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THE PERFORMANCE OF UNIVERSAL BANKS: EVIDENCE FROM SWITZERLAND

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The Performance of Universal Banks: Evidence from Switzerland

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Abstract

This paper examines the production structure of Swiss banks in the period 1996-99. Using a variety of output specifications, we find evidence of large relative inefficiencies across Swiss banks. The results show the importance of accounting for the broad range of activities that universal banks undertake, e.g., failure to account for off-balance sheet items, trading, and brokerage and portfolio management activities leads profit efficiency to be dramatically understated. We find evidence of economies of scale for small and mid-size banks, but little evidence that significant scale economies remain for the very largest banks. Finally, evidence on scope economies is weak for the largest banks that are involved in a wide variety of activities. These results suggest few obvious benefits from the trend toward larger universal banks.

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I. Introduction

As financial institutions continue to evolve and traditional industry lines blur, the question of the optimal structure has been brought to forefront as a research question. In the U.S., for example, the Gramm-Leach-Bliley Act has created the ability for commercial banks to expand more fully into securities underwriting and insurance businesses.[1] It remains an open question, however, whether fundamental reorganization of the production structure of financial institutions will lead to substantial gains from economies of scale, economies of scope, or improved profit and cost efficiency. Since U.S. banks had been prohibited from expanding into many activities, it is difficult to directly measure these potential synergies.[2]

The financial landscape in Europe, however, has been quite different and there is a long history of "universal banking" where financial institutions offer a broad range of financial services, including lending, deposit-taking, underwriting, brokerage, trading, and portfolio management. Moreover, the implementation of the European Second Banking Directive and the Directive on Investment Services, and the rise of mergers and acquisition between banks, securities companies and insurance companies, have reinforced the universal character of the European banking system.[3] This experience provides an ideal opportunity to gauge the potential production benefits from a fully diversified financial institution.

The first goal of this paper is to examine the production structure of banks in Switzerland, which are currently allowed to engage in universal banking. In particular, we measure cost efficiency, profit efficiency, economies of scale, and economies of scope for 290 banks from 1996 to 1999. By looking at a broad cross-section of Swiss banks using recent data, we can gain a better understanding of the factors that contribute to success in a financial environment with universal banking.

A second goal of this paper is to better understand the recent consolidation process in the Swiss banking sector. Since the early 1990s, there has been a steady decrease in the importance of small banking institutions that focus on traditional banking operations ("regional" and "cantonal" banks) and an expansion of larger, universal banks.[4] By measuring scale economies, scope

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[1]The Gramm-Leach-Bliley Act, passed in October 1999, expands the activities of financial holding companies to include commercial banking, investment banking, and insurance underwriting.

[2]Boyd and Graham (1986, 1988) and Lown, Osler, Strahan, and Sufi (2000) have examined potential diversification benefits by examining the volatility of earnings using pro-forma data from hypothetical mergers of commercial banks, securities, and insurance firms. These studies, however, cannot capture the potential gains (e.g., scope economies from consolidation of back-office expenses) or potential losses (e.g., inefficiency from conflicting systems or corporate cultures) that might result from broad consolidation.

[3]See Cybo-Ottone and Murgia (2000).

[4]The Banque nationale suisse (Swiss National Bank) divides Swiss banks among ten categories, including regional and cantonal banks, which we describe in detail in Section II.

economies, and profit and cost efficiency for different types of banks, we can identify factors that contribute to this trend. Our research differs from earlier work on Swiss banks' cost economies and cost efficiency by Hermann and Maurer (1991), Sheldon and Haegler (1993) and Sheldon (1994) in three respects. First, we consider a broader set of output definitions that includes trading and off-balance sheet activities to capture the effects of universal banking; second, we are the first to examine profit efficiency for universal Swiss banks; and third, we use much more recent data.

Our empirical results indicate substantial relative inefficiency across all types of Swiss banks. Using our preferred specification that includes a "universal" measure of bank output – traditional lending products, off-balance sheet credit instruments, trading activities, and brokerage and portfolio management activities – we estimate that roughly 40% of costs reflect cost inefficiency and about one-half of potential profits are foregone due to profit inefficiency. A comparison of efficiency across alternative output specifications shows the critical importance of accounting for these non-traditional activities. For example, if we estimate relative efficiency with a "naïve" output measure that includes only traditional banking products, we substantially understate both cost and profit efficiency. Our efficiency estimates by category of Swiss bank contrast with the widespread idea that regional and cantonal banks are relatively less efficient.

The data show evidence of scale economies for the small to mid-sized banks. For the very largest banks, however, our point estimates indicate scale economies, but we cannot formally reject the null hypothesis of constant returns to scale. This is true for ray scale economies and expansion path scale economies. We find some evidence of scope economies in our estimates of expansion path subadditivity, which again are largest for the small to mid-sized banks. Similarly, rank correlations between measures of specialization and ROE and ROA give ambiguous results.

We conclude that the substantial relative inefficiency and presence of economies of scale can only partly explain the consolidation trend in the Swiss banking industry.[5] The decline of cantonal banks and regional banks focusing on traditional activities, however, partially remains unexplained since we do not find them to be weaker in terms of profit and cost efficiency and since we do not find strong evidence for economies of scope for very large banks. Here, the only explanation we may offer lies in the lower degree of profitability observed for traditional activities compared to non-traditional activities. Finally, the weak evidence on scope economies for the largest banks suggests that the move toward universal banking in the U.S. and elsewhere will not guarantee success; there will likely be a range of outcomes with some banks succeeding in the new environment and others failing.

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[5]In the banking industry, weaker market participants rarely exit the market to be replaced by new firms, but they are usually taken over by firms already present in the market, which leads to consolidation.

II. Understanding the Swiss Banking System

The Swiss banking system is typically described as a universal banking system. As in most continental European countries, banking legislation does not distinguish between commercial and investments banks.[6] In principle, any institution authorized to operate as a bank may offer a range of financial services: lending and deposit-taking, underwriting, brokerage, trading, and portfolio management. Banks, of course, must still comply with prudential requirements including capital requirements, liquidity requirements, and best practices, etc. when engaging in these activities.

(a) Heterogeneity in Swiss Banks

Swiss banks vary in their use of the option to engage in all financial activities. Truly universal banks co-exist with institutions specializing either in traditional banking or in financial market activities. In the official statistics maintained by the Swiss National Bank, (Banque nationale suisse (2000)), Swiss banks are classified into ten major groups: big banks, cantonal banks, regional and savings banks, Raiffeisenkassen banks, commercial banks, consumer loan banks, stock exchange banks, other banks, foreign, and private bankers. Since our subsequent empirical work will explore differences among these types, it is useful to provide a brief description of each type.

The big banks pursue all lines of financial activities – from traditional banking to financial markets activities – and they are the key actors in most segments of the domestic market. The big banks are also heavily engaged in international financial activities. Cantonal banks are state-owned banks with the majority of their capital owned by the canton, which guaranties their liabilities.[7] Cantonal banks vary substantially in terms of size and business activities. While the smaller institutions focus on domestic, traditional banking, the larger ones typically engage in all types of financial activities. Regional banks tend to focus on domestic, traditional banking, with an emphasis on mortgage lending. Their activity is limited to small geographical areas.

The Raiffeisenkassen are small banks located mainly in rural areas. They are organized as cooperatives and focus on mortgage lending. The individual cooperatives have access to various services provided by a common institution, called the central bank of the Raiffeisenkassen. Commercial banks are, in general, universal banks of medium size that combine commercial and mortgage loans with brokerage and portfolio management activities. Stock exchange banks are rather small and they focus on brokerage and portfolio management activities. Their activity is only partially reflected in the balance sheet.

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[6] Universal banking has been allowed in Switzerland since the Banking Law of 1930.
[7] A canton is a territorial subdivision in Switzerland, roughly equivalent to a state in the U.S.

Consumer loan banks are small, and they finance durable consumption expenditures. Foreign banks are institutions operating under Swiss banking law, but whose capital is primarily owned by foreigners. They differ widely in their size and activities. Some qualify as universal banks, while others focus on trade credit or on financial market activities. Other banks include institutions with miscellaneous activities that cannot be assigned to a specific category. Finally, private bankers are unincorporated firms, involved mainly in portfolio management, whose owners are personally and fully liable for all the debts of their firms. For this reason, they have to comply only with part of the Swiss banking law, and do not qualify as banks in the strict sense and are not included in our analysis.

Table 1 reports summary statistics for each type of bank in 1999 from Banque nationale suisse (2000). The data show the enormous variation in size and product mix across the different types of institutions. The small Raiffeisenkassen banks, for example, hold about 80% of their assets as mortgages, while foreign and consumer banks hold virtually none. In terms of non-traditional activities, the big banks and other banks maintain relatively large trading positions, while the stock exchange banks focus on fee income and trading income. Regional and cantonal banks generate only a minor part of their income from financial market activities, as indicated by the low shares of trading and fee income.

(b) Evolution of Swiss Banking in the 1990s

We now discuss changes in the Swiss banking industry as a whole during the 1990s as summarized in aggregated industry data compiled in Les Banques Suisses.[8] Three significant changes are worth mentioning.

First, traditional banking activities (lending and deposit-taking) have decreased in importance with financial market activities (brokerage, underwriting, and portfolio management) growing. Interest income, for example, accounted for 86% of total income in 1990, but only 63% in 1999. By contrast, the share of brokerage, underwriting and portfolio management fees increased from 11% of total income in 1990 to 26% in 1999. A similar shift occurred in the contribution of different activities to banks' profitability: net interest income equaled 102% of fees and trading income in 1990, but only 48% in 1999. This trend towards non-traditional activities suggests that one must take a broad view of Swiss banks when examining the production structure.

Second, there was an important wave of consolidation as the number of banks fell from 495 in 1990 to 372 in 1999, while average bank size (measured in assets) increased from Sfr 2,260 to 6,029 million. During the first half of the 1990s, the economic recession and the collapse of the real estate

[8] To conserve space, we have not replicated the summary table from Banque nationale suisse (2000). It is available upon request from the authors.

market were the primary forces behind the consolidation trend. Write-offs and provisioning requirements rose from 0.56% to 1% of total assets from 1990 to 1995 and many institutions, especially regional and cantonal banks, suffered massive losses that put their solvency into question. Big banks faced a less dramatic increase in provisioning requirements and were able to stabilize their profitability due to good returns from financial markets activities. Many ailing regional and cantonal banks were acquired by larger institutions, especially the big banks, and the number of regional banks fell from 204 to 127 and the number of cantonal banks fell from 29 to 25. The market share of the big banks, measured as a percentage of total assets, rose from 48% to 55%, mainly at the expense of the regional banks.

General economic conditions improved in Switzerland in the second half of the 1990s as slow but positive growth returned and the real estate market stabilized. The financial condition of regional and cantonal banks recovered significantly, but big banks faced large increases in the provisioning requirements and reported losses. Consolidation of the Swiss banking system continued, although at a less dramatic pace. From 1995 to 1999, the number of banks decreased from 413 to 372. The number of regional banks decreased from 127 to 106, while the number of foreign banks fell from 141 to 123. The market share of the big banks rose from 55% to 67%, mainly at the expense of the declining regional banks (5.5% to 3.3%) and cantonal banks (19.8% to 13.2%).

A third notable change was the progressive abolition of cartel-like agreements, as requested in a 1989 report by the antitrust authority.[9] The impact of the increased competitive forces, however, is difficult to evaluate because of its coincidence with the deterioration of general economic conditions. Indeed, interest rate margins increased following the abolition of the cartel-like agreements, and thus do not point to an increase in competition.

The consolidation trend of the 1990s shows a decline in the importance of the smaller cantonal and regional banks, which focused on traditional banking activities, while the large, universal banks expanded. There is little doubt that the recession and the deterioration of the financial situation of the cantonal and regional banks at the beginning of the 1990s contributed to this consolidation process. After 1995, however, it is more difficult to explain the continuation of the consolidation process. During the late 1990s, general economic conditions improved as regional and cantonal banks were no longer in financial distress. Hence, to better understand the continued restructuring of the Swiss banking system, it is necessary to turn our investigations toward the industrial structure of the banking industry, and to examine the production characteristics of Swiss banks.

[9]See Commission des Cartels (1989).

(c) Earlier Studies on Swiss Banking

Several earlier studies have estimated scale economies and cost efficiency for Swiss banks. Hermann and Maurer (1991), for example, examine scale and scope economies at Swiss banks for a single year, 1989. They find economies of scale, except for the largest banks in their sample. They also report diseconomies for small banks and economies for large banks.

More recently, Sheldon and Haegler (1993) and Sheldon (1994) examine scale economies, scope economies, and cost efficiency for a panel of Swiss banks over the period 1987-1990 using both parametric and non-parametric methods. Both approaches point to significant economies of scale, particularly for small banks, but the evidence on economies of scope is ambiguous. Their parametric methods estimates indicate a low average cost efficiency, which rapidly decreases with bank size. Hence, size seems to be an advantage from a scale economies perspective, but a disadvantage from an efficiency perspective. This could explain the coexistence of banks of different sizes.

Bikker (1999) examines the cost efficiency of the banking systems in nine European countries using the stochastic cost frontier approach and an alternative method based on country specific dummies. Both methods are based on the translog function and indicate that Swiss banks rank among the best in terms of cost-efficiency. The study, however, does not examine scale and scope economies, and does not report correlates between relative efficiency and size.

These studies provide some interesting results on the production structure of Swiss banks in the 1990s, but several factors prevent it from helping us to fully understand the restructuring of the Swiss banking system over the last decade or from better understanding the implications for broader banking in the U.S. First, empirical evidence on Swiss banks cost efficiency is focused on an earlier period and leaves the second half of the 1990s unexamined. Important technological and market changes over this period make these very different environments. Second, size appears to have ambiguous effects on costs, as indicated by the presence of economies of scale and the negative correlation between efficiency and bank size. Third, the evidence on economies of scope also appears to be ambiguous. Hence, size and diversification do not seem to bring obvious cost benefits, which makes their role in the consolidation process unclear. Finally, these studies focused on a narrower definition of banking activities that excludes off-balance sheet and trading positions. Given the expansion of these activities in recent years, this is surely an important omission.

(d) Contributions of this Paper

The earlier empirical evidence on costs of Swiss banks does not explain why large universal banks continue to gain in importance, and why smaller banks focusing on traditional banking activities seem to be driven out. Moreover, since the earlier literature examined a period that was quite different from the current period using relatively narrow views of bank outputs, it is of limited use in evaluating gains for financial industries that are currently broadening their activities.

To better understand these issues, we present a broad analysis of the production structure of Swiss banks during the second half of the 1990s. Relative to the earlier literature, our study makes several important contributions. First, our analysis includes several alternative output specifications that range from a narrow view of traditional banking to a broader view of universal banks. Evidence from the U.S., e.g., Rogers (1998) and Stiroh (2000), shows that failure to include non-traditional outputs tends to understate measured bank efficiency. By estimating cost and profit efficiency, scale economies, and scope economies with a more realistic description of bank outputs, we can gain a more accurate view of universal banking in Switzerland. Moreover, only by analyzing the production structure of universal banks can we hope to gain insight on the future of broader banking in the U.S.

Second, profit efficiency of Swiss banking was not examined in earlier studies. As argued by Berger and Mester (1997), "profit efficiency is superior to the cost efficiency concept for evaluating the overall performance of the firm (pg. 900)." With imperfect competition, cost minimization is not equivalent to profit maximization, and the latter may be a more important driver of the structure of the banking industry. Moreover, several factors suggest that imperfect competition may prevail in banking in general, and in the Swiss banking industry in particular. As one piece of evidence, Egli and Rime (1999) report a significant relationship between rates on savings deposits and the degree of concentration across cantons, which may indicate regional segmentation of the retail banking market. In addition, due to the high degree of concentration in the Swiss banking industry, we cannot exclude some implicit collusion between Swiss banks, even if explicit cartel-like agreements have been abolished. Rime (1999), for example, uses the Panzar and Rosse (1987) statistics and rejects the hypothesis of perfect competition for the Swiss banking system, even after the abolition of cartel-like agreements.[10] A final advantage of the profit efficiency analysis is that it may capture quality effects (solvency of the bank, quality of its services) that are not, or only partially, reflected in the cost analysis (Berger and Mester (1997)).

Third, technology is rapidly changing for financial institutions, e.g., the advent of information technology allows broader consumer networks, more integrated activities, and better risk management, so it is important to examine the performance of financial institutions using timely data. While we don't estimate the pace of technological progress explicitly, earlier empirical work using data from the 1980s is likely to be of less relevance for understanding recent changes.

[10]The Panzar and Rosse statistics measures the elasticity of income with respect to input prices.

III. Data and Variable Definitions

Our primary econometric work is based on estimation of variable cost and variable profit functions for a sample of Swiss banks. This section describes the sample of banks and variables used in the econometric estimates.

(a) Sample of Swiss Banks

Our sample includes 290 Swiss banks that operated continuously from 1996 to 1999. Nine of the ten types of banks are included; private banks are excluded. Private bankers have to comply with limited reporting requirements, which prevents us from measuring some key variables for that type of institution. All groups of banks in the sample face identical accounting rules defined by the Federal Banking Commission and the Banque nationale suisse.

Given the universal character of the Swiss banking system, the inclusion of banks that vary strongly in size and output mix seems appropriate. Moreover, this variation in size and output mix is an advantage for identifying and measuring scale and scope economies. Heterogeneity of the sample, however, increases the risk that we fail to control for some unobservable bank characteristics that could bias our estimates. In earlier work on Swiss banks, Herman and Maurer (1991), Sheldon and Haegler (1993) and Sheldon (1994) also consider a very broad sample of banks. In contrast, the majority of empirical studies on U.S. banks consider more homogenous samples of financial institutions since U.S. banks are more restricted in the types of outputs they produce.

A priori, we suspect a lack of comparability for three groups of banks: the big banks, the Raiffeisenkassen and the foreign banks. The big banks, because of their size and of their wide range of activities, may be difficult to compare to smaller banks that are more focused. Raiffeisenkassen may also constitute a special case since they are cooperative institutions lending only to their members, who can be required to make additional payments to cover the liabilities of their cooperative. For foreign banks, most are subsidiaries of larger financial institutions located abroad, and an important part of their assets and liabilities consists of loans or deposits to/from the parent institution. These positions experience strong fluctuations and are frequently contracted at special conditions, which makes foreign banks difficult to compare with other banks in terms of observable quantities and prices. To address this comparability issue, we re-estimated the cost and profit function for subsamples excluding these three bank groups. In all cases, our findings did not change qualitatively, so we choose to focus on the full sample due to the already small number of observations.

Our sample period covers 1996 to 1999. The choice of this sample period reflects three main factors. First, new accounting principles were introduced in 1996, implying significant breaks in the series with respect to 1995 that could affect the quality of the earlier data. Moreover, the data based on the new accounting principles allow a better differentiation between traditional banking and financial market activities, e.g., the breakdown of fee income between brokerage, underwriting and portfolio management on the one side and loans on the other side, and a more exhaustive view of off-balance sheet positions. Second, we are interested in estimates that are not affected by the instability generated by the deterioration of banks financial strength during the first half of the 1990s. Third, the use of a relatively short observation period provides us with estimates that are more representative of the present situation and of future trends. A disadvantage in our efficiency estimates, however, is that random fluctuations play a more important role. Over a four years period, however, any good or back "luck" should not be the main driver of the efficiency estimates.

Table 2 presents summary statistics for these 290 banks for each year from 1996 to 1999. The data show a steady increase in the average size of the institutions as consolidation continued. These surviving banks also improved their performance with return on assets (ROA) and return on equity (ROE) rising, while costs per assets (C/A) fell.

(b) Cost and Profit Functions

The production literature for financial institutions distinguishes between the intermediation and the production approaches. In this study, we assume that banks transform deposits, purchased funds, and labor into loans, other assets, and a range of financial services. Hence, our definition of bank activities can be assimilated to a "broad" intermediation approach. The general cost and profit function methodology is quite common in the literature and we discuss the theoretical framework only briefly.[11]

The general cost function can be written as:

$$(1) \qquad C = f(\mathbf{w}, \mathbf{Y}, \mathbf{Z}, u, t)$$

and the general (alternative) profit function as:

$$(2) \qquad \Pi = f(\mathbf{w}, \mathbf{Y}, \mathbf{Z}, p, t)$$

where C is variable costs, Π is variable profits, $\boldsymbol{w}$ is a vector of input prices, $\boldsymbol{Y}$ is vector of variable outputs, $\boldsymbol{Z}$ is a vector of fixed netputs (either inputs or outputs), u is bank-specific cost inefficiency,

[11]See Berger and Humphrey (1997) for a detailed review of the literature and Berger and Mester (1997) for methodological details. In the literature on Swiss banks, Sheldon and Haegler (1993) and Sheldon (1994) also use the intermediation approach.

p is bank-specific profit efficiency, and t is time, which proxies for technological and other environmental changes.[12] We drop firm and time subscripts for ease of exposition.

Note that we focus on an alternative profit function, which includes output quantities as the arguments of the profit function, rather than a "standard" profit function, which include output prices as the arguments. As discussed below, this reflects a lack of reasonable output price data for some of our sample and our belief that it is a more appropriate function.[13]

A critical decision in this type of analysis is the choices of the vectors of outputs, inputs, and netputs. The remainder of this section describes our choices for each, the rationale for these decisions, and summary data.

i) Outputs and Netputs

As mentioned above, Swiss banks vary considerably in their involvement with non-traditional financial activities. This makes the definition of the output vector crucial to appropriately gauge the industry's production characteristics. In a universal banking system like Switzerland, it is imperative to consider the outputs related to financial market activities (portfolio management, trading, brokerage, etc.), as well as those related to traditional banking activities (different types of loans or securities). Thus, our study includes measures of brokerage and portfolio management activities, off-balance sheet items, and trading activities.

While conceptually desirable, the inclusion of these financial market activities also introduces several measurement problems due to limitations in the regulatory data. First, brokerage and portfolio management activities can be measured only jointly. For off-balance sheet (OBS) activities, we can only measure them in terms of quantities using the credit equivalent amounts, but it is not possible to isolate the income generated by these positions. Finally, trading activities can be measured in terms of income and quantity, but these two measures fluctuates strongly with market movements and are thus harder to interpret.

These measurement issues make it difficult to identify *a priori* the best output definition. To avoid arbitrarily selecting one specification, we use several variants ranging from a very narrow output definition to a very broad one. These broader specifications are richer than used by Sheldon and Haegler (1993) and Sheldon (1994), who do not consider off-balance sheet positions and trading activities, and provide a more accurate picture of the production structure of Switzerland's universal banks. The three specifications are defined as follows.

[12]Fixed netputs are quasi-fixed quantities of either inputs or outputs that affect variable costs or profits due to substituability or complementarity with variable netputs.

The "naïve" specification, Y-1, includes only three traditional measures of bank outputs in the output vector $\mathbf{Y}$: loans to banks, mortgage loans, and loans to customers (excluding mortgages). Equity capital and physical capital comprise the netput vector, $\mathbf{Z}$. All quantities are measured by the inflation-adjusted book value of the variable.

The "intermediate" specification, Y-2, augments the output vector with a fourth output, securities and participations, which is again measured by the balance sheet position. This is still a relatively traditional view of bank activities, although somewhat broader than the strict lending definition. In addition, we augment the netput vector with a third variable: the credit equivalent of traditional off-balance sheet positions such as contingent liabilities, irrevocable facilities, and commitment credits. These positions are credit related and thus a natural extension of the specification. The credit-equivalent of these positions is obtained by multiplying their notional amount with the conversions factors defined in the Swiss Banking Law.

The "universal" specification, Y-3, extends the output vector to include two non-traditional outputs: trading activities, and brokerage and portfolio management. Trading activities are measured by assets recorded in the trading book position, while brokerage and portfolio management activities are measured by the amount of securities accounts outstanding. The former is an imprecise measure of the quantity of trading activities, but data constraints force us to make this approximation since we do not have data on the number or volume of transactions. The netput vector is also extended to include the credit-equivalent of derivative activities, measured as the replacement value or initial exposure, depending on the bank's accounting method. This universal specification spans the full range of activities that Swiss banks undertake.

ii) Inputs

On the input side, the price vector, $\mathbf{w}$, includes the price of labor (measured as the average wage and benefit per employee) and the interest rate on all liabilities (measured as the interest payments on money-market paper, liabilities to banks, demand, savings and term deposits, bonds and mortgage bonds). Because Swiss banks are required to report only their total interest expenses, we were unable to calculate specific interest rates for the different kinds of liabilities. As mentioned above, premises and other fixed assets are considered a fixed netput, and not an input. This choice reflects the difficulty in calculating a reliable input price in the absence of data on the market value of real estate and premise. Sheldon and Haegler (1993) and Sheldon (1994) recognize the measurement

[13] We do estimate a standard profit function for a reduced sample of banks and a narrower output specification. Details are provided in Section VI.

problem, but nevertheless include a third input price defined as expenditures on office space and materials divided by total employees.

iii) Costs and Profits

From these definitions, variable costs, C, and variable profits, Π, are defined as follows. For all three specifications, variable costs are the interest expenses on all banks liabilities plus total salaries and benefits expenditure. Variable profits depend on the output specification. For Y-1, variable profits, $\Pi - 1$, is defined as the interest income from all loans less variable costs. For Y-2, $\Pi - 2$ equals $\Pi - 1$ plus interest income from securities and participations. For the third specification, Y-3, $\Pi - 3$ equals $\Pi - 2$ plus trading income and fee income generated by brokerage, underwriting, and portfolio management fees.

Table 3 reports summary statistics for all variables used in the cost and profit function estimates. As can be seen from all variables, there is considerable variation within our sample. Total assets, for example, ranges from Sfr 15 millions to over Sfr 1 trillion. Similarly, there is wide variation in outputs, with many banks choosing to produce none of a particular output. Table 3 also reports the mean value of measured costs and profits for each specification.

IV. Methodology

In this section, we present the methodology used to estimate relative cost and profit efficiency, economies of scale, and economies of scope. We begin with the functional form for both the cost and alternative profit function, and then detail the definitions used for cost efficiency, profit efficiency, economies of scale, and economies of scope.

(a) Translog function

We use a parametric approach with a translog specification throughout our analysis. This choice was motivated by the fact that the Fourier-Flexible specification, which is somewhat more flexible than the translog and common in many studies, requires the estimation of additional parameters and truncation of data. This is a problem for us due to the already small size of our sample. Moreover, while studies often fail to statistically reject the joint significance of the additional parameters, Berger and Mester (1997) indicate that the improvement obtained through the use of the Fourier-Flexible is not “significant from an economic viewpoint (pg. 924).” The translog specification takes the following form:

$$\ln X = a + \sum_i a_i \ln w_i + \sum_i b_i \ln Y_i + \sum_{ii} j_i \ln Z_i +$$

$$(3) \qquad \sum_i \sum_j l_{ij} \ln w_i \ln w_j + \sum_i \sum_j d_{ij} \ln Y_i \ln Y_j + \sum_u \sum_j f_{ij} \ln Z_i \ln Z_j +$$

$$\sum_i \sum_j t_{ij} \ln w_i \ln Y_j + \sum_i \sum_j h_{ij} \ln w_i \ln Z_j + \sum_i \sum_j k_{ij} \ln Y_i \ln Z_j + e$$

where X is a transformation of either variable costs or variable profits, and w_i, Y_i, and Z_i represent elements of the vectors, $\mathbf{w}$, $\mathbf{Y}$, and $\mathbf{Z}$, respectively. Time and bank subscripts are suppressed.[14]

There are several points to note about Equation (3). First, Equation (3) is the basic specification for all results, but the details differ across applications. For example, the number of outputs and netputs varies with across the three specifications described above. Second, in the cost and profit efficiency estimates, the independent variable and all right-hand side quantities are scaled by equity capital. This helps to reduce heteroskedasticity and scale bias. In addition, this gives a nice interpretation for the profit function estimates as a return on equity. Third, we impose linear homogeneity in all estimates. Finally, symmetry restrictions in all quadratic terms are imposed in accordance with economic theory, $l_{ij} = l_{ji}, d_{ij} = d_{ji}, f_{ij} = f_{ji}$.

Sheldon and Haegler (1993) and Sheldon (1994) use both a parametric and a non-parametric approach. We chose a parametric technique primarily because they correspond well with the cost and profit efficiency concepts outlined above. As argued by Berger and Mester (1997), non-parametric methods generally ignore input and output prices and account only for technical inefficiency (using too many inputs or producing too few outputs) and not for allocative inefficiency (errors in choosing inputs and outputs given relative prices). Thus, non-parametric techniques focus on technological optimization rather than economic optimization, and do not correspond to the cost and profit efficiency discussed above.

We examine both efficiency and scope and scale economies, so one methodological issue is whether one should include cost share equations when estimating the Equation (3). That is, Shephard's Lemma implies that the derivative of the log cost function with respect to a log input price equals that input's share of total costs. Here, we adopt a pragmatic approach. For the cost efficiency analysis, we follow Berger and Mester (1997) and we estimate Equation (3) without the cost shares equations, as the restrictions underlying Shephard's Lemma impose the undesirable assumption of no allocative inefficiency. For the estimation of cost scale and scope economies, however, we estimate

[14]To avoid taking logs zero values, all right-hand side quantities are set equal to one plus their reported value.

Equation (3) jointly with the cost share equations using Zellner's (1962) Seemingly Unrelated Regression (SUR) estimation technique to improve estimation efficiency.[15] The cost share equations are as follows:

$$(4) \qquad S_i = a_i + \sum_j l_{ij} \ln w_i + \sum_j t_{ij} \ln Y_j + \sum_j h_{ij} \ln Z_j + u$$

where S_i is the share of input i in total variables costs. Since the input cost share equations sum to unity, we omit one cost share equation from the estimated system of equations.

(b) Cost and Profit Efficiency: The Distribution-Free Approach

Our estimates of relative cost and profit efficiency are based on the "distribution-free" approach developed by Berger (1993), and recently employed by Berger and Mester (1997) and others. This approach has been described extensively in the literature and we provide only a brief summary of our methodology.[16]

The distribution-free approach estimates production efficiency by comparing the relative performance, measured either by costs or profits, for a common set of institutions over several periods. Intuitively, if a bank consistently reports higher costs (lower profits), *ceteris paribus*, it is considered cost (profit) inefficient. The econometric difficulty is in identifying the persistent part of unexplained costs (profits), which is considered the important firm-specific characteristic, from the transitory part, which is considered random noise. The distribution-free approach does this by comparing many observations of observed and predicted costs for each bank and inferring that the average difference is a good indicator of the unobserved inefficiency parameter.

More precisely, consider the following general specification for the cost function:

$$(5) \qquad \ln C = f(\mathbf{w}, \mathbf{Y}, \mathbf{Z}) + \ln u_i + e$$

where $f(\cdot)$ follows Equation (3), u_i represents unobservable firm-specific cost inefficiency, and e is random error.

To estimate the unobserved cost inefficiency component, the distribution-free approach uses separate cross-section regressions of Equation (5) for each of the t years of data in the sample. Under the assumption that the random errors average to zero over time for each bank, a simple average of the

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[15]As a practical matter, inclusion of the share equation changed the point estimates of scale and scope economies very little, although the standard errors were smaller.

[16]Other approaches to measuring relative efficiency include the data envelopment analysis (DEA), stochastic cost frontier, and the thick frontier approach. Berger and Mester (1997) compare these alternatives and we follow their methodology throughout.

t regression residuals approximates the unobserved bank-specific cost inefficiency term.[17] That is, banks with a small u_i are considered relatively cost efficient since they incur lower costs, all else equal.

A formal definition of bank-specific relative cost efficiency is:

$$\text{(6)} \qquad C - EFF_i = \frac{\exp(f(\mathbf{w}, \mathbf{Y}, \mathbf{Z})) \cdot \exp(\ln u_{\min})}{\exp(f(\mathbf{w}, \mathbf{Y}, \mathbf{Z})) \cdot \exp(\ln u_i)} = \frac{u_{\min}}{u_i}$$

where u_i is the average regression residual for bank *i* and $u_{\min}$ is the smallest value for all banks, i.e., the "best cost-practice" bank. Equation (5) provides a natural ranking of relative cost efficiency that ranges from 1.0 for the best cost-practice bank on the efficient frontier to zero (in the limit) for a highly inefficient bank. This definition also has a nice interpretation for banks that are labeled inefficient, i.e., if $C - EFF_i = 0.95$ then 5% of its observed costs can be attributed to cost inefficiency.

Relative profit efficiency is estimated in a similar conceptual manner, but a practical issue makes it more difficult to implement. Since profits can reasonably be negative, the simplified cost function in Equation (5) must be transformed to prevent taking logs of a negative number. This is done by adding a constant, Θ , set equal to one plus the absolute value of the minimum profit in each year, so that the general specification for the profit function becomes:

$$\text{(7)} \qquad \ln(\Pi + \Theta) = f(\mathbf{w}, \mathbf{Y}, \mathbf{Z}) + \ln p_i + e$$

and the measure of relative profit efficiency is:

$$\text{(8)} \qquad \Pi - EFF_i = \frac{\exp(f(\mathbf{w}, \mathbf{Y}, \mathbf{Z})) \cdot \exp(\ln p_i) - \Theta}{\exp(f(\mathbf{w}, \mathbf{Y}, \mathbf{Z})) \cdot \exp(\ln p_{\max}) - \Theta}$$

where p_i is estimated as the average residual for bank *i*, $p_{\max}$ is the maximum residual for the "best profit-practice" bank, and the $f(\cdot)$ function is evaluated using the estimated coefficients for each year and the right-hand side variables for each bank. The fitted values are then averaged across years to generate a single estimate of $\Pi - EFF$ for each bank. Note that unlike the cost efficiency measure, profit efficiency is not bounded at zero. A bank could inefficiently loose more than 100% of potential profits, which would cause profit efficiency to be negative.

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[17]Note that this differs from a fixed-effect regression since each cross-section is estimated separately, effectively allowing all coefficients to vary year-by-year. Sheldon and Haegler (1993) and Sheldon (1994), for example, use a constrained model where all coefficients are held constant over time and relative inefficiency is calculated from a traditional fixed effect. The distribution-free approach is less restrictive.

(c) Economies of Scale and Scope

Our sample of Swiss banks spans a wide range of sizes and a natural question is the existence of economies of scale. This has been a common topic in the empirical analysis of commercial bank performance with the most recent research finding strong evidence of scale economies in the U.S., e.g., Berger and Mester (1997) and Hughes and Mester (1998). Evidence from Switzerland, reported in Sheldon (1994) finds strong economies of scale throughout his sample using parametric methods, but a U-shaped average cost curve with diseconomies of scale setting in the Sfr 1 billion range.

To assess the importance of scale economies, intuitively described as a reduction in average costs as output size increases, we examine several related measures. Again, the methodology has been explained in detail elsewhere and we only brief review our approach.

The most obvious way to compare the performance of different size institutions is to look at familiar accounting ratios like ROA, ROE, or the efficiency ratio (defined as non-interest expense as a percent of net interest income plus non-interest income). In addition to these standard ratios, we create a cost to assets ratio (C/A) using costs, as defined above in Section II, and total assets. By comparing this ratio across different size institutions, we obtain a crude measure of scale economies.

A more formal measure is given by ray scale economies, RSE, developed by Baumol et al. (1982) and applied to banking by Berger et al. (1987). RSE is essentially the multi-product extension of the cost-output elasticity and measures the elasticity of costs with respect to a proportional increase in all outputs. RSE is defined as:

$$(9) \qquad RSE = \sum_{i=1} \frac{d \ln C(\overline{\mathbf{w}}, \overline{\mathbf{Y}}, \overline{\mathbf{Z}})}{d \ln Y_i}$$

where Y_i is the ith output from the output vector and bars reflect means of the vectors. $RSE < 1$ signifies scale economies since costs increase proportionally less than outputs, while $RSE > 1$ means diseconomies of scale.

While a useful statistic, RSE suffers from an important limitation. By assuming all outputs grow proportionally, it ignores the vast differences in output mixes across different size institutions. In Switzerland, for example, large banks hold more trading assets as a percent of total assets, while the smaller ones more securities and participations as a percent of total assets. To account for this distinction, Berger et al. (1987) developed an alternative measure of scale economies called expansion path scale economies, $EPSCE^{A,B}$, which measures the proportional changes in costs as banks move along the observed expansion path from the small bank A to the large bank B. $EPSCE^{A,B}$ is defined as:

$$(10) \qquad EPSCE^{A,B} = \sum_{i=1} \frac{d \ln C(\overline{\mathbf{w}}, \overline{\mathbf{Y}}^B, \overline{\mathbf{Z}}^B)}{d \ln Y_i} \cdot \frac{\left(Y_i^B - Y_i^A\right)}{Y_i^B} \times \frac{\left(C(\overline{\mathbf{w}}, \overline{\mathbf{Y}}^B, \overline{\mathbf{Z}}^B) - C(\overline{\mathbf{w}}, \overline{\mathbf{Y}}^A, \overline{\mathbf{Z}}^B)\right)}{C(\overline{\mathbf{w}}, \overline{\mathbf{Y}}^B, \overline{\mathbf{Z}}^B)}$$

where $\overline{\mathbf{Y}}^A$ and $\overline{\mathbf{Z}}^A$ are the mean output and netput bundle of banks in the smaller class A, $\overline{\mathbf{Y}}^B$ and $\overline{\mathbf{Z}}^B$ are the mean output and netput bundle of banks in the larger class B, and other input price means are for the entire sample. Like RSE, $EPSCE^{A,B} < 1$ implies economies of scale since costs increase proportionally less than outputs, while $EPSCE^{A,B} > 1$ implies diseconomies of scale. The important difference, however, is that $EPSCE^{A,B}$ accounts for observed changes in the output mix between small and large banks.

Our final measure is called expansion path sub-additivity, $EPSUB$, and is somewhat of a hybrid measure of scope and scale economies. $EPSUB$ measures the predicted cost differences if an observed bank were arbitrarily divided into two smaller banks that produced the same total output. That is, an observed bank B with output bundle $\mathbf{Y}^B$ is divided into two smaller banks A and D such that $\mathbf{Y}^A + \mathbf{Y}^D \equiv \mathbf{Y}^B$. $EPSUB$ compares the predicted costs from the two hypothetical bank to the observed bank as:

$$(11) \qquad EPSUB = \frac{C(\overline{\mathbf{w}}, \mathbf{Y}^A, \overline{\mathbf{Z}}) + C(\overline{\mathbf{w}}, \mathbf{Y}^D, \overline{\mathbf{Z}}) - C(\overline{\mathbf{w}}, \mathbf{Y}^B, \overline{\mathbf{Z}})}{C(\overline{\mathbf{w}}, \mathbf{Y}^B, \overline{\mathbf{Z}})}$$

where the cost functions are evaluated at the means of the other variables. $EPSUB < 0$ implies the two smaller banks could produce the same output at a lower total cost and output bundle B is not competitively viable. $EPSUB > 0$ implies the larger bank incurs lower costs and the smaller banks have an incentive to expand since joint production can occur at lower costs.[18]

V. Results

We now turn to our estimates of cost and profit functions for 290 Swiss banks from 1996-1999. We use these parameter estimates to examine relative cost and profit efficiency, economies of scale, and economies of scope for the Swiss banks.[19]

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[18] $EPSUB$ is a generalized version of a more conventional measure of scope economies that compares the observed bank to a hypothetical set of perfectly specialized banks. We do not use this measure of scope economies due to the unrealistic assumption of perfectly specialized banks. Moreover, as pointed out by Berger et al. (1987), estimates of traditional scope economies depend critically on the evaluation point for output quantities set arbitrarily near zero.

[19] The analysis began with 390 banks. We dropped 83 banks either because of obvious data errors or incomplete data for all years. In addition, since the price data are measured with error, we followed Berger and Mester (1997) and dropped questionable input price observations (more than 2.5 standard deviations form the annual mean). This left 290 banks with reasonable data for all four years.

(a) Efficiency Results

Our cost efficiency and profit efficiency results for all Swiss banks in our sample are reported in Table 4. For both measures, we report the mean efficiency (weighted averages across all banks) for each of the three output specifications and the corresponding standard deviations. As far as we know, these are the first estimates of profit efficiency for Swiss banks

In terms of cost efficiency, the estimates range from 0.48 for the naïve specification *Y-1* to 0.68 for the intermediate specification *Y-2*. These estimates imply substantial relative inefficiency in the Swiss banking system with one-third to one-half of all costs attributed to inefficient production. Our preferred universal specification Y-3, which includes the broadest combination of outputs and netputs, yields an estimate of 0.57 and is the most precisely estimated measure. This implies that about 40% of observed costs are due to inefficiency relative to the best cost-practice bank.

These results are consistent with earlier work on Swiss banks, e.g., Sheldon (1994) reports an estimate of cost efficiency 0.56 for 477 Swiss from 1987 to 1990 using non-parametric methods, although only 0.04 using parametric methods. Our universal specification, Y-3, yields a larger estimate, which likely reflects both our more flexible estimation procedure and our broader output concept. Given our results and the non-parametric results of Sheldon (1994), we conclude that Swiss banks operate with substantial relative inefficiency, but not the "astronomical" level from Sheldon and Haegler's (1993) parametric results. Those estimates appear implausible from an economic standpoint and seem to be driven by a few outliers (Sheldon and Haegler (1993), Figure 4).[20]

In terms of profit efficiency, our estimates show considerable variation over the three output specifications, ranging from –0.08 for the naïve specification to 0.48 for universal specification. We do not, however, give much credence to the profit efficiency estimates from the naïve and intermediate cases. These measures are estimated very imprecisely with large standard errors and ignore large parts of the activities that are clearly important to Swiss banks. This comparison, however, is quite informative and shows the critical importance of accounting for the large range of activities undertaken by universal banks in Switzerland. Failure to do so leads profit efficiency to be dramatically understated. From our preferred Y-3 universal specification we conclude that about one-half of potential profits are foregone relative to the best profit-practice bank.

[20]One possible explanation is that Sheldon (1994) and Sheldon and Haegler (1993) do not exclude banks with "abnormal" input prices. These outliers may bias the efficiency estimates based on the parametric approach, but not those based on the nonparametric approach since the latter does not take input prices into consideration.

Charts 1 and 2 plot the mean cost and profit efficiency for each output specification across 10 different size groups.[21] There appears to be little variation in cost efficiency across size classes, a result that is robust to the definition of bank size. Except for the very largest, banks appear most cost efficient when our universal banking specification is used. The results are similar for profit efficiency. The universal specification yields the highest estimates of profit efficiency, and the estimates from the naïve and intermediate specifications are implausibly low. Again, we interpret this as strong evidence that one must take a broad view of Swiss banks and include non-traditional banking activities to correctly gauge their productive efficiency. The remainder of our empirical work uses the universal specification since it appears to be the most reasonable representation of the bank activities.

To get a better sense of the variation in relative efficiency, Charts 3a and 3b plot the distribution of bank cost and profit efficiency from our preferred universal specification. Consistent with findings from the U.S, they show a wider distribution for profit efficiency with a long left-hand tail for the banks that appear exceptionally inefficient. This is not surprising, since profit efficiency includes not only the technical and allocative efficiency in the production process, but also the efficiency of the bank in pricing and marketing products and services.

Turning to the question of variation across types of Swiss banks, Chart 4 plots median efficiency from the universal specification for the nine types of Swiss banks in our study. The results indicate that the commercial banks are the most cost efficient, while the Raiffeisen banks appear the most profit efficient. As discussed earlier, Swiss banking consolidation has been most intense among the cantonal and regional banks. Both of these groups, on average, appear to be no different from the industry as a whole in terms of relative efficiency, which suggests that inefficiency was not a driving force behind their demise. This interpretation is tentative, however, since we are looking at surviving banks, and a survivor bias cannot be excluded. That is, the most inefficient banks may be the ones that have exited our sample. We can only conclude that regional and cantonal banks taken as a category are not currently less efficient that other banks.

Finally, there is some concern that these efficiency estimates are being driven by a subset of banks that behaves in fundamentally different ways from the majority. As a robustness check, we re-estimated cost and profit efficiency using two subsamples: one excludes the three largest Swiss banks and the second excludes the Raiffeisenkassen. In both cases, our qualitative findings did not change and we conclude that these banks are not driving our results.

[21] Size classes are formed as deciles with 29 banks in each class, based on average total assets over the four years. Each estimate is the weighted mean over the class, with the denominator of Equations (6) and (8) serving as

(b) Economies of Scale and Scope Results

We now turn to our estimates of economies of scale for Swiss banks for various size classes. Given the implausible profit efficiency findings using output specifications Y-1 and Y-2, we report estimates of RSE, $EPSCE^{A,B}$, and $EPSUB$ based on the universal specification Y-3. In all cases, we jointly estimate the cost function in Equation (3) and share equation in Equation (4) for each year. We then evaluate Equations (9)-(11) using the estimated coefficients and either annual means from the entire sample (input prices) or annual means for each size class (output and netput quantities). This emphasizes the impact of changes in the output bundle, ceteris paribus. The size classes are defined as: Class 1, assets < Sfr 100 million; Class 2, Sfr 100 million < assets < Sfr 200 million; Class 3, Sfr 200 million < assets < Sfr 500 million; Class 4, Sfr 500 million < assets < Sfr 1.5 billion; Class 5, Sfr 1.5 billion < assets < Sfr 10 billion; Class 6, asset > Sfr 10 billion.

Table 5 reports estimates for C/A, RSE, $EPSCE^{A,B}$ for each size group for each year. The most primitive measure, C/A, shows declining average costs with size. In all years, the smallest banks incur the highest costs per assets and costs remain relatively flat through the fifth size class (about Sfr 10 billion). The largest size class shows the smallest average cost in all years. This is somewhat different from Sheldon (1994), who found that diseconomies of scale set in between Sfr 160 million and Sfr 1.2 billion.

Turning to the more formal measures of economies of scale, we find some evidence of economies of scale in all years from both RSE and $EPSCE^{A,B}$. In 1999, for example, we estimate that a 1% increase in all assets would raise predicted costs by 0.59% for the smallest size classes and by 0.80% for the largest banks as measured by RSE. For $EPSCE^{A,B}$, a 1% increase along the expansion path increases costs by 0.89% from Class 1 to Class 2 and a 0.92% increase from Class 5 to Class 6. We cannot formally reject the null hypothesis of no economies of scale for the large banks in most cases, however, so we interpret the results as economies of scale for small banks, but not for the largest banks. Note, however, that there is some variation across years, particularly for $EPSCE^{A,B}$.

In general, these results are consistent with the earlier parametric results of Sheldon and Haegler (1993). They report RSE of 0.33 for the smallest asset class and 0.75 for the largest, with a sample average of 0.54; their $EPSCE^{A,B}$ ranged between 0.68 and 0.83.

Table 6 reports $EPSUB$ estimates, calculated in three different ways. Following Jagtiani and Khanthavit (1996), we create the hypothetical banks A and D from observed bank B by breaking down

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weights. As a robustness check, we also created size classed based on gross income (net interest income plus all fee income) and did not find substantial differences in the size distribution of efficiency.

the mean output vector in each size class into the minimum of each output and the residual, i.e., mean output less minimum output. This approach is called the “min-mean” path. Alternatively, we can break the maximum output into the mean output and the residual, i.e., maximum output less mean output. This is called the “mean-max” path. Both versions measure the cost savings from joint production. The third approach, following Mitchell and Onvural (1996), estimates $EPSUB$ along the expansion path from the mean output vector of one size class to the mean of the next size class. This approach is called the “mean-mean” path. In all cases, total predicted costs are then calculated using sample means of input prices and netput quantities.

For $EPSUB$ to capture scope economies, it is necessary that the hypothetical banks A and D be more specialized than bank B. To check this, we computed a Herfindahl-like indicator of each bank’s specialization, defined as the sum of the squared shares of traditional and non-traditional income, where non-traditional income equals brokerage fees, trading income, and other fees. Indeed, we observe a negative correlation between specialization and size (Table 7). This negative relationship between size and specialization means that bank B (the large bank) is less specialized than bank A and D (the two smaller banks) and implies that EPSUB captures some scope effects. Because the hypothetical banks A and D are not perfectly specialized, however, $EPSUB$ captures not only scope economies but also scales economies.

These results provide mixed evidence in terms of scope economies. While most estimates are positive, which implies costs are “subadditive” and there are cost savings for the combined bank, the significance levels vary considerably. Using the mean-max path, for example, we find evidence of significant scope economies for all but the two largest size classes. The min-mean estimates, on the other hand, are much smaller and show weak evidence of diseconomies of scope. We interpret this as limited evidence for scope economies for the smaller banks in our sample, but not for large ones.

Sheldon and Haegler (1993) report similar results in their $EPSUB$ estimates, which ranged from 0.42 and 0.28 for banks with assets below Sfr 45 billion, and –0.11 for larger banks. They also estimate a more traditional measure of scope economies, which indicated diseconomies of scope. Based on this ambiguous evidence, those authors infer the presence of diseconomies of scope and conclude that banks would gain greater cost savings if they specialized as they grew. Sheldon and Haegler (1993), however, do not report standard errors so it is difficult to judge the statistical significance of their results.

VI. Robustness Checks

Our econometric work provides estimates of cost and profit efficiency, scale economies, and scope economies using traditional parametric methods. To address the reasonability of the results and issues of robustness, we performed several additional calculations that provide corroborating evidence, use alternative methods, and examine particular subsamples of our data.

(a) Efficiency Correlates

To examine the robustness and reasonability of the efficiency results we calculated several rank correlations with standard accounting variables. We report rank correlations between cost efficiency, profit efficiency, ROA, ROE, size, traditional income share, degree of specialization, and credit risk in Table 7.[22]

The correlations are mostly reasonable. Both cost efficiency and profit efficiency are negatively correlated with C/A and positively correlated with ROA and ROE. Similar to results from the U.S., we find a significant negative correlation between cost and profit efficiency. Size and specialization are negatively related, as expected since larger banks are typically more diversified and universal in nature.

In terms of scale economies, there is no significant correlation between asset size and C/A, ROA, cost efficiency, or profit efficiency, although it is correlated with ROE. In terms of scope economies, the correlation between ROE and degree of specialization was negative, indicating that a diversified earnings stream is associated with higher profits. This correlation, however, was not very robust and does not hold for standard ROE correlations or for ROA rank correlations. Specialized banks also appear to be more profit efficient. Both are consistent with our weak evidence for scope economies. Traditional activities appear less profitable than non-traditional activities, as indicated by the negative correlation between ROA and ROE and the traditional income share. Taken together, these correlations provide the same general picture as the more formal econometric work.

(b) Risk Issues

We also looked at the relationship between risk and performance, size, and product mix. When bank managers or shareholders are not risk-neutral, cost minimization and profit maximization may explain only part of bank behavior. Hughes, Mester and Moon (2000) address this issue by modeling the bank's objective as value-maximization, thereby accounting for the possibility that, when ranking and choosing production plans, managers consider not only the expected cash-flows, but also their risk. Implementation of this methodology, however, requires data on output prices, which are not available for our complete sample of Swiss banks or for our broadest output specification. As an alternative, we briefly discuss the risk-related correlates in Table 7. Of course, these simple

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[22]Size is measured as total assets or gross income. Traditional income share is defined as net interest income on loans, securities, and trading assets as a percent of gross income (net interest income on loans, securities, and

measures do not account for the multiple links between these variables and cannot capture the complexity of the underlying relationships, but they are still useful robustness checks.

We begin with the link between risk and performance, and find no significant correlation between cost efficiency and two risk proxies: credit risk (defined as the ratio of provisions and write-offs to total assets) and the standard deviation of ROE. This suggests our cost efficiency estimates are not biased by banks that may limit their screening and monitoring activities or the diversification of their loan portfolio to save on operational costs. Similar results hold for profit efficiency.

We find a positive correlation between ROA and ROE and the standard deviation of ROE, credit risk, and excess capital (defined as the percent of capital held above the regulatory minimum). This implies that higher profitability is associated with higher risk and higher market capital requirements. The net effect appears to be a higher probability of default, as indicated by the negative correlation between ROE and the distance to default (defined as the ratio of average ROA plus the average equity ratio to the standard deviation of ROA).

The correlates between risk and bank size and output mix also provide several interesting results. We observe no significant correlation between the variability of bank profits and total assets, but a positive correlation with bank gross income. In terms of bank specialization, the degree of specialization is negatively correlated with the bank ROE, suggesting some diversification benefits in terms of risk reduction. The effects of risk diversification may, however, be masked by a voluntary increase in risk-taking by large, universal banks. Finally, the standard deviation of ROE is negatively correlated with the share of traditional activities, indicating that the higher profitability of non-traditional activities also implies more risk.

(c) Standard Profit Function

We estimated profit efficiency from a standard profit function that uses output prices as dependent variables. As discussed above, we consider this an inferior measure but it is worthwhile to compare results. One caveat, however, is that data limitations forced us to limit both the size of our sample and the breadth of the specification. For example, the Swiss data only report interest income for loans as a whole, so we were forced to combine all loans into a single output class. In addition, many banks experienced losses on non-traditional activities, so we were left with negative prices on certain assets. These observations had to be dropped. Despite these problems, we re-estimated cost efficiency, alternative profit, and standard profit efficiency for a set of 145 banks with complete data

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trading assets plus brokerage fees, trading income, and other fees). Specialization is defined above. Credit risk is measured as the sum of provisioning and write-offs divided by total assets.

for the full years.[23] For this subsample of banks, the average efficiency levels were 0.46 for cost, 0.50 for alternative profit, and 0.41 for standard profit. The correlation between the two measures of profit efficiency was 0.95. We conclude from this that alternative profit function gives a reasonable description for the sample of Swiss banks.

(d) Alternative Specifications

We calculated RSE, $EPSCE^{A,B}$, and $EPSUB$ using coefficients estimated from an alternative profit function. Similar to the methodology employed by Berger, Humphrey, and Pulley (1996) for alternative revenue functions, we asked the question of how profits (rather than costs) vary when banks change their scale and scope. We find no significant RSE and $EPSCE^{A,B}$, which indicates that profits do not increase more than proportionally with size. This contrasts with our finding of cost scale economies for small banks. One interpretation is that outputs are not totally comparable across banks of different size. For example, one can imagine that loans granted by the big banks to large firms generate, in proportion, less costs but also less income, than loans to retail borrowers granted by smaller banks. Alternatively, cost scale economies may be passed to the customers. In either case, we find no evidence that larger banks can generate higher profits because of their stronger pricing power. We also find no significant $EPSUB$, which indicates that customers are not ready to pay more for one-stop shopping. This is consistent with Berger and al. (1996), who find no significant revenue scope and scale economies.

We also created new size classes based on gross income, rather than total assets. Evaluating the cost-based RSE, $EPSCE^{A,B}$, and $EPSUB$ across these different size classes did not materially change the results. We again found evidence of cost scale economies for small and mid-size banks, but little evidence of significant scope economies for large banks.

Finally, we estimated cost functions excluding Swiss banks owned by foreigners. By dropping these 96 banks, our sample declined, but we avoid possible measurement problems associated with foreign-owned banks. These banks have balance sheet positions that change relatively quickly and are involved in contracts with parent companies that might not represent market conditions, so estimates could be biased. The estimate of RSE, $EPSCE^{A,B}$, and $EPSUB$ did not change materially for these subsets, however, so we conclude that the foreign banks were not driving our results.

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[23]This specification included 4 outputs (loans, securities and participations, trading, and amount of securities accounts outstanding) and 4 netputs (equity capital, physical capital, OBS commitments, and derivatives). The inputs were the same as earlier.

(e) Caveats

We end this section with a note of caution about our results. While both the rank correlations and the econometric results point in the same direction, these findings must nonetheless be interpreted cautiously. Important data limitations forced us to approximate parts of non-traditional outputs. In addition, absence of data on output prices for most non-traditional activities prevented us from estimating the standard profit function for the broadest output specification, so that we were unable to measure bank efficiency in choosing the profit-maximizing output mix. Finally, the current state of the art does not allow for a clean measurement of economies of scope. Since we have no direct way of knowing how large the approximation errors are, we cannot conclude that there are no scale and scope economies for the largest Swiss banks. Rather, we can only conclude that there is no obvious evidence when we use currently available data from regulatory sources and traditional methods

VII. Conclusions

This paper evaluates the production structure of Swiss banks in the late 1990s. By employing alternative output specifications with a broad range of outputs, we are able to capture the universal nature of Swiss banking and gauge the impact of banks' profitability and efficiency. Our results indicate substantial relative inefficiency across all types of Swiss banks. They also indicate that failure to account for off-balance sheet items, trading, and brokerage and portfolio management activities leads profit efficiency to be dramatically understated. In terms of scale and scope economies, we find evidence of cost scale economies for small and mid-size banks, but larger banks appear not to substantially benefit from further size gains or product diversity.

These results provide some insight into the recent evolution of Swiss banking and have implications for banks in other economies that are moving towards a more universal system. Regarding the Swiss banking system, the large observed differences in relative efficiency and the presence of cost economies of scale partially explain the consolidation trends observed during the last decade. Our results, however, contrast with the increase in importance of large universal banks at the expense of regional and cantonal banks: we find only little evidence of scale or scope economies for the largest banks and the regional and cantonal banks do not appear less efficient than other types of Swiss banks. The higher profitability observed in recent times in financial market activities may explain why Swiss banks formerly concentrating on traditional banking entered that segment, even in the absence of economies of scope. In terms of the move toward universal banking elsewhere, we find little evidence of substantial gains from either scale or scope economies for the largest banks. This suggests that the creation of larger banks with broader product mixes will not necessarily lead to improved efficiency or performance.

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Table 1: Comparison of Swiss Banks, 1999

	Big	Cantonal	Regional	Raiffeisen-kassen	Commercial	Stock Exchange	Consumer	Other	Foreign
Mean Assets (Sfr millions)	501'586	12'341	699	65'556	3'337	1'191	522	374	1'184
Number of Institutions	3	24	106	1	16	54	2	5	123
				Balance Sheet (% of assets)					
Assets									
Money market claims	6.4	2.0	0.3	0.0	4.5	7.8	0.0	0.0	4.4
Claims on banks	34.1	7.7	3.0	8.4	16.0	41.9	2.1	7.5	36.5
Claims on customers	18.1	16.0	10.0	8.0	18.0	20.8	81.8	19.5	35.4
Mortgages loans	12.5	61.1	77.0	79.5	40.5	4.2	0.4	54.9	2.5
Trading book	14.6	2.8	0.2	0.0	7.0	5.7	0.0	10.6	4.8
Securities	1.6	1.8	1.5	1.9	2.2	2.9	1.8	1.9	2.1
Liabilities									
Liabilities to banks	32.4	11.6	7.1	7.6	10.4	21.6	62.8	0.5	39.0
Savings deposits	7.6	33.8	47.2	63.9	29.6	2.6	1.3	26.7	1.5
Short term deposits	32.4	17.7	12.1	6.6	35.6	52.3	6.0	48.0	39.2
Long term deposits	0.6	4.3	8.3	9.9	3.1	0.1	7.7	4.0	0.3
Bonds	4.2	19.3	14.2	6.2	6.2	1.3	0.0	0.0	0.1
Off-Balance Sheet Items									
Derivatives (credit equivalent)	5.9	1.4	0.1	0.0	2.5	4.9	0.0	0.0	3.1
Commitments (credit equivalent)	31.7	1.6	0.7	0.6	0.4	1.3	0.0	0.0	5.5
				Income Statement (% of total income)					
Interest income: credit and discount	62.9	78.4	83.4	94.7	52.3	28.9	29.9	40.5	42.3
Interest income and dividends: securities	0.9	3.9	5.4	0.0	4.1	2.8	1.0	0.9	4.1
Fees: brokerage, underwriting, and portfolio management	18.9	10.5	6.7	3.4	26.0	49.9	0.0	11.7	38.3
Trading income	14.1	4.9	2.2	1.1	11.2	16.2	9.1	26.8	9.6
Interest expenses	49.4	50.3	49.0	54.9	32.6	21.0	8.2	16.0	31.9
Wages	21.1	15.2	14.4	13.0	23.0	23.3	19.4	23.0	23.5
Cost of physical capital	12.1	10.2	11.1	12.3	16.6	12.1	27.2	16.2	12.6
Write-offs and provisioning	6.1	16.4	12.4	17.8	12.3	5.9	7.6	13.8	8.4

Source: Banque nationale suisse (2000).

Table 2: Recent Trends in Swiss Bank Performance, 1996-99

Year	Number of Obs.	Total Assets	Equity Capital	Variable Costs	Variable Profits: Naïve, *Y-1*	Variable Profits: Intermediate, *Y-2*	Variable Profits: Universal, *Y-3*	ROA	ROE	C/A
1996	290	3'904.7	261.5	149.2	-4.7	1.7	52.2	0.90	5.48	4.63
1997	290	4'658.2	283.1	164.2	-3.6	2.8	66.5	1.26	7.92	4.32
1998	290	6'864.5	348.5	211.9	2.5	8.6	86.7	1.53	10.11	4.27
1999	290	7'539.2	358.3	217.0	-13.0	-6.4	100.0	1.51	10.34	3.78

Note: All values are simple means. Variable costs and variable profits are defined in Section III. Output specifications *Y-1*, *Y-2*, and *Y-3* are defined in Section III. Total assets, equity capital, variable costs, and variable profits are measured in millions of 1999 Swiss francs. ROA is net income divided by assets. ROE is net income divided by equity. C/A is variable costs divided by total assets. ROA, ROE, and C/A are percentages.

Table 3: Cost and Profit Function Variables, 1999

	Mean	Standard Deviation	Minimum	Maximum
Variable Costs	217.0	1'710.3	0.3	27'325.8
Variable Profits				
Naïve, *Y-1*	-13.0	212.4	-3'153.4	675.5
Intermediate, *Y-2*	-6.4	202.7	-3'113.2	676.2
Universal, *Y-3*	100.0	646.2	-4.7	1'020.0
Variable Input Prices				
Deposits	2.22	1.59	0.02	18.35
Wages and Salaries	132.5	57.8	17.0	421.3
Variable Output Quantities				
Money Market Claims	1'788.8	15'807.4	0.0	257'617.7
Bank Loans	2'162.5	22'312.6	0.1	356'858.0
Mortgage Loans	1'749.2	9'088.2	0.0	123'151.3
Securities	246.6	1'111.8	0.0	11'794.0
Trading Assets	824.1	11'613.9	0.0	196'811.7
Amount of Securities Accounts	5'881.8	39'690.9	0.0	613'753.1
Fixed Netputs				
Equity Capital	358.3	2'817.1	1.7	34'919.4
Physical Capital	60.2	560.1	0.0	6'741.6
OBS Commitments	423.5	4'453.6	0.0	73'966.9
Derivatives	2.2	11.5	0.0	137.7
Total Assets	7'539.2	66'879.3	15.5	1'098'175.4

Note: Variable costs, variable profits, variable output quantities, fixed netputs, and total assets are measured in millions of 1999 Swiss francs. Price of deposits is a percentage. Price of labor is in thousands of 1999 Swiss francs. Output specifications *Y-1* , *Y-2* , and *Y-3* are defined in Section III.

Table 4: Average Cost and Profit Efficiency, 1996-99

Output Specification	C-EFF	Π–EFF
Naïve, *Y-1*	0.483	-0.079
	(0.099)	(1.226)
Intermediate, *Y-2*	0.681	0.031
	(0.142)	(2.095)
Universal, *Y-3*	0.570	0.484
	(0.085)	(0.183)

Note: All efficiency measures are weighted averages for all 290 banks with weights equal to the denominator of the efficiency ratio. C-EFF=1 for the "best cost-practice" bank and Π-EFF=1 for the "best profit-practice" bank. Standard deviations are in parentheses. Output specifications *Y-1* , *Y-2* , and *Y-3* are defined in Section III.

Table 5: Economies of Scale by Size Class, 1996-99

Classes	Size Range	1996	1997	1998	1999
			Year		
			C/A		
1	A < 100	5.94	5.32	5.59	4.55
		(3.42)	(2.77)	(3.20)	(2.22)
2	100 < A < 200	4.84	4.58	4.07	3.70
		(2.04)	(2.47)	(2.06)	(1.75)
3	200 < A < 500	3.99	3.88	3.97	3.58
		(1.19)	(1.29)	(1.95)	(1.95)
4	500 < A < 1,500	4.38	4.20	4.25	3.93
		(1.56)	(1.45)	(1.83)	(2.17)
5	1,500 < A < 10,000	4.28	4.02	3.95	3.66
		(0.86)	(1.09)	(1.42)	(1.31)
6	10,000 < A	3.79	3.53	3.38	2.97
		(0.39)	(0.58)	(0.73)	(0.55)
			RSE		
1	A < 100	0.454	0.497	0.587	0.588
		(0.083)	(0.081)	(0.091)	(0.077)
2	100 < A < 200	0.473	0.549	0.607	0.611
		(0.075)	(0.077)	(0.090)	(0.079)
3	200 < A < 500	0.508	0.620	0.696	0.659
		(0.079)	(0.076)	(0.082)	(0.077)
4	500 < A < 1,500	0.518	0.643	0.693	0.664
		(0.086)	(0.078)	(0.088)	(0.080)
5	1,500 < A < 10,000	0.602	0.745	0.762	0.705
		(0.100)	(0.093)	(0.098)	(0.091)
6	10,000 < A	0.741	0.892	0.860	0.796
		(0.138)	(0.140)	(0.133)	(0.119)
			$EPSCE^{A,B}$		
1	A < 100	na	na	na	na
2	100 < A < 200	0.483	0.913	0.750	0.888
		(0.182)	(0.162)	(0.074)	(0.068)
3	200 < A < 500	0.787	1.024	0.844	1.303
		(0.122)	(0.146)	(0.108)	(0.349)
4	500 < A < 1,500	0.725	0.858	0.816	0.924
		(0.079)	(0.093)	(0.067)	(0.066)
5	1,500 < A < 10,000	0.740	0.921	0.845	0.970
		(0.091)	(0.092)	(0.073)	(0.081)
6	10,000 < A	0.778	0.965	0.898	0.918
		(0.117)	(0.123)	(0.115)	(0.104)

Note: C/A is variable costs per assets multiplied by 100 and the standard deviation for each size class is in parentheses. *RSE* and $EPSCE^{A,B}$ are estimated from a separate cost function using *Y-3* for each year and evaluated with means from each size class. Standard errors are in parentheses. Size classes are based on total assets, in Sfr millions.

Table 6: Economies of Scale and Scope by Size Class, 1996-99

Classes	Size Range	Year 1996	1997	1998	1999
			EPSUB - min-mean		
1	A < 100	0.022	0.002	-0.002	-0.001
		(0.034)	(0.005)	(0.001)	(0.000)
2	100 < A < 200	0.004	-0.001	0.001	-0.001
		(0.006)	(0.005)	(0.007)	(0.000)
3	200 < A < 500	0.003	-0.010	-0.010	-0.003
		(0.006)	(0.008)	(0.012)	(0.001)
4	500 < A < 1,500	0.002	-0.006	-0.004	-0.012
		(0.007)	(0.008)	(0.007)	(0.005)
5	1,500 < A < 10,000	-0.008	-0.038	-0.013	-0.012
		(0.017)	(0.020)	(0.023)	(0.012)
6	10,000 < A	-0.005	-0.036	-0.023	-0.031
		(0.024)	(0.014)	(0.013)	(0.014)
			EPSUB - mean-max		
1	A < 100	0.275	0.250	0.160	0.183
		(0.102)	(0.077)	(0.079)	(0.061)
2	100 < A < 200	0.298	0.205	0.090	0.151
		(0.104)	(0.102)	(0.079)	(0.078)
3	200 < A < 500	0.271	0.146	0.079	0.074
		(0.102)	(0.095)	(0.073)	(0.065)
4	500 < A < 1,500	0.304	0.185	0.111	0.158
		(0.113)	(0.090)	(0.081)	(0.079)
5	1,500 < A < 10,000	0.255	0.098	0.073	0.111
		(0.108)	(0.080)	(0.076)	(0.070)
6	10,000 < A	0.078	-0.026	-0.015	-0.013
		(0.108)	(0.079)	(0.063)	(0.060)
			EPSUB - mean-mean		
1	A < 100	na	na	na	na
2	100 < A < 200	-	0.298	0.243	0.169
		-	(0.077)	(0.077)	(0.070)
3	200 < A < 500	0.393	0.290	-	0.208
		(0.080)	(0.074)	-	(0.068)
4	500 < A < 1,500	0.356	0.236	0.187	0.195
		(0.086)	(0.072)	(0.073)	(0.064)
5	1,500 < A < 10,000	0.239	0.148	0.114	0.147
		(0.081)	(0.074)	(0.065)	(0.063)
6	10,000 < A	0.083	0.020	0.016	0.025
		(0.069)	(0.053)	(0.037)	(0.033)

Note: EPSUB is estimated from a separate cost function for each year using specification *Y-3* and evaluated with mean prices and netputs from each sample. Missing values reflect cases where at least one output did not decline between size classes. Standard errors are in parentheses. Size classes are based on total assets in Sfr millions.

Table 7: Rank Correlations for Selected Variables

	Cost Efficiency	Profit Efficiency	C/A	ROA	ROE	SD of ROE	Sharpe Ratio	Distance to Default	Total Assets	Gross Income	Traditional Share	Specialization	Credit Risk
Profit Efficiency	-0.28 ***												
C/A	-0.16 ***	-0.20 ***											
ROA	0.13 **	0.07	0.48 ***										
ROE	0.03	0.28 ***	0.38 ***	0.86 ***									
SD of ROE	-0.02	-0.05	0.54 ***	0.48 ***	0.51 ***								
Sharpe Ratio	0.04	0.20 ***	-0.46 ***	-0.22 ***	-0.19 ***	-0.91 ***							
Distance to Default	0.03	0.07	-0.55 ***	-0.45 ***	-0.47 ***	-0.94 ***	0.87 ***						
Total Assets	0.08	0.07	-0.07	-0.04	0.20 ***	0.09	0.00	-0.06					
Gross Income	0.05	0.06	0.43 ***	0.40 ***	0.52 ***	0.49 ***	-0.35 ***	-0.48 ***	0.72 ***				
Traditional Share	0.02	0.06	-0.76 ***	-0.64 ***	-0.55 ***	-0.69 ***	0.57 ***	0.68 ***	-0.03	-0.63 ***			
Specialization	-0.16 **	0.25 ***	-0.24 ***	-0.05	-0.13 **	-0.15 **	0.14 **	0.19 ***	-0.52 ***	-0.53 ***	0.26 ***		
Credit Risk	-0.01	0.08	0.40 ***	0.20 ***	0.13 **	0.36 ***	-0.32 ***	-0.35 ***	-0.08	0.27 ***	-0.48 ***	-0.04	
Excess Capital	0.22 ***	-0.35 ***	0.43 ***	0.52 ***	0.18 ***	0.37 ***	-0.37 ***	-0.38 ***	-0.47 ***	-0.01 **	-0.53 ***	0.14 **	0.23 ***

Note: All variables are averages over the 4-year period for each of the 290 banks in the sample, except standard deviation (SD) which is the bank's standard deviation. Cost Efficiency and Profit Efficiency are estimated from output specification *Y-3*. Sharpe Ratio is defined as mean ROE divided by standard deviation of ROE. Distance to default is defined as mean ROA plue mean Equity/Asset, divided by standard deviation of ROA. Credit risk is defined as provisions plus write-offs divided by total assets. Excess capital is defined as available capital less required capital divided by required capital. Other variables defined in text. *, **, *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.