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Douglas Fisher and Walter N. Thurman

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1.0 INTRODUCTION

Among the European countries that operated on the periphery of the industrial revolution, Sweden stands out because of the unusual speed with which she developed once the industrialization process took hold. Before the industrial revolution, Sweden had a distinguished record as a European economic and political power and a solid economic base by the agricultural standard of the time, but somehow it was by-passed in the first industrial revolution (to 1850). Indeed, it has been claimed by Sandberg (1979) that Sweden was actually relatively "impoverished but sophisticated" in 1850 after 150 years of a relative economic decline (meaning that it had a growth rate significantly lower than the European average).[1] By "relatively sophisticated" Sandberg means that compared to other countries at the same state of development, Sweden "had a strikingly large stock of human and institu-

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We are grateful to Lars Sandberg, Richard Tilly, the members of the Triangle Economic History Workshop, and two referees for their helpful comments on earlier drafts of this paper.

[1]Lars G. Sandberg, "The Case of the Impoverished Sophisticate: Human Capital and Swedish Economic Growth before World War I," Journal of Economic History, 39 (March 1979), pp. 225-41.

tional capital."[2]

> This conclusion is based on data on literacy levels, numbers of students attending schools and universities, the quality and quantity of scientific and technical research, infant mortality rates and life expectancy figures, and the remarkable size and efficiency of the modern financial system.[3]

As a direct result, argues Sandberg, in the sixty years after 1850, "Sweden had the highest rate of growth of per capita GNP and the second highest rate of growth of total GNP" among the developing European countries.[4]

As any scholar of the Swedish economy knows, there exists an outstanding collection of numbers for the Swedish economy for the second half of the 19th century.[5] Drawn from the national income accounts, Figure (1) illustrates the level of real gross domestic product for Sweden from 1861 to 1910.

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[2] Ibid., p. 225.

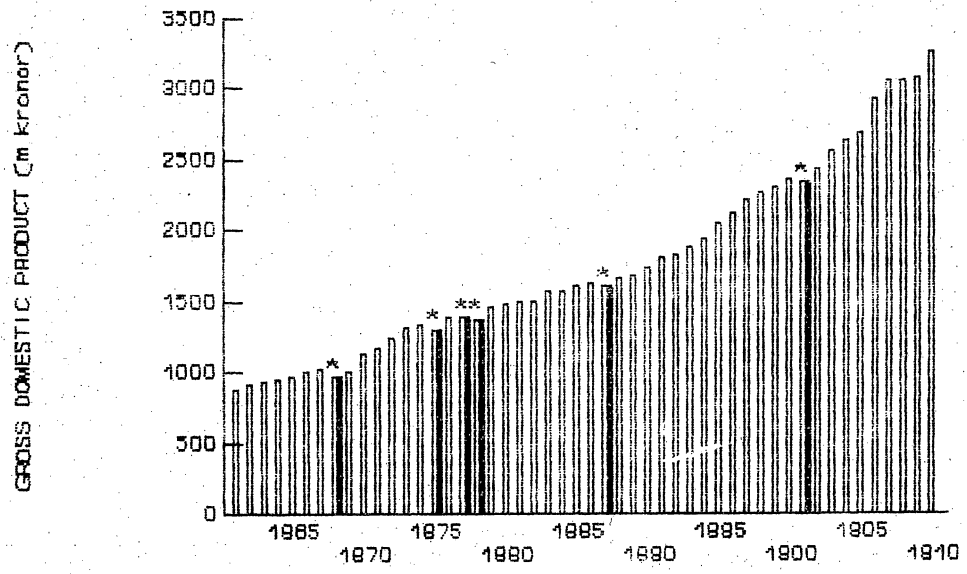
[3] Ibid.

[4] Ibid.

[5] The Swedish aggregate data for the last half of the 19th Century are possibly the best available for any country in that period. The national income accounts are complete on an annual basis and have been carefully built up from raw materials that are both very reliable and very detailed; the source used here is the work of Olle Krantz and Carl-Axel Nilsson, Swedish National Product, 1861-1970 (Lund, 1975), pp. 217. The monetary data are equally precise and are largely the work of Lars Jonung of the University of Lund; see Studies in the Monetary History of Sweden, Ph.D. Dissertation, University of California (Los Angeles, 1975), pp. 222. Not only are these statistics, too, built up from individual records for each year, but they enable a separation of the money stock into an M1 and an M2 series. This detail, too, is rare before the 20th Century. For our purposes, perhaps the most important point about the data is that they exist in long and parallel runs of annual observations that are especially useful for empirical testing.

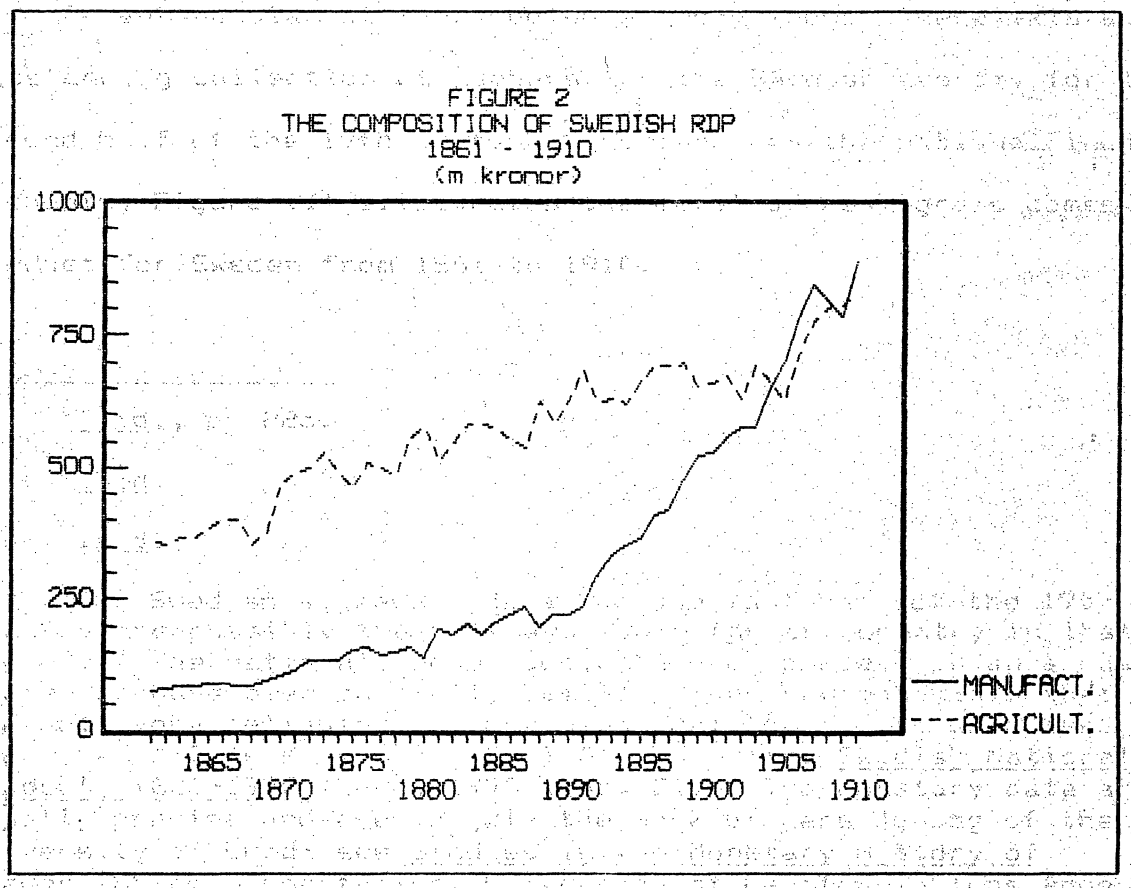
FIG. 1. SWEDISH GROSS DOMESTIC PRODUCT

1861 - 1910



Here it is apparent that growth was quite steady over the 1861 to 1910 period and that it accelerated somewhat toward the end (it was just over 3 percent per year for the last twenty years of this period). In this long upward stretch there are only six

years (1868, 1875, 1877, 1878, 1887, and 1901) when real domestic product declined from the previous year's level and only in the first of these was the decline in excess of 2 percent; the years are marked (*) and shaded in Figure (1). The speed of Sweden's development is not as apparent in Figure (1) as it is in Figure (2), which breaks out the agricultural and manufacturing components of real domestic product.[6]



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[6] In general the extractive industries are included in the "agricultural" sector in this study.

In this case, a roughly parallel growth of the two sectors until around 1891 is interrupted by a spurt in the manufacturing component of real domestic product that begins in 1888 and carries the latter from a level of roughly a third of agriculture's contribution (to RDP) to equality in just 13 years. This is an industrial transformation that truly can be called a revolution, at least as far as general numbers such as these can reveal.

In this paper we are interested in something we will provisionally call "financial sophistication," although in the final analysis this turns out to be an elusive concept. A version of Sandberg's proposition could be phrased as the notion that in 1850 something like "relatively excess financial capacity" existed from which the Swedish economy was able to make withdrawals, as it were, over the next sixty-odd years. Such a concept could be labelled "financial sophistication" possibly, but it would not be easy to grasp empirically. In any event, the notion has not been uniformly well-received in the literature.[7]

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[7] In "Sweden in 1850 as an 'Impoverished Sophisticate': A Comment," Journal of Economic History, 42 (December 1982), pp. 918-20, Charles P. Kindleberger takes a sharply critical view of Sandberg's proposition. He says (p. 918),

> Designation of Sweden in 1850 as sophisticated raises a question primarily because so many writers on the subject take the view that the Swedish banking and credit system prior to 1850 was antiquated.

In 1870, says Kindleberger, the financial system was well developed, but this development was primarily related to the rapid growth of the export industries. As evidence of this tradition, Kindleberger cites Eli F. Heckscher in An Economic History of Sweden (Cambridge, 1954), pp. 308, who says (p. 247),

Instead, in this paper we will examine financial sophistication by studying several financial variables in a series of time series tests that are consistent with the approach of Friedman and Schwartz in their recent Monetary Trends.[8] Our concepts of financial development are based on (a) the behavior of the velocity of money, (b) the magnitude of the income elasticity of the demand for money, and (c) the existence of economies of scale in commercial banking.

In Section (2) we establish certain institutional points about the development of the Swedish economy between 1850 and 1910. Most importantly, we note an especially rapid growth of banking in this period, with a rough coincidence between economic

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> ... by and large, there was no such thing as a capital market; hence the distribution of capital among various industries as well as individual firms was more fitful and haphazard than was really necessary. Around the middle of the century, the influence of banks began to make itself felt, ...

The sources of capital to industry, indeed, were the private savings of industrialists and foreign sources (pp. 247-8):

> ... the influx of foreign capital was one of the main prerequisites for the expansion of the Swedish economy throughout practically the whole period ending with the outbreak of the First World War.

There are many other earlier writers, as Kindleberger notes, who could be taken to agree with this.

In defense of Sandberg we should point out that his notion requires a comparison with other countries at similar stages of development. Thus the appropriate comparison (e.g.) would be with an English financial system of approximately a century earlier, in which case Sweden's system would certainly look a lot better, relatively.

[8] Milton Friedman and Anna J. Schwartz, Monetary Trends in the United States and the United Kingdom (New York, 1982), pp. 664.

and financial development. At the same time, we will go over the literature on the behavior of velocity in Sweden, emphasizing work by Bordo and Jonung on the determinants of velocity.[9] It seems that much of this literature actually treats the role of the financial sector in overall development as a causal matter, perhaps best phrased as whether (or in what sense) Swedish banking might have been a "leading sector" in Swedish development. If this is a reasonable interpretation, then it has a lot in common with the monetary-causality literature of recent years. That is, the argument put forward is very much like the "money matters" arguments advanced by monetarists and evaluated, for example, by Granger-Sims causality tests.[10] With this analogy in hand, Section (3) considers the results of Granger-causality tests involving bank assets, the money stock, the price level, real income and investment for Sweden from 1860 to 1910.

In Section (4) we turn to questions concerning the various measures of financial development proposed for Sweden. After a brief discussion, we settle on one for illustrative purposes: this is the velocity of money transformed into what we will call

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[9]Michael D. Bordo and Lars Jonung, "The Long Run Behavior of the Income Velocity of Money in Five Advanced Countries; An Institutional Approach," Economic Inquiry, 19 (January 1981), pp. 96-116 and The Long-run Behavior of the Velocity of Circulation: The International Evidence (Cambridge, 1987), pp. 181.

[10]The tests are described in Clive W.J. Granger, "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," Econometrica, 37 (July 1969), pp. 424-38 and Christopher A. Sims, "Money, Income, and Causality," American Economic Review, 62 (September 1972), pp. 540-52.

a financial sophistication index, along the lines suggested by Friedman and Schwartz.[11] This measure is then subjected to a battery of Granger-causality tests in order to evaluate the role of Sweden's financial sector in a more direct way than was possible in Section (3) - which considered financial influence in a strictly "money matters" context. Finally, in Section (5), recognizing that there are strong hints that the quantity of money is not an exogenously determined variable, we propose and test a simultaneous-equation model of the monetary sector, with the two equations being money supply and money demand. The purpose here is to permit an endogenous money stock and to pin down as precisely as possible the value of the income elasticity of the demand for money. As we will argue, this elasticity is an important measure of the state of the development of Sweden's financial sector. But the inclusion of a money supply framework produces yet another finding about Sweden's financial development in the 19th century. This is that there appear to be well defined and significant "economies of scale" in the Swedish banking industry at this time.

2. SWEDEN'S FINANCIAL DEVELOPMENT: A BRIEF REVIEW

By 1850, Sweden had in place a financial system that featured most of the technology of modern banking of that time, although it was geographically concentrated and not very impres-

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[11] Friedman and Schwartz, Monetary Trends, pp. 145-53.

sive when judged in per capita terms. As Ingemar Nygren puts it,

> ... the Swedish commercial banking system prior to the middle of the nineteenth century was notable for solidity and profitability, but it did lack liquidity. ... Deposits were negligible. ... the 1850s were the first decade to feature banking innovations and structural changes of significance for the future.[12]

Indeed, the impression from Nygren's detailed and well balanced discussion is that a significant contribution from bank development is more obvious from the 1870s onward than from the 1850s. There is no suggestion of significant financial development in 1850, but at the same time there is a distinct possibility that the financial industry was a "leading sector" after 1870, the period of most rapid growth.

In 1834, private banks (enskilda banks), aided by limited liability, began to issue currency and these issues grew to 43.2 per cent of the total note issue by 1859.[13] The enskilda were inhibited by regulation of the interest rates they could charge; furthermore, their deposit business was small. In 1863 the Bank Reform Act established private banking on the joint stock principle and permitted banks to lend at market interest rates. Banks, especially those outside Stockholm, quickly branched all over the country. From this point bank assets per capita rose

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[12] Ingemar Nygren, "Transformation of Bank Structures in the Industrial Period, The Case of Sweden 1820-1913," Journal of European Economic History, 12 (Spring 1983), p. 45.

[13] Lars G. Sandberg, "Banking and Economic Growth in Sweden before World War I," Journal of Economic History, 38 (September 1978), p. 661.

from 47.9 Kr in 1860 to 523.1 Kr in 1910. Indeed, as a percent of national income, they rose from 29.6 to 103.5 percent over the same period (a figure that was 13 percent in 1830).[14] During this period Sweden also had a central bank (the Sveriges Riksbank was chartered in 1656) that assumed "lender of last resort" functions in the 1890s. So, indeed, there was considerable institutional development during this period.

A series of studies authored by Jonung contains much of what we know about the development of the Swedish monetary system between 1860 and 1910.[15] An important consideration for our work is that from 1873 to 1910 Sweden was on the Gold Standard and maintained its position at an exchange rate that remained basically constant over the entire period (£ = Kr18.16, $ = Kr3.73).[16] Even so, as Jonung explains,[17] the Swedish central bank and commercial banks were not rigorously tied to gold inflows and

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[14] Ibid., pp. 650-51.

[15] Lars Jonung, Studies in the Monetary History of Sweden; "Money and Prices in Sweden, 1732-1972," Scandinavian Journal of Economics, 78 (No. 1, 1976), pp. 40-58; "Sources of Growth in the Swedish Money Stock, 1871-1971," Scandinavian Journal of Economics, 78 (No. 4, 1976), pp. 611-27; "The Long-Run Demand for Money--A Wicksellian Approach," Scandinavian Journal of Economics, 80 (No. 2, 1978), pp. 216-30; "Monetization and the Behavior of Velocity in Sweden, 1871-1913," Explorations in Economic History, 20 (October , 1983), pp. 418-39; and "Swedish Experience under the Classical Gold Standard, 1873-1914," in Michael David Bordo and Anna J. Schwartz (eds.), A Retrospective on the Classical Gold Standard, 1821-1931 (New York, 1984), pp. 361-99.

[16] Actually, Sweden, with Norway and Denmark, formed the successful Scandinavian Monetary Union over this period.

[17] Jonung, "Swedish Experience under the Classical Gold Standard," p. 376.

outflows by reserve requirements, so the money supply was at least partly able to react to internal pressures. From the point of view of this study, this finding suggests that the money stock should not necessarily be taken as exogenously determined, depending on what factors influence the note issue and bank deposit supply decisions and, of course, depending on private decisions to use money in financial and commodity transactions.[18]

Another important question addressed in the Swedish literature concerns the steady decline of the income velocity of money during this period. As we shall argue below, this phenomenon is not unusual in less financially-developed countries, and the Swedish experience in this respect compares rather remarkably with that of the United States in the same period.[19] The general hypothesis is

> . ... The downward trend in velocity is due to the process of monetization. This process is made up of ... (1) the decline of barter and payments in kind ... and (2) the rise of a commercial banking system supplying the public with notes and

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[18] In the standard setup of Philip Cagan in The Determinants and Effects of Changes in the Stock of Money, 1875-1960 (New York, 1965), pp. 380, the contributions to the money stock of the currency-money ratio (C/M), the reserves-deposit ratio (R/D) and the monetary base (generally defined to be bank reserves plus currency in the hands of the public) are measured under the assumption that these proximate "determinants" are uncorrelated with each other. Over the 1871 to 1896 period, Jonung, in "Sources of Growth in the Swedish Money Stock," finds that the monetary base contributes slightly less than 50 percent to the growth of the money stock while from 1897 to 1913 it has a much closer relation to money growth. The two (presumably endogenously determined) ratios provide the remainder of the effect.

[19] The United Kingdom in this period is clearly relatively financially sophisticated. In the United Kingdom the velocity of money rose very slightly over the same period. See Figure (3).

deposit facilities.[20]

These changes are institutional in nature say Bordo and Jonung, who study the velocity function in terms of a large number of potential determinants.[21] In any case, what we will do in the remainder of this paper is undertake a formal causal analysis of the influence of such structural factors, and account for the direct (causal) influence of money, bank assets, etc. on real income itself. We are also interested in the value of the income elasticity of the demand for money, since high values here could suggest a lack of financial sophistication in that as a "luxury" good, money has not reached its potential (unsophisticated) users. This is not an independent factor, of course, but is tied up with the behavior of the financial sophistication index.

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[20]Bordo and Jonung, "The Long-Run Behavior of the Income Velocity of Money," p. 98. In an earlier work, Lars Jonung in "The Long-run Demand for Money," puts foward roughly the same view.

[21]Proxies suggested and used by Bordo and Jonung are the percentage of the labor force in nonagricultural activities, the currency-money (C/M) ratio and the ratio of nonbank financial assets to total financial assets. These also appear in Friedman and Schwartz's Monetary Trends. A broader set of financial variables is tested separately by Jonung in "Monetization and the Behavior of Velocity," over the 1875 - 1913 period. Here C/M, the ratio of cash payments to the total wages of farmhands, labor's share in national income, and the ratio of urban population to the total population produce significant coefficients in a log-linear test of the velocity equation.

3. THE CAUSAL RELATION BETWEEN THE FINANCIAL SECTOR AND THE ECONOMY

In the course of the preceding discussion several hypotheses have emerged with respect to the lines of causation in Sweden's rapid industrial development before 1914. So-called causal tests clearly are not very powerful devices for uncovering causal links because of their astructural nature (for one thing), but when combined with other information developed by economic historians they do provide information that has a bearing on some of the existing disputes in the literature. Most importantly, as seen below, they can suggest areas into which one might look for a deeper - structural - understanding of what is driving the system.

To this point we have argued that financial development seems strongest just at (and not noticeably before) the period of most rapid growth in real domestic product. One can certainly argue that the economic "climate" was right for a broad and sustained take-off - and it clearly was, given the results - but a formal causal analysis, being sensitive to non-obvious leads and lags, seems better than leaving the financial hypothesis in such an imprecise position. The method used here is the Granger-causality test as applied to the following regression equation.[22]

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[22] See Granger, "Investigating Causal Relationships." An F-test is applied to the ratio of the sum of squared residuals from Equation (1) compared to the sum of squared residuals from the same regression, with each δ_i restricted to zero.

$$(1) \qquad y_t = \alpha + \sum_{i=1}^{n} \beta_i y_{t-i} + \sum_{i=1}^{n} \delta_i x_{t-i} + e_t$$

In this setup, x will be said to cause y if the δ coefficients are statistically significant as a group. Significance here is judged by an F-test, carried out at a 5 percent level of significance.

The place to begin this discussion is with the traditional money-neutrality test, conditioned immediately by our interest in the development of the Swedish banking system. That is, the first empirical excursion here is related to the causation among financial assets, real income, and the price level but with the emphasis on the role of the financial assets. These results are reported in Table (1). The variables here are bank assets and broad and narrow money (M2 and M1), and the potential objects of their influence are real domestic product (RDP) and its deflator (P).[23] Note that the tests in the table are expressed in pairs with direct causation appearing first and "reverse" causation appearing immediately below; note, also, that all variables are in logs and that the real and financial variables are in per capita terms. Finally, note that an asterisk indicates rejection at a 5 per cent level of significance (i.e., it indicates that

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[23]The national income and price data employed in this study come from Krantz and Nilsson, Swedish National Product. The financial and monetary data are from Sandberg, "Banking and Economic Growth," and Jonung, Studies in the Monetary History of Sweden. Michael Bordo kindly supplied corroborating data and a long-term interest rate from a recent study (co-authored with Lars Jonung) of velocity (The Long Run Behavior of the Velocity of Circulation).

Granger-causality is established).

TABLE 1
MONEY AND REAL ACTIVITY IN SWEDEN
1871 -1910

		Levels of Significance (p-values) for lags of 1	2	3	4
1.	Bank assets causing RDP	.74	.92	.48	.15
	RDP causing bank assets	.0001*	.01*	.01*	.05*
2.	M1 causing RDP	.83	.85	.95	.86
	RDP causing M1	.07	.003*	.003*	.002*
3.	M2 causing RDP	.50	.68	.40	.13
	RDP causing M2	.00001*	.002*	.002*	.01*
4	M1 causing prices	.06	.004*	.06	.02*
	Prices causing M1	.0003*	.00001*	.0002*	.0001*
5.	M2 causing prices	.68	.03*	.19	.20
	Prices causing M2	.52	.09	.48	.56

* Significant results (at .05 level).

The results in Table (1) strongly suggest that both bank assets and money, the latter defined as broad money (M2) or narrow money (M1), are Granger-caused by real income in this period and not the converse (a separate set of results, not shown, for 1861 - 1910 are very similar in this respect).[24] Similarly, both

[24] In the tables that follow, generally only results for 1871 to 1910 are presented. In every case where it was possible, the tests were extended back to 1861. There were only rare cases where this made any difference and those cases are reported either in the tables or in the footnotes. We present the 1871 results solely for consistency of display.

measures of money Granger-cause the price level. These are typical results in the causality literature, and they do not imply any special causal role for the financial sector as a leader in economic development.

There is an important exception in Table (1), though, and that is the strong result in the second part of line (4) for M1, of what is often called "reverse causation" between prices and money. This result, which shows that prices also drive money is possibly related to Sweden's failure to play by the rules of the international gold standard. In turn, it suggests that the Swedish money stock might be endogenous. Another sharp difference between the two measures of money will be seen in a moment, when we look at a financial sophistication index constructed partly from the money stock measures.

Table (1), then, does not suggest that the financial sector was a leading sector. According to the first test reported, indeed, there is no direct link to real domestic product per capita. Conversely, as suggested above, it appears to be rapid real growth that pulled along the banking system and the money supply. While this is certainly interesting, it is not remarkable. However, the possibility does exist that the links are less direct, as many writers have suggested, and that the influence of money is on capital formation (that is, on real domestic investment) and then from investment to real income (along with a host of other influences). To see if this is the case for Sweden, we looked at causal links (taken singly) between

the financial assets and real per capita domestic investment (RDI) and then between investment and real income. Again, all variables are measured as natural logarithms. The results are in Table (2).

TABLE 2

MONEY, INVESTMENT AND REAL INCOME
IN SWEDEN

1871 - 1910

	Levels of Significance (p-values) for Lags of 1	2	3	4
1. Bank assets causing RDI	.08	.0002*	.01*	.05*
M1 causing RDI	.00001*	.00001*	.001*	.0001*
M2 causing RDI	.04*	.002*	.06	.10
2. RDI causing bank assets	.79	.91	.69	.16
RDI causing M1	.002*	.08	.55	.80
RDI causing M2	.77	.84	.70	.17
3. RDI causing RDP	.08	.32	.51	.69
RDP causing RDI	.02*	.02*	.04*	.06

* Significant results (at .05 level).

In this case, in the first set of results, there appears to be a strong causal line running from financial entities to investment (the signs here are positive in the underlying regressions). Investment, in turn, in Set (3) appears to be Granger-caused by real income (and possibly the converse). It appears, then, that the Swedish financial system actually did play a role in stimulating Swedish investment during the industrial revolution. It also seems that Swedish investment

spending was important to Swedish growth but that the causal link between bank assets and real income was dominated by the very strong demands of economic growth on the financial system (by a kind of reverse causation). On net, these Granger-causality tests provide little support for the leading-sector hypothesis.

4. SWEDEN'S FINANCIAL SOPHISTICATION: FURTHER EXPLORATIONS

This section will consider how the behavior of velocity - transformed into a "financial sophistication index" - might both cause and be caused by the variables at hand. What Friedman and Schwartz do is take the velocity series of each country, invert it, and then multiply the result by 52. This index then gives the number of weeks of national income that the current money stock will finance. Velocity itself has reasonable credentials as a measure of financial development, since high velocities might suggest inadequate stocks of money relative to spending. Indeed, in the early stages of development when financial markets present few liquid alternatives to money, it seems reasonable to employ velocity in this capacity, at least as a first approximation. In later stages of development, however, when financial intermediaries come on stream (with money substitutes), this interpretation is not credible. Indeed, in the later experiences of the developed countries, velocity often tends to rise as money

substitutes are developed; it did so in Sweden.[25] But for the pre-1914 Swedish data for which velocity is declining steadily, we can possibly neglect the influence of intermediaries and if so, the decline of velocity/rise of the financial sophistication index can be interpreted as we do.[26]

In Figure (3) the three countries (the United States, the United Kingdom, and Sweden) are compared in terms of the financial sophistication index just described. Here Sweden and the United States appear to have had common experiences over the period, while the U.K. index fluctuates around a constant level. For comparability, the money stock here is M2 in all cases.

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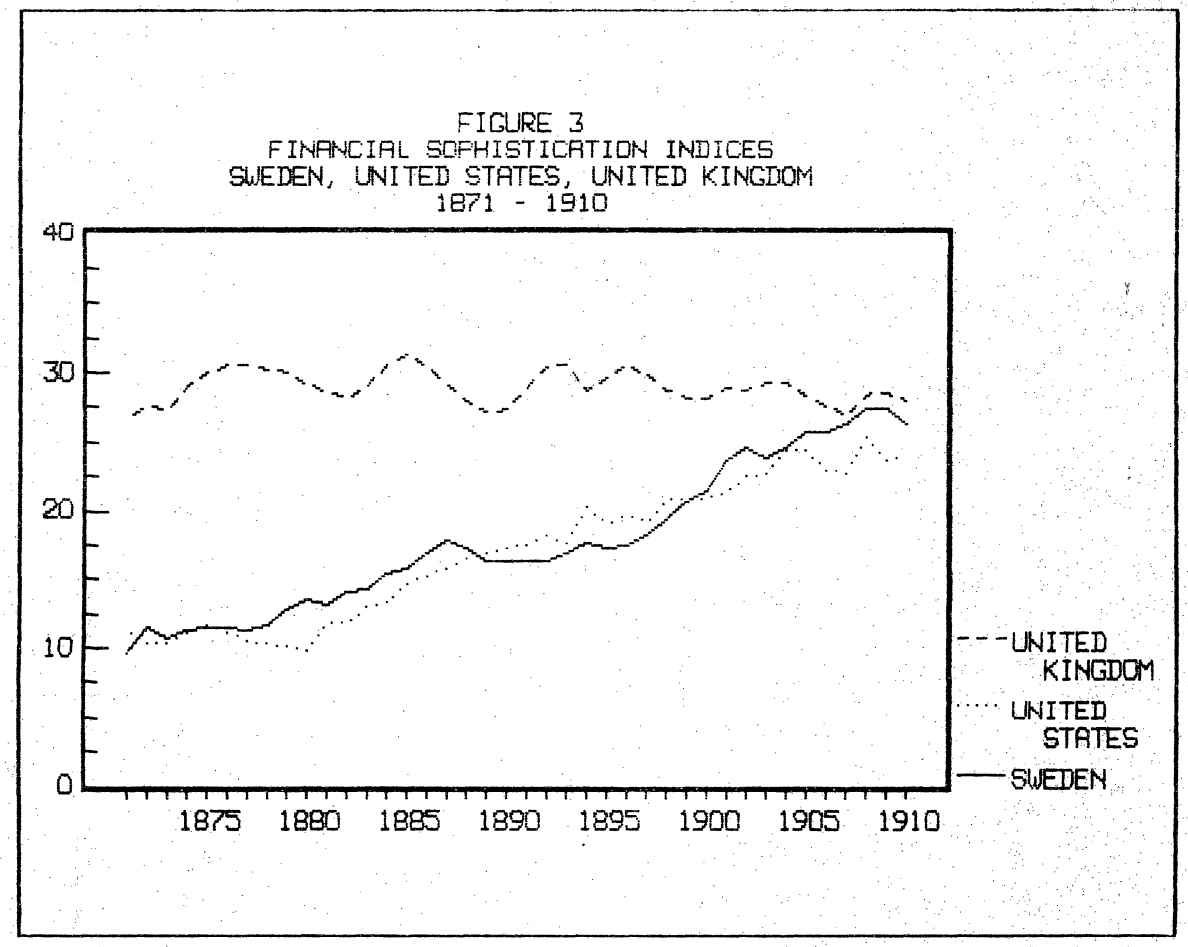
[25] In their recent study of the behavior of velocity, Bordo and Jonung, The Long-run Behavior of the Velocity of Circulation, pp.22-23, argue that the period of declining velocity is the result of the monetization process, whereas the period of the rising velocity is the result of increasing financial sophistication. "Financial Sophistication" in this case is defined as both the emergence of a large number of substitutes for money and the development of various methods of economizing on money balances. We are, of course, suggesting that monetization itself brings financial sophistication and, in any case, are studying only the period of declining velocity.

[26] Of course, there are other forms of money, ranging from the sublime (commercial bills) to the ridiculous (reindeer skins). The former are certainly in increasing use in this period, although in the absence of really good figures on their volume, it is not possible to offer more than the conjecture that they did not influence the demand for money sufficiently to disrupt our proposition.



What Friedman and Schwartz say about the United States in the 1870s (compared with the United Kingdom) is

> The United States, by contrast, though wealthier and more populous, was still financially backward, conducting its international trade largely in sterling. Nearly three-quarters of the population was classified as residing in rural areas, and half of the working force (male and female) was still in agriculture. ... These differences meant a much higher demand for money relative to income by United Kingdom than by United States residents.[27]

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[27] Friedman and Schwartz, Monetary Trends, p. 146.

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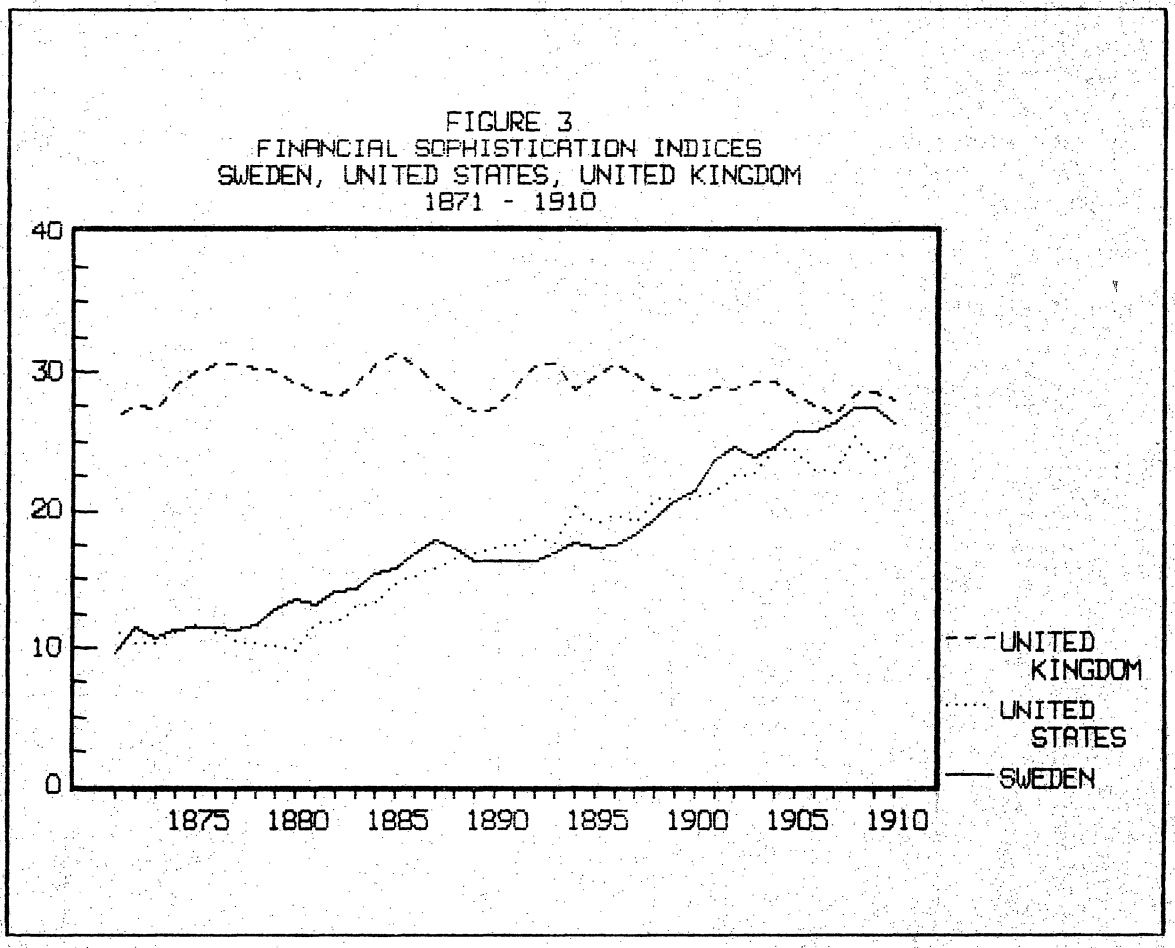

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[27] Friedman and Schwartz, Monetary Trends, p. 146.

Indeed, say Friedman and Schwartz, much of the change to a sophisticated economy occurred between 1870 and 1906. In any case, as Figure (3) makes clear, Sweden's experience parallels that of the United States as judged by the financial sophistication index. And, as we saw in Figure (2), in 1875, indeed the value of Swedish agricultural output in gross domestic product was four times that of its industrial output (the two were dead even in 1905). Needless to say, a significant majority of her workers also were in the agricultural sector.

The main issue in this section concerns the determinants of the Swedish financial sophistication index itself - of velocity, that is to say - during the period of her industrialization. It is not hard to find suggestions for the determinants of velocity in the literature. The most obvious is bank assets per capita which could suggest, given the demand for bank services, a supply influence on Sweden's financial sophistication. Interest rates are also often mentioned as determinants of velocity, since a fall in the nominal interest rate (as occurred in this period) would, other things being equal, increase money holding, decrease velocity, and, accordingly, increase the financial sophistication index. Then, too, there are nonfinancial influences. Bordo and Jonung and, separately, Jonung,[28] for example, mention the rise

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[28]Bordo and Jonung, "The Long Run Behavior of the Income Velocity of Money"; Bordo and Jonung, The Long-run Behavior of the Velocity of Circulation; Jonung, "Monetization and the Behavior of Velocity"; and Jonung, "Swedish Experience under the Classical Gold Standard."

of industry and commerce and of urbanization and use the currency/money ratio, labor's share of GNP, the ratio of urban population to total population, the percent of the labor force in non-agricultural activities, and the number of inhabitants per bank office among other "institutional" variables. These variables seem reasonable, certainly, in view of what we reported in Figure (2). Not all of these are available in time series, of course, but many of these potential influences are considered in our causal tests.

Table (3), then, groups the variables proposed into potential money-demand, financial structure, and industrial sector categories. The theme of the table is that of locating the factors that are the determinants of financial sophistication in Sweden and, in the last column, of identifying those financial or real entities that are themselves influenced by the financial sophistication index. The table contains the p-values obtained from the Granger-causality tests, and we have marked with an asterisk those that imply significant causation. Note that the measure of financial sophistication uses M2, not M1, since the literature suggests that it is the banking sector as a whole that is involved and not just its demand deposit and note-creating activities.[29] Note also that the rare instances of reverse causation - meaning that the index itself influences the vari-

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[29] In any event, the same tests were run using M1. There are some differences, with interest rates affecting the M1 version of the financial sophistication index, and with the industrial structure variables not providing any effect in that case.

ables listed on the left - are indicated in the last column of the table.

TABLE 3

CAUSAL INFLUENCES ON SWEDISH FINANCIAL SOPHISTICATION
1871 - 1910

Causal Agent	p-Value for Lags of 1	2	3	4	Sign	Reverse Causation
Demand Factors						
1. Interest Rate-short	.04*	.06	.06	.12	+	No
2. Interest Rate-long	.33	.36	.49	.61	...	No
3. Interest Rate-Consol	.41	.03*	.03*	.05*	...	No
4. Real Income per Cap.	.002*	.01*	.01*	.01*	...	No
5. Currency/M2 (C/M)	.38	.73	.37	.22	...	Yes
Financial Structure						
6. Bank Assets per Cap.	.01*	.06	.14	.14	+	No
7. Real Money per Cap.	.002*	.01*	.01*	.01*	...	Yes
8. Reserves/Deposits(R/D)	.01*	.19	.29	.20	-	No
9. Bank Offices per Cap.	.62	.93	.87	.99	...	No
10. High-Powered Mon (H)	.22	.85	.97	.99	...	Yes
Industrial Structure						
11. Manufacturing/RDP	.002*	.07	.19	.32	+	No
12. Ag/Mfg in RDP	.01*	.10	.26	.44	-	No
13. Nonag Employ percent	.01*	.34	.56	.71	+	No

*Significant results (at .05 level).

In these results there appears to be a mixture of structural, demand and financial supply influences on Sweden's financial sophistication index. Generally, financial sophistication does not affect any of the real variables in the system (see the last column in Table (3)), so that seems to dispose of the possibility that the financial system was a (causally) leading

sector. At the same time, variables from each of the arbitrary categories, demand, financial structure, and industrial structure factors, are shown to Granger-cause the financial sophistication index. Clearly, velocity in Sweden is driven by market and structural factors (and by real and financial factors). This is what the historical literature described above claims, although our tests provide an empirical corroboration. Note that of the three "proximate" determinants of money (C/M, H, and R/D), only R/D has an influence on financial sophistication, while causation runs the other way for H and C/M. This implies that the monetary determinants approach is invalid for Sweden; it may also imply that Sweden's money stock is endogenously determined as suggested above. In sum it appears that in a very broad sense the domestic economy drove Sweden's financial sector for the most part, with the banking sector showing an influence primarily on other financial variables rather than on real variables.

5.0 FINANCIAL SOPHISTICATION AND THE DEMAND AND SUPPLY OF MONEY

In the quotation above from Friedman and Schwartz, reference was made to the demand for money. They point out that the income elasticity of money demand is higher in the United States than in the United Kingdom in this period and that, indeed, in the United States its income elasticity is significantly greater than unity (even when adjusted for the increase in financial sophistication in the United States). If so, then money (M2 in their case) is a luxury good in this period and this can be taken as further

indirect evidence of a relative lack of financial sophistication in the United States. The same argument can be advanced for Sweden, of course, and so this section will look into questions concerning the income-elasticity of the demand for money. As we will see, though, econometric considerations force us to estimate the demand for money in a simultaneous-equations framework. This is the result of the fact that the money stock is evidently endogenously determined in Sweden (as we have already argued at several points in this study). But, as we shall demonstrate, there is additional information on financial sophistication to be gleaned from the money supply function.

Single-equation estimates of a standard log-linear demand for money function tend to support the idea of a lack of financial sophistication in this period, as revealed by the following results for 1871 - 1910.[30]

$$M1_t = a + \underset{(5.12)}{.535}\, M1_{t-1} + \underset{(4.71)}{.742}\, y_t - \underset{(5.57)}{5.927}\, i_t \qquad \bar{R}^2 = .996,\ DW = 1.974$$

$$M2t = a + \underset{(15.96)}{.930}\, M2_{t-1} + \underset{(1.27)}{.167}\, y_t + \underset{(.97)}{.898}\, i_t \qquad \bar{R}^{-2} = .990,\ DW = 1.772$$

The numbers in parentheses are t-values. Here the interest rate is the Bank of Sweden's discount rate (the only short-term rate available) and the long-run income elasticities for the two measures of money are 1.597 for M1 and 2.400 for M2. These

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[30]The variables are narrow (M1) and broad (M2) money and are measured in log real per capita form. The Cochrane-Orcutt adjustment was employed to deal with serial correlation in the residuals.

numbers compare favorably with those produced by Friedman and Schwartz for the United States (for M2, the elasticity is not as high).

The results just given are suggestive, of course, but have two major problems. Most obviously, perhaps, the result for M2 is poorly determined with only the lagged dependent variable being significant; this difficulty continues to trouble our experiments in the remainder of this section and so most of our reported results refer to M1. The second problem is that the evidence of simultaneity that we discussed earlier is not dealt with by these OLS-single equation models. At the least, a two-stage least squares approach should be adopted, and possibly one might need to take a systems approach (of money demand and money supply simultaneously determined) to deal with the endogeneity problem. We will do both of these things in what follows, although the two-stage estimates are sufficient to tell the story.

Our discussion so far indicates that the money stock in Sweden was an outcome of an equilibrium determined within Sweden. That is, the Swedish money supply is partly endogenously determined although, of course, subject to exogenous factors from both national and international markets. Thus, for example, an increase in income would tend to increase the demand for money which, in turn, bids up the price of monetary services and, ultimately, leads to an increase in the money stock. This line is suggested by the Granger-causality test, which suggests (a)

that the real sector of the economy equilibrates independently of the monetary sector and (b) that the money stock and interest rates are basically the outcome of the equilibration of the demand and supply of monetary services.[31] This, then, suggests the appropriateness of a model of money demand and supply in which the quantity of money and Swedish interest rates are the endogenous variables.

Let us follow Benjamin Klein in constructing such a model.[32] Suppose, first, that the banking system is competitive. By this we mean that both the commercial banks and the Riksbank behave competitively (in their money supply behavior), by which assertion we mean that the depositors of these institutions are forced to bear the marginal costs of maintaining their deposits. This is clearly acceptable for the private banks, but whether currency was supplied on that principle, particularly after the Riksbank assumed total control of the note issue (after 1903), is certainly debatable. It is also essentially moot in this study, since the sample ends in 1910.

The demand for real money balances, as before, is assumed to be a function of the nominal interest rate and real income.[33]

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[31] Recall that Swedish GDP Granger-causes money but not the converse.

[32] Benjamin Klein, "Competitive Intrest Payments on Bank Deposits and the Long-Run Demand for Money," American Economic Review, 64 (December 1974), pp. 931-49.

[33] We will assume that both the demand and supply functions used here are stable over the 1871 - 1910 period.

The supply of money, though, is not a function of the same variables (at least directly) because of the need to model technical factors in money supply. In particular, as in the theory of the (banking) firm, we will assume that a higher real quantity of money will be supplied only in expectation of a higher marginal profit in the banking industry. To make this notion precise requires a specification of the price of money services that is relevant both to suppliers and demanders and is thereby capable of equilibrating the market for the services of banks.

Consider, first, the rental price of money faced by the representative consumer. Let us assume that the consumer can hold wealth in two forms: as (narrow) money or as an asset that generates no flow of monetary services. The latter asset pays a nominal rate of interest of i. Assuming that no interest is paid on currency but that interest is paid on deposits at the rate r_D, the average return to holding money is then $(D/M)r_D$, where D is deposits, C is currency, and M=C+D is money. The opportunity cost of holding money, then, is $P_M = i - (D/M)r_D$. This is the proper measure of the rental price of money. It is the price attached to the flow of monetary services and it is what we would put into the following demand for money function.

$$M_D = f(y, P_M) \tag{3}$$

Above we said that because of our assumption of competition the holder of one krona in deposits must pay the actual marginal

cost of producing that deposit. The marginal cost, we may suppose, is the opportunity cost of holding reserves against the deposit. Assume, then, that the bank holds the quantity MRD (kronor) for each additional krona of deposits (MRD being the marginal reserves to deposits ratio). Let us also assume that the bank's marginal investment opportunity cost is represented by the same nominal interest rate i. Then the marginal cost to the bank of providing a deposit is [(MRD)*(i)] per time period. Equating the deposit holder's cost to the marginal cost of producing a deposit yields the equation [$i - r_D = (MRD)*(i)$] which is the same thing as

$$r_D = i(1 - MRD) \tag{4}$$

This becomes the structural equation for money supply in a competitive financial system, because of the obvious dependence of MRD on the size of the money supply (since $M \equiv C + D$).

Increasing costs of providing banking services enter into this framework as increases in MRD, the marginal reserves-to-deposit ratio. In particular, it is possible that as banks expand into new locations, they make themselves less liquid and that this induces them to hold more reserves per deposited krona. MRD would then be increasing in M ($\equiv C + D$). Conversely, economies of scale in banking would be reflected in an MRD that declines with M. In either case - that is, whether one has increasing or decreasing costs - the actual quantity of money supplied is not predetermined and depends on where we land along

the supply curve. That, of course, depends on money demand as well. In general that is to say both M and r_D are determined simultaneously by the supply function just given and the demand for money.

To put the model into empirical terms, we must now state which variables are equilibrating in the Swedish money market and which might be fixed by foreign markets. For interest rates, we do have a series on the return on deposits (r_D) in Sweden. In terms of the discussion just undertaken, this rate is taken to be the endogenously-determined rate. In this case equilibrium in the Swedish money market can be described by the supply function (Equation (4)) and the conventional money-demand function provided in Equation (3). We will now proceed to estimate this model.

5.1. ESTIMATES

Friedman and Schwartz have argued that there is a close integration of the American and British capital markets during this period.[34] It seems likely to us that in the second half of the 19th century, the Swedish capital market might also have shared in the international capital pool and so we will, here, extend that hypothesis to include the Swedish capital market. The way we will implement this is to take as the opportunity cost of Swedish funds (i) the U.S. corporate bond rate, as published

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[34] Friedman and Schwartz, Monetary Trends, pp. 305-38.

by Friedman and Schwartz.[35] This will turn out to be a useful strategy in an empirical sense in what follows. For the domestic rate, the return on deposits, we will use the only short-term rate currently available to us, the Bank of Sweden discount rate. Note again that our definition of money is an M1 measure and income is real domestic product.

Let us return to the demand function in Equation (3) and linearize as follows.

$$m_{Dt} = \beta_o + \beta_1 P_{Mt} + \beta_2 y_t + e_t$$

Here m_{Dt} is per capita real money, P_{Mt} is the rental price of money defined above, y_t is per capita real domestic product, and e_t is a random error. Substituting in the defintion of P_M yields the final estimating equation for money demand.

$$(5) \qquad m_{Dt} = \beta_o + \beta_1 [i_t - (\frac{D}{M})_t r_{Dt}] + \beta_2 y_t + e_t$$

where $(D/M)_t$ is the deposit-to-money ratio and i_t is the U.S. corporate bond rate. The real money and real income measures in Equation (5) are taken to be in per capita terms.

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[35] Ibid., p. 122-3. Bordo and Jonung, The Long-run Behavior of the Velocity of Circulation, p. 92 and Jonung, "Swedish Experience under the Classical Gold Standard," suggest using the British bond rate to measure the opportunity cost for holding money. We did, but the results were not as well determined as with the U.S. corporate bond rate. We note, in view of our work both above and below, that Bordo and Jonung are pessimistic about the possibility of applying the Klein model to the Swedish data for this period.

Table (4) reports a two-stage least squares estimate of Equation (5). As noted, the two stage least squares approach was required because of the need to treat m_{Dt} and r_t as endogenous variables. In addition, the table lists two autoregressive (AR) coefficients; this proved to be necessary because of the pattern of serial correlation in the residuals (e_t) in Equation (5). Because of the AR terms, the method of estimation employed is nonlinear two-stage least squares. The instruments used in the Table (4) estimates are i, y, the agricultural and manufacturing components of y, two lags of the preceding variables, and two lags of r_D and m. The fit of the model is quite good, with β_2 and the AR coefficients particularly well determined.[36]

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[36]The estimates of Table (4) are consistent under the maintained hypothesis of simultaneously determined r_D and m. Is there evidence that r_D is endogenous in the demand for money? The evidence comes from a Wu-Hausman test of the predeterminedness of r_D in (5). See De-Min Wu, "Alternative Tests of Independence between Stochastic Regressors and Disturbances," Econometrica, 41 (July 1973), pp. 733-50 and J.A. Hausman, "Specification Tests in Econometrics," Econometrica, 46 (November 1978), pp. 1251-71 . The Wu-Hausman test compares (nonlinear) OLS estimates of (5) with the (nonlinear) 2SLS estimates. Under the null hypothesis of a predetermined interest rate, both OLS and 2SLS are consistent and their difference should be small. If their difference is significantly different from zero, then the Wu-Hausman test rejects the null hypothesis. The Wu-Hausman statistic, which is asymptotically standard normal under the null hypothesis, takes the value 6.082 for the specification reported in Table (5), thus rejecting the predeterminedness of r_D.

TABLE 4

NONLINEAR 2SLS ESTIMATES OF SWEDISH MONEY DEMAND

PARAMETER	ESTIMATE	ASYMPTOTIC STANDARD ERROR
β_0	3.911	10.101
β_1	-3.270	1.630
β_2	.110	.019
AR1	1.161	.150
AR2	-.435	.147

The Durbin-Watson statistic is 2.11

The interest elasticity of money demand is that with respect to P_M, the rental rate of money. That elasticity, calculated at the sample means, is -.169.[37] The income elasticity of the demand for money from Table (4), evaluated at the sample means, is 1.055. It is significantly positive but is not significantly different from unity. M1, at least, is not a luxury good in Sweden at this time and this aspect of a lack of financial sophistication is not supported here.

5.2. MONEY SUPPLY AND ECONOMIES OF SCALE

We also have an interest in the supply function that we derived above since it may have some bearing on the topic of

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[37]The mean-evaluated elasticity with respect to i from Table (4) is -.331. Holding i constant, the elasticity with respect to the return on demand deposits, r_D, is .162. Both signs are the expected ones: an increase in foreign interest rates increases the opportunity costs of holding Swedish bank deposits and (thereby) reduces the demand for money; an increase in domestic interest rates increases the demand for domestic deposits.

financial sophistication. Indeed, a plausible notion of financial sophistication has to do with how the marginal cost of banking services changes with changes in the quantity of money. Decreasing marginal costs would imply yet-to-be-exploited economies of scale and financial unsophistication in this sense, while increasing costs would suggest a banking system without this potential.

The supply equation which we have postulated appears as Equation (3) above; it is a function of the marginal reserves-to-deposits ratio (MRD) and the opportunity cost (i_t) of funds to the banks. Let us assume that MRD is a linear function of real per capita money balances (m_t) as in

$$MRD_t = \delta_o + \delta_1 m_t$$

If we substitute this into Equation (4), we then have our final estimating equation for money supply.

(6) $$r_{Dt} = i_t(1 - \delta_o - \delta_1 m_t) + u_t$$

Increasing costs in banking then would be represented by a positive parameter δ_1, while decreasing costs would appear as a negative value of δ_1. Using the same definitions of i, m, and r_D as in the money demand estimates, Table (5) presents the estimates of Equation (6). As in the case of the money demand function, there is an AR(2) structure to the residuals from Equation (6). The two AR parameters, along with the structural parameters in (6), are again estimated with nonlinear 2SLS. The

instruments employed to deal with the endogeneity of m_t are the same as those used in the demand estimates: i, y, the agricultural and manufacturing components of y, two lags of the preceding variables, and two lags of r_D and m.

TABLE 5

NONLINEAR 2SLS ESTIMATES OF MONEY SUPPLY

PARAMETER	ESTIMATE	ASYMPTOTIC STANDARD ERROR
δ_0	.3445	.1382
δ_1	-.0124	.0033
AR1	1.0437	.1391
AR2	-.4607	.1394
Durbin-Watson statistic = 2.234		

The most important result from Table (5) is the sigificantly negative estimate for δ_1, implying marginal costs of banking that decline with the quantity of money; that is, there appear to be increasing returns-to-scale in Swedish banking in the 19th Century. The increase in returns to deposits is apparently due to the lower marginal cost of providing them at their new higher level. In addition, the mean-evaluated elasticity of r_D with respect to m is .459; that is, a 1 percent increase in the real per-capita money supply will lead to a .459 per cent increase in the return to deposits.[38] The significance of this effect in the

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[38] Put differently, the sample mean of r_D of 4.722 per cent implies that a 1 per cent increase in the real quantity of money will increase the return to deposits by approximately two basis points.

1860 to 1910 period is that the total sample variation in the real per capita money supply over the sample period accounts for slightly more than half a percentage point in the variation in the return to deposits. More importantly, from the point of view of this study, it appears that the financial system of Sweden had unexploited economies of scale that were available as the demand for financial services expanded during Sweden's industrial revolution. A simultaneous-equations estimate of this system confirms these results.[39]

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[39]The two equations discussed in this section were estimated simultaneously with nonlinear three-stage least squares. As one would expect from a properly specified system, the coefficient estimates do not change much, but their standard errors are reduced. The system estimates and related statistics are

NONLINEAR 3SLS ESTIMATES OF THE MONEY SUPPLY AND DEMAND SYSTEM

PARAMETER	ESTIMATE	ASYMPTOTIC STD. ERROR
DEMAND: (DW = 2.066)		
β_0	-3.301	9.467
β_1	-1.774	1.503
β_2	.121	.018
AR1	1.170	.154
AR2	-.427	.151
SUPPLY: (DW= 2.184)		
δ_0	.263	.147
δ_1	-.101	.003
AR1	1.037	.141
AR2	-.441	.140
Correlation of supply and demand residuals = -.523		

6.0 CONCLUSIONS

What we have done in this paper is to undertake an empirical investigation of the role of financial factors in Sweden's industrial revolution. There are two main hypotheses in the literature. The first, due to Sandberg,[40] argues that Sweden's rapid growth during its industrial take-off was related to the extraordinary relative size and quality of its financial capital stock around 1850; the second, appearing more implicitly in the literature, suggests that the financial sector might have been a leading sector in Sweden's economic explosion near the end of the 19th Century. We have found it possible to investigate the latter directly in this paper.

In our first set of experiments we have examined the possibility that Sweden's financial sector is at the same time a leading sector in the sense of one that Granger-causes real variables (notably real domestic product or real investment). In these tests there is some sign of an effect on investment, but the overall impression one gets is that the growth of the banking sector is caused by and does not cause, general economic growth (and structural change) in this period.

The interpretations given above, of an income elasticity of the demand for money near unity and increasing returns to scale in money supply, are also maintained: in the 3SLS estimates, δ_1 is again significantly negative and the mean-evaluated income elasticity of money demand is 1.16 with a standard error of 0.17.

[40] Sandberg, "The Case of the Impoverished Sophisticate."

These tests do not dispose of the possibility that Sweden already had an adequate stock of financial capital in 1860 (for example) and was merely living off its surplus during the next 50-odd years. If so, however, the financial sophistication index (based on broad money) should not have increased as sharply as it did; indeed, the index compares favorably in this respect with the same index for the United States (a country sometimes described as relatively unsophisticated). At the same time, estimates of the income elasticity of a single-equation demand for narrow money appear to establish narrow money (and probably broad money) as a luxury good. However, this result disappears in a test in which the real money stock (M1 again) is treated as an endogenous variable. In a separate estimate of the money supply function we were able to identify the existence of unexploited economies of scale, and both results - the unitary income elasticity and the economies of scale - carried over into systems estimates of the two equations taken together. Apparently, for what it did in 1850 or so (which was to provide note issue and short-term finance), the Swedish banking system was adequately developed. Even so, it had room to grow both in the sense of changing structurally and in terms of utilizing unexploited economies of scale in the provision of banking services. Its rapid growth, however, was induced by the growth of the economy and not the converse.