German Banking and Japanese Banking: A Comparative Analysis

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INTRODUCTION

WHEREVER there are banks there are arguments about the macro-economic effects of banking policy. One of the best theoretical formulations of the effect of German banking on German development appears in Alexander Gerschenkron's "Economic Backwardness in Historical Perspective" and "Reflections on the Concept of Prerequisites of Modern Industrialization."[1] This problem is given an empirical treatment in "German Banks and German Growth, 1883-1913: An Empirical View," by Hugh Neuburger and Houston H. Stokes.[2] Our intention in this paper is to test further our previous findings and to contrast our findings for Germany with those for post-World War II Japan. While the two situations are not entirely comparable they are similar enough to make such a comparison worthwhile.

Comparative analysis has long been part of the historian's craft. Among modern historians, comparisons of Germany with Japan are frequently heard, although less often committed to print. The economic historian need not go far afield to make such a comparative analysis, since many similarities quickly come to mind. By British or Belgian standards both countries experienced belated but quite rapid and successful industrializations. In both the German and the Japanese cases industrialization was accompanied by wars which, although brief, were important in making clear to the leadership of both countries the industrial requirements of modern military

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1 Alexander Gerschenkron, *Economic Backwardness in Historical Perspective* (Cambridge: Harvard University Press, 1962).

2 Hugh Neuburger and Houston H. Stokes, "German Banks and German Growth, 1883-1913: An Empirical View," JOURNAL OF ECONOMIC HISTORY, XXXIV (September 1974), 710-731, hereafter called Neuburger-Stokes.

power.[3] Finally, the leading industries in both cases were those in which large-scale enterprise was advantageous both for technological and for administrative reasons. It is this last similarity that is most relevant to a comparison of the roles of financial systems in German and Japanese economic development.

As explained in Neuburger-Stokes, the major *Kreditbanken* played a significant role in German economic development. Economic historians of Japan often ascribe an equally significant role in Japanese development to the "ordinary banks" and particularly to the big five *Zaibatsu* banks.[4] These five were the Mitsui, the Mitsubishi, the Sumitomo, the Daiichi and the Yasuda. As among the German *Kreditbanken,* there existed in Japan a group of second class *Zaibatsu,* among which numbered the Kawasaki, Yamaguchi and Konoike banks. Those familiar with the contribution of the major *Kreditbanken* to economic development will note similarities between them and the *Zaibatsu* banks in Sakurai's description of the *Zaibatsu* banks.

> The *Zaibatsu* banks amassed large deposits at relatively lower interest rates because of the high reputation of the *Zaibatsu* names. These funds were invested in new *Zaibatsu* industries or in the enlargement of existing ones. It is well to note that most of these funds were used to finance very long-term investment in heavy industry. This helped the development of capital-intensive production by the *Zaibatsu.*[5]

Although perhaps not to the same extent, long-term financing of a similar kind was used by the *Kreditbanken* to foster German economic development.

Such similarities between *Kreditbanken* and *Zaibatsu* banks should not obscure the very important differences between them. *Zaibatsu* banks functioned as integral parts of industrial empires comprising manufacturing, financial and commercial branches, usually under the control of one family. Holding companies provided the means by which family control was maintained.[6] Such arrange-

[3] On this question see: Shigeto Tsuru, *Essays on Economic Development* (Tokyo: Kinokuniya Bookstore Co., Ltd., 1968), p. 112.

[4] See Kinichiro Sakurai, *Financial Aspects of Economic Development of Japan, 1868-1958* (Tokyo: The Science Council of Japan Division of Economics, Commerce and Business Administration Economic Series, #34, 1964), p. 63. Also see William W. Lockwood, *The Economic Development of Japan* (Princeton: Princeton University Press, 1968).

[5] Ibid., p. 66.

[6] The implications of this arrangement are clearly explained by Sakurai, *Financial Aspects,* p. 67, who comments that "although most of the [*Zaibatsu* bank] funds were

ments did not characterize the relations of *Kreditbanken* and the German industrial firms. Interlocking directorates could certainly be found in pre-World War I Germany among banks and industrial firms, but these banks and firms owned at most only small amounts of each other's shares and continued to perceive one another as having separate as well as common interests. Moreover, shares of German banks and industrial firms were held by a broad range of investors and institutions. Shares of *Zaibatsu* banks and companies were held by single families which usually retained at least a controlling interest in *Zaibatsu* enterprises. Furthermore, Japanese banks made extensive use of "overloans" (that is, loans beyond those warranted by deposits) for which the Bank of Japan provided support. There was nothing comparable to this practice in Germany. The significance of these differences should not be underestimated because we shall present econometric results showing that the respective financial systems were not equally successful.

In comparing the roles of *Kreditbanken* and *Zaibatsu* banks in the industrializations of their respective countries, the question of other differences arises. A recent, thought-provoking essay by Yamamura challenges the traditional view that German and Japanese banks were similar in stimulating industrialization in the early stages.[7] Yamamura contends that in the early period of Japanese industrialization (until 1914) Japanese "ordinary banks" played a minor role, one comparable to that of English banks in the industrialization of Britain. Only in the period after World War I does he view Japanese banks as having functioned like their German counterparts. A stimulating presentation of the traditional view of the contribution of Japanese banks to industrialization has been made by Hugh Patrick.[8] He argues that the chief sources of industrial funds in the early period (before 1914) were new capital stock issues (sold to holders of previously issued shares) and bank loans, and that by 1900 "bank loans were clearly the major source."[9] There is substan-

used effectively from the point of economic development, the dominant motive in allocation decisions was more often the private interests of the *Zaibatsu* as a whole from the aspect of a holding company than the interest of the banks."

[7] Kozo Yamamura, "Japan, 1868-1930: A Revised View," in *Banking and Economic Development*, edited by Rondo Cameron (New York: Oxford University Press, 1972).

[8] Hugh T. Patrick, "Japan, 1868-1914," in *Banking in the Early Stages of Industrialization*, edited by Rondo Cameron (New York: Oxford University Press, 1967).

[9] Ibid., pp. 283-284.

tial agreement between Patrick and Yamamura about the prominent part played by the big five *Zaibatsu* banks in industrial finance after World War I.

The Gerschenkron hypothesis concerning German banking provides the basis for a similar consensus among those who have studied German industrialization.[10] According to this consensus, the *Kreditbanken* were a highly significant influence on the pace and character of German industrialization. Neuburger-Stokes have made use of a production function to measure the effect of *Kreditbank* financing on the levels of output attained by the German non-agricultural economy in the years 1883 to 1913. In the case of the *Kreditbanken,* it was necessary to find a proxy for the efficiency of the industrial financing of these banks. Because most of this financing was accomplished by means of current-account credit, the ratio of current account credit to total credit extended by the *Kreditbanken* was chosen for this purpose.[11] A Cobb-Douglas production function was estimated using various lagged values of this ratio as a shift parameter. The coefficient of the lagged value of this ratio was significant and its sign was negative, indicating that the credit allocation of the *Kreditbanken* introduced an inefficiency into the German non-agricultural economy in the period for which data were available.

The usefulness of this approach in investigating the role of the *Kreditbanken* suggested that a similar approach might prove applicable in analyzing the role of the Japanese "ordinary banks" in economic development. Preliminary efforts employing available data for the interwar period showed that these data were not suitable for use in a production function. In contrast to the interwar period, the period from 1955 to 1967 offers a data series (recently constructed by Richard F. Kosobud) which are well suited to production function studies. While providing no direct evidence about earlier Japanese economic development, the production function for the years 1955 to 1967 does provide a helpful tool in analyzing the contributions of Japanese banks to the reconstruction and rapid growth of the Japanese economy after World War II. Furthermore, the results of such an approach in the post-war era may be interpreted as *indirect* evidence about the contribution of Japanese banks in the interwar years. To make such an interpretation, it must be

[10] Gerschenkron, *Economic Backwardness in Historical Perspective.*

[11] E. Eistert, *Die Beeinflussung des Wirtschaftswachstums in Deutschland von 1883 bis 1913 durch das Bankensystem* (Berlin: Duncker and Humblot, 1970), p. 91.

shown that certain basic characteristics of the interwar Japanese economy persisted in the post-war years.

The two characteristics essential for such an interpretation are the continuation of the *Zaibatsu* as centers of power in finance and industry and the freedom of the *Zaibatsu* and other "ordinary banks" to allocate credit as they wished.[12] The allied governments did attempt to break the power of the *Zaibatsu* in the years immediately following World War II, but this attempt is generally regarded as a failure.[13] In fact, the monetary policy followed by the Bank of Japan in the mid-1950's is alleged to have helped in restoring the strength of the *Zaibatsu*.[14] In periods of tight money, *Zaibatsu* restricted the credit extended to unrelated (mainly smaller) enterprises while maintaining or even expanding credit extended to *Zaibatsu* companies. Moreover, this credit policy was allowed and perhaps encouraged by the government presumably because the government recognized that the technology imported by these companies would more than offset the declining marginal product of capital associated with rationing of this kind. The pursuit of such a policy indicates that the banks were free to follow their own wishes in credit allocation. The policy permitted two percent of Japan's companies to receive two-thirds of all commercial bank loans (in 1957).[15] These conditions are quite similar to those that prevailed in the interwar period and this similarity makes it possible to make inferences about the interwar period based on the experience of the post-war years.

As in the German case an analysis of the influence of the Japanese banks on the level of income attained by the Japanese economy requires the choice of an appropriate shift parameter. Because large-scale manufacturing is a field in which the *Zaibatsu* were especially active, the ratio of credit extended by all "ordinary banks" to manufacturing to total credit extended by "ordinary banks" has been chosen for this purpose. Given the predominance of the *Zaibatsu* banks in extending credit to industry, the ratio captures the effect of their credit allocation. Yet the inclusion of the credit extended to

[12] See T. A. Binson, *Zaibatsu Dissolution* (Berkeley: University of California Press, 1954).

[13] See Bank of Japan, *Money and Banking in Japan* (1964). Legal restrictions did prevent a bank from holding more than ten percent of the shares of a corporation, but these restrictions did not bar the resurgence of the *Zaibatsu*.

[14] Hubert F. Schiffer, *The Modern Japanese Banking System* (New York: University Publishers, Inc., 1962), pp. 139-140.

[15] Ibid., p. 149.

manufacturing by all "ordinary banks" guarantees that the impact of credit allocation by all "ordinary banks" can be gauged. If the coefficient of the lagged value of this ratio is significantly different from zero, then information is obtained about the effect of credit allocation of the Japanese "ordinary banks" on the efficiency of the Japanese aggregate production function. Before the results of the estimation of the Japanese production function are given, some additional tests of the results of the estimation of the German production function are presented.

FURTHER TESTS ON THE GERMAN RESULTS

In our previously mentioned paper on "German Banks and German Growth," we estimated a constrained and unconstrained Cobb-Douglas production function with the present and various lagged values of the ratio of current-account to total credit as a shift parameter.[16] Although we tested our results for serial correlation of the residual and corrected the equation by the use of generalized least squares where appropriate, we did not subject our results to a test of some of the other assumptions of the linear regression. We report the results of these tests here. Note that our results have passed a more powerful serial correlation test and that there is no evidence of heteroskedasticity. We have also tested our results for normality of the residuals. Again the results indicate that our best equations (best in the sense of correctly specified) show no evidence of non-normality of the residuals.

One of the problems of the Durbin-Watson test for serial correlation is that there is an often substantial "uncertain" range where it is neither possible to accept the assumption of serial correlation nor possible to reject that assumption. Using the modified von Neumann ratio, Theil has developed an alternate test based on the BLUS residuals.[17] The drawback is that such a test requires a substantial computational effort. We have calculated two sets of BLUS residuals for each of our equations, where the first base was selected so

[16] For the unconstrained case the functional form actually estimated was $\ln Y = \ln A + \lambda_1 V_1 + \lambda_2 V_2 + \ldots + \alpha_1 \ln L + \alpha_2 \ln K + \ln u$ for the constrained case

$$\ln (Y/L) = \ln A + \lambda_1 V_1 + \lambda_2 V_2 + \ldots + \alpha_1 \ln (K/L) + \ln u$$

where L and K are labor and capital, Y is real output and V_1 is time and $V_2 \ldots V_n$ are various time periods of our shift parameter.

[17] For a good description of the BLUS procedure see *Principles of Econometrics* by Henri Theil (New York: John Wiley and Sons, 1971), Chapter 5.

that we would have the most powerful test for serial correlation and the second base was selected so that we would have the most powerful test for heteroskedasticity. For the BLUS residuals used to test for serial correlation, we computed successive bases starting from the first k observations as the base, the first k-1 and the last observation as the base . . . to the last k observations as the base. The base selected was the set of BLUS residuals giving the highest sum of eigenvalues. These BLUS residuals were used to compute the modified von Neuman ratio for all the equations that we have reported in Neuburger-Stokes. These results are listed in Table 1. Such results indicate that there is no evidence of serial correlation in our equations except for footnote 22, equation (1). However, this equation was re-estimated to give an equation (FN 22-2) showing no evidence of serial correlation. Thus, we conclude that our estimates of the variance of our coefficients are not biased by serial correlation. Although virtually no investigators test a time series equation for the assumption of a constant variance of the error (homoskedasticity), lack of meeting this assumption can be potentially as serious as serial correlation of the residuals because heteroskedasticity can bias the estimates of the standard errors of the coefficients. We, however, have tested for heteroskedasticity by selecting a base at equal intervals from the middle third of the observations and again computing BLUS residuals. Using these BLUS residuals we have formed an F-statistic consisting of the sum of the first third of the squared BLUS residuals in the numerator and the sum of the last third of the squared BLUS residuals in the denominator. We have reported this statistic as F_h in Table 1. F_hProb is the probability that the assumption of heteroskedasticity can be accepted. Inspection of the Table indicates some heteroskedasticity when the shift parameters are *not* in the equation (equation 6) and when there is some serial correlation (equation 9). However, in no case can heteroskedasticity be accepted at the ninety-five percent level. It should be noted that in our major equations (8) and (10) for the unconstrained case, and (15) and (16) for the constrained case, the lowest indicated level of heteroskedasticity appears. This result is probably due to the fact that these equations represent the best specification. At the very least, it indicates that our standard errors of the coefficients are not biased by heteroskedasticity.

TABLE 1
FURTHER TESTS ON EQUATIONS REPORTED PREVIOUSLY BY NEUBERGER-STOKES

Equation No.	*Chi*	*Chi Prob*	F_h	F_h*Prob*	*MVN*
6	1.333	.2788	.4132	.8862	1.8601
7	1.704	.3639	1.4370	.7008	1.6706
8	4.296	.7688	.7983	.6193	1.8003
9	10.590	.9859	.3686	.9126	1.6408
10	3.615	.6939	.7878	.6263	1.7041
11	3.185	.6361	1.445	.7035	1.7699
12	5.037	.8309	1.273	.6389	1.7814
15	8.370	.9611	.9894	.5006	1.9130
16	11.33	.9899	1.006	.5034	—[a]
FN 22-1	1.643	.3503	1.246	.6274	.67646
FN 22-2	2.815	.5789	2.221	.8719	1.9071

[a] For equation (16) BLUS residuals were not calculated because the constant would not enter the equation. F_h is calculated for the GLS residuals.

Sources: For a discussion of the data and equations estimated see Neuberger-Stokes. Note that the equation numbers refer to the original paper. Chi is the Chi-square value for a goodness of fit test for normality using five cells with an expected value of 20% of the observations in each cell. Chi Prob is the probability of the Chi-statistic. F_h is a statistic calculated from dividing the first third of the BLUS residuals squared by the last third of the BLUS residuals squared. The base for the calculation of the BLUS residuals consists of observations taken out of the middle third at equal intervals. Such a procedure has been suggested by Theil. F_hProb is the probability of F_h occurring. MVN is the modified von Neumann ratio calculated from BLUS residuals where the base has been selected by taking successively the first k, first k-1 and the last 1 observation . . . last k observations. For each base the sum of the eigenvalues has been calculated. The base selected is the basing having the largest sum of the eigenvalues. For a more detailed discussion of the Table, see text.

For the last test of the assumptions of a linear regression we formed a Chi-square test on the adjusted residual to test for normality.[18] The results of this test are reported in Table 1. Note that the constrained equations (15 and 16) indicate lack of normality of the residuals while the unconstrained equations (except for equation (9) which shows serial correlation) show no significant evidence of lack of normality. These findings suggest that our evidence for the negative significance for the lagged shift parameter reported in our unconstrained equations in our previous paper reflect a properly specified model. This finding is important because it removes the possibility that our findings resulted in part from a misspecified model.

[18] This test involved dividing all the GLS residuals by the square root of the residual variance and testing whether the resulting vector was normally distributed.

THE JAPANESE FINDINGS

Using a procedure similar to that used in the German case, we have estimated an unconstrained and constrained Cobb-Douglas production function for Japan in the period 1955-1967.[19] At first we attempted to estimate a production function for Japan in the inter-war period. This attempt was not successful because we were unable to find the appropriate data to adjust our labor and capital indices for quality and utilization rate changes in this period. For the period 1955-1967, we were able to obtain data from Kosobud who followed the general approach of Christensen and Jorgenson and constructed divisia quantity indices of gross enterprise national product, labor and capital services.[20]

By linearizing the Cobb-Douglas production function into two functional forms, one for unconstrained estimation and one for constrained estimation, we were able to test whether assumptions about the returns to scale in the model would change our results. The two basic equations estimated were:

$$\ln Y = \ln A + \lambda_1 t + \lambda_2 (PT) + \lambda_3 (MF/TO)_{t-1} + \alpha_1 \ln L + \alpha_2 \ln K \qquad (1)$$

$$\ln (Y/L) = \ln A + \lambda_1 T + \lambda_2 (PT) + \lambda_3 (MF/TO)_{t-1} + \alpha_3 \ln (K/L) \qquad (2)$$

[19] The Kmenta test (see Neuburger-Stokes for a more extended discussion of the use of this test) has been used to test whether Cobb-Douglas was the correct specification. The result for the period 1952-1968 was

$$\ln Q = \underset{}{.0071} + \underset{(.3227)}{1.725 \ln L} + \underset{(5.180)}{1.008 \ln (K/L)} - \underset{(11.586)}{.013 (\ln (K/L))^2} \quad \underset{(.2166)}{}$$

$R^2 = .998$; DW = 1.91; SEE where t-statistics are under the coefficients

Since the coefficient of the squared term of the regression is not significant and is equal to $1/2\ \rho\gamma\delta[1 - \delta]$ where ρ is a substitution parameter, γ is a scale parameter and δ a distribution coefficient and the coefficient of ln (K/L) was significant and is defined as $\gamma\delta$, this implies that the elasticity of substitution σ (which is equal to $1/(1 + \rho)$) is unity. Since the elasticity of substitution is unity Cobb-Douglas is an appropriate specification. An extensive discussion of the data is given below.

[20] For a more extensive discussion of the data see Allen Sinai and Houston H. Stokes, "Real Money Balances and Production: The Japanese Case, 1952-1968," which forms the basis of the appendix discussion of Kosobud's data and from which we quote: "There were some minor differences between the Christensen-Jorgenson and Kosobud approaches to the data. These were due primarily to a lack of adequate data. For example, excise and sales taxes were not subtracted from output in Kosobud's study. He did not add production subsidies to output but included as part of output government expenditures on transportation, power and communication. There was not as detailed a disaggregation of capital as in Christensen-Jorgenson. Some of the estimates, e.g., of rental prices and wages, required uncertain statistics. However, Kosobud appears to have followed Christensen-Jorgenson as closely as possible and his data are probably superior to any other for the post-war Japanese economy."

where Y, L and K are Divisia indices for real output, labor and capital, t is a time shift parameter, PT is an index that reflects the payments made for imported technology and (MF/TO) is the outstanding loans to manufacturing divided by total oustanding loans and discounts of all banks.[21] We expect the sign of λ_1 and λ_2 to be positive. As we have argued in Neuburger-Stokes, the Gerschenkron hypothesis suggests that λ^3 should be positive although for the German case this coefficient was significantly negative.

The results of estimating equations (1) and (2) are reported in Table 2. Generalized least squares has been employed in all cases except equation (5) because the results using ordinary least squares showed evidence of serial correlation. As with the German results, we have tested for serial correlation with the modified von Neuman ratio and have again used BLUS residuals to test for heteroskedasticity. We have not reported results for our normality test because the number of observations in our sample does not permit us to use even a five cell test without falling under the minimum number of observations needed in each cell.

Our findings indicate that λ_3 is significantly positive in equations with (3 and 5) and without time (4 and 6). In equation (4) the presence of time resulted in the loss of significance on the coefficient on labor. Because the correlation between ln L and time is at the .85037 level this suggests that the loss of significance of ln L might possibly result from the the multicollinearity between these two variables. In equation (6) where we have constrained the coefficients to sum to one the coefficient of time is again insignificant. In *all* equations the coefficient of $(MF/TO)_{t-1}$ remained positive and highly significant. The implication of this finding is that the role of the financial sector was to increase the level of output, the

[21] A detailed discussion of data sources is found in the Appendix. Although we were able to get data on gross national enterprise national product, labor and capital services for the period 1952-1968 we were unable to obtain data for our index of the rental payments for the import to technology except for the period 1955-1967. It is for this reason that we have restricted our estimation to the period 1955-1967. If equation (1) and (2) were estimated without PT, then a significant positive coefficient for $(MF/TO)_{t-1}$ would have an ambiguous interpretation since it would be difficult to distinguish between upward shifts of the production function due to the import of new technology and upward shifts of the production function due to changes in the financial structure or the way in which loans are made. If we had been able to adjust fully our input indexes to reflect the import of new technology, we would not have had to use PT explicitly in the production function. Such an adjustment was not possible. If PT and $(MF/TO)_{t-1}$ can both be shown to enter the production function, then a more precise interpretation of the coefficient λ_3 is possible.

TABLE 2
ESTIMATES OF THE PARAMETERS OF THE COBB-DOUGLAS PRODUCTION FUNCTION, JAPAN 1955-1967

(3) $\ln Y = -.5715 + 1.475(MF/TO)_{t-1} + .0614PT + .525 \ln L + .6108 \ln K$
$(-5.153) \quad (5.583) \quad (5.938) \quad (2.025) \quad (8.358)$

$R^2_{or} = .9990$; $R^2 = .99969$; $SEE_{or} = .01364$; $SEE = .00719$; $F_h = 2.290$
$F_h Prob = .7431$; $DW = 2.637$; $MVN = 2.655$; $p = -.6027$

(4) $\ln Y = -.5967 + 1.507(MF/TO)_{t-1} + .06073PT$
$(-4.959) \quad (5.423) \quad (5.637)$
$+ .00955T + .5321 \ln K + .3366 \ln L$
$(.7182) \quad (3.991) \quad (.8939)$

$R^2_{or} = .99893$; $R^2 = .9996$; $SEE_{or} = .01426$; $SEE = .00747$; $F_h = 1.107$
$F_h Prob = .5637$; $DW = 2.77$; $MVN = 1.605$; $p = -.60$

(5) $\ln (Y/L) = -.5914 + 1.556(MF/TO)_{t-1} + .0593PT + .6317 \ln (K/L)$
$(-3.892) \quad (5.150) \quad (4.696) \quad (6.612)$

$R^2 = .9992$; $SEE = .01337$; $F_h = .333$; $F_h Prob = .8032$; $DW = 2.938$;
$MVN = 2.511$

(6) $\ln (Y/L) = -.5784 + 1.464(MF/TO)_{t-1} + .06021PT$
$(-6.139) \quad (6.752) \quad (6.135)$
$+ .006566T + .5603 \ln (K/L)$
$(.8814) \quad (6.978)$

$R^2_{or} = .99898$; $R^2 = .9996$; $SEE_{or} = .01334$; $SEE = .00691$; $F_h = 1.373$
$F_h Prob = .5995$; $DW = 2.690$; $MVN = 2.470$; $p = -.6093$

Sources: For data sources see text. t-statistics under coefficients. For definitions of F_h, $F_h Prob$, MVN see Table 1. All of the above equations have been estimated using a first order GLS procedure with the exception of (5) which has been estimated using OLS. R^2 is the adjusted R^2. R^2_{or} and SEE_{or} refer to OLS equation.

result that Gerschenkron suggested. In all equations PT remained highly significant. The importance of this variable is not limited to showing that the importation of technology increased the level of potential output, a result that would be expected. Rather the value of having PT in the equation is that the inclusion of such a variable makes it difficult to argue that $(MF/TO)_{t-1}$ is significant because it is a proxy for the importation of technology. Since $(MF/TO)_{t-1}$ is only slightly correlated with time (.09531) and PT (.0189), the reason that $(MF/TO)_{t-1}$ enters the equation with a significant positive coefficient cannot be its proxying for these variables.[22] The

[22] Kosobud also reported data for labor, capital and output (see Kosobud, page 43 manuscript) which he describes as "conventional" indexes. We have used

reason that PT enters equations significantly when time often does not is most likely the fact that the correlation between time and PT is .98965. Since PT proxies more successfully for neutral technological change than does time, PT often enters significantly when time does not.

In equations (3)-(6) the levels of the MVN ratio indicate that there is no evidence of significant positive or negative serial correlation of the error term. In addition there is no evidence of significant heteroskedasticity. Thus we can conclude that our estimates of the variance of $(MF/TO)_{t-1}$ are not biased. The importance of this finding is that we can conclude that increases in $(MF/TO)_{t-1}$, which signify an increased percentage of credit going to manufacturing, were associated with upward shifts in the aggregate production function for Japan in the period 1955-1967.

SUMMARY AND CONCLUSION

Earlier it was noted that the Bank of Japan allowed or even encouraged the larger (*Zaibatsu*) "ordinary banks" to ration credit in favor of big *Zaibatsu* enterprises. Because of imported technology and economies of scale, there were substantial increasing returns to be captured in these industries. This mechanism suggests the presence of the effect that Gerschenkron argued for in the German case. Why has such an effect been encountered in Japan in the years 1955 to 1967, but not in Germany in the years 1883 to 1913? The

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this data source to estimate a constrained equation including PT, ln (K/L) and $(MF/TO)_{t-1}$. The results for this equation were

$$\ln(Y/L) = \underset{(-4.746)}{-.9886} + \underset{(6.643)}{.08528PT} + \underset{(5.403)}{2.270(MF/TO)_{t-1}} + \underset{(2.040)}{.3109\ln(K/L)}$$

$R^2 = .996$; SEE = .01944; DW = 2.0588; MVN = 1.358; $F_h = 4.195$; F_hProb = .90

It is important to note that $(MF/TO)_{t-1}$ entered the equation using a completely different data source. Although the "conventional" data have not been corrected for utilization and quality change and as a consequence are not as suitable as the "divisia" data that were used in the equations reported in Table 2, the results showing $(MF/TO)_{t-1}$ to be significant are additional evidence that our findings in Table 2 were not due to some pecularity of the "divisia" data that was used. When the "conventional" data were used in an equation of the form of (6) we found that time reduced the significance of ln (K/L) but that $(MF/TO)_{t-1}$ continued to remain significant (coefficient 1.814, t-stat 4.027). When the "conventional data" were used in equations of the form of (3) and (4) $(MF/TO)_{t-1}$ remained positively significant (coefficient 2.167, t-stat 6.319 and 2.754, t-stat 3.831 respectively) with all variables significant and the right sign in all equations except for the fact that time was not significant in (4). We can conclude from these findings that the sign and significance of the coefficient of $(MF/TO)_{t-1}$ appears to be invariant to either various specifications of the functional form estimated or the data source used.

range of reasons that might be adduced is very broad, but a few merit special attention. An important consideration is that in the periods examined, Germany had to develop most of its own technology while Japan was able to borrow heavily from the West. Furthermore, the *Kreditbanken* may well have had a part in executing a national policy directed more to strengthening certain industries, possibly to advance national defense, than to promoting economic development in general. The Japanese "ordinary banks," and particularly the *Zaibatsu* banks, appear to have given special support to industries which led in importing advanced technology and in manufacturing a broad range of products for export.

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APPENDIX I

DEFINITIONS OF VARIABLES AND SOURCES OF DATA

OUTPUT: (Y) Defined as a Divisia quantity index number of gross enterprise national product. Source: Kosobud, Table 1, Appendix, Col. 1.

LABOR: (L) Defined as a Divisia quantity index number of private domestic labor input. The labor input was measured as the employed labor force in agriculture and non-agriculture. The latter category was adjusted for sex and by level of education attainment by males. Source: Kosobud, Table 1, Appendix, Col. 3.

CAPITAL: (K) Defined as a Divisia quantity index number for private domestic capital input. Capital input was measured by capital stocks for agriculture, housing, and non-agriculture, non-housing capital stock. Weighting by estimates of rental prices reflected "quality change." Source: Kosobud, Table 1, Appendix, Col. 2.

INDEX IMPORTED TECHNOLOGY: (PT) Index of the real value of imported technology. Constructed by dividing the nominal value of imported technology by the price deflator for national product. The data for the nominal value of imported technology were defined as yen expenditures for licenses, royalties, patents, etc., in the technology balance of payments. The data were obtained from Kosobud who in turn obtained the data from the "White Paper on Science and Technology," Science and Technology Agency, Government of Japan (March

1970). The data is discussed in Kosobud, pp. 33-36, manuscript and in Sinai-Stokes, op. cit.

BANK SHIFTER: (MF/TO) Defined as outstanding loans and discounts of all banks to manufacturing divided by total outstanding loans and discounts of all banks. Source: Economic Statistics Annual 1968 and various monthly issues of the Bank of Japan.

Appendix II

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