621)	(4.232)*	(1.746)*	(−.69)						
(3)	−0.004	0.378	0.941	0.668		0.41	0.262			0.342	0.048	1.72		15.54*
	(−.07)	(1.274)	(2.433)*	(3.963)*		(4.621)*	(1.804)*							

Sweden, 1880–1986													
(1)	0.033	1.31	2.221	0.868[a]						0.449	0.048	1.2	
	(−3.601)*	(3.534)*	(1.742)#	(6.105)*									
(1A)	−0.031	1.055	1.98	0.843[a]					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[a]	−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[a]	−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[a]		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)*				
Norway, 1880–1986 (excluding 1939–1945)													
(1)	−0.44	1.658	1.934	1.136[a]						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	1.87	
	(−4.032)*	(4.131)*	(1.919)#	(6.005)*					(4.43)*				
(2)	−0.036	1.188	2.565	1.196[a]	−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)*	(2.089)*	(−1.136)	(4.734)*				
(3A)	−0.039	1.232	2.681	1.413		0.434	0.583		0.408	0.654	0.044	2.11	23.34*
	(−3.941)*	(3.587)*	(3.09)*	(7.121)*		(5.127)*	(2.74)*		(4.495)*				

Note: See notes to Table 1.

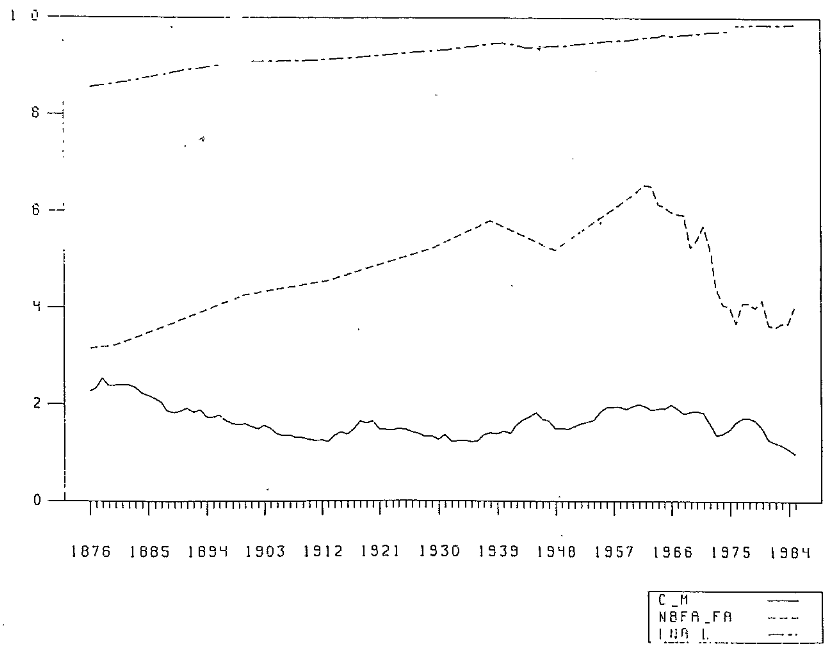

Figure 8. Institutional variables. United Kingdom, 1876–1985.

variables seem to be robust to the new sample. According to the hypothesis, *C/M* captures the spread of commercial banking, a process that recent deregulation of the banking sector has stimulated, whereas *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]

[22]In this vein, Hoffman and Rasche (1989) fit a cointegrating vector to real cash balances,

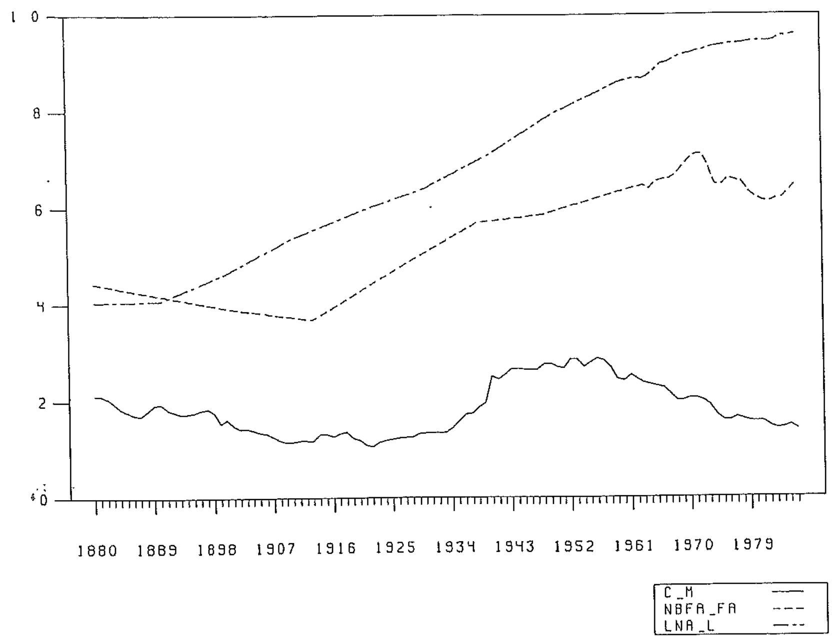

Figure 9. Institutional variables. Sweden, 1880–1986.

5. CONCLUSIONS AND IMPLICATIONS

This article 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 1970s. The extra 12–14 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

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 (1988) 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 United States, the United Kingdom, and Canada using our data extended through 1986. He also incorporates an error correction term into a dynamic specification of the hypothesis.

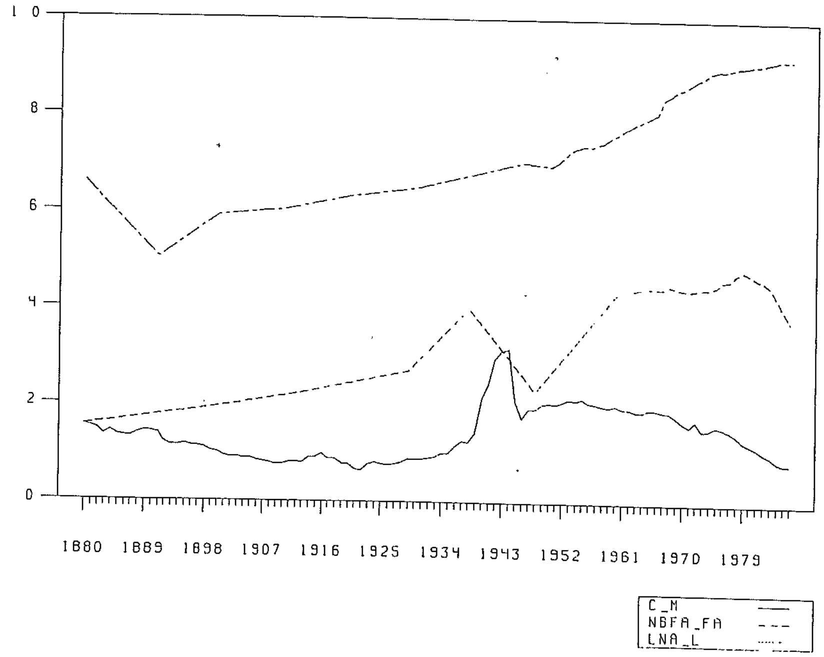

Figure 10. Institutional variables. Norway, 1880–1986.

that although the benchmark equation is stable through the 1980s 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-1970s, we predicted velocity over the subsequent 10–15 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.

Table 5: Dynamic Forecast Errors from Out-of-Sample Predictions, mid-1970s to 1980s Derived From the Coefficients From the Regressions Estimated in Table 1. Five Countries (Cochrane–Orcutt Technique)

Equation Number	**Root mean square Error (%)**	**Equation Number**	**Root mean square Error (%)**
United States, 1973–1986		Sweden, 1975–1986	
(1)	2.16	(1)	4.03
(2)	2.78	(1A)	4.21
Canada, 1976–1986		(2)	3.09
(1)	9.50	(2A)	2.97
(2)	6.15		
United Kingdom, 1975–1985		Norway, 1975–1986	
(1)	8.09	(1)	8.24
(2)	10.65	(1A)	7.94
		(2)	5.13
		(2A)	5.69

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

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 finding 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, with adjustment 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-1940s in a number of countries, that produced 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 with the phenomena of the previous three decades, is not that unusual compared with the cyclical declines of the two world wars and the 1930s. 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 in order to follow a fine-tuning policy, is that it may create more instability than it is supposed to offset. Such a result is a possible implication of evidence that V contains a unit root for the United States (Gould and Nelson, 1984; Nelson and Plosser, 1982) and for other countries (Bordo and Jonung, 1987, chap. 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 not contradict 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, for example, by Haraf (1986) could also avoid the problem of institutional change in the financial sector. Since price indexes are better understood by the public and are published more often and are less subject to revision than GNP, a price level rule may be superior to a

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

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.

APPENDIX 1: DATA SOURCES

The data used in this article are an update of the data used in Bordo and Jonung (1987), in which 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 M2/M3 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).

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Comments on "The Long-Run Behavior of Velocity: The Institutional Approach Revisited"

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1. INTRODUCTION

In their article "The Long-Run Behavior of Velocity: The Institutional Approach Revisited" (this issue) Michael Bordo and Lars Jonung update portions of the work published in Bordo and Jonung (1987). Specifically, they expand their data to include the period from the early 1970s to the mid-1980s for Canada, Norway, Sweden, the United Kingdom, and the United States, and they reestimate equations that relate the income velocity of M2 money to a set of economic variables. Three main empirical results are reported. First, the variables selected in their previous work to measure institutional change in the financial sector "remain significant determinants of the long-run velocity function." Second, for a majority of the countries examined, the previously selected long-run velocity function that incorporates these institutional variables "has not undergone significant change over the last 10–15 years." Third, making use of these institutional variables produces out-of-sample forecasts for velocity that are "superior to those based on a benchmark long-run velocity function for a number of countries." These three empirical results are used to justify the main conclusion of the work: "This article has provided evidence for the period from 1880 to 1986 that institutional variables are significant determinants of velocity in five advanced countries."

My comments on this article are divided into three parts. I begin with a discussion of the overall approach that Bordo and Jonung are using, including a review of some of the more important concepts and claims from their earlier work. Next, I address the issue of how well the empirical results presented by Bordo and Jonung support the conclusion that institutional factors play an important role in determining

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the income velocity of money. Finally, I evaluate the actual implementation of the Bordo–Jonung methodology to the data used here, paying particular attention to the econometric issues that arise.

2. THE OVERALL APPROACH

In *The Long-Run Behavior of the Velocity of Circulation: The International Evidence,* Michael Bordo and Lars Jonung (1987) show that for a number of countries a plot of the income velocity of a broad money (M2) against time reveals a U-shaped pattern. The secular declines in velocity generally are visible from the late nineteenth century to the early or middle part of the twentieth century, with secular increases taking over at this point. The authors' explanation for this phenomenon is that the downward trend in velocity is due to the "process of monetization," which is defined as the "spread of the money economy" and the "proliferation of commercial banking." The upward trend in velocity is attributable to "financial sophistication," defined as the "emergence of money substitutes" and the "development of methods of economizing on cash balances." Both monetization and financial sophistication are seen as changing velocity by altering the demand for money.

To support their conclusion, the authors report the results of ordinary least squares, time series regressions of velocity on (a) standard money demand variables such as real income and interest rates, and (b) institutional variables designed to proxy for the process of monetization and financial sophistication. The data for the regressions span the period from the late nineteenth century to the early 1970s. The institutional variables enter the regression equation statistically significantly, and with the sign predicted a priori by the authors.

In their current article the authors expand their previous data to include the period from the early 1970s to the mid-1980s for Canada, Norway, Sweden, the United Kingdom, and the United States. With this additional data they again plot velocity against time to see if the U-shaped pattern remains and also reestimate the regressions described above.

In assessing the overall approach used by Bordo and Jonung, I think it best to focus on a point the authors make quite clearly, early on in their article. "Much of the recent literature has treated financial innovation and its effects on velocity as if it were a phenomenon of the 1970s. We believe that such a short-run perspective is misleading. The events of the past 15–20 years may fruitfully be understood within the context of a longer-run picture."

I could not agree more with this point. Economists all too often resort to explaining each individual change in an economic series with a separate theory. This is in contrast to the more scientific approach of investigating whether the theory developed to explain today's occurrences is also consistent with information obtained from other times. For example, changes in velocity in the 1970s have often been explained as a result of institutional and financial innovation without regard to the potential role these factors may have played in other time periods. Bordo and Jonung are to be applauded for their investigation of whether institutional factors have had an impact on velocity not only during the period that motivates interest in the issue, but also over long and sustained periods throughout history. People may disagree about the details of how to best measure the impact of these factors on velocity, but hopefully there is no disagreement that it is beneficial to investigate whether there is any observable, sustained relation between institutional elements and velocity. In short, I like the overall approach of Bordo and Jonung very much.

3. EMPIRICAL EVIDENCE THAT INSTITUTIONAL FACTORS INFLUENCE VELOCITY

The empirical evidence that Bordo and Jonung present in support of their conclusion that institutional factors have provided a steady and pervasive long-run influence on velocity comes from ordinary least squares regressions of velocity on the standard money demand variables (income, interest rates, and expected inflation) plus a set of institutional variables that the authors select. Three findings are reported: (1) the institutional variables enter the regressions statistically significantly; (2) regressions that include the institutional variables are relatively stable over time; and (3) making use of institutional variables improves the out-of-sample forecasts for velocity during the last 10–15 years.

How well do these empirical results justify the conclusions being made? Not as well as the authors would like us to believe.

Turn first to the issue of institutional variables entering the velocity equations significantly. There are three such variables: *C/M*, the currency-to-money ratio (designed to measure the spread of commercial banking); *LNA/L*, the share of the labor force in nonagricultural pursuits (designed to measure the degree of monetization); and *TNBFA/TFA*, the ratio of total nonbank financial assets to total financial assets (designed to measure the degree of financial development). However, *LNA/L* enters significantly only when the regressions are run in level form and not when the regressions are run in first differences. Given the trend-like behavior of this variable, it appears likely that the regressions in level form are picking up a spurious correlation between velocity and *LNA/L*, and the focus of attention should therefore shift to the relationship of velocity with *C/M* and *TNBFA/TFA*.

Although *C/M* and *TNBFA/TFA* do enter the regressions significantly in both the levels and first-difference formulation, I am concerned about the ability of these variables to accurately and primarily reflect movements of the types of institutional factors envisioned by the authors. For example, *C/M* should be closely negatively related to the money multiplier, a proposition that I feel is well supported by an examination of Figures 6–10. Thus, a finding that an increase in *C/M* is correlated with an increase in velocity could well be interpreted as indicating that a decrease in the money multiplier will lower money supply and thereby raise velocity. With this interpretation, little or no particular interest in the type of institutional factors described by the authors is indicated. A similar point could be made with regard to *TNBFA/TFA*, as it is clearly an endogenous choice variable of the public, reflecting not only possible exogenous institutional factors but also a variety of other endogenous factors that are closely linked to standard money supply and demand models.

As regards the stability of the estimated velocity equations, it appears to me that the institutional variables do not play a crucial role. For the United States and Sweden, there is no statistically significant evidence of instability either with or without the institutional variables. For the United Kingdom and Norway, there is statistically significant evidence of instability both with and without the institutional variables. Only for Canada does the inclusion of the institutional variables turn an unstable relation into an apparently stable one.

Turning to the out-of-sample forecasts, the success of institutional variables is again far from overwhelming. Out-of-sample forecasting performance is improved dramatically for Canada, improved slightly for Sweden, worsened slightly for the United States and Norway, and worsened considerably for the United Kingdom. This evidence may be suggestive, but it should not be used to justify any strong conclusions.

4. ECONOMETRIC ISSUES

Several econometric issues arise in this article. The most important is the potential use of instrumental variables estimation. This arises in two ways. First, as previously mentioned, the endogenous nature of the regressors *C/M* and *TNBFA/TFA* make instrumental variables estimation a desirable procedure if one wishes to recover the behavioral relationships about which this article is concerned. The instruments chosen should be those variables that are most closely tied to the exogenous institutional factors the authors describe. For example, the number of banks per capita might be a good instrument for *C/M*.

The second use of instrumental variables arises from the role that expectations play in the velocity equations. Both permanent income and expected inflation are included in the analysis. These unobserved variables are replaced by proxies in the ordinary least squares estimation, a procedure that has been shown by Pagan (1984) to lead to reporting of incorrect standard errors. A preferred approach, which would yield correct standard errors, would involve using proxy variables (perhaps consumption as a proxy for permanent income and actual inflation as a proxy for expected inflation) and instrumental variables estimation as a standard procedure for dealing with errors-in-variables.

The final econometric issue I will address is serial correlation. The authors use a Cochrane–Orcutt correction, which constrains the lagged effects of all variables affecting velocity to decay at the same rate. I would have preferred to see a less constrained lag structure, obtained by including lagged variables in the regression directly as a method of dealing with serial correlation. In many cases, the only lagged variable to enter significantly is the lagged dependent variable. Correctly capturing the dynamic behavior of velocity is important in any attempt to measure the impact that various factors have on velocity.

5. CONCLUSION

This article was both interesting and informative. Though the authors and I may disagree over the conclusions that emerge from the empirical analysis, I nonetheless found the article to be enjoyable to read. The authors should be commended on their attempt to use a century's data to shed light on an important issue, the role of institutional factors in influencing money demand and velocity. They should also be commended on their breadth of empirical analysis. Evaluating the performance of the equation of interest by both in-sample Chow tests and out-of-sample prediction error criteria demonstrates a thoroughness that I truly appreciate. The liberal use of figures to illustrate the time series movements of key variables is also extremely helpful for understanding the data to be analyzed. Hopefully the insights developed in this article can lead to more conclusive empirical results in the future.

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