German Banks and German Growth, 1883-1913: An Empirical View

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INTRODUCTION

ALMOST without exception interpretations of the remarkable growth of the German economy before the First World War stress the role of the German banking system, in general, and that of the universal or *Kreditbank*, in particular.[1] The most subtle and penetrating view of this question is that developed in Alexander Gerschenkron's essays, "Economic Backwardness in Historical Perspective" and "Prerequisites of Modern Industrialization." According to this view, "backward" countries which experience successful industrializations do so by making institutional "substitutions" which enable them to compensate for or even to turn to their advantage their initial deficiencies of productive factors.[2] The institution which is "substituted" in Germany to perform this function is the *Kreditbank*. This interpretation places special emphasis on the growth-inducing character of these banks, but is also open to the possibility that an industrialization led by such institutions might have entailed certain costs. In fact, Professor Gerschenkron explicitly invites help in assessing these costs in commenting: "it would be a fruitful undertaking in research to explore and perhaps to measure and compare the difficulties, the strains, and the cost which were involved in the various processes of substitution . . . ."[3] Thanks to

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1 Among the better known works referred to are J. Riesser, *The Great German Banks and their Concentration* (Washington: U.S.G.P.O., 1911); O. Jeidels, "Das Verhältnis der deutschen Grossbanken zur Industrie mit besonderer Berücksichtigung der Eisenindustrie," in *Staats- und sozialwissenschaftliche Forschungen*, Band XXIV, Heft II, 1-271 (Leipzig: Duncker & Humblot, 1905); W. Sombart, *Das Wirtschaftsleben im Zeitalter des Hochkapitalismus* (Munich: Duncker & Humblot, 1928); J. Schumpeter, *Business Cycles*, Vols. I & II, New York: McGraw-Hill Book Co., 1939; and R. Hilferding, *Das Finanzkapital* (Frankfurt: Europäische Verlaganstalt, 1968).

2 Alexander Gerschenkron, *Economic Backwardness in Historical Perspective* (Cambridge: Harvard University Press, 1962), p. 46.

3 Ibid., p. 51.

the work of Ekkehard Eistert, who has constructed a reliable set of statistics on the German banking system in this era, it is now possible to attempt such a "fruitful undertaking."[4] Making use of these data, an econometric model has been constructed to test the hypothesis that the manner in which the *Kreditbanken* allocated credit contributed to the growth of German non-agricultural output. Our findings strongly suggest that the credit allocation policy of these banks was inhibiting rather than stimulating the German economy in the period for which data are available and that previous interpretations are in need of serious revision. It appears that, in Gerschenkron's terms, the "cost" of bank-led industrialization was far greater than anyone has previously suggested.

HISTORICAL BACKGROUND

A proper understanding of the role of the German banking system requires some familiarity with its evolution in the nineteenth century. Prior to 1848 there were no joint-stock banks in Germany but only private banking houses of the traditional type. In order to alleviate the crisis of that year, the Prussian government granted a corporate charter to the banking firm of A. Schaafhausen in Cologne. Similar charters were granted to the *Bank für Handel und Industrie* (Darmstadt) in 1853, the *Discontogesellschaft* (Berlin) and the *Berliner Handelsgesellschaft* in 1856, the *Deutsche Bank* (Berlin) and the *Commerz- und Disconto-Bank* (Hamburg) in 1870, the *Dresdner Bank* in 1872 and the *Nationalbank für Deutschland* (Berlin) in 1881. Although well over one hundred such institutions were formed by the early 1870's, these eight banks comprised the core of joint-stock banking in Germany before the First World War. Beside their new legal status, what most distinguished these institutions from traditional private banking houses was their combining of investment and commercial banking. Because a crucial feature of their role was company promotion, these banks should also be considered development banks.[5]

It is this promotional role which gave the *Kreditbanken* their special character and established the close relations with industry for which they were so well known. Although the point has been

[4] Ekkehard Eistert, *Die Beeinflussung des Wirtschaftswachstums in Deutschland von 1883 bis 1913 durch das Bankensystem* (Berlin: Duncker & Humblot, 1970).

[5] A *Kreditbank* performs the functions of a commercial bank, an investment bank, a development bank, and an investment trust.

disputed, the conception of this kind of institution is generally attributed to the Pereires, the founders of the *Crédit Mobilier*, who were at any rate the most vocal proponents of the idea.[6] It is an interesting irony that the fate of the German version of the Pereires' conception should have been so much happier than that of the French. From the first days of the initial spurt of German industrialization in the 1850's, *Kreditbanken* flourished with the industries they served. Institutions like the *Bank für Handel und Industrie* were major sources of investment capital for railroad and metallurgical development. The scheme according to which this financing was arranged was simple but risky in terms of traditional banking practice. Very large amounts of both fixed and working capital were advanced to industrial firms that were either starting up or expanding their operations. After this capital had been put to work, the banks converted these loans to marketable debt or equity. This scheme has always won lavish praise for its apparent success.

The financing of German industrialization was not the exclusive preserve of *Kreditbanken*. Private banks of the older type remained active throughout this era, although they steadily lost ground to their new competitors. Because industrial finance required great capital strength, *Kreditbanken* had a telling advantage inasmuch as they were able to increase share capital frequently. New bank shares could be issued with relative ease during boom periods when banks' earnings were high and their profit prospects seemed good. By 1913 the share capital of the major *Kreditbanken* had grown to enormous proportions. Private banks, to which this avenue of expansion was closed, could not keep pace and were absorbed by *Kreditbanken* in large numbers. The increasing interest in attracting deposits shown by these banks as well as the shift to branch banking in which most participated further strengthened their position against that of the private banks. That the *Kreditbanken* became during this era the dominant force within German banking (excluding the *Reichsbank*) and a key force within the economy as a whole has never been disputed.

Contemporaries who analyzed the role of the *Kreditbanken* were most fascinated by their intimate relations with the major German industrial firms. The origins of this intimacy are not at all mysterious. Such close relations were a natural outgrowth of the scheme accord-

[6] Rondo Cameron, *France and the Economic Development of Europe* (Chicago: Rand McNally, 1966), pp. 96-137.

ing to which the banks arranged industrial financing.[7] The policy of granting large credits for fixed capital against security of uncertain value was unusually risky so that measures to reduce that risk must have been a matter of special concern. One simple expedient was the requirement that the borrower conduct all business through one bank (or in cases where a loan was made by a consortium, through the leading bank). If this rule was followed, a bank was guaranteed adequate knowledge of a firm's condition. A second measure was the requirement that bank officials be appointed to the supervisory boards of the firms to which credit was granted. The directorships insured the banks a voice in policy-making in the industries they financed. In view of the fact that by 1905 the representation of the eight major *Kreditbanken* had grown to 819 directors of industrial firms, this voice was clearly a strong one.[8] These aspects of the banking system, account services and board memberships, were the most direct links between the banks and industry. Of the two, the former is the more relevant to an econometric approach.

THE ROLE OF CURRENT-ACCOUNT CREDIT

To provide suitable account services to their growing industrial clientele, the *Kreditbanken* developed a modernized version of an ancient banking practice, the current-account. The current-account is rather like a combined demand-deposit account and line of credit.[9] Interest was paid on credit balances at a rate of one percent under the *Reichsbank* discount rate and charged on debit balances at one percent over that rate plus minor fees. Deposits and withdrawals could be made as the account holder chose, provided he did not exceed his line of credit, and settlements were made quarterly. Security required for such accounts, if any, was usually a mortgage on real property or bonds or shares. Because of their extraordinary flexibility, current-accounts became the predominant form of account service used by German industry.

[7] It should be noted that Germany had neither a general anti-trust law nor any other statute restricting interlocking directorates. Furthermore, tax and securities market legislation appears to have been far more concerned with raising revenue and insuring honest dealing than with preserving competition in banking. Riesser cites this legislation as a significant cause of the concentration movement in German banking. See Riesser, *Great German Banks*, Section IV, Chapter 2.

[8] Ibid., Appendix IV, pp. 897-920.

[9] Siegfried Buff, *Das Kontokorrentgeschäft in deutschen Bankgewerbe* (Berlin: Cotta'sche Buchhandlung, 1904), p. 47.

Not all current-accounts in the *Kreditbanken* were held by industrial firms, but they held a large part of these accounts so that they received most of the credit extended through them.[10] Since commercial credit was arranged primarily through bills of exchange, such credit does not pose a problem for data on current-accounts. Eistert reports that "current-account credit is chiefly used to provide fixed or working capital to industry. The evidence that current-account credit is used in this way may be found in the annual reports of the banks."[11] Adding to the usefulness of current-account credit as an indicator of the extent of industrial financing by banks is its growth as opposed to that of domestic bill credit. Until 1895 current-account credit grew at a rate only moderately faster than that of domestic bill credit. After that year, the growth of current-account credit accelerated dramatically leaving domestic bill credit far behind. This pattern reflects the deepening of relations between banks and industry caused by the great boom that began in that year. In 1883 domestic bills of exchange made up 42 percent of total credit extended by all *Kreditbanken*, and current-accounts 50.8 percent; by 1913 these shares were 20 percent and 72.8 percent respectively.[12] This shift indicates the extent to which *Kreditbanken* transferred their attention from commerce to industry over the period as a whole.

To the banks the current-account form offered many advantages, not the least of which was that a large part of bank earnings came from such accounts. Riesser's description of these advantages is so revealing that it is worth reproducing in full:

> Through the current-account the bank serves in the first place in the capacity of "maid of all work" in the business household of its customers, performing a thousand and one services each for a small consideration. This menial position, as a rule, is, however, only a temporary stepping stone in its progress to a position of influence, at times even of dominance, and one offering great advantages of the most diverse kinds.
>
> For this reason the current account more than any other branch of business represents the field in which the various banks fight their competitive battles, particularly the battle for industrial clientele. Once regular relations are established through the current account, a direct road is opened to power and profit for the bank. This road leads past the various forms of loans, which of themselves, especially the right to close the account, give a certain amount of

[10] Eistert, *Die Beeinflussung*, pp. 89-91. Note that data used in this paper have been corrected to exclude current-account credit extended for other than industrial purposes.

[11] Ibid., p. 91.

[12] Ibid., p. 149.

influence to the bank. It leads further to increased power and profit through reorganizations, promotions, floatations of securities, consolidations and permanent participations in industrial undertakings through stock ownership, or representation on the supervisory board or both. Through these transactions it leads to the conquest of entire branches of industrial activity, to close affiliation with commanding industrial concerns, cartels, and syndicates, and marks the beginning of the supremacy of groups of banks.[13]

As these observations make abundantly clear, the current-account was the basic nexus between bank and industrial firm.[14] It is important to attempt to disaggregate the effects of this nexus if we are to assess the impact of the German banks on German growth in this period.

The *total effect* of the German banks on growth can be thought of as comprising a *substitution effect*, an *institutional effect* and a *credit effect*. While the model that is developed in succeeding paragraphs attempts to distinguish these effects, each effect must first be defined. The use of current-account financing was a method by which banks could extend long-term credit to particular industries at short-term rates. The chief consequence to the economy of the banks' use of such accounts was that various heavy industries obtained financing at rates below the free market, long-term rate of interest while other industries paid a correspondingly higher rate of interest. What is implied is that capital was not allocated strictly in accordance with its marginal product in the different sectors. Such a policy brings about a *substitution effect* which represents an implied inefficiency in the economic system caused by the banking system. Given the institutional intricacies of mixed banking, the *Kreditbanken* themselves suffered no net loss from this policy and so remained good profit maximizers. Any loss to the banks implied by their credit policy was more than counterbalanced by lowered costs of information about the firms they served and enhanced opportunities for profitable securities issue and sale.[15] Under such circumstances a cost of the banks' credit policy to the entire nonagricultural economy could have resulted which the banks may never have perceived. If the banking system actually contributed to growth, then this cost must have been offset by other effects.

Such possible effects include an *institutional effect* and a *credit*

[13] Riesser, *Great German Banks*, pp. 259-260.

[14] Also see Jeidels, "Das Verhältnis," pp. 121-127.

[15] For an explanation of the meaning of current-accounts from the banks' side, see Buff, *Das Kontokorrentgeschäft*, pp. 57-67.

effect. The *credit effect* arises from the fact that in general an economy will grow if there is more credit available providing that such credit does not stimulate an unstable inflation causing widespread disruption to the economy. Any test of the effect of the special institutions of the German banking system must correct for the *credit effect*, since this effect is characteristic of all banking systems. What must be tested is whether there is something to be gained from the special German institutional arrangements. If there is such a gain, it may be called the *institutional effect.* While it is clear that the *substitution effect* will lower potential output and the *credit effect* will raise potential output, it is unclear whether the *institutional effect* will raise or lower output. On the one hand a case could be made that the banks assisted certain industries significantly insofar as the banks were able to improve relations between various firms in an industry and this function resulted in a net gain to the industry. On the other hand, a case could be made that there were serious diseconomies in the institutional arrangement that gave the banks positions on the boards of the various firms in an industry.

Our task is to filter out the *credit effect* and measure the *credit-constant total effect* which consists of the *institutional effect*, the sign of which is unknown, and the *substitution effect* which has a negative sign. Our model will determine exactly the sign of the *credit-constant total effect.* This sign will in some cases give a sure indication of the sign of the *institutional effect.* For example, if the *credit-constant total effect* is positive, then the *institutional effect* must be positive, since the latter must have outweighed the *substitution effect* which is known to be negative. On the other hand if the *credit-constant total effect* is negative, signifying that on balance the growth of current-account financing caused a reduction in the potential output of the German economy, then it cannot be determined directly whether the *institutional effect* is positive or negative.[16]

The preceding sections suggest that although the current-account is the mechanism by which the banks established their close connections with certain industries, the total amount of current-account

[16] This latter case is what was encountered in our empirical section where it was found that in our complete model the coefficients of labor and capital of the production function summed to more than one in contrast to our simple model where they summed to one. In the section "A Test of the Implications of our Findings" we subject our finding to an additional test suggested by Fogel and Engerman to filter out the scale effect from the *credit-constant total effect.*

credit is not a sufficient measure to determine the effect of the German banks upon growth. Difficulties would arise because such a measure confuses the *credit effect* with the *substitution* and *institutional effects*. What is needed is a measure of the extent of involvement of the banking system with industry that is adjusted for the total credit extended by the banking system. This measure can be obtained by computing the ratio of current-account credit extended by the banks to total credit extended by the banks or the banks' *Mittelbereitstellung* in Eistert's terminology.[17] The use of this ratio makes it possible to measure the *credit-constant total effect*, since the ratio has been corrected for the level of total credit. If changes in this ratio can be related in a significant way to changes in the level of non-agricultural output, then a good estimate can be made of the degree of stimulus or restraint that the German non-agricultural economy received from the banks as a consequence of bank financing. A remaining question to be answered is whether the appropriate econometric test is the estimation of a cross section or time series production function.

THE APPROPRIATENESS OF CROSS SECTION VERSUS TIME SERIES ANALYSIS

Although it might at first appear that the correct way to approach the question of the impact of the institutional arrangements of the banking system in advancing or retarding growth in Germany in the period 1883 to 1913 is to estimate a cross sectional production function, this approach does not answer the question. We accept the testimony of Gerschenkron and others that banks made long-term loans to industry at short-term rates via current account.[18] The implication of the use of this technique is that the rate of return on long-term capital is not uniform throughout the economy. The resulting *substitution effect* means that certain light industries used relatively less capital than they should have. The problem with this approach is that it does not correct for technological change and innovation in the different industries that could account for the presumed differences in the measured marginal product of capital in these sectors. Rather than a cross section approach, what is called

[17] Eistert, *Die Beeinflussung*, p. 33ff. It should be noted that the use of *Mittelbereitstellung* as the denominator of this fraction indicates a concern only with the allocation of credit by the banks and *not* with the borrowing decisions of firms.

[18] Gerschenkron, *Economic Backwardness*, p. 14.

for is a time series production function in which the ratio of current-account to total bank credit is used as a shift parameter. If the banks actually contributed to the growth of Germany in this period, then this shift parameter would enter with a positive sign. Were the converse true, this shift parameter would enter with a negative sign. The question at issue is not whether the use of current-account financing favored the growth of German heavy industry in the period. Jeidels and others noted that it did and the government could not have been expected to object to a bank policy that would have enhanced German military potential and increased the German share of world export markets.[19] The central question remains whether the policy of the banks resulted in so serious a misallocation of capital that the potential total of German non-agricultural output in the period was not reached. It is to this latter question that we address ourselves below.

MODEL AND DATA

In this section a model is developed to measure whether credit extended through current-accounts was allocated in a manner that maximized non-agricultural output. If MB is defined as the total credit extended for productive purposes by these banks, then

$$MB = CA + DB + FB + SEC \qquad (1)$$

where CA = current-account credit; DB = domestic bill credit; FB = foreign bill credit; and SEC = credit extended through security holdings.[20]

Since CA/MB represents the proportion of total bank credit extended through current-accounts, CA/MB serves as a proxy for the closeness of the relations between these banks and industry. If, in fact, this arrangement contributed to the efficiency of the economic system, some form of CA/MB should enter into the production function as a positive shift parameter. This formulation does not test whether increases (decreases) in bank credit increase (decrease) efficiency. Rather it tests the hypothesis that a relative rise of current-account credit accompanied increases in efficiency.

To perform this test, we estimate a Cobb-Douglas production

[19] Jeidels, "Das Verhältnis," p. 270. For an account of government policy toward industry in defense related matters see Eckart Kehr, *Schlachtflottenbau und Parteipolitik, 1894-1901* (Berlin, 1930).

[20] All of the above data come from Eistert, *Die Beeinflussung*. See Appendix I for a complete listing of data sources.

function with some form of CA/MB as a shift parameter.[21] The Cobb-Douglas form of the production function has been selected because it is simple and widely used. The Kmenta test has confirmed its appropriateness.[22] Specifically we postulate that

$$Y = Ae^{\lambda_1 v_1 + \lambda_2 v_2 + \ldots + \lambda_n v_n} L^{\alpha_1} K^{\alpha_2} u \qquad (2)$$

[21] It is important to note that it is not being argued that some form of CA/MB is a factor of production. Instead it is being asserted that CA/MB measures the current-account segment of total bank credit extended to industry for productive purposes. By looking at the sign of the coefficient of this shift parameter, one may determine whether an increase or a decrease in CA/MB is associated with an increase or decrease in the efficiency with which the factors or production (i.e., labor and capital) are used.

[22] To test whether the appropriate specification of the production function is Cobb-Douglas, a modification of the Kmenta test suggested by Nadiri (see M. Nadiri, "Some Approaches to the Theory and Measurement of Total Factor Productivity: A Survey," *Journal of Economic Literature*, VIII [December 1970], 1137-1178), pp. 1150-1154 has been used. What is required is the estimation of

$$\ln Y = \ln \gamma + \mu\delta \ln \left[\frac{K}{L}\right] + \mu \ln L + B \left[\ln \left(\frac{K}{L}\right)\right]^2 + u$$

where $B = \varrho\mu\delta \frac{(1-\delta)}{2}$, ϱ is a substitution parameter, γ a scale parameter, δ a distribution coefficient and μ the degree of returns to scale. If B is insignificant with $\mu\delta$ significant, this indicates that $\varrho = 0$ which means that the elasticity of substitution $\sigma = 1$ since $\sigma = 1/(1 + \varrho)$. This would indicate that the Cobb-Douglas production function is the correct specification. The results of the test are

$$\ln Y = \underset{(-3.34)}{-.04176} + \underset{(4.40)}{.5793 \ln (K/L)} + \underset{(10.42)}{1.462 \ln L} + \underset{(.356)}{.03704 [\ln (K/L)]^2}$$

$R^2 = .997$
SEE = .01618
DW = .747

where R^2 = the coefficient of determination, SEE = the standard error of the regression, DW = the Durbin-Watson statistic, and t statistics are listed under the coefficients. Since the Durbin-Watson test indicated serial correlation of the residuals which bias the standard errors of the regression coefficients, generalized least squares has been used resulting in

$$\ln Y = \underset{(-.1720)}{-.005253} + \underset{(2.514)}{.3426 \ln (K/L)} + \underset{(9.789)}{1.491 \ln L} + \underset{(1.682)}{.3041 [\ln (K/L)]^2}$$

$R^2 = .990$
SEE = .03059
DW = 1.96

which no longer shows serial correlation of the residuals. In both equations B is insignificant at the 95% level (since the t statistic is below 1.706), indicating that the Cobb-Douglas production function is the correct specification. μ is 1.491 which suggests increasing returns to scale. In subsequent empirical results (see Table 1) when time is added to the equation the indicated returns to scale fall substantially to a value of around unity. Data for K, L and Y are for non-agricultural output in the period 1883-1913. K and L have been corrected for utilization. For a more complete description see the data section of this paper and Appendix I on data sources.

where[23] Y = real output; L = labor; K = capital; A = efficiency parameter; α_1 = elasticity of output with respect to labor; α_2 = elasticity of output with respect to capital; V_i = shift parameter, i = 1, n; λ_i = coefficient of shift parameter, i = 1, n; and u = disturbance term.

If V_1 = time, then λ_1 = the rate of disembodied or neutral technological change. If V_2 = CA/MB, then a significantly positive (negative) λ_2 indicates that as the current-account segment of total bank credit increases this will result in an increase (decrease) in the level of efficiency in the economy. This methodology allows us to measure what Gerschenkron calls the "costs of substitution," and what we call the *credit constant total effect.*

Equation (2) is initially estimated in log linear form as

$$\ln Y = \ln A + \lambda_1 V_1 + \lambda_2 V_2 + \ldots + \lambda_n V_n + \alpha_1 \ln L + \alpha_2 \ln K + \ln u \qquad (3)$$

using ordinary least squares. When a low Durbin-Watson test statistic indicated serial correlation of the residuals, equation (3) was reestimated with generalized least squares to obtain unbiased estimates of the standard errors of the coefficients.

Sources for Y, L and K are listed in Appendix I. Y, L and K have been corrected to reflect only non-agricultural output. We have made this correction because we note that the banks did not make loans to the agricultural sector during the period. The Gerschenkron hypothesis is that the banks significantly increased growth of heavy industry. If we were to use only data for heavy industry, such a restricted definition of output, labor and capital would not have allowed us to test whether in fact such a bias in favor of heavy industry lowered aggregate non-agricultural output. The rationale behind using non-agricultural output rather than total output is our wish to make our test more sensitive by isolating the non-agricultural sector of the economy.

Labor and capital data have been additionally corrected for utilization using an adjustment to take into account the declining work-hours per year during the period and the rate of unemployment. It has been assumed that the rate of unemployment of labor was the same as the rate of unemployment of capital. Since Mein-

[23] See Appendix I for a complete description of data sources which are all yearly averages.

ert's[24] data indicate that work-hours per year declined .53 percent each year during the period, the corrected labor value is given by

$$L_i = L_i^* (.9947)^i \qquad i = 1, 31 \qquad (4)$$

where L_i = the corrected labor figure in period i and L_i^* = raw labor figure for non-agricultural production in period i. If u_i = Kuczynski's figure for unemployment in period i[25] then

$$K_i = K_i^* (1 - u_i) \qquad i = 1, 31 \qquad (5)$$

where K_i is the corrected capital figure in period i and K_i^* is the raw capital figure for non-agricultural production in period i.

Time has been added to the equation to compensate for possible adjustments in the data that cannot be measured directly because of lack of precise knowledge about changes in the quality of factors of production. It is important to test whether CA/MB replaces time or whether each or neither is significant. If time replaces CA/MB or only one shift parameter enters, this result indicates that both are a proxy for the same shift. If both enter, then it can be concluded that both measure distinct production function shifts. If neither enters, it can be concluded that our data for labor and capital are corrected completely and that there has been no shift in the production function in the period. The use of CA/MB allows us to test whether there has been any shift in the efficiency of labor and capital in the period that is due *only* to the actions of the banks in extending increasing percentages of their credit in the form of current-account credit. For definitions of the variables see the text and Appendix I. All equations have been estimated using generalized least squares with a first order lag scheme. R^2_{or} is the coefficient of determination for equation *not* corrected for autocorrelation. SEE_{or} is the standard error of estimate for equation *not* corrected for autocorrelation. The generalized least squares technique that has been used is outlined in Johnston.[26]

[24] See R. Meinert, "Die Entwicklung der Arbeitszeit in der deutschen Industrie 1820-1956," dissertation, Münster, 1958, pp. 110.

[25] Four observations for unemployment were missing in J. Kuczynski's series. See "Germany 1800 to the Present Day," *A Short History of Labor Conditions Under Industrial Capitalism, Volume Three, Part I* (London: Frederick Muller Ltd., 1945). These figures were generated by the use of a Phillips curve. See A. Phillips, "The Relationship Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957," *Econometrica*, XXV (1958), 283-300.

[26] For a complete discussion of the generalized least squares technique see J. Johnston, *Econometric Methods* (New York: McGraw-Hill Book Company, 1963),

RESULTS

Table 1 lists the results of estimating equation (2) in the form of equation (3) for various combinations of shift parameters. Equation (6) represents the usual production function with time as a shift parameter. All variables are significant and the coefficients are of the expected sign and magnitude. If our hypothesis is correct, then the results of subsequent equations will be better than those in this equation. Equation (7) replaces time with CA/MB lagged one period. The SEE of the original version of equation (7)—(.0144)—is lower than the SEE of the original version of equation (6)—(.0151)—indicating that equation (7) is a better fit. CA/MB has been lagged one period to test whether changes in the financial structure influence the economy with a lag. The highly significant negative coefficient of $(CA/MB)_{t-1}$ of −.1921 suggests that the effect of increasing the role of the *Kreditbanken* through current-account financing was to reduce the efficiency of the economy after a one-year lag. Equation (7) indicates increasing returns to scale on the order of what was found when the Kmenta test was run. This result appears to be a consequence of omitting time from equation (7). Equation (8) rectifies this omission by including both $(CA/MB)_{t-1}$ and time. Both variables are significant and indicate that while there was positive neutral technological change in the economy the effect of increased bank credit via current-account was a reduction in potential output. Because of the inclusion of time, the measured degree of increasing returns to scale falls. In equation (8) the SEE of the original equation falls still further to .0128. Equation (9) adds CA/MB and $(CA/MB)_{t-2}$ to equation (7). These terms do not enter significantly suggesting that the effect of changes in the structure of the banking system is not instantaneous. Time and $(CA/MB)_{t-1}$ remain significant and are unaffected by the inclusion of these two variables. Since the Durbin-Watson test for equa-

pp. 179-200. This technique involves first estimating $Y_t = a + B X_t + u_t$ to obtain a vector of errors $(u_1 \ldots u_t)$ to be used to estimate ϱ where $u_t = \varrho u_{t-1} + e_t$. The original equation is lagged one period, multiplied by ϱ and this transformed equation subtracted from the original equation. The transformed data is then used to re-estimate the original equation which is now in the form $(Y_t - \varrho Y_{t-1}) = a(1 - \varrho) + B(X_t - \varrho X_{t-1}) + e_t$. This procedure will not change the estimated coefficients. If it raises the Durbin-Watson test statistic, it will give better estimates of the standard errors of the coefficients. An alternative estimation procedure is to use first differences. This technique is merely a special case of generalized least squares where it is assumed that $\varrho = 1$. When Y and X are in log form, such a procedure reduces to estimating the equation in percentage change rather than in level form.

TABLE 1
ESTIMATES OF THE PARAMETERS OF THE COBB-DOUGLAS PRODUCTION FUNCTION, GERMANY 1883-1913[a]

(6) $\ln Y = -.06322 + .01562T + .2533 \ln K + .7443 \ln L$
(5.45) (3.053) (1.996) (3.556)

$R^2_{or} = .998$ $SEE_{or} = .0151$ $R^2 = .996$ $SEE = .0232$ $DW = 1.79$ $\alpha_1 + \alpha_2 = .9976$

(7) $\ln Y = .0542 - .1921(CA/MB)_{t-1} + .5762 \ln K + 1.011 \ln L$
(1.42) (−2.96) (6.69) (4.85)

$R^2_{or} = .998$ $SEE_{or} = .0144$ $R^2 = .991$ $SEE = .0293$ $DW = 1.86$ $\alpha_1 + \alpha_2 = 1.5872$

(8) $\ln Y = .01754 + .01187T - .1429(CA/MB)_{t-1} + .3485 \ln K + .8070 \ln L$
(.4753) (2.57) (−2.31) (2.93) (3.99)

$R^2_{or} = .9985$ $SEE_{or} = .0128$ $R^2 = .994$ $SEE = .0245$ $DW = 1.87$ $\alpha_1 + \alpha_2 = 1.1555$

(9) $\ln Y = .0128 + .0124T - .08907(CA/MB) - .1443(CA/MB)_{t-1}$
(.1618) (2.51) (−.1255) (−2.11)

$+ .0223(CA/MB)_{t-2} + .3559 \ln K + .7482 \ln L$
(.275) (2.72) (2.97)

$R^2_{or} = .999$ $SEE_{or} = .0131$ $R^2 = .996$ $SEE = .0216$ $DW = 1.67$ $\alpha_1 + \alpha_2 = 1.1041$

(10) $\ln Y = .0561 + .009748T - .02826(CA/MB) - .1883(CA/MB)_{t-1}$
(.682) (1.90) (−.407) (−2.65)

$+ .0334(CA/MB)_{t-2} + .4828 \ln K + .6063 \ln L$
(.4238) (3.28) (2.30)

$R^2 = .996$ $SEE = .0196$ $DW = 1.84$ $\alpha_1 + \alpha_2 = 1.0891$

[a] t statistics under coefficients.
Source: See text.

tion (9) is right on the boundary, a second order generalized least squares scheme has been used to estimate equation (10). This procedure does not alter our results which show conclusively that the role of the banks in allocating current-account credit was to decrease the efficiency of the economy. In an additional equation not reported, $(CA/MB)_{t-3}$ and $(CA/MB)_{t-4}$ have been added to equation (9) to test whether other lagged values of CA/MB enter significantly. Their failure to do so gives us further confidence in our interpretation of the negative coefficient of $(CA/MB)_{t-1}$.

A FURTHER VERIFICATION OF THE HYPOTHESIS

Although the analysis of the preceding section gives convincing evidence that the role of the banks in allocating current-account credit was to reduce the efficiency of the economy, there is some

question as to how a negative coefficient of $(CA/MB)_{t-1}$ should be interpreted. It is possible that it is not increases in CA that cause a negative coefficient but instead increases in MB. Were this the case, it would imply an entirely different hypothesis. In order to test this hypothesis we estimated an equation where $(CA/MB)_{t-1}$ was replaced by $\ln(CA/P)_{t-1}$ and $\ln(MB/P)_{t-1}$, where P is the price index. This equation does not argue that these variables should be treated as inputs in the production function; rather, it uses them only to test which variable retains significance. The results are listed below.

$$\ln Y = \underset{(1.057)}{-.02298} + \underset{(2.41)}{.01262t} + \underset{(2.66)}{.3383 \ln K} + \underset{(3.91)}{.8335 \ln L} + \underset{(1.41)}{.07658 \ln (MB/P)_{t-1}} - \underset{(-2.04)}{.08695 \ln (CA/P)_{t-1}} \qquad (11)$$

$R^2_{or} = .9986$ $\quad SEE_{or} = .01259$ $\quad R^2 = .995$ $\quad SEE = .02259$ $\quad DW = 1.76$

While $\ln(MB/P)_{t-1}$ is not significant, $\ln(CA/P)_{t-1}$ is negatively significant. This evidence confirms our prior conclusion that the role of the *Kreditbanken* in allocating current-account credit was to inhibit growth. As a further verification, $\ln(MB/P)_{t-1}$ has been added to equation (9). These results listed in equation (12) below further support our hypothesis.[27]

$$\ln Y = \underset{(.4918)}{.09968} + \underset{(2.50)}{.01294t} + \underset{(2.65)}{.3361 \ln K} + \underset{(3.82)}{.8156 \ln L} - \underset{(-2.05)}{.1371 (CA/MB)_{t-1}} - \underset{(-.4095)}{.09843 \ln (MB/P)_{t-1}} \qquad (12)$$

$R^2_{or} = .9987$ $\quad SEE_{or} = .01249$ $\quad R^2 = .995$ $\quad SEE = .0225$ $\quad DW = 1.79$

In equation (12) $(CA/MB)_{t-1}$ remains significant even when $\ln (MB/P)_{t-1}$ is added to the equation. This result proves that the negative coefficients that are reported for $(CA/MB)_{t-1}$ in equation (7), (8), (9) and (10) are not due to an increase of $(MB/P)_{t-1}$. This finding shows that $(CA/MB)_{t-1}$ is a valid shift parameter to

[27] Both equation (11) and (12) have been estimated using generalized least squares with a first order lag scheme.

test whether in allocating current-account credit the banks added to the efficiency of the economy in the period 1883-1913.

At this time it is important to note that we are not making a cyclical argument for CA/MB_{t-1} being significant. If such an argument were made, it would proceed in the following fashion. If we argue that the banks converted current-account loans to long-term debt or equity then, CA might fall in periods of high growth of output, since in such periods it was easier to sell long-term securities. There are several problems with this argument. First, if this argument holds, then MB would have fallen when CA fell and in that case we should find CA and MB highly collinear. This result is not what is shown by equation (11) where we note that $\ln(CA/P)_{t-1}$ remains significant in the presence of $\ln(MB/P)_{t-1}$. Another problem with this cyclical argument is that it is not consistent with the persistent rise in CA/MB over the period despite the positive significance of time. What occurred was an increase in the percentage of MB that was CA during the period. If the cyclical argument were consistent with a positive coefficient on time, one should find that there were cyclical fluctuations about a constant mean "long-term" value of CA/MB. This pattern is not what the data show.

Another possible variant of the cyclical argument is to assert that during periods of high growth other categories of credit such as domestic bill credit and foreign bill credit increased, lowering the level of CA/MB_{t-1} and giving us our result. The problem with this interpretation is that it is not consistent with the evidence in equations (11) and (12), which indicates that $\ln(MB)_{t-1}$ does not enter the equation significantly when either $(CA/MB)_{t-1}$ or $\ln(CA/P)_{t-1}$ is in the equation.

A TEST OF THE IMPLICATIONS OF OUR FINDINGS

While our findings show that the increased role of the *Kreditbanken* in current-account financing tended to reduce the efficiency of the economy at some levels of output by lowering the intercept of the production function, a close inspection of our results indicates that the measured returns to scale increased from essentially one (.9976, to be exact) in equation (6) to some value more than one in equations (7) to (10).[28] These findings suggest that the banks

[28] The measured returns to scale can be calculated by adding the coefficients of labor and capital (α_1 and α_2).

caused some form of increasing returns to scale, oligopolistic market structure. An interesting question is whether the resulting *scale effect* arising from the level of operation of these new industrial facilities was large enough to overcome the inefficiencies introduced by the apparent misallocation of current-account credit. Fogel and Engerman have suggested a test to determine whether the economy was actually operating at a level high enough to overcome (via increasing returns) the reduction of the intercept of the production function. This test[29] reduces to whether ξ is greater or less than zero where

[29] For a complete discussion of this test see R. Fogel and S. Engerman, *Time on the Cross: The Economics of American Negro Slavery* (Boston: Little Brown and Company, 1974), Appendix B. The essential idea is to rewrite:

A $$Y = \hat{A}L^{\alpha_1}K^{\alpha_2} \quad \text{as}$$

B $$Y = \hat{A}\left[\frac{Y}{\hat{A}}\right]^{\frac{\beta}{1+\beta}} L^{\frac{\alpha_1}{1+\beta}} K^{\frac{\alpha_2}{1+\beta}}.$$

In order to do this we must develop coefficients X_1 and X_2 such that

C $$\frac{\alpha_1}{1+\beta} + X_1 = \alpha_1 \quad \text{and} \quad \frac{\alpha_2}{1+\beta} + X_2 = \alpha_2.$$

These reduce to $$X_1 = \frac{\beta\alpha_1}{1+\beta} \quad \text{and} \quad X_2 = \frac{\beta\alpha_2}{1+\beta}.$$

We can now rewrite equation A as

D $$Y = \hat{A}L^{\frac{\alpha_1}{1+\beta}} K^{\frac{\alpha_2}{1+\beta}} L^{\frac{\beta\alpha_1}{1+\beta}} K^{\frac{\beta\alpha_2}{1+\beta}}.$$

We note that

E $$L^{\frac{\beta\alpha_1}{1+\beta}} K^{\frac{\beta\alpha_2}{1+\beta}} = \left[\frac{Y}{\hat{A}}\right]^{\frac{\beta}{1+\beta}}.$$

Equation D can now be quickly reduced to equation B where

F $$\hat{A}\left[\frac{Y}{\hat{A}}\right]^{\frac{\beta}{1+\beta}}$$

is the "adjusted" intercept that takes into account the effects of possible increasing

$$\xi = \left[\frac{\hat{A}'}{\hat{A}}\right]\left[\frac{Y'}{\hat{A}'}\right]^{\frac{\beta}{1+\beta}} \qquad (13)$$

and it is assumed that the base equation has constant returns to scale and Y' is the mean of output; $\hat{A}'$ is the intercept of the equation to be tested; $\hat{A}$ is the intercept of the base equation; and $\beta = \alpha_1 + \alpha_2 - 1$. The results for ξ of such a test for equations (7), (8), (9) and (10) in comparison to equation (6) are .98, .99, .94 and .94 respectively. Since all values of ξ are less than one, these results indicate that the gains from increasing returns to scale (measured by the sum of the coefficients of labor and capital) in equations (7) to (10) did not outweigh the losses of output due to the shift downward of the production function measured by the negative coefficient on the shift parameter $(CA/MB)_{t-1}$. This test shows that the scale of operations of the German non-agricultural economy in the period 1883 to 1913 was apparently not large enough to overcome the downshift in the production function that resulted from the increasing use of current-account credit by the banks.[30]

(decreasing) returns to scale. The test reduces to computing ξ which is the ratio of the two "adjusted" intercepts. The general form of ξ is

G
$$\frac{\hat{A}'\left[\frac{Y'}{\hat{A}'}\right]^{\frac{\beta}{1+\beta}}}{\hat{A}\left[\frac{Y}{\hat{A}}\right]^{\frac{\beta_0}{1+\beta_0}}} = \xi$$

which quickly reduces to equation (13) when the base equation has returns to scale equal to one which implies $B_0 = 0$.

[30] The Fogel-Engerman test uses the mean values of all variables within the sample period. While this procedure is correct, the use of the technique does not answer the question of whether the scale effect ever will outweigh the static efficciency loss within the sample period. To answer this question, we have computed ξ for equations (7), (8), (9) and (10) in comparison to equation (6), where we have used end of sample period values for all variables. The values of ξ are .94, .97, .90 and .89 respectively, which are uniformly lower than those obtained for ξ when the mean values of these variables were used. The explanation is that during the sample period the rise in CA/MB was sufficient to outweigh the increase in production arising from the measured increasing returns to scale. If the level of CA/MB had remained constant, then the increasing returns might eventually have "canceled" the output reducing effect of the static loss associated with CA/MB.

AN ALTERNATIVE SPECIFICATION OF THE MODEL

We have presented arguments in support of the hypothesis that the industrial financing of the *Kreditbanken* was plagued by an allocative inefficiency serious enough to have limited the growth of non-agricultural output. The preceding section on the Fogel and Engerman test was based on the belief that in some fashion the actions of the *Kreditbanken* were captured by an increase in the measured returns to scale in equations (7) through (10) in comparison to equation (6). Such an interpretation may be overly generous to the Gerschenkron view since it is equally plausible to argue that the level of increasing returns to scale as measured in an equation such as (8) or (9) more nearly reflects a true measure of the returns to scale because the returns to scale as measured in equation (6) are downwardly biased owing to incompleteness of the model. In this section we test this hypothesis by restructuring the model so that constant returns to scale are assumed. In this manner we obtain a measure of the effect of the method of industrial financing by the *Kreditbanken.*

If we assume that $\alpha_1 + \alpha_2 = 1$, then equation (2) becomes

$$\frac{Y}{L} = Ae^{\lambda_1 v_1 + \lambda_2 v_2 + \ldots + \lambda_n v_n} \left[\frac{K}{L}\right]^{\alpha_1} \tag{14}$$

which can be estimated in log-linear form. Such estimates are presented in equation (15) and (16), where we have used GLS because the original equations indicated serial correlation.

$$\ln (Y/L) = \underset{(.3571)}{.01281} + \underset{(5.71)}{.01481T} - \underset{(-2.20)}{.1309\,(CA/MB)_{t-1}} + \underset{(2.840)}{.3218 \ln (K/L)} \tag{15}$$

$$SEE_{or} = .01256 \quad SEE = .02342 \quad R^2 = .98 \quad DW = 1.885$$

$$\ln (Y/L) = \underset{(4.764)}{.01397T} - \underset{(-3.399)}{.1374\,(CA/MB)_{t-1}} + \underset{(.736)}{.03567\,(CA/MB)_{t-2}} + \underset{(2.963)}{.3473 \ln (K/L)} \tag{16}$$

$$SEE_{or} = .01299 \quad SEE = .0200 \quad R^2 = .988 \quad DW = 1.65$$

Equation (15) supports our hypothesis that the actions of the *Kreditbanken* lowered potential output since the coefficient of

$(CA/MB)_{t-1}$ is negatively significant. Equation (16) shows similar results, although not all the variables entered the equation due to insufficient F level.[31] The alternative specification of the model shows that our results are not sensitive to the assumption of non-constant returns to scale. It is interesting to note that although in equation (15) in comparison to equation (8) the coefficient of time is biased upward owing to the constraint of $\alpha_1 + \alpha_2 = 1$, $(CA/MB)_{t-1}$ remains highly significant.[32] Thus although equation (8), (9) and (10) are probably better specifications of the underlying production function in the period, our findings are not sensitive to our not assuming constant returns to scale.

SUMMARY AND CONCLUSION

Since the sign of the coefficient of the shift parameter in this model is a proxy for the efficiency of allocation of current-account credit and in every case the coefficient was negatively significant for this shift parameter lagged one period, we conclude from this model that the industrial financing of the *Kreditbanken* in the period 1883 to 1913 was plagued by allocative inefficiency serious enough to have hampered the growth of non-agricultural output. The literature suggests one possible interpretation of this result. Alexander Gerschenkron and Otto Jeidels, contemporary scholar and banker, call attention to the banks' bias in favor of heavy industry and against light industry.[33] Because of the impressive record made by German exports in this era, the possibility of a bias in favor of export industries should also be considered. Moreover, industries thought to have been making important contributions to national defense might have been given special preference in bank credit allocation as well, either out of patriotic feeling or at the urging of the government. In fact, all three of these biases may have influenced bank credit allocation, perhaps with the tacit approval or encouragement of the government. Whatever its origins this bias surely had its cost, for when current-account credit was not allocated where mar-

[31] In equation (16) the constant and CA/MB would not enter.

[32] If the coefficient on time was the same in equation (8) and (15) this would suggest that there actually were constant returns to scale and that the estimates of α_1 and α_2 in equation (8) were biased upward. Our contrary finding suggests that in fact it is a misspecification to assume constant returns to scale and that α_1 and α_2 are not biased in equation (8).

[33] Gerschenkron, *Economic Backwardness*, p. 15 and Jeidels, "Das Verhältnis," p. 270.

ginal efficiency of capital was highest Germany attained lower levels of non-agricultural output than those that would have been attained in a freer capital market.[34] It would be most interesting to know exactly what German political and economic decision-makers were paying for and whether it was worth the price.

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APPENDIX I

DEFINITIONS OF VARIABLES AND SOURCES OF DATA

OUTPUT: real NNP for non-agricultural sector = real NNP at factor cost − agricultural product at factor cost (1913 prices), Hoffmann (pages 454-455, cols. 10 and 1 respectively).

LABOR: labor force in non-agricultural sector = total employment, Hoffmann (page 205, col. 9) − agricultural work force, Hoffmann (page 205, col. 1). This raw figure was adjusted via equation (4) using Meinert's data (page 110) on work-hours per year.

CAPITAL: capital in non-agricultural sector = total capital stock derived from Hoffmann (page 26, col. 2) times the percentage of capital stock that is not agricultural derived from Hoffmann (page 44). Thus quantity is adjusted for utilization via equation (5) using Kuczynski's data (p. 163) on unemployment.

PRICE: derived from dividing nominal output, Hoffmann (page 248, col. 5), by real output, Hoffmann (page 827, col. 7).

CA: curren-account credit, Eistert (table 15, page 98).

DB: domestic bill credit, Eistert (page 82, col. 7a).

FB: foreign bill credit, Eistert (page 120, col. 3).

SEC: credit extended through securities, Eistert (table 19-21, col. 6).

Where Hoffmann refers to W. Hoffmann, *Das Wachstum der deutschen Wirtschaft seit der Mitte des 19. Jahrhunderts* (Berlin: Springer Verlag, 1965) and Eistert refers to E. Eistert, *Die Beeinflussung des Wirtschaftswachstums in Deutschland von 1883 bis 1913 durch das Bankensystem* (Berlin: Duncker & Humblot, 1970). Meinert refers to R. Meinert, "Die-Entwicklung der Arbeitszeit in der deutschen Industrie 1820-1956," Dissertation, Münster, 1958. Note that the above data are annual averages.

[34] It is interesting to speculate how much loss of non-agricultural output was actually associated with the rise of the use of the current-account by the banks. If we assume that − .1429 is the coefficient of $(CA/MB)_{t-1}$ (see equation 8) and that the index number on non-agricultural output in 1913 was 3.010300778, the rise in CA/MB from 50.8% to 72.8% in the period caused an apparent loss of real output of .094637835. The percentage loss was 3.14%.

Appendix II

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