Research Summaries

The Efficiency and Soundness of Banking Systems

Introduction

Bank of Canada staff undertake research designed to improve overall knowledge and understanding of the Canadian and international financial systems. This work is often pursued from a broad, system-wide perspective that emphasizes linkages across the different parts of the financial system (institutions, markets, and clearing and settlement systems). Other linkages of importance may include those between the Canadian financial system and the rest of the economy, as well as those with the international environment, including the international financial system. This section summarizes some of the Bank's recent work.

The three articles presented in this section focus on research related to the efficiency and soundness of banking systems. In particular, they address issues pertaining to the performance of the Canadian banking industry, as well as bank failures and resiliency in Latin America and East Asia.

A key question in financial institution policy is whether larger banks can achieve greater efficiency and reduce production costs. Indeed, Bank of Canada Governor David Dodge asked in a December 2004 speech, "How can we enhance our policy framework to provide greater incentives for innovation by encouraging competition while, at the same time, giving our [financial] institutions the scope to improve efficiency?"[1] In *Efficiency and Economies of Scale of Large Canadian Banks*, the presence of economies of scale and efficiency in the Canadian banking industry is assessed statistically. Using detailed disaggregated industry data over the period 1983 to 2003, the authors account for the impact of technological and regulatory changes on the banking industry. In particular, Canadian banks are modelled as producing multiple outputs, including non-traditional activities, such as security underwriting and wealth management, using multiple inputs. The inclusion of non-traditional bank activities, which now generate more than half of the total revenues of the Canadian banking industry, in a cost function for banks allows for a more appropriate statistical assessment of whether "bigger is better" from an efficiency perspective.

Expansion through acquisitions has been a feature of the financial sector in both Canada and the United States for decades. Acquisitions are of interest for financial sector efficiency and stability partly because of their potential impact on industry costs and performance. Over the past several years, six major Canadian banks have established significant operations outside Canada. Given the extent of these investments and the trend for Canadian banks to look abroad for expansion opportunities, it is important to assess whether it is firms that are successful domestically that increase their degree of internationalization (DOI), or whether, in fact, it is the DOI that improves performance. Such research is thus particularly relevant for Canadian banks seeking to enhance their performance through expansion. In *Degree of Internationalization: An Analysis of Canadian Banks*, the link between performance and DOI is tested using quarterly data on the foreign-asset exposures of Canadian banks over the period 1994 to 2003.

During the1990s, countries in East Asia and Latin America experienced acute episodes of systemic banking crisis that compromised a substantial share of their banking sectors and caused enormous negative macroeconomic consequences. In the third article, *Bank Failures and Bank Fundamentals: A Comparative Analysis for Latin America and East Asia during the 1990s*, the author provides systematic cross-country

1. "Financial System Efficiency: A Canadian Imperative," Remarks to the Empire Club of Canada and the Canadian Club of Toronto, Toronto, Ontario, 9 December 2004.

empirical evidence as a basis for assessing the degree of resilience of the banking sectors in both regions during the crisis periods. In particular, he looks at whether systemic shocks pushed mainly those banks that were weakest before the onset of the crisis to fail, rather than provoking bank failures through a persistent decline in bank fundamentals resulting from the crisis periods. The issue of the resilience of the banking sector in emerging-market economies (EMEs) to systemic shocks assumes particular relevance for banks in industrialized countries that have asset exposures in EMEs. Banking-sector resilience in EMEs is also related to the DOI discussed in the second article, since the participation of foreign banks in EMEs has been found to increase stability in these markets.

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.

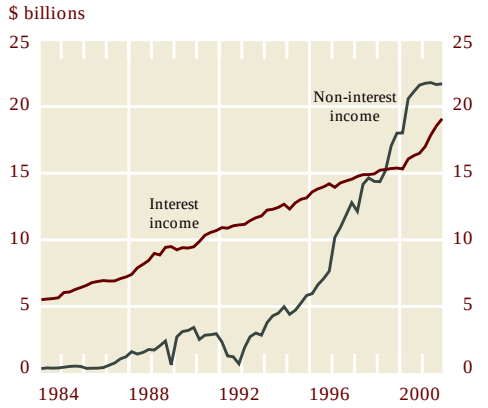
* This article summarizes a recently published Bank of Canada working paper (Allen and Liu 2005).

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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Degree of Internationalization: An Analysis of Canadian Banks

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The role of banks as intermediaries in global financial markets continues to evolve in response to regulatory reform, financial product innovation, and advances in information technology. A popular perception of this process is that banks have become more globalized, as witnessed by their ever-expanding operations in foreign jurisdictions. A simple question emerges: Does greater internationalization lead to better performance for Canadian banks?

Sullivan's (1994) seminal study offers a simple framework in which to measure the link between the degree of a bank's internationalization and its performance. His study is based on the premise that, as firms increase their share of operations abroad, and thus their degree of internationalization (DOI), they also experience higher levels of performance. DOI can be measured as the share of total sales, assets, income, or employees located outside a company's home country.[1] Performance can be measured as Tobin's Q, return on investment, return on equity, or profitability.

Objectives

This study has two objectives. First, we argue that the framework suggested by Sullivan must be implemented carefully. Its methodology implicitly assumes that internationalization is the "cause" of the observed value of firm performance—that is, increasing DOI has a direct impact on firm performance. Although it is partly true that causality may move from DOI to performance, this assumption ignores a very important aspect of international business theory: that firms go abroad to exploit firm-specific advantages. That is, firms develop techniques and products that give them some competitive advantage, which then allows the innovating firm to perform well in the domestic market. These firms then move abroad through foreign direct investment (and other methods) to exploit these firm-specific advantages. Since the firms that are doing well domestically are the most likely to move abroad, we expect superior performance before the move is made. Not explicitly accounting for this initial success may result in attributing too much significance to DOI.

The second objective is to formally account for risk in the analysis. Studies that use DOI as a predictor of firm performance implicitly assume that an increase in performance is a good thing for firms. Although this may seem obvious, the risk associated with the firms' foreign operations and how they compare with their domestic operations must also be taken into account. If the movement abroad increases the risk profile of a particular firm's operations, then an increase in performance is the minimum that would be expected by shareholders. The relevant question would relate to whether the increase in performance is sufficient to compensate shareholders for the increased risk. This study addresses that question directly.

Data and Methodology

Using quarterly data on the foreign-asset exposure of Canadian banks over the period 1994 to 2003, we test the link between performance and DOI, focusing on domestic banks operating in Canada, six of which have a significant DOI. The data on foreign-claims exposure are taken from the consolidated quarterly report on banking statistics collected by the Bank of Canada. Every bank operating in Canada provides quarterly statistics of the total asset exposure to each foreign jurisdiction in which it operates, on a fully consolidated basis. This covers all claims,

1. See Contractor, Kundu, and Hsu (2003) for an excellent survey of the DOI literature.

including deposits to other financial institutions; loans to financial institutions and firms; and securities, both government and corporate, made outside and inside Canada. These foreign claims of domestic Canadian banks are adjusted to account for exchange rate revaluation. The data cover the exposures of all Canadian banks to over 150 jurisdictions between 1994 and 2003. Additional bank balance-sheet data are also used, including assets, market capitalization, and other bank-specific characteristics.

We use a rigorous statistical methodology to test whether it is firms that are doing well that increase their DOI, or whether it is the DOI itself that improves their performance.[2]

We also examine whether just the degree of international operations is needed to test the relationship between DOI and performance, or if a breakdown of the level of risk involved is also required. We do this by breaking down the foreign investments; first, by country and, second, by the type of claim. We are thus able to compare the effect on performance of holding the least risky types of foreign claims, such as U.S. government securities, with that of holding the most risky, such as loans to businesses in developing countries. The ability to distinguish between the types of foreign-asset claims is very important, since it introduces one of the most basic principles of finance: that the higher the risk associated with an investment project, the higher should be its expected return. Tests of the relationship between DOI and performance that do not address this issue are averaging these two effects.

Results and Implications

The analysis suggests that there is a significant (but weak) positive relationship between DOI and performance, thus confirming one of the main theoretical predictions of international business. But the composition of foreign claims, in terms of risk, is important. Banks that take on more risk (i.e., more loans rather than greater claims in the form of securities) often have higher returns.

The implications for bank managers and their boards are clear. If internationalization is believed to somehow improve firm performance, then corporate strategists may be led to believe that expanding abroad will cause improvements in firm value. Moreover, to the extent that firm values are high to begin with, because of firm-specific advantages, then corporate strategists will realize that internationalization is a reflection of underlying firm-specific advantages and, hence, of high market values. The results of this study suggest that if firms decide to move abroad to improve performance, and if this decision is based only on the positive relationship between DOI and performance, then such a strategy may not result in improved performance.

This is because the impact on firm performance must take into account the risk profile of the companies' operations. If the expansion of multinational activities does not result in greater risk in the firm's operations, then a positive impact of DOI on performance can be interpreted as a good result. On the other hand, if the movement abroad also increases the risk exposure of the firm, then the increase in performance must be sufficient to compensate for the greater risk.

The implication for regulators is that not only is the degree of internationalization an important determinant of bank performance but so is its composition. Regulators must therefore consider the potential impact of banks' decisions to allocate their portfolios between domestic and foreign claims. This will assist regulators in ensuring safe and efficient financial markets.

2. Two approaches are taken. First, we attempt to control for bank characteristics that may be correlated to the level of DOI and performance; second, we implement generalized method of moments (Arellano and Bond 1991) estimation to control for the endogeneity of the relationship between DOI and performance.

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Bank Failures and Bank Fundamentals: A Comparative Analysis for Latin America and East Asia during the 1990s

Marco Arena

During the 1990s, countries in East Asia and Latin America experienced acute systemic banking crises that compromised a substantial share of their banking sectors, requiring government intervention at considerable cost.[1] These episodes have renewed interest in academic and policy circles about the contribution of individual bank weaknesses to bank failures during systemic banking crises. This issue is particularly relevant for industrialized countries like Canada, given the exposure of their banking sectors to foreign assets in emerging markets (EMs). Specifically, the overall EM portfolio of banks in industrialized countries could be affected if problems in the banking sector of one country spread to others because of contagion.

To date, the empirical literature on bank failures in EMs has focused mainly on the characteristics of failed banks relative to non-failed banks. However, no systematic cross-country empirical evidence is available to assess whether it was mainly the weakest banks (defined in terms of their fundamentals related to solvency and liquidity) that failed during the crises. In this context, the purpose of this study is to examine the episodes of systemic banking crisis during the 1990s in Latin America (Argentina, 1995; Mexico, 1994; and Venezuela, 1994) and East Asia (Indonesia, Korea, Malaysia, the Philippines, and Thailand in 1997), using bank-level data to answer the following questions: (i) To what extent did the financial conditions of individual banks explain bank failures? (ii) Did only the weakest banks, in terms of their fundamentals, fail in the crisis countries?

1. Examples include recapitalization and restructuring costs (Caprio and Klingebiel 2003).

Methodology

First, the individual probabilities of bank failure are estimated as a function of bank-level fundamentals related to solvency, liquidity, profitability, and asset quality. This is done by using cross-sectional multivariate logit models to evaluate whether bank-level heterogeneity is important in explaining cross-country bank failures (i.e., if crisis countries had weaker banks ex ante than non-crisis countries, rather than just having worse shocks ex post). Second, based on the estimated individual probabilities of bank failure (propensity scores), the distribution for failed and non-failed banks in the crisis countries is analyzed by evaluating the degree of overlap between the distribution of both groups to assess whether it was mainly the weakest banks that failed in the crisis countries. In addition, the average of the propensity scores for failed and non-failed banks is computed to determine the relative contribution of only bank-level fundamentals to the likelihood of failure.

Results

The results for East Asia and Latin America show that bank-level fundamentals not only significantly affect the likelihood of a bank failure, but also account for a significant proportion of failed banks (between 50 and 60 per cent). The results thus support the view that failed banks in the systemic banking crises in EMs during the 1990s suffered from fundamental weaknesses in their asset quality, liquidity, and capital structures before the onset of the crisis. However, bank-level fundamentals are not enough to explain cross-country differences in crisis outcomes.

Regional differences appear when the distribution of the estimated probabilities of failure is analyzed. The results for East Asia show little

overlap in the distribution of propensity scores between failed and non-failed institutions in the crisis countries. This suggests that systemic shocks—macroeconomic and liquidity shocks—destabilized banks whose fundamentals were the weakest before the shock. However, the results for Latin America show a considerable overlap in the distribution of propensity scores between failed and non-failed banks in the crisis countries. This would suggest that a fraction of banks that were relatively non-weak before the onset of the crisis may have been forced to fail in the context of unexpected aggregate shocks to the system. An analysis of the banks' survival time that takes into account the effect of banking-system and macroeconomic variables over the crisis period shows that the failure threshold of this group of ex ante relatively non-weak banks was shifting during the crisis period. This explains the quality difference between failed and non-failed banks in Latin America.

These results suggest areas for further research on the issue of regional asymmetries in the degree of the banking sector's resilience to systemic shocks that are associated with either macroeconomic or liquidity shocks or both. Such research should assess whether the banking sector in Latin America is less able to withstand or absorb unexpected systemic shocks than the banking sector in East Asia. Using banking-system and macroeconomic variables, Kaminsky and Reinhart (1998) find that East Asia and Latin America have different regional patterns for systemic banking crises, with those in Latin America being more volatile and severe than those in East Asia.

Policy Implications

These results suggest that the supervision of financial systems in EMs could be strengthened by putting emphasis on the traditional financial ratios associated with the CAMEL rating system,[2] at least as near-term indicators of bank vulnerabilities. The latter does not preclude the use of market-based indicators (e.g., deposit interest rates and interest rate spreads) to identify bank vulnerabilities, as part of an early warning system.

Banking regulation and supervision should also take into account the influence of macroeconomic developments on individual banks (i.e., assess the financial institution's exposure to systemic shocks) in order to make the banking (financial) system more robust to such shocks. For this purpose, it will not only be necessary to continue conducting macro-prudential analysis related to banking supervision and to the Financial System Assessment Programs (FSAPs), but also to reform the regulatory framework, ensuring that bank exposures to macroeconomic sources of risk are properly accounted for. This would include, for example, the exposure of banks to foreign currencies and their loan concentration to a particular economic sector (e.g., real estate).

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2. CAMEL stands for Capital, Asset quality, Management, Earnings, and Liquidity.