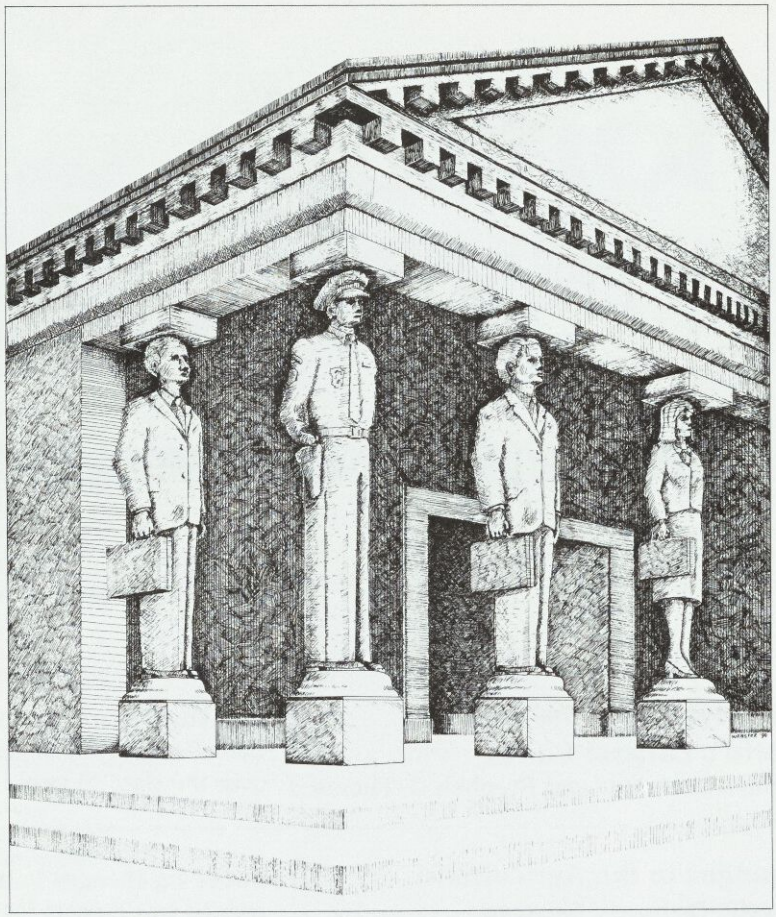

Employment in the World's Largest Banks

William C. Hunter and Stephen G. Timme

Analyzing labor utilization patterns has been a common method of measuring the performance of the world's largest commercial banks. This article expands and updates research on this subject by describing changing employee utilization patterns of banks from industrialized countries since the late sixties. The authors find that large U.S. banks have come to need significantly more workers to produce the same level of services than banks in many other industrialized nations. This research has important implications regarding the effects of country-to-country differences in regulatory structure on bank efficiency.

One aspect of banking system performance that has received continued attention is the use of labor among the world's largest banks. Findings in this area of research have implications for a wide range of banking-related activities, from the effects of different regulatory regimes on banks to the possibilities of substituting capital for labor. This article updates and extends earlier analyses of employment at the world's largest banks; such research is especially important in this time of accelerating change in the financial services industry.

George G. Kaufman initiated this approach to analyzing bank operations in a 1970 study of the labor intensiveness of large banks from several industrialized and less developed countries. In an effort to understand how efficiently banks utilize labor in producing financial services, the researcher found that banks headquartered in the United States required the fewest employees to produce the same level of financial services. The study used 1967 data and controlled for differences in exchange rates, total assets, and number of worldwide offices. Banks headquartered in Japan were among the least efficient in their use of labor, and banking organizations in less developed countries generally lagged far behind industrialized nations' banks in terms of efficient labor utilization.

In 1971 Brock K. Short extended Kaufman's research, using data for the same year but including banks from more countries. Sang-Rim Choi and Adrian Tschoegl (1984) eventually updated Short's work with 1979 data. From their research came the rather surprising result that, over the 12 years following the Kaufman study, U.S. banks needed significantly more employees to produce financial services than banks headquartered in many other industrialized countries, including those headquartered in Japan. Once again, these results emerged after controlling for differences in exchange rates, assets, and the number of worldwide offices, as well as for inflation.

Given the potential for such dramatic changes in employment utilization in the production of financial services, economists' and policymakers' ongoing interest in this topic is not surprising. In part, this focus reflects a desire to understand better the extent to which capital can be substituted for labor in the banking industry and whether certain regulatory structures in place in one country are more conducive than those in other countries to promoting efficiency, particularly in the use of labor.

One implication of such a differential effect would be the potential for structural arbitrage on the part of international bank managements. If the regulatory structures imposed by various countries affect bank production differently, banks operating in a location where regulations detract from production efficiency would be at a competitive disadvantage vis-a-vis banks in locations with more favorable regulations. Over time bank managers are likely to move their production activities "off-shore" to countries whose regulatory climates are more amenable to efficient production. Under such a scenario, these competitive advantages and disadvantages would presumably disappear over time, and international banks—regardless of their particular country of charter—would all have similar performance characteristics.

In the literature examining differences among the world's largest commercial banks, the choice of employee utilization as the performance measure reflects the fact that detailed micro-production and financial data of the type examined in typical bank production efficiency studies of domestic banks are not readily available for foreign banks. However, by relating bank employment to available key determinants other than wages and capital costs—such as total assets and number of worldwide offices—one can gain insight into questions related to labor intensiveness, productivity, and efficiency across banks under a variety of regulatory regimes.

This article updates and extends the studies by Kaufman, Short, and Choi and Tschoegl. Under analysis are shifts in employee utilization among banks headquartered in industrialized countries from 1980 to 1986; these movements are then related to bank size. This research has

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potential importance for providing insights into international competitive viability, the effects of technical progress and deregulation, and changes in equilibrium market structures.

Empirical results indicate that banks in industrialized nations still have significantly different employee utilization patterns from those in developing countries. Even among industrialized countries substantial differences in this aspect of banking performance persist. These differences are present in both a dynamic and a static sense. That is, the research uncovers significant differences in the rate of change in employee utilization as well as variations across time. One might expect that employee utilization in banks from industrialized nations differs from that in less developed countries, given the disparities in cultures, values, and market orientation that characterize the two categories of countries. In less developed countries close ties usually exist between banks and the state, for example, and bank regulation is often used as a tool of social policy, especially in the employment policy area.

A more surprising finding is the presence of significant differences in employment patterns among banks from the industrialized countries. Besides suggesting that bank regulation may have a significant effect on bank production efficiency, this research implies that free entry by foreign banks into domestic banking markets may not be without its costs since structural abritrage by international bank managements has not yet equalized performance.

This article also reports that employment at U.S. banks increased significantly over the 1980-86 period, taking into account the effects of asset size and number of branches, while banks from other industrialized countries displayed significant annual declines in employment. Perhaps large U.S. banks, using traditional measures of efficiency, are becoming increasingly less productive or efficient relative to their major international competitors. However, this finding may result from other factors, including differences in product mixes that mask U.S. banks' true efficiency or by the timing of investments in bank production technology.

The research in this article is presented in two major sections. First, the analyses conducted by Kaufman, Short, and Choi and Tschoegl are updated, using 1986 data to compare employee utilization differences between banks from both the industrialized or developed countries and from the less developed nations. Next, information is provided on the time-series properties of employee utilization for banks from several different countries, including an examination of the relationship between bank size and employment.

Employment in the World's Largest Banks: 1986

Before examining the results of this article's research, it is useful to look at earlier efforts and their methodologies. Kaufman, Short, and Choi and Tschoegl studied data for number of employees, total assets, and worldwide offices for the world's largest 150 banks as published annually in the *American Banker*. Table 1 shows the regression model used to examine the relationships among these variables. Differences in employee utilization among the sample banks—after controlling for total assets and worldwide offices headquartered in each country represented in the sample—are captured by the coefficient on the country indicator (dummy) variable. The estimated parameter values of the employment model used by Short, as well as Choi and Tschoegl, appear in Table 1, along with updated estimates for 1986. In updating the Kaufman study, Short added banks from several additional countries. Since Choi and Tschoegl's study updated Short's work using the same model, Table 1 does not report on Kaufman's original study.

For each study reflected in Table 1 total assets for the sample banks were converted into millions of U.S. dollars using either end-of-year or end-of-third-quarter spot exchange rates. In the Choi and Tschoegl update and the current study total assets are expressed in 1967 U.S. dollars, using the GNP deflator to make the results comparable to those of Kaufman and Short.

The results in Table 1 (the b_{TA} parameter values) suggest that—other things being equal—the number of employees per million 1967 dollars of total assets fell significantly over the measured period. The index dropped from 1.22 in 1967 to 0.66 in 1979 and fell further to 0.34 in 1986. On the other hand, the index relating

Table 1.
Comparative Regression Results for the Bank Employment Model
(standard errors in parentheses)

$$EMP = b_{TA}TA + b_{BR}BR + d_{US}D_{US} + d_JD_J + d_{BI}D_{BI} + d_{OLDC}D_{OLDC} + d_{UKP}D_{UKP} + d_{DE}D_{DE} + d_{SPG}D_{SPG}$$

Parameter	Short (1967)*	Choi-Tschoegl (1979)*	Hunter-Timme (1986)*
b_{TA}	1.22‡ (0.10)	0.66‡ (0.08)	0.34‡ (0.07)
b_{BR}	9.81‡ (0.62)	7.69‡ (0.74)	10.95‡ (0.86)
d_{US}	−411 (566)	5,592† (2,117)	11,236‡ (2,451)
d_J	1,633† (731)	−1,689 (1,781)	−4,215 (2,499)
d_{BI}	35,169‡ (3,381)	87,834‡ (6,456)	112,850‡ (9,577)
d_{OLDC}	4,295‡ (1,052)	12,375‡ (1,912)	950 (4,336)
d_{UKP}	585† (991)	16,109‡ (2,495)	19,567‡ (2,904)
d_{DE}	−19 (578)	−2,008 (1,418)	2,012 (1,729)
d_{SPG}	4,749‡ (1,481)	2,957 (8,110)	−5,581 (4,940)
R_2	0.89	0.87	0.92
Mean Employees	8,582	17,290	19,567

EMP is number of full-time employees, *TA* is total assets, and *BR* is the number of worldwide offices. Total assets are measured in millions of 1967 U.S. dollars. The dummy variables equal one for a bank in the respective country and zero otherwise. Following Short and Choi-Tschoegl, the dummy variables are defined as the United States (*US*); Japan (*J*); Brazil and India (*BI*); Other Less Developed Countries (*OLDC*); the United Kingdom, Canada, Australia, and South Africa (*UKP*); Developed European countries and Israel (*DE*); and Spain, Portugal, and Greece (*SPG*).

* *The results in the "Short (1967)" column are for the year 1967 from Short (1971), the "Choi-Tschoegl (1979)" column for the year 1979 from Choi and Tschoegl (1984), and the "Hunter-Timme (1986)" column for the year 1986 from the current study.*

† *Significant at the .05 percent level.*

‡ *Significant at the .01 percent level.*

employees to offices was mixed, dropping from 9.81 in 1967 to 7.69 in 1979 but then increasing to 10.95 in 1986. Thus, while employee productivity or efficiency appeared to improve significantly between 1967 and 1979, the efficiency gains were somewhat diminished between 1979 and 1986 because of the increased number of employees per bank office. This branch office labor intensity parameter, b_{BR}, measures the marginal impact on total employment of one bank office.

Reasons for Changes in Efficiency. As Choi and Tschoegl noted, three important causes of efficiency gains are economies of scale, changes in firm product mix, and technological change. In their study, these two researchers concluded that economies of scale do not appear to be a major contributing factor to apparent increases in employee efficiency. Recent analyses of costs and production efficiency imply that this conclusion is still valid. Studies by Alan Berger, Gerald Hanweck, and David Humphrey (1987) for small U.S. banks, and by the authors of this article (1988) for very large U.S. banks, cast additional doubt on scale economies as an important explanation of employee efficiency gains. Ber-

ger, Hanweck, and Humphrey found no evidence of scale economies for U.S. banks with $10 million to $1 billion in total deposits. Hunter and Timme (1988) found evidence of mild diseconomies of scale for U.S. banks with more than $5.0 billion in total assets stated in 1986 dollars. The average asset size of the sample banks in the current study is $57.8 billion (in 1986 dollars) ranging from a bank with $15.6 billion in total assets to an institution with total assets of $239.6 billion. The finding that the employment effects of bank offices served to diminish employee efficiency gains over the 1979-86 period is consistent with 1986 research conducted by authors of this article. In that study, bank offices were found to have a negative impact on bank efficiency in a sample of large U.S. bank holding companies over the period 1972-82.

With respect to many of the banks examined in this article, changes in product mixes might provide a more appealing, though less than complete, explanation of measured employee efficiency gains. By 1979, Eurocurrency markets had matured; most major banks (except for those owned by the Japanese) had already penetrated the wholesale banking markets, and these institutions could now increase their assets without necessarily adding significantly to their work forces. On the other hand, increases in off-balance sheet banking products during the 1980s and the movement into other investment-banking-type services—in an effort to increase fee-based income while simultaneously lowering total balance-sheet assets—should have led to a net increase in the ratio of employees per million 1967 dollars in total assets. This result would occur because increases in off-balance sheet assets and investment banking activities tend to boost labor inputs without commensurately raising output as measured by total assets. Since these two observed trends in product mix changes lead to opposite conclusions concerning employment efficiency gains, the product mix explanation appears to be less than complete.

Another way to explain the measured efficiency gains might be through the substantial investment in technology that has occurred in the banking industry over the past two decades. Technological change is embodied in more efficient computer hardware and software, better-educated and more knowledgeable work forces, and new vintages of telecommunications equipment. Even the liberalization of various bank restrictions can be thought of as disembodied technological change in the sense that bank managers can implement a wider array of efficiency enhancing procedures, products, and technological applications in a less restrictive regulatory environment. More descriptive tests of bank efficiency gains are reported below.

Country Variables. An analysis of the country variables in Table 1 by specific years reveals that significantly different bank employment patterns continue to exist between countries. This evidence does not lend much support either to the hypothesis that employment utilization is independent of regulation or to the notion that world banking markets are sufficiently open to permit effective structural arbitrage. As would be expected, banks in the less industrialized countries of Brazil and India have significantly higher employment indexes than banks in other countries. A similar relationship holds for banks from other less developed countries for the years 1967 and 1979, and for banks from Spain, Portugal, and Greece in 1967. The trend, however, toward less significant differences in employment patterns observed for the banks from these countries could be due to the diffusion of technology and overall liberalization of the domestic economies of these nations, such as with the removal of trade restrictions. On the other hand, the differences could also result from endogenous changes in preferences for financial performance and economic growth in these countries.

The results indicate that banks headquartered in both the developed European countries and Israel had higher employment indexes in each of the three years examined. U.S. banks also had a significantly higher index for 1979 and 1986. These results are examined in further detail in the next part of this article.

Extension of Previous Studies

The data in Table 1 indicate that the country-specific employment index for banks in industrialized nations is different and somewhat mixed during the years under study. This sec-

tion examines employment utilization in a more detailed fashion in order to determine if the annual differences observed in Table 1 are being eliminated or perhaps exaggerated over time. That is, this research studies the dynamic time series trend in employment for the sample banks during more recent years. This analysis also allows better determination of what effects technological change and other factors may have had on employment in the sample banks.

The Model. Conducting the dynamic analysis required specifying the following model of the bank employment function, where *ln* represents natural logarithms:

$$\begin{aligned} lnEMP = {} & b_0 + b_{TA}\,lnTA + b_{BR}\,lnBR + b_T T \\ & + b_{T,\,TA}\,T \cdot lnTA + b_{T,\,BR}\,T \cdot lnBR \\ & + \Sigma_i d_i D_i + \Sigma_i d_{TA,\,i} D_i \cdot lnTA \\ & + \Sigma_i d_{BR,\,i} D_i \cdot lnBR \\ & + \Sigma_i d_{T,\,i} D_i T + e, \\ & \text{for } i = US, J, GER, CAN, \text{ and } UK. \end{aligned} \tag{1}$$

In equation (1), T is a measure of time (0, 1, . . . , 6) for the years 1980-86, *EMP* is the number of full-time employees, *TA* is total assets, *BR* is the number of offices worldwide, and e is an additive error term. Time is used as a measure of efficiency, or more precisely a residual efficiency index, in the sense that, holding all other variables in equation (1) constant, any changes in the number of employees can be attributed to efficiency gains associated with technological change or changes in product mix and relative factor input prices. The D_is are dummy or indicator variables as used previously. If a bank is headquartered in the United States, Japan, West Germany, Canada, or the United Kingdom, D_i is set equal to one; otherwise, the dummy variable is set equal to zero. The dummy variables measure employment differences of banks headquartered in these countries relative to banks headquartered in a base or reference group. The "Base Group" comprises those banks not headquartered in any of the countries explicitly modeled—Australia, Austria, Belgium, Finland, France, Italy, the Netherlands, Spain, Switzerland, and Sweden.

Based on equation (1), the annualized percentage change in employees for banks headquartered in country *i*, holding constant the effects of total assets and branches, is measured by:

$$\begin{aligned} \%CHEMP_i &= \partial lnEMP/\partial T \\ &= b_T + b_{T,\,TA}\,lnTA_i \\ &\quad + b_{T,\,BR} \cdot lnBR_i + d_{T,\,i} D_i\,, \end{aligned} \tag{2}$$

where TA_i and BR_i are the geometric mean values of total assets and number of offices for banks headquartered in country *i* over the period 1980-86. For the Base Group, the annualized percentage change in employees is measured by dropping the dummy variable term in equation (2) and using the geometric mean value of *TA* and *BR* for banks headquartered in the Base Group countries. The 1980-86 period—characterized by significant changes in regulation, monetary policies, and financial innovation—was chosen because it is more germane to current policy and managerial decision making than a period inclusive of much earlier years. In addition, the analysis is restricted to banks in developed countries since such banks are assumed to have more incentive to improve efficiency given the overall increase in financial services competition during the 1980s. Finally, special emphasis is placed on the major trading partners of the United States.

The $\%CHEMP_i$ index given by equation (2) represents a modified measure of technological change; it gauges the annualized percentage change in employees, holding all the determinants of employment (with the exception of factor input prices and product-mix) constant.[1] Thus, this index captures the effects on employment of changes in technology, management, and organizational processes, as well as relative factor prices. The inclusion of the geometric mean values of total assets and number of offices in equation (2) facilitates the examination of any scale bias associated with employment changes. Scale bias involves the relationship between bank size and the modified measure of technological change, *%CHEMP*. Examining scale bias can help answer the question of whether the impact of modified technological change on employment in the large sample banks is different from its impact on employment in the smaller sample banks. A finding of scale-biased employee change has important implications for optimal bank size and, in turn, market structures and regulation.

Table 2.
Estimated Regression Coefficients for the Bank Employment Model for Industrialized Countries
(standard errors in parentheses)

$$lnEMP = b_0 + b_{TA}\,lnTA + b_{BR}\,lnBR + b_T T + b_{T,TA}\,T \bullet lnTA + b_{T,BR}\,T \bullet lnBR + \Sigma_i d_i D_i + \Sigma_i d_{TA,i} D_i \bullet lnTA + \Sigma_i d_{BR,i} D_i \bullet lnBR + \Sigma_i d_{T,i} D_i T,$$

for i = *US*, *J*, *GER*, *CAN*, and *UK*

Parameter	Estimate	Parameter	Estimate	Parameter	Estimate
b_0	3.075‡ (0.273)	$d_{T,US}$	0.031‡ (0.008)	d_{CAN}	−0.861 (0.882)
b_{TA}	0.356‡ (0.030)	d_J	0.122 (0.381)	$d_{TA,CAN}$	−0.207† (0.086)
b_{BR}	0.446‡ (0.019)	$d_{TA,J}$	−0.055 (0.037)	$d_{BR,CAN}$	0.448‡ (0.119)
b_T	0.043 (0.028)	$d_{BR,J}$	0.114‡ (0.039)	$d_{T,CAN}$	0.014† (0.006)
$b_{T,TA}$	−0.059† (0.028)	$d_{T,J}$	−0.050‡ (0.005)	d_{UK}	0.419 (1.584)
$b_{T,BR}$	0.002 (0.002)	d_{GER}	−2.362‡ (0.857)	$d_{TA,UK}$	0.367† (0.155)
d_{US}	−0.775 (0.647)	$d_{TA,GER}$	0.332‡ (0.083)	$d_{BR,UK}$	−0.483‡ (0.090)
$d_{TA,US}$	0.246‡ (0.064)	$d_{BR,GER}$	−0.244‡ (0.024)	$d_{T,UK}$	−0.036 (0.024)
$d_{BR,US}$	−0.233‡ (0.040)	$d_{T,GER}$	0.008 (0.009)	R_2	0.98

EMP is the number of full-time employees, *TA* is total assets, and *BR* is the number of worldwide offices. Total assets are measured in millions of 1980 U.S. dollars. The dummy variables equal one for a bank headquartered in the respective country and zero otherwise. The dummy variables are defined as the United States (*US*), Japan (*J*), Germany (*GER*), Canada (*CAN*), and Great Britain (*UK*).

† *Significant at the .05 percent level.*

‡ *Significant at the .01 percent level.*

Assuming that the number of offices is a function of total assets ($BR = f[TA]$), the scale biasedness of this modified technological change index is measured by:

$$\begin{aligned} \partial\%CHEMP_i/\partial TA &= \%CHEMPSB \\ &= \partial^2 lnEMP/\partial T\partial lnTA \\ &\quad + (\partial^2 lnEMP/\partial T\partial lnBR_i) \\ &\quad \bullet (\partial lnBR_i/\partial lnTA_i) \\ &= b_{T,TA} + b_{T,BR} \\ &\quad \bullet (\partial lnBR_i/\partial lnTA_i). \end{aligned} \tag{3}$$

A *%CHEMPSB* index less than (greater than) zero indicates that technological change caused larger banks to achieve a larger (smaller) percentage reduction in employees than smaller banks.

Data and Empirical Results. To carry out this extended analysis, data on number of employees, total assets, and offices were collected for each of the world's top 200 banks for the period 1980-86 as reported in the *American Banker*. Only those banks headquartered in developed countries and having complete data for the entire sample period were retained. The final sample consists of 112 banks.[2] The results of estimating the employment model in equation (1) are shown in Table 2.

Summarizing the results in Table 2, Table 3 reports estimates of the percentage change in

employees, %*CHEMP* in equation (2), for the Base Group and each of the countries explicitly modeled.[3] After adjusting for total assets and number of offices, the number of employees was reduced by approximately 0.6 percent per year for the Base Group over the sample period. Employment at Japanese banks dropped at an annual rate of approximately 6.0 percent, and for U.K. banks employment dropped 4.0 percent per year. The increase in efficiency for the Japanese banks probably reflects gains associated with changes in product mix as well as pure efficiency gains. Over the sample period, Japanese banks became major lenders of dollars in both the European and U.S. markets, in part because of the massive Japanese dollar trade surplus. Over the same period, yen-denominated credits to non-Japanese residences rose sharply as a result of increased trade financing and liberalization of the Japanese financial system. Substantial measured efficiency gains for the Japanese banks would, therefore, be expected to the extent that economies exist between loan size and number of employees.

The U.K. banks in the sample are dominated by the four large clearing banks: Barclays, Lloyds, Midland, and National Westminster. These banks operate extensive branching networks that, in the early 1980s, exhibited one of the highest ratios of employees to total assets among banks headquartered in the industrialized countries. The clearing banks also experienced increased competition over the sample period from, for example, the U.K. building societies and foreign banks. In this regard, the significantly reduced number of employees at these banks reflects, to a large degree, an attempt by these firms to increase efficiency in order to stay viable competitively.

The results in Table 3 show that, for U.S. banks, employment increased approximately 2 percent per year over the sample period (%*CHEMP* = 2.30 percent). This significant increase in employee utilization for the U.S. banks is somewhat surprising given these banks' investment in automation. For example, over the 1981-85 period U.S. banks invested approximately $30.0 billion in systems technology; during this same time, systems expenses at U.S. banks were rising at an average annual rate of 17.6 percent as compared to a 10.5 percent annual increase in overall operating expenses.[4]

Table 3.
Estimates of Percentage Change in Bank Employment (%*CHEMP*) and Scale Bias (%*CHEMPSB*) for Industrialized Countries

Country	%*CHEMP*	%*CHEMPSB*
United States	2.30†	−0.53†
Japan	−5.89†	−0.56†
Germany	0.33	−0.44†
Canada	0.84	−0.57†
United Kingdom	−4.38†	−0.50†
Base Group*	−0.59†	−0.55†

* *The Base Group is made up of banks in Australia, Austria, Belgium, Finland, France, Italy, the Netherlands, Spain, Switzerland, and Sweden.*

† *Significant at the .05 percent level.*

However, this finding may reflect a significant change in output mix at U.S. banks, as was the case for the Japanese banks. During the sample period, U.S. banks lost a substantial amount of wholesale lending to Japanese banks and the commercial paper market, which—without an accompanying reduction in employment—would serve to lower employee efficiency. At the same time, off-balance sheet activities for large U.S. banks accelerated significantly. Many large U.S. banks also began to build employment ranks at European offices in the early and mid-1980s in anticipation of greater investment banking activity. As noted earlier, increases in off-balance sheet assets and investment banking activities could serve to boost labor inputs without commensurately raising output as measured by total assets, thus giving the impression of lower employee efficiency.

Table 3 also reports estimates of the scale bias measure of the change in employee utilization, %*CHEMPSB*. The results show that banks from all countries exhibited significant scale bias, indicating that the larger (smaller) sample banks experienced a larger (smaller) percentage reduction in employment as a result of modified technological change. To derive robust policy prescriptions from these results, one must assume that product mixes for the largest banks in a given country are approximately the same. With this assumption, the results suggest

that public policies allowing freer banking combinations do not necessarily run counter to the public interest. In fact, these policies may permit the existence of larger banks and thus increase bank employee efficiency. This environment would promote banks' long-run competitiveness and, through lower prices and increased quantities of bank services, improve public welfare.

Conclusion

This article updates and extends the analyses of employment in the world's largest banks reported by Kaufman, Short, and Choi and Tschoegl. Now evidence on employment utilization at the world's largest banks covers almost two decades. The empirical results presented here indicate that statistically different employment patterns and patterns of employment efficiency gains persist among banks headquartered in industrialized countries. These findings indicate that similar differences exist between banks headquartered in the less developed countries as well.

While much of the observed efficiency gains seems to be attributable to modified technical change—that is, factors such as changes in production technology, organizational and managerial processes, and relative factor prices—this research is not able to dismiss changes in product mix as an alternative, or at least partial, explanation for some countries. In particular, the finding that U.S. banks increased employment utilization over the sample period while banks in other industrialized countries reduced employment utilization is surprising and, while suggestive of inefficiencies, could result from significant changes in product mix.

The results point out the critical nature of product mix differences among international banks and underscore the importance of having measures that account for differences in product mix when examining production in financial intermediaries. Berger, Hanweck, and Humphrey have recently developed such measures to account for product-mix differences in bank efficiency studies. However, the application of these measures to efficiency studies of international banks must await the availability of detailed microproduction data from these institutions.

The varying patterns of employment utilization observed for banks headquartered in different industrialized countries suggest that country-specific bank regulation has important differential effects on bank production efficiency. Although value-maximizing bank managers would be expected, over time, to move their production activities to climates most favorable to efficient production, our empirical results suggest that such structural arbitrage, if indeed present, has not worked to equalize differences in employment utilization and efficiency across the world's largest banks. One conclusion based on this finding is that domestic banking markets have not achieved the degree of openness to foreign banks that would be required for structural arbitrage to equalize performance. These results should encourage ongoing efforts to coordinate international banking regulation and thus provide a more level playing field across national boundaries.

Notes

[1]For examples of studies examining technological change, see Berndt and Khaled (1979); Blackorby, Lovell, and Thursby (1976); Hunter and Timme (1986, 1988); and Stevenson (1980).

[2]To mitigate the effects of inflation and changes in the real exchange rate, total assets for each bank were adjusted as follows: U.S. dollar total assets, as reported in the *American Banker,* were converted into nominal home country currency values using end-of-year exchange rates. Nominal home currency values were next converted into real terms by using each country's GNP deflator, setting 1980 as the base year. Finally, all real home currency values were converted into real U.S. dollars by applying the 1980 exchange rate to all years. For U.S. banks, total assets were expressed in real terms by deflating the nominal values by the GNP deflator with 1980 as the base year.

[3]The model in equation (2) was estimated using a generalized least squares procedure, which adjusts for heteroskedasticity and first-order autocorrelation. See Kmenta (1971): 508-14.

[4]See Salomon Brothers (1986, 1987).

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