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Finance, investment, and growth in Meiji-era Japan

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Abstract

This paper examines whether financial factors played a leading role in the rising investment rates and per capita incomes that characterized Japan over the 1880–1913 period. After an account of financial reforms undertaken during the Meiji transition (1868–1884) that created favorable conditions for successful finance-led development, a set of vector autoregressive models offers evidence that the financial sector was indeed instrumental in promoting Japan's rise to world prominence by the eve of the First World War.

JEL classification: E44; N15; N25; O53

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1. Introduction

In the decade that followed the ascendance of western-looking business and political leaders under the aegis of a restored Meiji regime in 1868, Japan made the transition from a country with suppressed economic potential to one in which developing markets, trade, and an openness to new technologies had placed it at the threshold of vigorous economic growth. Over the next 35 years, as policies initiated during the transition promoted the adoption of improved agricultural and machine-based industrial methods, annual real per capita growth rates averaged 1.7 percent for output and 4.2 percent for investment.[1] While an expanding financial sector has been often cited (e.g. Ott, 1960, 1961; Lockwood, 1968; Goldsmith, 1983) as a probable contributing factor in Japan's rise to world prominence by 1913, Suto and James (1999) empirically isolate a large component in a shifting savings/

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[1] See Appendix A for data sources. Real per capita output growth averaged 2.4 percent per annum from 1880 to 1899, and slowed somewhat thereafter. Average growth rates of real investment per capita did not vary appreciably across decades.

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investment function that labor-saving technical progress and foreign capital flows cannot explain, and strongly suggest that financial factors were central to this residual. The following extends the analysis of Meiji Japan in Rousseau (1995) to lend statistical support to Suto and James, and also identifies a role for finance in promoting general development as measured by output per head.

Specifically, the study constructs new annual series from available historical statistics that reflect both the extent of formal intermediation in Japan and the growing importance of publicly held corporate securities, and links these series to the time paths of real per capita estimates of output, gross investment, and private investment, as well as investment's share in output. Inferences are drawn from cointegrated vector autoregressive (VAR) systems. Lack of feedback from output or investment to the financial variables indicates that these links were unidirectional, while the dynamic structure of the analysis makes it unlikely that the findings are a result of omitted variables.

The article is organized as follows. Section 2 describes recent theoretical and empirical perspectives on the finance–growth nexus that might capture features of the institutional framework of Meiji Japan. Section 3 describes the data and variables used in the empirical analysis. Section 4 considers issues of model selection, presents the VAR results and their causal implications, and examines responses of output and investment to financial shocks. Section 5 concludes the analysis.

2. Motivation

The notion that financial factors can exert a first-order influence on macroeconomic outcomes has seen renewed interest in the macroeconomic and development literatures over the past decade.[2] Most formal models address the dual role of financial intermediaries in promoting capital accumulation through the mobilization of otherwise unproductive savings (e.g. Bencivenga and Smith, 1991; Rousseau, 1998) and in raising total factor productivity through improvements in project selection and monitoring (e.g. Townsend, 1979; King and Levine, 1993). Recently, however, attention has also turned to the presence of non-linearities in the finance–growth nexus. Wachtel and Rousseau (1995) and Rousseau and Wachtel (1998), for example, present evidence from the historical experiences of five industrializing countries (the US, UK, Canada, Norway and Sweden) that implies a most critical role for intermediaries in the earlier stages of economic development. Related contributions identify pre-conditions, such as the presence of unexploited productive potential, that might make it possible for a developing financial system to overcome thresholds associated with fixed costs and thereby avoid development traps (e.g. Berthelémy and Varoudakis, 1996).

From the historical record, it appears that reforms in the decade immediately following the restoration created conditions in Japan that were favorable to successful finance-led

[2]The link between finance and economic performance was posited by Joseph Schumpeter (1911). These ideas were formally developed in seminal contributions by Goldsmith (1969), McKinnon (1973) and Shaw (1973), to which much of the new literature owes its underpinnings.

growth. For example, rice rents to which the former feudal nobility had grown accustomed were replaced by government issues of long-term commutation bonds which were redeemable only at heavy discounts. When an 1876 revision of the National Bank Act increased allowable bank profit margins and made commutation bonds available as bank capital, the number of national banks expanded rapidly from a mere five in 1876 to 151 in 1879 (Bank of Japan, 1966, p. 196). Increasing note issues by these banks were largely responsible for rapid inflation by 1879, yet the growing financial structure clarified a need for consolidation of the note-issuing function and perhaps hastened the arrival of Japan's first central bank, which started operations in 1882.

In the meantime, growing opportunities in international trade led the government to start the Yokahama Specie Bank in 1880 to assist in conducting foreign transactions. Industrial technologies (such as the power loom) that had been used in Europe and the US for decades also became available to Japanese entrepreneurs as the economy became more open to Western influences. The financing needs induced by the adoption of these technologies as well as advances in agriculture and small-scale manufacturing led to rapid expansion of a system of ordinary banks which did not issue notes.

With a central bank to control currency issues and a system of banks to allocate credit in place by 1885, the foundations of the financial sector were solid enough for firms to venture into the direct issue of securities. The par value of such corporate issues, while negligible in 1884, reached 50 percent of the combined assets of banks, thrifts and insurance companies by 1900.

It is only in light of these pre-conditions that Japan's rapid growth from 1885 to 1913 can be truly understood. The remainder of the analysis rigorously examines possible channels through which the innovations described above and their subsequent impact on the size of the financial sector led to capital deepening and growth.

3. Measures of financial and macroeconomic development

The formal analysis employs two measures of financial development. The first is an estimate of the total assets of financial intermediaries (FIA). This series, which includes commercial banks (national, private and ordinary), special banks, savings banks, agricultural cooperatives and insurance companies, reflects the size and possibly the sophistication of Japan's most important financial institutions.[3] A second, broader aggregate

[3]It is important to note that the assets of quasi-banks which engaged in both financial and non-financial activities are not included in FIA due to a lack of consistent and reliable estimates. According to Goldsmith (1983, p. 27), these institutions numbered about 120 in 1880 and over 750 in 1885, with capital increasing from ¥1.2 to ¥15 million over this period. Since lendings of the quasi-banks appear to have been financed almost exclusively from capital, these figures could have accounted for less than 1 percent of intermediary assets in 1880 but about 7 percent in 1885. Combined with a large but unquantified number of country pawnshops and small credit cooperatives with total loans that declined from ¥25 million in the mid-1870s to a negligible amount by 1885, the excluded components may have enhanced the explanatory power of the financial aggregates in output fluctuations, especially given the short-term agricultural focus of most lending by these organizations. The impact of their omission in explaining fixed capital formation is likely to be much smaller.

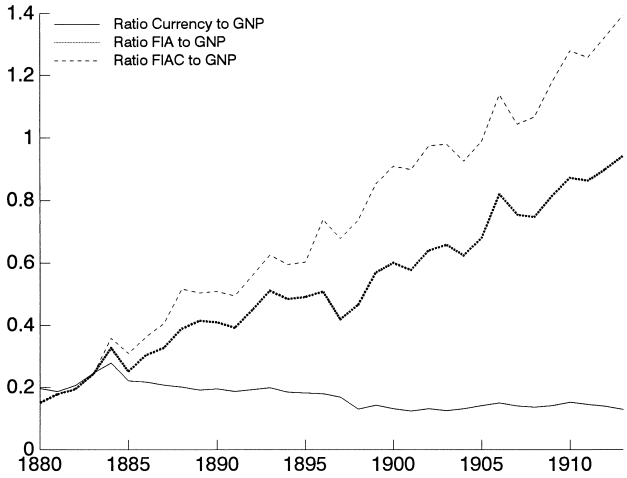

Fig. 1. Ratios of financial variables to gross national product, 1880–1913. Sources: see Appendix A.

(FIAC) appends non-intermediary holdings of corporate stocks and bonds to FIA, and as such accounts for the growing importance of directly placed securities in savers' portfolios after 1885. The data items used to build the aggregates are from the Bank of Japan's 1966 *Hundred Year Statistics of the Japanese Economy* (HYS), David J. Ott's 1960 dissertation *The Financial Development of Japan, 1878–1958*, and a series of volumes edited by Kazushi Ohkawa et al. entitled *Estimates of the Long-Term Economic Statistics of Japan Since 1868* (ELTESJ).

Fig. 1 depicts the above measures as well as the amount of currency in circulation (from Emi et al., 1988) as shares of GNP. It is striking how rapidly the financial superstructure grew after 1880, with FIA and FIAC reaching nearly 94 and 140 percent of GNP, respectively, by 1913. The share of circulating currency in GNP, as is often the case in countries that experience rapid financial development, fell from almost 20 percent in 1880 to 13 percent by 1913. The sharper movements in this ratio over the 1880s can be attributed to policies of the finance ministry aimed at curbing inflation through a sharp contraction of the monetary base, and declines in economic activity that accompanied the policy.

Per capita GNP serves as a measure of economic performance. While this measure clearly cannot account for distributional shifts in income, most readings of the sparse evidence suggest that inequality did not see a pronounced rise from 1880 to 1913 (e.g. Suto and James, 1999; Lockwood, 1968, pp. 271–278). In this case, per capita output would be a fair, if perhaps conservative, index of general development. To test for the influence of financial factors on the accumulation of capital, the study also considers gross domestic fixed investment in both the aggregate (GDFI) and the private sector only (PDFI). To examine Suto and James' hypothesis that financial factors were important in shifting savings/investment rates, the ratios of GDFI and PDFI to GNP also enter the formal

analysis. The macroeconomic aggregates were constructed from series available in ELTESJ.[4]

The empirical representations described in the next section consider financial and non-ratio macroeconomic measures in per capita terms that have been deflated to reflect 1934–1936 prices. Since the outstanding financial stocks are measured at the end of each year, the GNP deflator (designed for use with a flow variable) is applied to the average of consecutive year-end observations in these cases. Appendix A describes further the sources and methods used to construct all series.

4. Selection and estimation of VAR systems

To determine an appropriate framework for studying interactions in systems that include financial assets, output and investment while allowing long-run relationships to enter the models, it is important to first evaluate the stationarity properties of the data and to identify long-run relationships among the variable combinations that comprise each potential system. To this end, Section 4.1 presents a series of unit root tests, while Section 4.2 presents tests for cointegration in VAR systems that include a macroeconomic indicator, the amount of circulating currency, and a measure of financial development. Section 4.3 summarizes evidence from VAR models of a leading role for financial factors in investment and output, with inferences based on tests for the validity of zero restrictions on the coefficients of the lagged financial variables. Some insights about the propagation of financial shocks through output and investment are then obtained from selected plots of the estimated impulse responses.

4.1. Unit root tests

This section presents Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) (Phillips and Perron, 1988) tests for all the series used in the analysis. If the tests are unable to reject the null hypothesis of a unit root for a series in levels, yet reject the null after differencing, it is appropriate to treat the series as non-stationary in subsequent modeling. The univariate representations for the ADF tests include three lags.[5] The PP

[4]Several estimates of gross domestic fixed investment are available for Meiji Japan. Perhaps the most reliable were published by K. Ohkawa et al. (1974) in the summary volume (no. 1) of the ELTESJ series, but this source does not provide a sectoral breakdown. Another series compiled earlier by K. Emi (1971) appears in Volume 4 of ELTESJ and includes government and private components. The level of Emi's series averages only about 65 percent of Ohkawa's series from 1887 to 1913. Both aggregates exhibit similar fluctuations through time. Using Ohkawa's series for gross investment and Emi's series for private investment ensures analysis of the best available data. If long-term movements in investment's share were the main focus of the study, one could (with some additional manipulation, see Suto and James, 1999) also approximate net investment from changes in estimates of the net capital stock that appear in Volume 3 of ELTESJ. The dynamic nature of the empirical analysis conducted here, however, requires data that reflect year-to-year fluctuations in investment as accurately as possible, and as such I choose to work directly with the published gross aggregates.

[5]The Akaike criterion selects two lags in all cases. Here, however, the test regressions use three lags since Schwert (1989) has shown that ADF tests tend to over-reject in small samples when this criterion is employed and that the loss of power from the inclusion of an additional (and possibly unnecessary lag) is generally small.

Table 1
Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) statistics for macroeconomic indicators and measures of financial development, 1880–1913[a]

Macroeconomic indicators	Levels		1st differences	
	ADF	PP	ADF	PP
Gross national product (GNP)	−2.72	−1.58	−3.35**	−6.24**
Gross domestic fixed investment (GDFI)	−2.67	−2.05	−3.23**	−4.80**
Private domestic fixed investment (PDFI)	−2.48	−1.83	−2.64*	−5.17**
Ratio gross domestic fixed investment to GNP (GDFI/GNP)	−2.81	−2.85	−4.21**	−5.41**
Ratio private domestic fixed investment to GNP (PDFI/GNP)	−2.25	−2.13	−2.71*	−5.72**
Financial variables				
Total financial intermediary assets (FIA)	−3.36*	−2.42	−3.12**	−4.46**
Intermediary assets, corporate stocks and bonds (FIAC)	−2.90	−2.11	−2.23	−3.55**
Currency in circulation (CC)	−1.86	−2.15	−3.00**	−5.04**

[a] All variables are in logs, and with the exception of the GDFI/GNP and PDFI/GNP ratios represent per capita real quantities. The test specifications include constant and trend for the levels variables and constant only for first differences. Three lags are used in the ADF regressions. A * and ** denote rejections of the unit root hypothesis at the 10 percent and 5 percent levels, respectively. Finite sample critical values are from Fuller (1976, Table 8.5.2).

tests, which automatically select a bandwidth for computing the spectrum (see Andrews and Monahan, 1992), provide an alternative to ADF tests, which are known to be sensitive to lag order. The trending nature of all series makes both constant and trend terms necessary in the levels specifications, while a constant-only regression is used for the first differences. The log transformation is applied to all series to render deterministic components in the data more nearly linear.

Table 1 reports test statistics and significance levels. Neither test rejects the null of a unit root for the data in levels, with the exception of FIA, which rejects at the 10 percent level with the ADF test only. At least one test rejects the null for each of the differenced series. The findings imply that it is reasonable to model all of the relevant variables as non-stationary.

4.2. *Cointegration tests*

This section tests for stationary long-run relationships between the macroeconomic indicators and measures of financial development. As is common in empirical models of monetary economies with central banks that actively manipulate the monetary base to effect macroeconomic outcomes, a measure of narrow money (in this case, the real per capita quantity of currency in circulation) is included as a key endogenous variable.[6] This yields a set of tri-variate systems. Since the study of dynamic links from finance to economic performance lends itself to hypothesis testing in a VAR framework, it is important to ensure that statistics for block exclusion conform to standard distributions.

[6]King and Plosser (1984) is among the more notable examples of this practice. In this study, I am particularly concerned with the effects that transitory shocks to outside money may have on short-term output fluctuations, and choose to control for these influences.

Table 2
Johansen test statistics for cointegration, 1880–1913[a]

System	Trace (η_r)		Maximum eigenvalue (ζ_r)		
	$r = 0$	$r \leq 1$	$r = 0$	$r \leq 1$	$r \leq 2$
GNP, CC, and					
FIA ($K = 3$)	38.53[b]	10.16	28.36[c]	5.22	4.94
FIAC ($K = 3$)	39.23[c]	12.18	27.04[c]	8.62	3.56
GDFI, CC, and					
FIA ($K = 4$)	35.47[c]	13.25	22.12[c]	9.51	3.83
FIAC ($K = 4$)	28.15[b]	9.24	18.90[b]	5.66	3.58
PDFI, CC, and					
FIA ($K = 4$)	46.45[c]	8.97	37.48[c]	5.14	3.83
FIAC ($K = 4$)	49.40[c]	8.89	40.51[c]	5.12	3.76
GDFI/GNP, CC, and					
FIA ($K = 4$)	43.68[c]	15.56[c]	28.11[c]	11.61	3.95
FIAC ($K = 4$)	35.45[c]	11.29	24.15[c]	6.20	5.10
PDFI/GNP, CC, and					
FIA ($K = 4$)	46.29[c]	9.49	36.80[c]	5.60	3.89
FIAC ($K = 4$)	50.19[c]	9.13	41.05[c]	5.21	3.91

[a] Each system includes a macroeconomic indicator, currency in circulation and the financial measure listed at the left. K is the lag at which the levels terms enter the test regressions. The columns labelled $r = 0$ test a null hypothesis of no cointegration, while the $r \leq 1$ ($r \leq 2$) columns test a null of at most one (two) cointegrating vectors. [b] and [c] denote rejections of the null at the 10 percent and 5 percent levels respectively, with critical values from Osterwald-Lenum (1992), Table 1.

This requires determining whether the variables in each system are cointegrated, since Sims et al. (1990) have shown that Wald tests for Granger causality in tri-variate systems with a single cointegrating relationship are asymptotically distributed as chi-square.[7]

Here, the full information maximum likelihood approach of Johansen (1991) is used to identify the number of stationary long-run relationships. Each system is modeled as a vector autoregression of the form

$$\Delta x_t = \mu + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-k} + e_t, \tag{1}$$

where x_t is a vector containing the three potentially endogenous variables and k is adequately large both to capture the short-run dynamics of the underlying VAR and to generate residuals that approximate the normal distribution. The lag order for each system is chosen with a series of nested likelihood ratio tests. Trends in the data suggest the inclusion of an unrestricted intercept. The Johansen methodology tests whether the Π matrix in Eq. (1) is of less than full rank via the trace and maximum eigenvalue statistics.

Table 2 reports these test statistics for the relevant tri-variate combinations. Rejection of the null hypothesis of no cointegration ($r = 0$) coupled with a failure to reject the null of at

[7] The finding of Toda and Phillips (1993) that the asymptotic distributions of Granger-type tests in cointegrated VAR systems are non-standard due to nuisance parameters does not apply to the tri-variate case. In the absence of cointegration, non-stationary variables in a VAR are normally differenced.

most one cointegrating vector ($r = 1$) provides evidence of a single long-run relationship in a given system. This result obtains in all 10 systems with rejections of the $r = 0$ hypothesis at the 10 percent level or less.

4.3. Dynamic interactions in the cointegrated systems

Analysis of dynamic links is conducted with a series of tests for Granger non-causality. The single cointegrating relationships that characterize each system, in light of Sims et al. (1990), suggest that VARs in levels are appropriate for conducting exclusion tests that allow for the impact of long-run attractions in the data. These VARs take the form

$$x_{1,t} = a_{1,0} + \sum_{i=1}^{k} a_{1,i}x_{1,t-i} + \sum_{i=1}^{k} b_{1,i}x_{2,t-i} + \sum_{i=1}^{k} c_{1,i}x_{3,t-i} + u_{1,t} \tag{2a}$$

$$x_{2,t} = a_{2,0} + \sum_{i=1}^{k} a_{2,i}x_{2,t-i} + \sum_{i=1}^{k} b_{2,i}x_{2,t-i} + \sum_{i=1}^{k} c_{2,i}x_{3,t-i} + u_{2,t} \tag{2b}$$

$$x_{3,t} = a_{3,0} + \sum_{i=1}^{k} a_{3,i}x_{1,t-i} + \sum_{i=1}^{k} b_{3,i}x_{2,t-i} + \sum_{i=1}^{k} c_{3,i}x_{3,t-i} + u_{3,t} \tag{2c}$$

where x_1 is a macroeconomic indicator, x_2 is currency in circulation, and x_3 is a measure of financial development. Table 3 summarizes the findings, with the left panel including FIA as the measure of intermediary development and the right panel considering systems with the broader FIAC aggregate. To provide information on the direction of the causal effects, the columns report the algebraic sum of the regression coefficients on, respectively, each of the k lags of x_1, x_2 and x_3

$$\left(\sum_{i=1}^{k} \hat{l}_{j,i}\right); \quad l = a, b, c;\ j = 1, 2, 3; \tag{3}$$

and, in parentheses, the significance levels of F-statistics for the restrictions that correspond to Granger non-causality, namely

$$\hat{l}_{j,i} = \hat{l}_{j,i+1} = \cdots = \hat{l}_{j,k} = 0; \quad l = a, b, c;\ j = 1, 2, 3. \tag{4}$$

The first set of results in Table 3 include per capita output as the macroeconomic indicator. FIA and FIAC Granger-cause output at the 7 and 2 percent levels, respectively, with positive sums of the regression coefficients (see the third column of each panel on line 2a), while output does not Granger-cause the financial variables (see the first column of each panel on line 2c). The results with GDFI, PDFI and their ratios to GNP are even stronger, with both financial variables Granger-causing the macroeconomic aggregates at the 2 percent level or less in all systems. As before, there is no evidence of feedback to the financial variables. The real per capita amount of circulating currency Granger-causes the macroeconomic indicators at the 5 percent level or less in all but one system,[8] and weaker

[8]Currency Granger-causes gross domestic fixed investment at the 10 percent level.

Table 3
VAR estimates and Granger causality tests, 1880–1913[a]

Macro Indicator	Eq.	Total financial intermediary assets				FIA, Corporate stocks and bonds			
		Macro	CC	FIA	R_a^2	Macro	CC	FIA	R_a^2
GNP ($K = 3$)	Eq. (2a)	0.418	0.080	0.151	0.963	−0.065	0.204	0.255	0.968
		(0.274)	(0.042)	(0.070)		(0.847)	(0.028)	(0.017)	
	Eq. (2b)	−0.539	0.804	0.127	0.755	−0.598	0.876	0.104	0.767
		(0.354)	(0.000)	(0.292)		(0.321)	(0.000)	(0.176)	
	Eq. (2c)	−0.205	−0.262	0.977	0.987	−0.598	−0.007	1.080	0.993
		(0.939)	(0.444)	(0.000)		(0.710)	(0.889)	(0.000)	
GDFI ($K = 4$)	Eq. (2a)	0.388	0.546	0.239	0.958	0.264	0.810	0.310	0.949
		(0.011)	(0.041)	(0.004)		(0.020)	(0.087)	(0.023)	
	Eq. (2b)	−0.207	0.920	0.083	0.772	−0.164	0.911	0.034	0.786
		(0.112)	(0.000)	(0.321)		(0.178)	(0.000)	(0.202)	
	Eq. (2c)	−0.018	−0.240	0.909	0.983	0.058	−0.174	0.904	0.992
		(0.800)	(0.559)	(0.000)		(0.627)	(0.620)	(0.000)	
PDFI ($K = 4$)	Eq. (2a)	0.070	1.947	0.893	0.956	−0.119	2.602	0.988	0.963
		(0.084)	(0.010)	(0.002)		(0.035)	(0.002)	(0.001)	
	Eq. (2b)	−0.131	0.985	0.113	0.797	−0.134	1.050	0.079	0.832
		(0.043)	(0.000)	(0.242)		(0.026)	(0.000)	(0.056)	
	Eq. (2c)	−0.055	−0.179	0.979	0.985	−0.050	0.016	0.979	0.991
		(0.448)	(0.441)	(0.000)		(0.760)	(0.662)	(0.000)	
GDFI/GNP ($K = 4$)	Eq. (2a)	0.200	0.737	0.150	0.870	−0.039	1.070	0.252	0.839
		(0.020)	(0.003)	(0.001)		(0.030)	(0.015)	(0.008)	
	Eq. (2b)	−0.293	0.982	0.057	0.795	−0.239	0.960	0.018	0.804
		(0.047)	(0.000)	(0.289)		(0.089)	(0.000)	(0.205)	
	Eq. (2c)	−0.020	−0.251	0.903	0.983	0.050	−0.134	0.914	0.991
		(0.732)	(0.546)	(0.000)		(0.520)	(0.587)	(0.000)	
PDFI/GNP ($K = 4$)	Eq. (2a)	−0.057	2.101	0.743	0.917	−0.243	2.685	0.820	0.926
		(0.204)	(0.005)	(0.002)		(0.076)	(0.002)	(0.001)	
	Eq. (2b)	−0.147	0.995	0.087	0.796	−0.146	1.049	0.055	0.833
		(0.044)	(0.000)	(0.255)		(0.024)	(0.000)	(0.055)	
	Eq. (2c)	−0.061	−0.165	0.965	0.985	−0.050	0.014	0.969	0.992
		(0.463)	(0.488)	(0.000)		(0.668)	(0.617)	(0.000)	

[a] Each VAR system includes the macroeconomic indicator listed at the left, currency in circulation (CC), and either FIA (left panel) or FIAC (right panel). All variables are in log levels, and with the exception of the GDFI/GNP and PDFI/GNP ratios represent real per capita quantities. Equation numbers correspond to those in the text, with (a), (b) and (c) employing the macroeconomic indicator, CC and the financial measure as the respective dependent variables. The columns report the sum of the regression coefficients on each variable block with the significance level of the F-test for Granger non-causality in parentheses. The adjusted R^2 are also reported.

evidence implies feedback to currency from the macroeconomic indicators. Thus, the inclusion of currency in all systems is clearly justified. A set of Lagrange multiplier (LM) and Q-tests at various lags (not reported here) indicate no evidence of general serial correlation in the residuals for any of the systems, while the generous (and automatically selected) lag orders for the VARs make it unlikely that the unidirectional causal findings are a result of an under-specified time horizon.

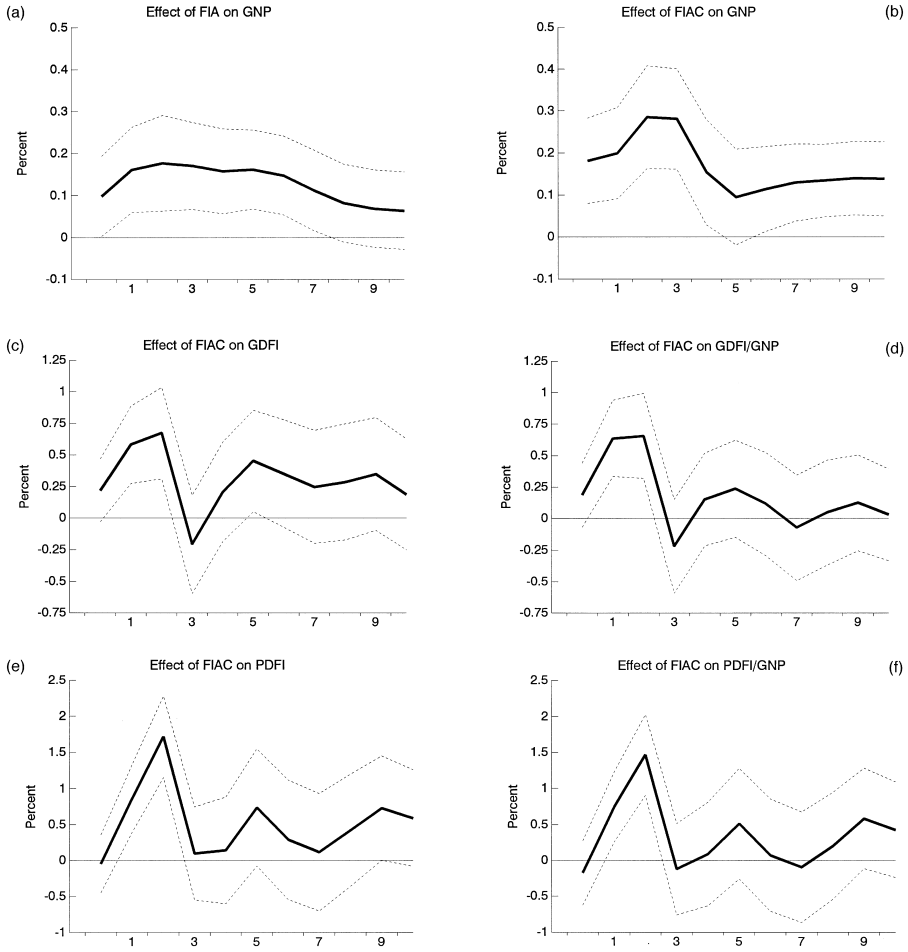

Fig. 2. Responses of macroeconomic indicators to 1 percent increases in financial assets. *Notes*: The plots illustrate the percent changes in real per capita output, investment and the ratios of investment to output that result over a 10-year horizon from a 1 percent change in the orthogonalized innovation to FIA or FIAC in selected tri-variate systems from Table 3. Financial assets are placed first, currency second, and the macroeconomic indicator third. Using the Monte Carlo integration technique outlined in Doan (1995), the thick solid lines plot the mean impulse responses that result from 5,000 random draws from the posterior distribution of the coefficients in each system. The dotted lines are one standard error bands.

Selected responses of the macroeconomic indicators to single 1 percent shocks in orthogonalized innovations to the financial development measures are tracked with one standard error bands in Fig. 2. The impulse response functions order the system variables according to their relative exogeneity, with the financial variable placed first, currency second, and the macroeconomic indicator last. The responses of output to shocks in FIA and FIAC are both positive and begin to decay in the fourth year. The sizes of these responses are also considerable. For example, an increase of ¥1 in FIA (1.66%) from its

sample mean of ¥60.14 (at 1934–1936 prices) would be associated with an increase in real output per capita that peaks after 2 years of ¥0.38 (0.29%) from its sample mean of ¥127.88. An increase of ¥1 in FIAC (1.25%) from its sample mean of ¥79.52 would be associated with an increase in real output per capita of ¥0.46 (0.36%) from its sample mean. While small sample comparisons of impulse response functions must be made cautiously, the sharper peak and more rapid decline of output's response to FIAC than to FIA is also notable. These differences are consistent with a more rapid absorption of direct investment funds than bank-intermediated (and possibly government-directed) funds into capital goods and pressure on private firms to achieve outcomes that make possible generous distributions to direct investors.

The other impulse response functions depicted in Fig. 2 consider only the FIAC aggregate.[9] Both investment variables and their ratios to output respond strongly and rapidly to financial shocks, and decay begins in the third year. The plots for GDFI and GDFI/GNP imply that a ¥1 change in FIAC (1.25%) from its sample mean of ¥79.52 is associated with increases that peak after 2 years of ¥0.16 in GDFI (0.85%) from its sample mean of ¥19.32 and 0.12 percentage points in GDFI/GNP from its sample mean of 14.91 percent. The plots for PDFI and PDFI/GNP imply that the same ¥1 change in FIAC from its sample mean is associated with increases of ¥0.09 in PDFI (2.16%) from its sample mean of ¥4.08 and 0.06 percentage points in PDFI/GNP from its sample mean of 3.15 percent.[10]

It is perhaps surprising that the responses of both output and investment to increases in financial assets (FIAC) begin to decay so quickly after a fairly vigorous rise. The rapid utilization of new financial resources implied by these patterns is consistent with an economy that was technologically prepared for expansion yet lacked the required resources. In fact, the evidence suggests that injections of previously idle resources had little difficulty in finding productive outlets at this early stage of Japan's modern development. A comparison of the responses of GDFI and PDFI with their ratios to GNP also indicates that growth in financial assets largely affected investment in the first year, while output gains accompanied a continued rise in investment over the second year. These delayed responses of output also decay more slowly than those associated with PDFI and GDFI. This lends support to the notion that the mobilization of resources for investment was the key channel through which financial factors affected growth in the Meiji era.

5. Conclusion

This paper constructs series for total financial assets in Japan from 1880 to 1913 and relates them to both investment and general economic activity with a series of cointegrated VAR systems. The findings indicate that expansions of the financial superstructure that

[9]The responses of investment and their output ratios to shocks in FIA, like the results obtained for output, are a bit less pronounced and decay more slowly than the responses for FIAC. The full set of impulse responses is available from the author.

[10]Since PDFI and GDFI were constructed from independent historical sources with different overall levels but similar time patterns (see Footnote 4), their responses to shocks in the quantities of financial assets are not directly comparable.

began near the close of the Meiji transition (ca. 1879) played a leading role in the rapid expansion of output and investment over the next three decades. A leading role for finance in gross and private investment rates also supports Suto and James' view that financial factors were central to a residual in the savings/investment function that cannot be explained by technical progress and capital flows.

Appendix A

This appendix lists the sources and describes the methods used to construct historical series for the analysis.

POP – mid-year population; 1880–1913 from HYS p. 12.

GNP – gross national product; 1885–1913 from ELTESJ:1, table 1, col. 7, p. 178. 1880–1884 from HYS p. 32 'national income produced' (estimated by Ohkawa) was ratio-spliced to the later series.

IPD – Deflator for gross national product (1934–36 = 1); 1885–1913 from ELTESJ:1, table 30, col. 6, p. 232. 1880–1884 from HYS p. 32 'general deflator' (estimated by Ohkawa) was ratio-spliced to the later series.

GDFI – gross domestic fixed capital formation; 1885–1913 from ELTESJ:1, table 1, col. 3, p. 178. 1880–1884 from ELTESJ:4, table 1, col. 4, p. 224 was ratio-spliced to later series.

PDFI – private domestic fixed capital formation; 1880–1913 in 1934–1936 prices from ELTESJ:4, table 3, col. 3, pp. 230–233. The series is the sum of construction and equipment. A break in the construction component after 1886 was accommodated by computing the 1887/1886 ratio of the equipment component, and multiplying the construction component by this result for 1880–1886.

GDFI/GNP – investment's share in gross national product; 1880–1913 is the quotient of GDFI and GNP as described above.

PDFI/GNP – private investment's share in gross national product; 1880–1913 is the quotient of PDFI and delated GNP (using IPD as described above).

CC – currency in circulation; 1880–1913 from ELTESJ:5, table 18, col.(a), p. 214; coverage includes standard and subsidiary coin 1880–1913, government and national bank notes 1880–1899, Bank of Japan notes 1885–1913, Bank of Taiwan notes 1899–1913, Bank of Chosen notes 1909–1913, and gold and silver notes of the Yokohama Specie Bank 1906–1913.

FIA – total assets of financial intermediaries, 1880–1913; coverage includes national banks and ordinary and private banks (CBA), special banks (SPA), savings institutions

(SAVA), credit cooperatives (COPA), and insurance companies (INSA) as described below:

CBA – assets of commercial banks 1880–1913; 1902–1913 from Ott (1960) table B-11, col. 1, pp. 191-5; 1880–1901 are sum of lendings of national banks (HYS, p. 196), lendings of ordinary and private banks (HYS, pp. 198–200), security holdings of commercial banks (Ott, 1960, table B-11, col. 7, p. 191) and cash holdings (Ott, 1960, p. 191, col. 2). The total of these components were ratio-spliced to the asset series for 1902–1913.

SPA – assets of special banks; 1880–1913 from Ott (1960) table B-9, col. 1, p. 164; coverage includes the Yokohama Specie Bank 1880–1913, the Hypothec Bank 1899–1913, Prefectural Agricultural and Industrial Banks 1899–1813, the Hokkaido Colonial Bank 1899–1913, and the Industrial Bank of Japan 1902–1913.

SAVA – assets of savings institutions 1880–1913; coverage includes savings banks 1893–1913 from Ott (1960) table B-13, pp. 201–204 (a ratio splice connects total assets in 1902 to the sum of the available components from 1893–1902), and outstanding postal transfer and savings 1880–1913 from HYS, p. 244.

COPA – loan agricultural cooperatives; 1903–1913 from Ott (1960) table B-19, col. 1, pp. 225–226.

INSA – assets of insurance companies 1892–1913; coverage includes home insurance companies 1892–1913 from Ott (1960), table B-15, col. 1, pp. 207–208, non-life insurance companies 1909–1913 from HYS (pp. 236–239), and life insurance companies 1909–1913 from HYS (pp. 238–241).

FIAC – financial intermediary assets and non-intermediary holdings of corporate stocks and bonds 1880–1913; sum of FIA aggregate as described above, paid-in capital of corporate stocks and shares 1884–1913 from ELTESJ:5 (table 23, p. 228), and domestic corporate bonds (1908–1913 from ELTESJ:5, table 23, 1891–1907 from Ott, 1960, table A-6, col. 1, p. 101). Financial intermediary holdings of corporate stocks (Ott, 1960, table B-6, p. 153) and bonds (Ott, 1960, table B-5, p. 144) were removed to avoid double-counting.

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