Efficiency and Economies of Scale of Large Canadian Banks

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This study measures the efficiency and economies of scale in the Canadian banking industry. Efficiency is defined as a bank's cost level compared with that of a "best-practices" bank of similar size, controlled for the type of banking activity and the input prices it faces.[1] Economies of scale occur when a bank can lower its average cost by increasing output.

Measures of efficiency and economies of scale can provide important insights to managers making operational decisions, as well as to policy-makers in the debate on regulatory issues. Measuring efficiency allows us to compare the cost structure of banks both laterally and over time. A knowledge of the systematic differences in efficiency can help regulators to better understand the banking industry. Measuring economies of scale on the basis of existing business conditions and technology allows us to statistically assess whether "bigger is better" for banks.

Research into the efficiency and economies of scale of financial institutions has a long history in the United States and Europe. Northcott (2004) provides a detailed summary of the current theoretical and empirical literature on efficiency and competition and how it relates to the Canadian banking industry. Studies on U.S. banks find that, on average, banks are approximately 80 per cent as cost-efficient as a best-practices bank, while studies on economies of scale point primarily to moderate scale effects in smaller banks.

There is less empirical work on Canadian banks, owing to a limited amount of data. Murray and White (1983) find economies of scale in a cross-section of credit unions in British Columbia, while Nathan and Neave (1992) find mixed results on the size of scale effects. When examining a cross-section of banks, McIntosh (2002) finds economies of scale, using aggregate panel data for five of Canada's major banks.

Key Features

The study outlined here is the first to use detailed disaggregated panel data on Canadian banks to answer questions about efficiency and economies of scale. Furthermore, the lengthy time period considered—1983 to 2003—allows us to examine the impact of technological and regulatory changes on the banking industry. Existing studies typically use cross-sectional data or, less frequently, a set of panel data covering a short time period. The disaggregation of the data is critical and allows Canadian banks to be modelled as producers of multiple outputs. We adopt the intermediation approach in which banks minimize costs by producing multiple outputs using multiple inputs. These inputs include capital, labour, and deposits. Banks produce loans (consumer, mortgage, and business) and engage in securities investment and non-traditional banking activities (e.g., deposit account services, security underwriting, and wealth management).

Incorporating non-traditional activities into a bank's cost function is a relatively new idea.[2] Most studies measure the output of banks by their traditional activities, such as lending, which generate interest income. But banks have been moving into non-traditional activities that generate non-interest income. Chart 1 shows the rapid growth of non-interest income relative to interest income. Estimating a bank's

1. This is sometimes referred to as the X-efficiency.

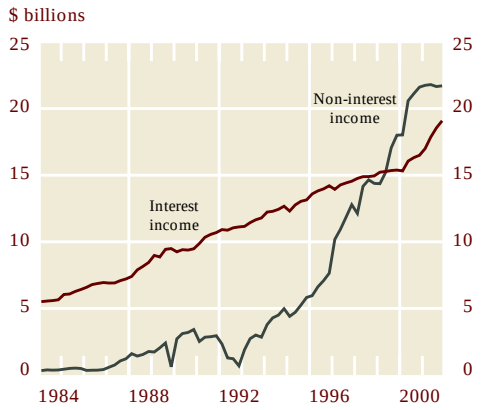
* This article summarizes a recently published Bank of Canada working paper (Allen and Liu 2005).

2. See Clark and Siems (2002) for an example using U.S. data.

cost function without including non-traditional activities could lead to incorrect inferences about efficiency and economies of scale.

The long time period covered by the disaggregated data used here provides some insight into the effects of technological and regulatory changes on banks' cost-minimizing behaviour. Freedman and Goodlet (1998) note that the financial-services industry has recently been undergoing significant technological changes that affect the way services are provided, the instruments used to provide them, and the nature of the financial-service providers. Regulatory changes can also affect the banks' cost structure. Calmès (2004) suggests that changes to the Bank Act in 1987, 1992, and 1997 may have encouraged the trend towards direct financing; i.e., financing done in financial markets rather than through financial intermediaries. At the same time, banks have been increasingly involved in non-traditional, typically market-oriented activities.

Chart 1 Bank Income



Methodology

The analytical framework used to examine efficiency and economies of scale in the Canadian banking industry is the translog cost function, first proposed by Diewert (1971) and Christensen, Jorgenson, and Lau (1971). The translog cost function is a flexible functional form that allows for multiple outputs and does not impose restrictions on the production function. Thus, restrictions, such as Cobb-Douglas technology, can be formally tested.

More specifically, a firm's cost-minimization problem can be written as a general cost function:

$$C = f(q, w) + \xi + \varepsilon, \qquad (1)$$

where C is a bank's costs; q is a vector of a bank's output; w is a vector of input prices that a bank faces; and $f(q, w)$ is a translog function, consisting of the individual and cross-product terms of q and w. Efficiency measures are generated from ξ, while ε is assumed to be identically, independently distributed (i.i.d.). Inferences regarding the scale economies of banks are drawn from the derivative of C with respect to q. This specification is applied to a panel of six Canadian banks over the period 1983 to 2003.

We estimate the translog cost function using four different econometric techniques: (i) a time-varying fixed-effects panel model, estimated by ordinary least squares (OLS); (ii) a stochastic cost-efficiency frontier model, estimated by maximum likelihood (ML); (iii) a system of seemingly unrelated regressions (SUR), using generalized least squares (GLS); and (iv) a time-varying fixed-effects model, including leads and lags of the explanatory variables, estimated by dynamic ordinary least squares (DOLS). Multiple techniques are used to ensure robustness, given that each technique has advantages and disadvantages. The interpretation of our findings is based on all four models, which generate consistent results. That said, we place more emphasis on the results from method (iv), because unit-root and cointegration tests suggest that there is cointegration in our panel. Kao and Chiang (2000) argue that, in this case, the technique using DOLS is the most appropriate estimator to use.

To capture the possible effects of technological change on the banks' cost structure, two methods are used. First, a time trend and a squared time trend are added to equation (1). (It is assumed that banks are subject to the same technological shocks over time.) Second, technological changes are allowed to affect banks differently through the inclusion of a time trend and a squared time trend in the fixed-effect term of each bank. The effect of regulatory changes is then investigated by including dummy variables representing the date when regulatory changes took place.

Data

The data used for this study consist of quarterly observations for the six largest banks in Canada from the first quarter of 1983 to the third quarter of 2003. The data set is from the consolidated balance sheets and income statements collected by the Office of the Superintendent of Financial Institutions. The data at the aggregate level are published in the *Bank of Canada Banking and Financial Statistics*.[3] All variables are deflated by the GDP deflator.

Three input prices are included: labour, capital, and deposits. They are measured, respectively, as the average hourly wage of bank employees, the expenses on real estate and fixtures divided by the total stock of these items, and the effective interest rate that a bank pays on its pool of deposits. A bank's output is divided into five categories: consumer loans, mortgage loans, non-mortgage loans, other financial assets on a bank's balance sheet, and an asset-equivalent measure of a bank's non-traditional activities.

Measuring a bank's non-traditional activities is challenging because of the lack of data. We adopt the asset-equivalent measure introduced by Boyd and Gertler (1994). Assuming that non-traditional activities yield the same rate of return on assets (ROA) as traditional activities, the assets that are required to produce non-interest income can be calculated by dividing non-interest income by the ROA of traditional activities.

Conclusions

The assumption that banks face constant returns to scale is rejected. Unit costs fall as output increases in all models. Depending on the model and the assumptions, the results suggest that banks can reduce average costs by 6 to 20 per cent by doubling each of the five outputs, while the preferred model (using DOLS) suggests that the estimates are closer to 6 per cent. These estimates are slightly higher than those found in previous studies on large U.S. banks.

Our findings suggest that, all else held constant, Canadian banks could enjoy cost savings from becoming larger. This does not necessarily imply that the same cost savings would arise from bank mergers, because the business mix and input prices are likely to change after a merger. Even if cost savings can be achieved by joining two banks, those savings may not be passed on to consumers. Whether savings are passed on depends on the market structure and contestability in banks, topics that merit further research.

Our findings regarding efficiency suggest that the measure of the inefficiency of Canadian banks is approximately 0 to 20 per cent and that this range has been decreasing over time. This range is close to those found in studies on U.S. banks (of all sizes).

Larger banks appear to rank higher in efficiency than smaller banks. Given that scale economies are already accounted for in the model, this

3. Disaggregated data are confidential.

result may stem from differences in other factors, such as management skills and the speed with which new technologies are adopted. This finding seems to suggest that, in addition to scale economies, banks may realize extra cost savings by being bigger.

Finally, technological and regulatory changes are found to have had beneficial effects on the cost structure of banks over time. The analysis also suggests that banks that adopt newer technologies are likely to be more cost-effective than those using older technology.

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