PROBLEMS

Financial Innovation and the Demand for Money in Austria-Hungary, 1867-1913

John Komlos
University of Pittsburgh

Understanding the demand for money has been an important theoretical concern in economics and therefore econometricians have devoted some effort to testing various theories primarily with current data. Yet, as a review article has pointed out, in a historical context only a few such studies have been undertaken, most of them probing the American experience.[1] The evidence hitherto assembled, primarily for the twentieth century, overwhelmingly supports the notion that the demand for real balances has been a stable function of a relatively small number of variables,[2] such as income, and the opportunity cost of holding money, the interest rate. An exception to this generalization can be

* This paper has benefited from comments by Michael Bordo of the University of South Carolina, Gilbert Ghez of Roosevelt University, and Robert Khon, Robert Lucas, and Arnold Zellner of the University of Chicago. The responsibility for the final mix of ideas, needless to say, rests entirely with the author.

[1] MICHAEL D. BORDO and ANNA J. SCHWARTZ, "Issues in Monetary Economics and their Impact on Research in Economic History." in ROBERT E. GALLMAN (ed.), *Recent Developments in the Study of Business and Economic History*, Supplement 1 (Greenwich, Connecticut; JAI Press, 1977), p. 118. MICHAEL D. BORDO and LARS JONUNG, "Long Run Behaviour of the Income Velocity of Money in five Advanced Countries, 1870-1975: An Institutional Approach," *Economic Inquiry*, XIX (January 1981), pp. 96-116.

[2] EDGAR L. FEIGE and DOUGLAS K. PEARCE, "The Substitutability of Money and Near-Monies: A Survey of the Time-Series Evidence". *Journal of Economic Literature* (June 1977), p. 439. JAN TORE KOVLAND, "The Stability of the Demand for Money in the Interwar Years: The Case of Norway, 1925-1939". *Journal of Money, Credit, and Banking*, 14 (May 1982), II, pp. 252-64. ARTHUR GANDOLFI, "Stability of Demand for Money during the Great Contraction; 1929-1933", *Journal of Political Economy*, II (1974), V, pp. 969-984. MILTON FRIEDMAN and ANNA SCHWARTZ, *A Monetary History of the United States, 1867-1960*. (Princeton, N.J.: Princeton University Press, 1963).

found at times of increasing financial sophistication or intense institutional change in the financial sector, such as in the United States during the last quarter of the nineteenth century [3] and in the 1970s.[4] Volatile velocities have also been found in eighteenth-century France, in which the financial sector was not undergoing much institutional change but in which monetization was at a very low level.[5]

The present study examines the demand for money in an underdeveloped economy; that of late nineteenth-century Austria-Hungary, using the method of recursive residuals. The recursive residual test, described below, detected instability in the functional relationship of a standard money-demand equation: the coefficients of the independent variables varied systematically over time. The tests indicated a marked departure from stability in the late 1880s. In other

[3] FRIEDMAN and SCHWARTZ note that the "character of the financial system clearly affects velocity", and that "the rapid spread in financial institutions in the United States" accounted for the fall in the velocity between 1876 and 1903. The analysis of this feature of the monetary development of the United States lay beyond the scope of their study, but they asserted that one would need to consider such variables as the number of bank offices per capita in order to account for the institutional changes. They dealt with this issue in a rather perfunctory manner by increasing the money stock in this period sufficiently so as to eliminate the discrepancy. This is tantamount to using a dummy variable for the period. MILTON FRIEDMAN and ANNA SCHWARTZ, *Monetary Trends in the United States and the Unitetd Kingdom: Their Relation to Income, Prices, and Interest Rates*, 1867-1975 (Chicago: University of Chicago Press, 1982), pp. 145, 216. For three extensive reviews of their book see *The Journal of Economic Literature*, XX (1982), pp. 1528-1556. For a critical view of their approach see DAVID F. HENDRY and NEIL R. ERICSSON, *Assertion without empirical basis: An econometric appraisal of "Monetary Trends..." by Milton Friedman and Anna Schwarz*, (London: Bank of England, 1983).

[4] P.D. QUICK and J.D. PAULUS, "Financial Innovations and the Transactions Demand for Money". Unpublished manuscript, Board of Governors, Federal Reserve System, Feb. 1977. J. PAULUS and S.H. AXILROD, "Recent Regulatory Changes and Financial Innovations Affecting the Growth of Monetary Aggregates". Unpublished manuscript, Board of Governors, Federal Reserve System, Nov. 1976. R.D. PORTER and E. MAUSKOPF, "Some Notes on the Apparent Shift in the Demand for Demand Deposits Function". Unpublished manuscript, board of Governors, Federal Reserve System, Nov. 1978. S.M. GOLDFELD, "The Case of the Missing Money",*Brookings Papers on Economic Activity*, 1976, III, pp. 683-730. R.D. PORTER, T.D. SIMPSON and E. MAUSKOPF, "Financial Innovation an the Monetary Aggregates", *Brookings Papers on Economic Activity*, No. 1, 1979, pp. 213-229. CHARLES LIEBERMAN, "Structural and Technological Change in Money Demand", *American Economic Review*, LXIX (1979) 2, pp. 324-329. THOMAS CARGILL and ROBERT MEYER, "Stability of the Demand Function for Money, an Unresolved Issue". *American Economic Review*, LXIX (1979), 2, pp. 318-324.

[5] JAMES RILEY and JOHN MC CUSKER, "Money Supply, Economic Growth and the Quantity of Money: France, 1650-1788", *Explorations in Economic History* XX (1983), pp. 274-293.

words, the explosion in the stock of real balances held by the public after the mid-1880s was not in proportion to either a decline in interest rates or the secular rise in per capita income. Consequently, there was a precipitous decline in the income velocity of circulation. This discovery led to an investigation of the financial institutions and the innovations in financial technology that occurred in Austria-Hungary in the 1880s which could have caused this structural change in the behavior of monetary aggregates. The exogenous institutional changes which induced shifts in both the demand and supply functions for real balances were found to be the following: a) A government sponsored postal savings system was instituted in 1883; b) The required reserves on the paper issues of the central bank were decreased in 1887; c) The gold standard was adopted in 1892; d) The government transferred its gold hoard to the central bank, increasing the quantity of high-powered money; e) The government encouraged the use of demand deposits by opening an account at the central bank, and the National Bank forced its customers to open demand deposit accounts in 1893 in order to economize on the issue of paper currency. These institutional changes increased intermediation, and high-powered money, as well as the deposit/currency ratio, and extended the money market into the backwater regions of the Monarchy where this market had existed only in an incipient form prior to these developments. These institutional changes lowered the transaction costs of acquiring deposits in the countryside, thereby eliminating the excess demand for real balances that appears to have existed there. Once the instability in the standard money-demand function was identified, and once these institutional changes occurring in the late 1880s were found, the model was expanded to include proxies for the institutional changes. After all, the opportunity cost of holding demand deposits included not only the earnings foregone as a consequence, but also the transaction costs of acquiring such deposits. The number of banking offices could serve as a proxy for these transaction costs. In addition, the share of GNP originating in agriculture could serve as a proxy for the subsistence economy and in turn for the process of monetization. The proxies turned out to have significant explanatory power, as in other economies,[7] but did not eliminate the instability completely.

The recursive residual method of testing the stability of a functional relationship was developed by Brown, Durbin, and Evans.[8] With this method

[6] JOHN KOMLOS, "Diffusion of Financial Technology into the Austro-Hungarian Monarchy toward the end of the Nineteenth Century", in JOHN KOMLOS (ed.), *Essays on the Economic Development of the Habsburg Monarchy* (New York: East European Monographs, Columbia University Press, 1983), pp. 137-163.

[7] BORDO and JONUNG, p. 96.

[8] MOHSIN KAHN, "The Stability of the Demand-for-Money Function in the United States 1901-1965." *Journal of Political Economy*, LXXXII (Nov. 1974), pp. 1205-1219. ROBERT H. HELLER and MOHSIN S. KAHN, "The Demand for Money and the Term Structure of Interest Rates," *Journal of Political Economy*, LXXXVII (Feb. 1979), pp.

ordinary least squares regression (OLS) is used to estimate the initial relationship on a data base the size of which is one more than the number of independent variables. This relationship is then used to forecast one (or more) period(s) ahead. After each forecast the error (residual) is calculated and the data base is increased by one. In turn, another forecast is made and compared with the actual value of the dependent variable. Thereafter another forecast error is calculated. This process is continued until the data are exhausted. In order to test the null hypothesis that the regression coefficients vector is constant over time the cumulative sums of the standardized forecast residuals (CUSUM) are analyzed along with the sums of their squared values (CUSUMQ). Since the residuals of the moving OLS regressions are assumed to be normal white noise, under the null hypothesis a visual inspection may be revealing to the extent that systematic patterns of under- or overprediction and sudden jumps signal departure from the model.[9] In addition, exact tests have been proposed in order to test the null hypothesis.[10] The drawback of the recursive residual test is that in the presence of autocorrelation it is unreliable. Yet it is still suggestive, and once one has a notion of when a break occurs in the structural model one can supplement it with the Chow test.

Recursive residual tests are presented for three dependent variables: demand deposits in Austria and in Hungary separately and on M1 (currency plus demand deposits) for the whole Monarchy.[11] M1 cannot be ascertained in Austria and in Hungary separately because these autonomous political units formed a customs union during the period under study and had a common currency (see Table 2). This frustrates any attempt to estimate the amount of

109-129. Robert M. Stern, Christopher F. Baum and Mark N. Greene, "Evidence on Structural Change in the Demand for Aggregate U.S. Imports and Exports," *Journal of Political Economy*, LXXXVII (Feb. 1979), pp. 179-192. R.L. Brown, J. Durbin, and J.M. Evans, "Techniques for Testing the Constancy of Regression Relationships over Time." *Journal of the Royal Statistical Society*, Ser. B, XXXVII (1975), 2, pp. 149 ff. Jean-Marie Dufour, "Methods for Specification Errors Analysis with Macroeconomic Applications" (Unpublished Ph.D. dissertation, University of Chicago, 1979).

[9] This test is more powerful than the Chow test since the investigator is not burdened with the task of having to search for the appropriate demarcation by dividing his sample into various periods of differing lengths and running regressions over these periods.

[10] Dufour, pp. 39-41. R.L. Brown, J. Durbin and J.M. Evans, p. 150. The recursive residual test was performed using the B34S program. See Houston Stokes, "The B34S Data Analysis Program: A Short Writeup." College of Business Administration, University of Illinois at Chicago Circle, Working Paper Series, Report FY 77-1, Revised 14 July, 1981.

[11] The test was performed on M3 as well. Since the results turned out to be very similar to the ones presented here they are not reported here, but are available from the author on request. Aggregate data on output are from John Komlos, *The Habsburg Monarchy as a Customs Union: Economic Development in Austria-Hungary in the Nineteenth Century* (Princeton University Press, 1983), Appendix E.

currency circulating in each half of the union separately.[12] Various specifications of the standard demand for money function were investigated. The results were found not to be sensitive to the particular model used. Due to space limitations only two formulations are presented here. The first model has current income and the second, (because of the lagged dependent variable) has permanent income as the constraint. Specifically:

Eq. 1) $\ln(DD/P)_{t-1} = C + a \ln r + b \ln Y + \epsilon$

Eq. 2) $\ln(DD/P)_{t-1} = C + a \ln r + b \ln Y + d \ln(DD/P_{t-1}) + \epsilon$

DD = nominal demand deposits
P = price level
Y = real current income
r = nominal return on long term Austrian government obligations
M1 = DD + currency
ln = natural logarithms

The one step ahead recursive residuals for Eq. 1, Austria (1874-1913) show a systematic propensity for under-prediction after 1886 as evinced by the long run of positive residuals thereafter. As a consequence, CUSUM (Figure 1) wanders away from its expected value of zero quite noticeably after 1888. The Chow test is also significant at the 99% confidence level when the sample was split into two periods in 1888. The estimated coefficients show considerable fluctuations (Figures 2-3). All of these characteristics indicate an unstable relationship for the demand for demand deposits in Austria in the late 1880's and early 1890's.

The model in Equation 2 is superior to Equation 1 in predictive ability if Model 1 were plagued by autocorrelation. The results of the tests done on Equation 2 are, however, very similar to those found for Equation 1 (Because of the similarity the graphs are not presented here). In this model the systematic underprediction is as evident as in Model 1. CUSUM points to a breaking point in 1887. The drift of the coefficients from constancy is much more apparent in this formulation than in the previous one, and they all occur in the late 1880s.[13] The Chow test is again significant at the 95% confidence level. Hence instability of the model is once again indicated.

[12] To be sure, citizens of one country could and undoubtedly did hold deposits in the other half of the customs union. These, however, were probably relatively small and are not likely to bias the results.

[13] The coefficient of the lagged demand deposit variable, d, is negative until 1886. This is contrary to the usual assumption that one adjusts one's current permanent income by some fraction of the difference between current and actual income from last period. This negative coefficient is a bit puzzling, but might be interpreted to imply that the information content of past incomes was much more important than current income in forming expectations about next year's income. This is entirely plausible in the gloomy psychological milieu subsequent to the market crash of 1873 in Austria.

Figure 1 - *Plot of CUSUM of one step ahead recursive residuals* (Equation 1)

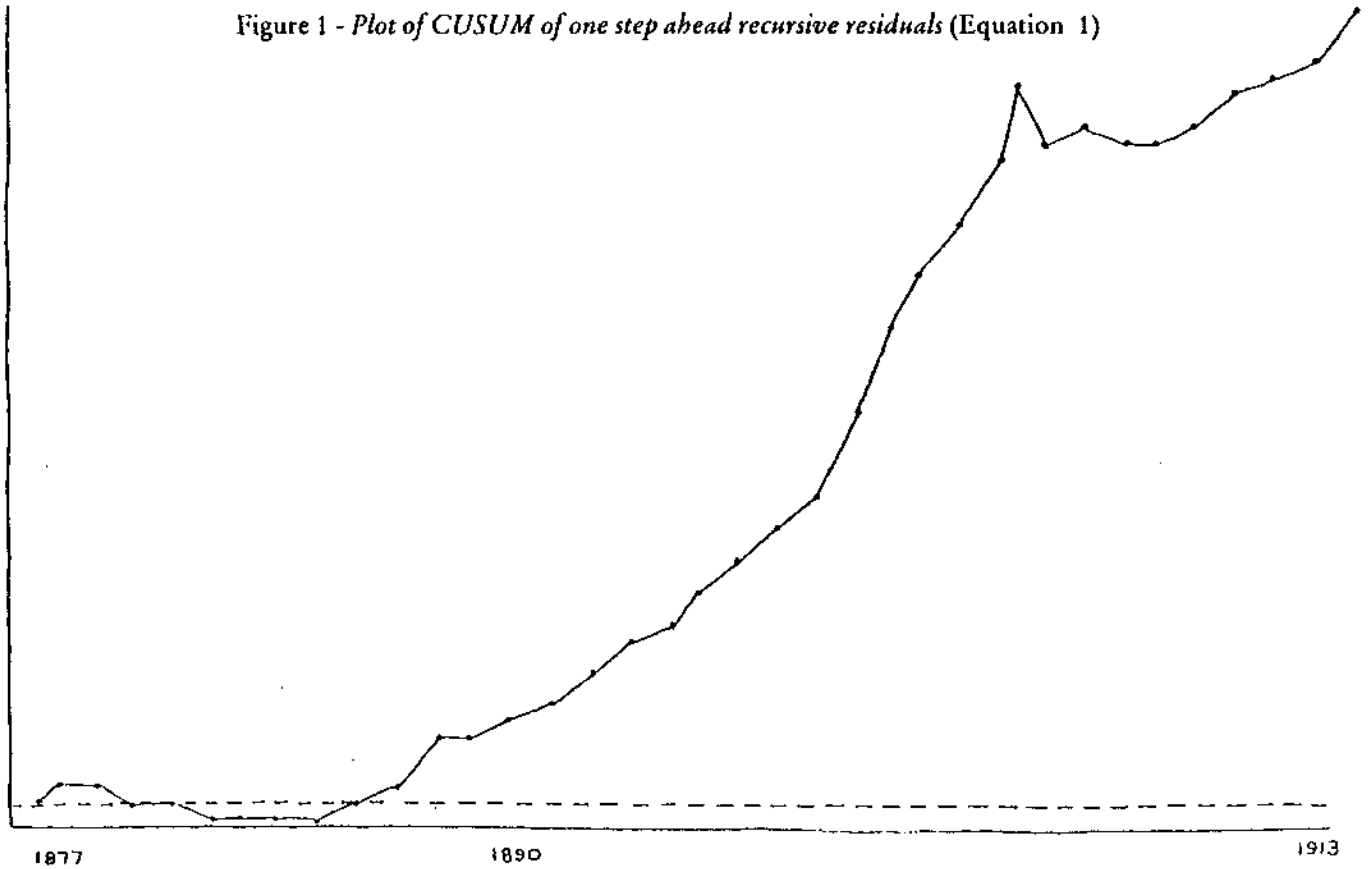


Figure 2 - *Plot of coefficient of the interest rate* - (Equation 1)

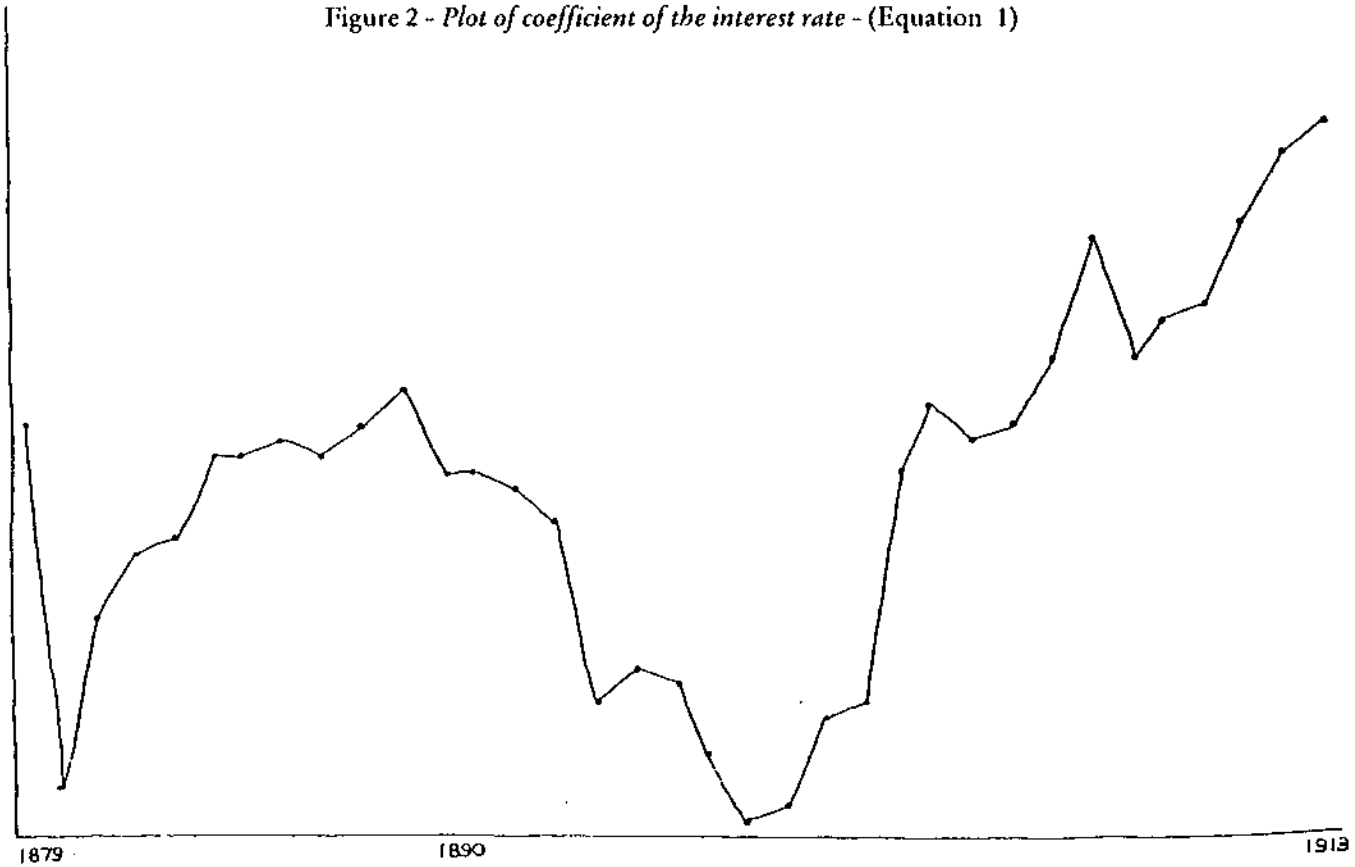


Figure 3 - *Plot of coefficient of income* (Equation 1)

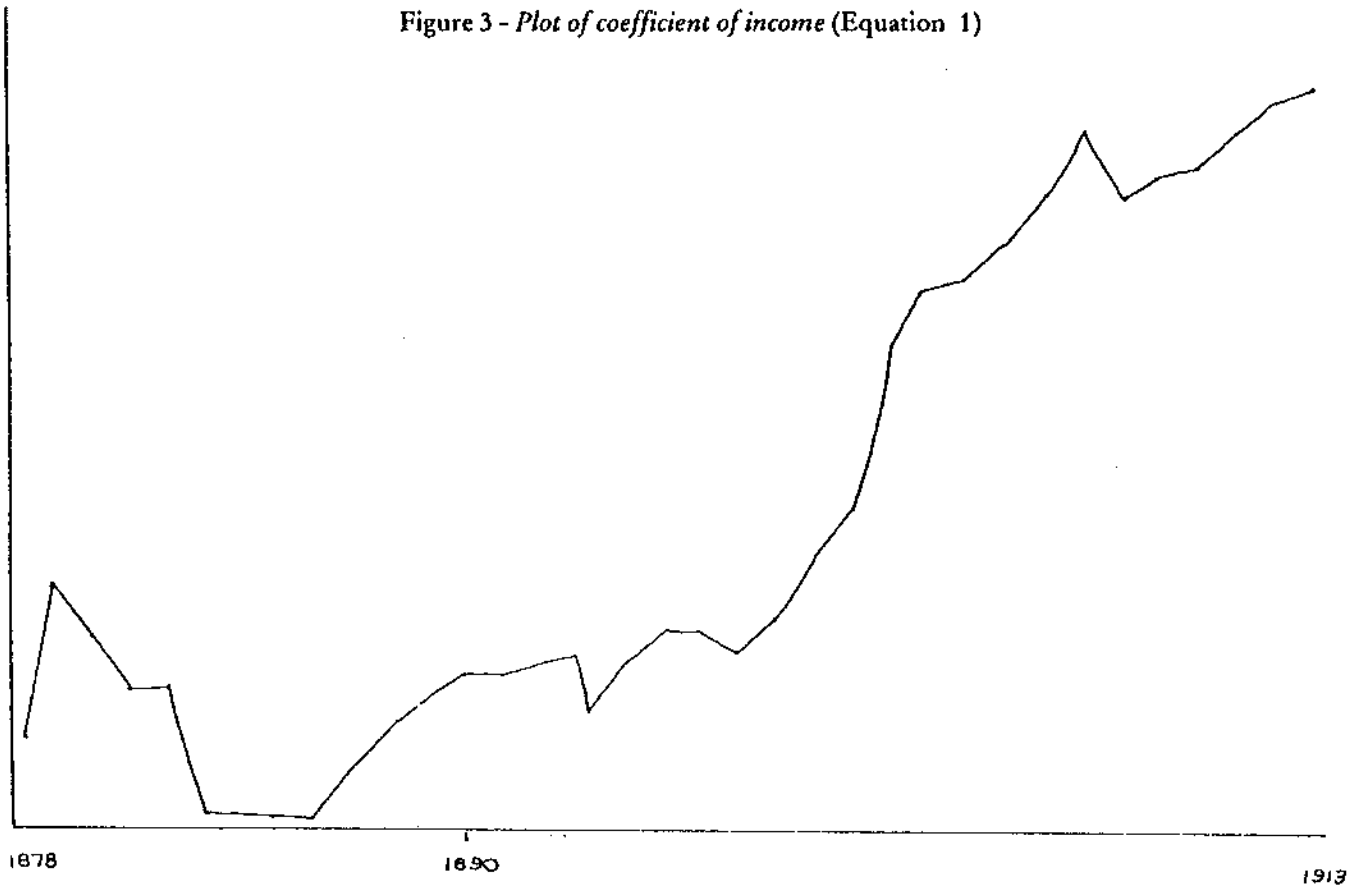


Figure 4 - *Plot of coefficient of the interest rate* (Equation 4)

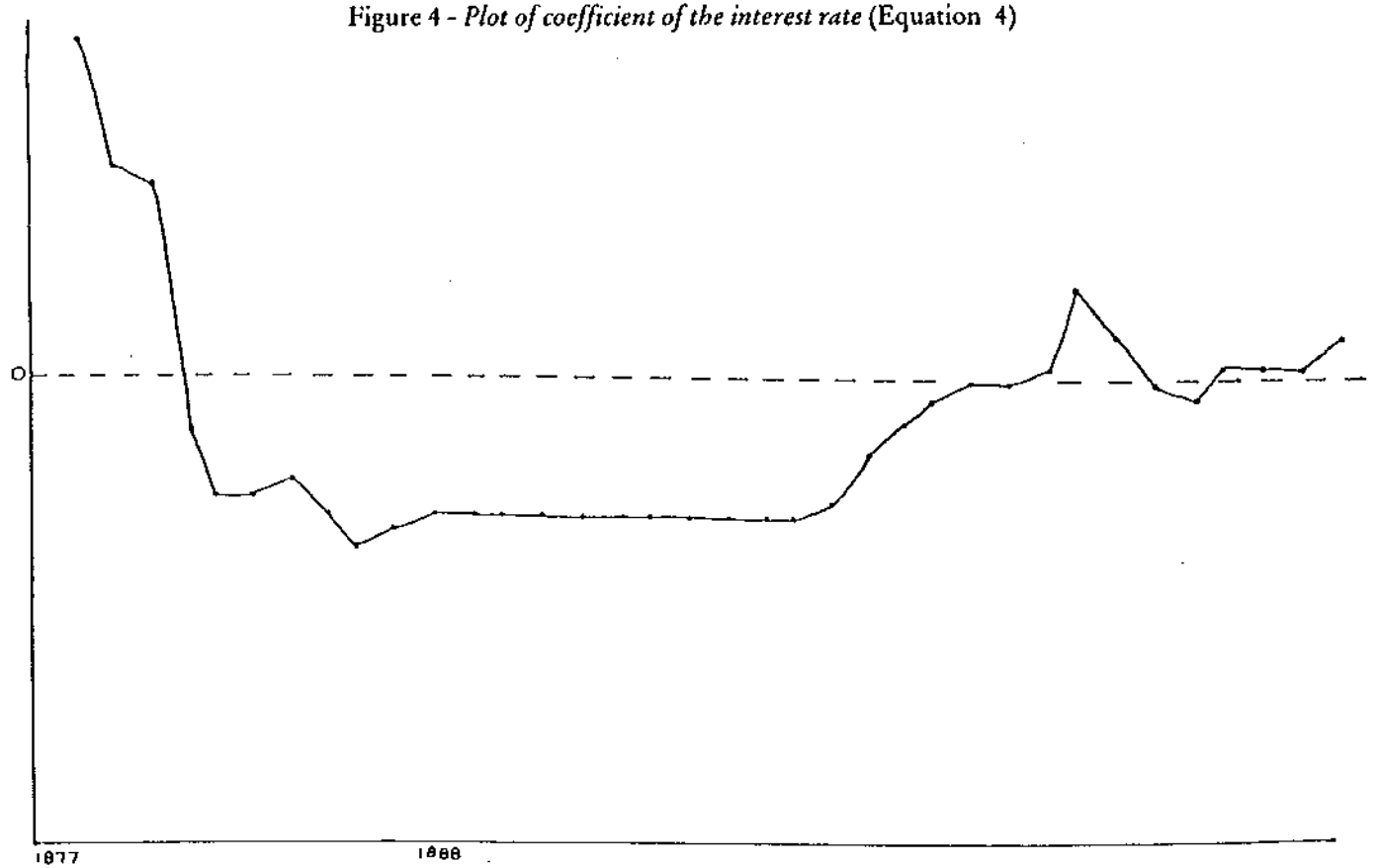
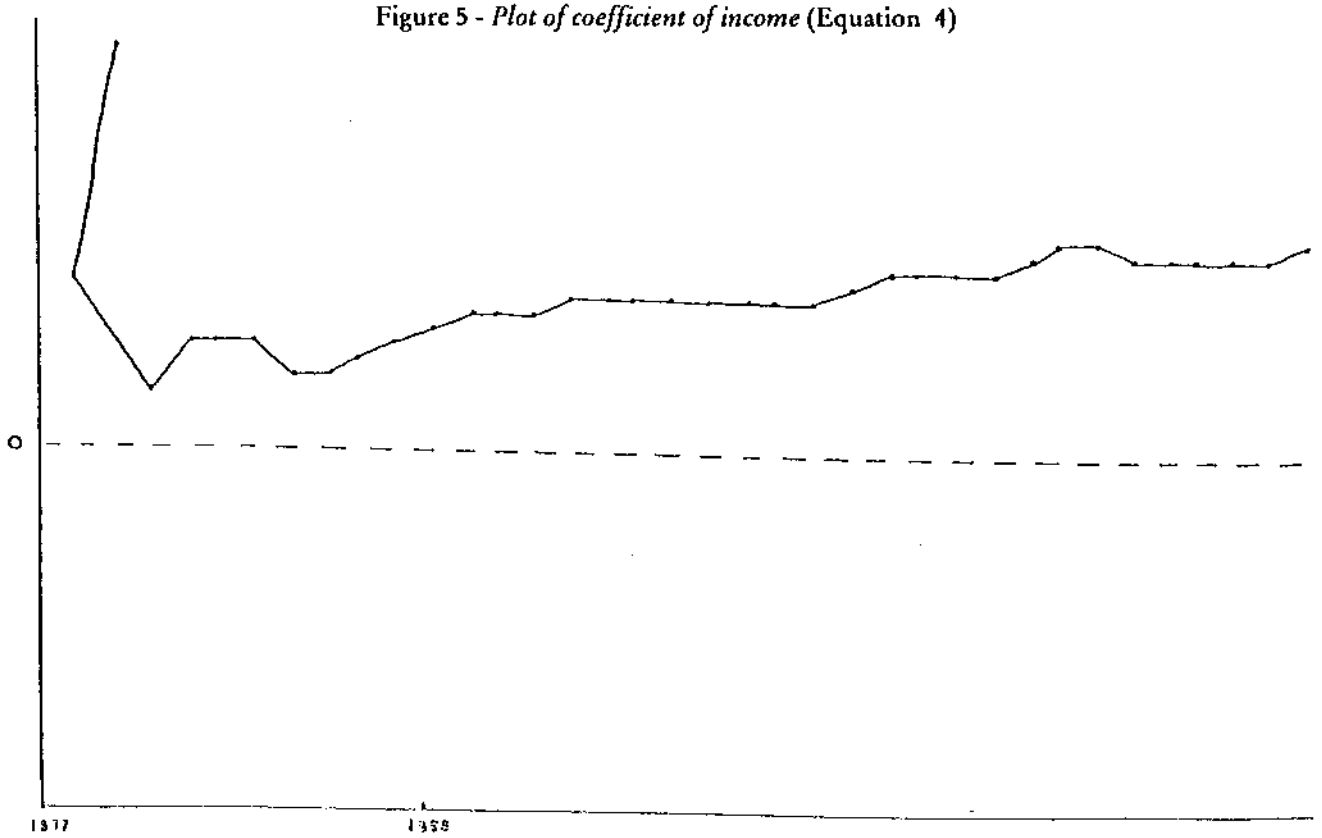


Figure 5 - *Plot of coefficient of income* (Equation 4)



The recursive residuals Equation 2 for Hungarian demand deposits (1874-1913) indicate a departure from the model somewhat earlier than the test for Austria. The coefficients have a tendency to show breaks in the late 1880's. The Chow test is significant at the 90% confidence level.

A slight variation of Equation 2 was used to perform the recursive residual test on M1 for Austria-Hungary (1867-1913). In order to purge the right hand side from the lagged endogenous variable that could bias the CUSUM test one might transform Equation 2 to:

$$\text{Eq. 3)}\quad \ln\frac{(M1)}{P} - \hat{d}\ln\frac{(M1)}{P_{t-1}} = c + a\ln r + b\ln Y + \epsilon$$

where d is estimated using OLS. This formulation is still far from perfect because it assumes that d was constant over time which, in fact, is unlikely. Nonetheless, the results are suggestive in that they are quite similar to the ones obtained with the other models. This model also underpredicts consistently. CUSUM and CUSUMQ show instability in the 1880's. The regression coefficients are time variant. The interest elasticity of the demand for money drifts until 1892; the income elasticity drifts until 1880, and becomes constant thereafter. In brief, all of the tests unambiguously indicate a change in the functional relationship of the demand for real balances in the late 1880's.

The results of the recursive residual tests are confirmed by the regressions performed on the two sub-periods 1874-1888 and 1889-1913 (Table 1). Lines 1,5, and 9 show that all of the coefficients are significantly different from zero for the demand for demand deposits in Austria, in Hungary separately and for M1 in Austria-Hungary between 1874 and 1888. Yet in the subsequent period none of the interest elasticities of demand are significantly different from zero (Lines 2,6,10) even when the model is extended to include permanent values of the independent variables (lines 3,7,11) and price expectations (lines 4,8,12).

The argument has been advanced recently that the demand for real balances in the United States has undergone a structural change in 1974 due to financial innovations.[14] The large decline in the velocity of circulation of most industrializing countries in the late nineteenth century is explained by institutional changes as well as by the process of commercialization and monetization of the economies.[15] The structural changes in the demand for money in Austria-

[14] JOHN JUDD and JOHN SCADDING, "The Search for a Stable Money Demand Function: A Survey of the Post-1973 Literature", *Journal of Economic Literature*, XX (Sept. 1982), pp. 993-1023.

[15] In Norway, the United States, Canada, and Austria, velocity fell from a range of 3.5-7 in 1870 to about 1.5-3 by World War I. The United Kingdom, whose velocity reached 2 as early as 1870 and stayed at that level throughout our period, is a major exception to this generalization; this anomaly is explained by the high level of development of the British financial sector. The German case is less easily explained. Velocity there stayed between 3 and 3.8 until the turn of the century. Only then did it begin to fall;

Hungary in the late 1880's were similarly influenced by developments within the financial sector. In order to test the effect of these institutional changes on the demand for money, proxies for those variables were included explicitly in the demand function:

Eq. 4) $\ln(M1/P) = a + b\,r + c\ln Y + d\ln(A/Y) + e\ln B + \epsilon$

r is the interest rate (level instead of logs);[16] A/Y is the ratio of agricultural output to real income, and B is the number of banking offices. A/Y is included in order to capture the level of commercialization of the economy, and the number of banks is included in order to proxy for the increasing financial sophistication and the lowering of transaction costs.[17] These variables turn out to have significant explanatory power in the money demand equation. The values of the coefficients were:[17B]

a	b	c	d	e
(−4.67)	0.89	1.03	−2.24	0.21
(−4.64)	(0.34)	(7.97)	(−6.64)	(2.82)

The regression was performed for 1868-1913. The inclusion of these variables increased the F statistic considerably, from 235 to 791; yet serial correlation is still evident and b, the coefficient of the interest rate, is still not significant. (This can be explained partly by the fact that the interest rate did not vary greatly during the latter half of our period). In addition, the income elasticity of demand for money (1.03) is close to those found for other countries and much more plausible than those reported in Table 1.

The recursive residual test still indicates a shift in the money demand function in 1888, even with the above institutional variables included. The Chow test was once again significant at the .999 level. However, as Figures 4-5

by World War I, it had fallen about 20%. The French case is also difficult to understand since according to a recent calculation velocity had reached 1.6 by 1784. Bordo and Jonung, pp. 100-102. Lars Jonung, "The Long Run Demand for Money: A Wicksellian Approach", *The Scandinavian Journal of Economics*, LXXX (1978), pp. 216-30. Riley and McCusker, p. 281. Richard Selden, "Monetary Velocity in the United States", in Milton Friedman, *Studies in the Quantity Theory of Money* (Chicago: University of Chicago Press, 1956), pp. 179-257. Richard Tilly, "Zeitreihen zum Geldumlauf in Deutschland, 1870-1913", *Jahrbüchern für Nationalokonomie und Statistik*, CLXXXVII (1973), 4, pp. 330-363.

[16] Note that one can use ln r or r, since ln(1+r) is almost equal to r. Indeed, it did not change our results any when ln r was included instead of r in the regressions that follow.

[17] A similar tactic was adopted by Bordo and Jonung (1981). Friedman and Schwartz (1982) proxy the growing financial sophistication by multiplying the money supply figures by a decreasing factor, which is tantamount to using a dummy variable.

[17B] The relevant statistics of the regression were the following (for explanation of the abbreviations see Table 1):

R	F	D.W.	M	GLS
.99	791	1.27	.77	1

TABLE 1

DEMAND FOR REAL BALANCES IN AUSTRIA-HUNGARY

	Time	Const	ln Y	ln R	ln M_{-1}	dln P	R^2	F	D.W.	H*	GLS**
Dependent Variable: ln DDA/P											
1.	1874-1888	−5.01	.728	−1.66			.91	71	1.31	.574	0
		(−2.35)	(2.29)	(−5.25)							
2.	1889-1913	−19.09	2.75	−.485			.72	30	1.42	.872	1
		(−3.63)	(7.50)	(.498)							
3.	1889-1913	−.315	.041	−.091	.964		.99	600	2.06	.576	0
		(−.132)	(.158)	(−.336)	(12.7)						
4.	1889-1913	−1.13	.105	−.179	.958	−.70	.99	477	1.98	.537	0
		(−.475)	(.409)	(−1.67)	(12.99)	(−1.48)					
Dependent Variable: ln DDH/P											
5.	1874-1888	−15.14	1.07	−3.78			.90	62	2.04	.53	0
		(−8.5)	(3.66)	(−5.21)							
6.	1889-1913	−20.1	2.97	−.352			.83	61	2.03	.68	0
		(−6.18)	(10.9)	(−.45)							
7.	1889-1913	−1.71	.314	.077	.897		.98	361	2.17	.57	0
		(−.81)	(1.35)	(.25)	(13.2)						
8.	1889-1913	−2.62	.490	.147	.835	1.03	.99	358	2.29	.64	1
		(−1.23)	(2.05)	(.47)	(11.6)	(1.62)					
Dependent Variable: ln M1/P											
9.	1874-1888	.147	.488	−.979			.75	21	1.37	.73	1
		(.106)	(2.99)	(−4.13)							
10.	1889-1913	−13.56	2.13	−.479			.88	85	1.75	.87	1
		(−5.6)	(12.9)	(−1.02)							
11.	1889-1913	−1.43	.241	−.018	.893		.99	914	2.15	.98	1
		(−1.05)	(1.38)	(−.119)	(11.63)						
12.	1889-1913	−1.55	.227	−0.54	.909	.36	.99	444	2.38	.98	0
		(−1.07)	(1.19)	(−.332)	(10.6)	(−1.18)					

Note: The numbers in parentheses are the t-statistics.

* Probability of Heteroscedasticity; ** O = OLS, 1 = corrected for autocorrelation.

TABLE 2

MONETARY AGGREGATES IN AUSTRIA-HUNGARY

	Demand[ac] Deposits Hungary	Demand[ac] Deposits Austria	Currency in Hands of Public	M1[ac] Austria-Hungary	Time and Savings Hungary	Time and Savings Austria	M3[a] Austria-Hungary	GNP[d] Austria-Hungary
1867	20[b]	120	957	1097	130	558	1785	7748
1868	25[b]	351	1034	1410	168	623	2201	7968
1869	30[b]	453	1036	1519	216	728	2463	7608
1870	35[b]	520	1091	1646	234	854	2734	7640
1871	40[b]	641	1183	1924	286	1001	3211	8080
1872	45[b]	1320	1156	2521	318	1174	3013	7943
1873	64	761	1209	2034	328	1233	3595	7286
1874	46	551	1031	1628	357	1371	3356	7768
1875	35	426	1029	1490	385	1449	3324	7794
1876	38	400	1058	1496	422	1475	3393	7594
1877	38	376	1052	1466	460	1525	3451	8424
1878	40	394	1068	1502	482	1573	3558	9923
1879	61	436	1045	1542	546	1696	3784	8493
1880	82	491	1029	1602	606	1800	4008	8977
1881	104	581	1076	1761	680	1922	4363	8939
1882	119	584	1123	1826	718	1916	4460	10723
1883	120	538	1182	1840	766	2130	4736	10644
1884	140	614	1134	1888	803	2204	4895	11090
1885	117	581	1117	1815	827	2366	5008	11769
1886	129	611	1129	1869	886	2521	5276	11465
1887	129	640	1196	1965	913	2629	5507	11564
1888	195	652	2055	2055	983	2766	5804	11569
1889	250	835	1217	2302	1043	2994	6339	11062
1890	285	857	1272	2414	1121	3121	6656	12310
1891	364	915	1329	2608	1121	3279	7008	12489

TABLE 2 (Continued)

	Demand[a,c] Deposits Hungary	Demand[a,c] Deposits Austria	Currency in Hands of Public	M1[a,c] Austria-Hungary	Time and Savings Hungary	Time and Savings Austria	M3[a] Austria-Hungary	GNP[d] Austria-Hungary
1892	406	1045	1320	2771	1290	3496	7557	12866
1893	386	1220	1277	2883	1328	3710	7921	12929
1894	421	1356	1339	3116	1380	3949	8445	13386
1895	499	1518	1342	3359	1463	4165	8987	14121
1896	490	1489	1317	3296	1519	4343	9158	13760
1897	542	1604	1347	3493	1631	4543	9667	12976
1898	600	1692	1418	3710	1717	4692	10119	13983
1899	601	1859	1388	3848	1739	4878	10465	14462
1900	604	2143	1433	4180	1797	5227	11204	13996
1901	643	2287	1439	4349	1886	5455	11710	14000
1902	685	2388	1295	4368	1971	5792	12131	14989
1903	686	2393	1403	4482	2090	6072	12644	14981
1904	765	2796	1391	4952	2265	6412	13629	13832
1905	858	3114	1467	5439	2454	6726	14619	15731
1906	1118	3781	1579	6478	2629	7131	16238	17448
1907	1220	3818	1578	6616	2796	7601	17013	17586
1908	1226	3972	1598	6836	2978	8190	18004	17545
1909	1472	4375	1435	7282	3212	8735	19229	17755
1910	1749	4873	1539	8161	3591	9453	21205	18377
1911	2166	5406	1643	9215	4003	10004	23222	18696
1912	2185	5750	1707	9642	3928	10142	23712	19990
1913	2317	6057	1715	10089	4006	10312	24407	19547

a Millions of crowns nominal excluding coins.
b Estimation based on extrapolation
c Net of Interbank deposits
d Prices of 1911/13 the estimation was based on Fellner's national income calculations for 1911/13 (FELLNER, 1917, p. 113). That income was extrapolated backwards by the use of agricultural, mining and industrial production indexes (KOMLOS, 1913, Appendix E; LÁSZLÓ KATUS, "Economic Growth in Hungary during the Age of Dualism, 1867-1913, A Quantitative Analysis." In *Social-Economic Researches on the History of East-Central Europe*, edited by E. PEMLÉNYI (Budapest: Akadémiai Kiadó, 1970), p. 92; ROMAN SANDGRUBER, *Österrichische Agrarstatistik 1750-1918* (Vienna: Verlag für Geschichte und Politik, 1978), p. 110).
Sources: for monetary aggregates are the *Ungarishes Statistisches Jahrbuch* and *Österreichisches Statistisches Handbuch*.

indicate, the coefficients of the regression equation were much more stable than those found in Figures 2-3. This indicates the importance of the institutional variables, though they were unable to explain fully the shift in the demand for money that occurred in 1888. In sum, the institutional variables were able to account for some of the shift in the demand function, but not all. Perhaps better proxies should ultimately be found for the institutional changes that took place in the late 1880s.

What were these financial innovations? Innovations on the supply side included changes in the central bank's statutes lowering or practically eliminating the reserve requirements on its paper issues. The legal changes enabled the bank to eliminate entirely its substantial excess reserve holdings within a short time. The new regulations were also conducive to expanding the demand deposit liabilities of the central bank, which were negligible until 1887. By 1890, however, there were a thousand accounts in both Austria and in Hungary. The total value of the cheques cleared through the bank jumped from 800 million in 1887 to 4500 million in 1890. The government wanted to encourage the use of demand deposits in order to economize on currency, thereby paving the way for its long established goal of reintroducing the convertibility of the gulden into gold. The Austro-Hungarian Bank was willing to accommodate the government and expand its demand deposit liabilities, since converting deposits to currency was no longer constrained legally by the amount of notes the bank could issue. (From 1893 onward the bank refused to discount bills-of-exchange for customers who did not have a checking account with it).

The increase in demand deposits lowered the currency/deposit ratio thereby increasing the money multiplier. Of course, the increased stability of the financial system on account of the changes in the regulations contributed to consumer confidence, inducing a substitution from currency to deposits. At the same time, the government's transfer of specie to the central bank increased high powered money, while the sharp fall in excess reserves reinforced this very effect. The adoption of the gold standard, moreover, put the currency virtually on a fixed exchange rate, thereby facilitating money imports, previously hindered by the unpredictable fluctuations in the Austrian currency's value.[18] In turn, this increased the liquidity of the financial sector.

The confluence of these developments within the financial sector signalled an increased willingness to inject liquidity into the economy. The increased supply of money was an inducement to extend the money market into the backwater areas of the monarchy by increasing branch banking. The number of branches of all banks including the central bank increased from 80 in 1888 to 168 by 1896. The adoption of the postal savings systems by the government in the 1880s also increased intermediation greatly. As a consequence the number of

[18] Carl Menger, "Von unserer Valuta", *Allgemeine Juristen Zeitung*, XV (1892), 12, 13; in *Gesammelte Werke* (Tubingen: Mohr, 1970), IV, p. 294.

offices capable of transacting banking business increased by thousands in a few years. This was instrumental in mobilizing the savings of the poorer segment of the population and increased the money multiplier by lowering the currency/demand deposit ratio. The extension of branch banking and the inception of the savings system operated by the post office meant not only an increase in intermediation, but also a decrease in barter.

The resulting increase in the supply of money need not have destabilized the money market. The standard result would have been to decrease the rate of interest sufficiently to equilibrate the demand and supply of money. The outcome was more complicated, however, because not only was there an increased supply of financial assets but the quality of these assets also increased, for several reasons. The increased stability of the financial system and the adoption of the gold standard in 1892 meant an increase in public confidence, thereby shifting the demand curve for real balances to the right. In addition, the gold standard enabled domestic money to be used more easily in international transactions. This, too, was a qualitative change which induced a substitution of domestic for foreign money, thereby increasing the demand for domestic currency, the crown.

At the same time, the extension of the financial sector into the hinterlands of the monarchy and the commercialization of agriculture, that is, the extension of the money market, shifted the demand for money in the r, M/P space by lowering the transaction costs of acquiring deposits. Rather than putting downward pressure on the interest rate, the increased supply of money induced an increase in the number of branches of the financial institutions, thereby bringing people into the market who had, up to then, been excluded from it. The high dispersion of nominal interest rates in the Monarchy in the 1870s and 1880s, and the eventual diminution of this dispersion, is evidence that a segmented money market was being integrated in late nineteenth century Austria-Hungary.[19] Of course, the true cost of holding money fell, because the increase in branch banking lowered the transaction costs for the acquisition of a myriad of financial instruments. Hence the interest rate, by itself, is not a perfect measure of the opportunity cost of acquiring real balances at a time when the financial sector is expanding. The lowering of transaction costs meant that in the r, M/P space the demand for real balances was shifting to the right.

In addition, the increased mediation meant that loanable funds became available to those who desired to increase their expenditures beyond their current income but had been prevented from doing so previously by the absence of an organized market for loans in their geographic region.[20] Demand for real

[19] David F. Good, "Financial Integration in Late Nineteenth Century Austria". *The Journal of Economic History*, 37(Dec. 1977), pp. 890-910.

[20] Max Wirth, "The History of Banking in Germany and Austria-Hungary", in *A History of Banking in all the Leading Nations* (New York: The Journal of Commerce and Commercial Bulletin, 1896), Vol. IV, pp. 86, 104.

balances of this segment of the population would have appeared to have increased with the lowering of transaction costs, that is, by the fact that an intermediary institution was located within reach.[21] The spread of the money economy also induced a decline in barter transactions that would have contributed to the decline in the true velocity of circulation. This process is captured by the A/Y variable.

One should also note that the true increase in the supply of money was less than the measured increase used here, because the increased supply of money pushed out of the market a number of near-monies, such as bills-of-exchange, and of money substitutes, such as book credit. This means that the fall in measured velocity overstates the fall in the true velocity of circulation.

The demand for money was unstable because the limited extent of the market prior to the 1880s left much demand unsatisfied. The interest rate alone did not ration money, but transaction costs also played an important role by keeping some people out of the market.[22]

The conclusion therefore emerges that the money holding habits of the public were influenced by the diffusion of financial technology from abroad, a process in which the government played a crucial part. The instability of the demand for real balances in late nineteenth century Austria-Hungary indicated by the recursive residual tests points to a shift in the demand function of money starting about 1887, at a time when fundamental changes were occurring in the Austro-Hungarian financial sector. The innovations increased the quality of money, increased intermediation, integrated the financial market within the monarchy, and integrated the monarchy's money market with that of the rest of the world. The implication is that an institutional "upheaval" might cause profound structural changes in the demand for and supply of money.

The increased liquidity contributed to a decline in barter and to the commercialization of agriculture, thereby contributing to the efficiency of the real sector. In addition, the increase in the money supply not only put downward pressure on the interest rate, and upward pressure on prices, but, perhaps most importantly, put upward pressure on output. Prices did increase, to be sure; the

[21] A much less important effect of the spread of the banking system could have been exactly the opposite: Decreasing the demand for money by lowering precautionary balances, since people could rely on the institutions in time of unforeseen need. This, however, was no doubt a second order effect.

[22] The value of silver coins relative to its face value decreased by 6.5% between 1879 and 1887. The process accelerated thereafter. By 1892 the value decreased by 17.4%, of which a full third was lost between 1887 and 1888. This changing relationship between the value of silver coin and of paper currency may have induced people to hold less of the former and more of the latter. Carl Menger "Beiträge zur Währungsfrage in Oesterreich-Ungarn" *Jahrbücher für Nationalökonomie und Statistik*, III (1892), p. 19; in *Gesammelte Werke*, IV, p. 147.

rise in prices could not, by itself, have equilibrated the money market, however. For, after the adoption of the gold standard in 1892, the monarchy was integrated into the world's goods market, where the price level of traded commodities was determined.

This undoubtedly contributed to some extent to the higher than average growth in rates of real output that were obtained subsequent to the reforms. This is one line of reasoning that needs further research in order to ascertain or estimate the contribution of the financial sector to the accelerated growth in output during the decades bracketing the turn of the century.