



Research

Summaries

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), linkages between the Canadian financial system and the rest of the economy, and linkages to the international environment, including the international financial system. This section summarizes some of the Bank's recent work.

In "Endogenous Market Incompleteness with Investment Risks," Césaire Meh and Vincenzo Quadrini use models of theoretical economies to study the macroeconomic and welfare implications of institutional reforms that make available financial contracts which provide the best insurance possible against idiosyncratic investment risks. Indeed, investment activities are subject to important uninsurable idiosyncratic risks, which are pervasive in the macroeconomy. The results confirm that the presence of these types of risks may lead to an under-accumulation of capital relative to that in an economy where such idiosyncratic risks can be fully insured. These findings imply that institutional reforms in Canada that make the use of state-contingent contracts (with payoffs conditional on the state of the world) more enforceable can have important positive consequences for the overall welfare of Canadians. This paper thus supports the Bank's efforts to promote the efficiency of the Canadian financial system.

In many countries, including Canada, multiple regulatory agencies oversee the activities of deposit-taking institutions. Multiple agencies are by no means the rule, however, and many countries have chosen to consolidate their bank regulatory regime. In "An Analysis of Bank Closure Policy under Alternative Regulatory

Structures," Greg Caldwell develops a theoretical model of banking under alternative regulatory regimes. The aim of the paper is to determine which delegation of responsibilities between supervisory authorities facilitates an efficient allocation of credit and proper risk management among banks. The author shows that although regulatory structure is important, effectiveness requires the presence of market discipline.

Over the last few years, the U.S. ability to finance its current account deficit has been facilitated by massive purchases of U.S. Treasury Bonds and agency securities by Asian central banks. In this process, Asian central banks have accumulated large stockpiles of U.S.-dollar foreign exchange reserves. In determining the optimal level of reserves, the monetary authority will seek to balance the macroeconomic adjustment costs incurred if reserves are exhausted with the opportunity cost of holding the reserves. In "An Empirical Analysis of Foreign Exchange Reserves in Emerging Asia," Marc-André Gosselin and Nicolas Parent assess a panel of eight Asian emerging-market economies to see how much their current level of reserves differs from that predicted by the standard macroeconomic determinants. The authors use an econometric technique that formally addresses the weaknesses in prior studies on this topic. They observe that their model cannot explain the very strong pace of reserve accumulation in these countries over the last two years. The authors conclude that a slowdown in the pace of reserve accumulation is therefore likely, implying negative risks for the U.S. dollar. However, the substantial capital losses that Asian central banks would incur if they were to drastically change their holding policy mitigate the risks of a rapid depreciation of the U.S. dollar triggered by such a move.

Endogenous Market Incompleteness with Investment Risks

Césaire Meh (Bank of Canada) and Vincenzo Quadrini (University of Southern California)*

In their review of the literature on financial structure and growth published in the first issue of the *Financial System Review*, Dolar and Meh (2002) argue that the legal system, the enforceability of financial contracts, a transparent accounting system, and transparent corporate governance all have a positive impact on macroeconomic performance. Consequently, policy-makers should pursue institutional reforms that deliver growth-enhancing financial services, such as those that lead to better sharing of the idiosyncratic (individual-specific) risks associated with investment activities.

Indeed, investment activities are subject to important, uninsurable idiosyncratic risks, and these risks are pervasive in the macroeconomies of both developing and developed countries. In the United States for instance, entrepreneurs and private investors face highly variable returns (Moskowitz and Vissing-Jørgensen 2002). Moreover, the incomes of entrepreneurs are two to four times more volatile than those of non-entrepreneurs. The survival rate of private firms is only 39 per cent over the first five years, and returns on investment vary widely among surviving firms.

These large idiosyncratic risks are likely to have important consequences for macroeconomic performance and welfare, since privately held companies account for about half of production, employment, and corporate equity, in addition to representing more than half the financial wealth of rich households.

Objective

Meh and Quadrini (2005) examine the macroeconomic and welfare implications of institutional reforms that produce financial

contracts which provide the best possible insurance against idiosyncratic investment risks. More specifically, the authors seek to determine the effect of such institutional reforms on aggregate capital accumulation and welfare.¹

Methodology

To address this objective, general-equilibrium models of three economies are considered²: (i) the complete markets economy, (ii) the optimal contract economy, and (iii) the debt contract economy. In the first two, agents can sign optimal state-contingent contracts; i.e., contracts where the payoffs are conditional on the state of the world—defined according to whether the entrepreneur's investment fails or succeeds (idiosyncratic investment risks). These risks are independently distributed across entrepreneurs. When the project fails, the entrepreneur receives an insurance payment, and when it is successful, the entrepreneur makes a payment to the financial intermediary. By pooling a large number of entrepreneurs, the financial intermediary is able to provide insurance against idiosyncratic investment risks. The provision of full or partial insurance by state-contingent contracts, however, depends on whether there is complete or incomplete information.

In the *complete markets economy*, information is complete, and all actions of the entrepreneurs are observable. Therefore, full insurance against idiosyncratic investment risks is possible. This is the benchmark economy with which the others are compared.

In the *optimal contract economy*, information is incomplete (asymmetric information), and the

* This report draws on a forthcoming journal article (Meh and Quadrini 2005).

1. For further details, see Meh and Quadrini (2005).
2. These general-equilibrium models are theoretical, not empirical, models.

entrepreneur's actions are not publicly observed. As a result, there is a moral-hazard problem in the sense that the entrepreneur has an incentive to invest in riskier projects when insurance is available. Because of this moral-hazard problem, the financial intermediary will structure the contract such that the entrepreneur has an incentive not to undertake projects that are too risky (i.e., the contract is incentive-compatible). Thus, the optimal state-contingent contract provides less than full insurance to the entrepreneur. Examples of such contracts are: options; credit derivatives, such as credit default swaps; and equity contracts.³ Another practical example of a state-contingent contract is one that would share the funding of pension deficits between workers and the firm when a firm encounters financial difficulty.

Unlike the first two economies, the *debt contract economy* does not feature any state-contingent contracts. As a result, agents can sign only non-contingent contracts, where the borrower makes a pre-arranged payment regardless of the success or failure of the investment (that is, regardless of the investment risk).

Results

By comparing these three theoretical model economies, we show that:

(i) In the two model economies with incomplete markets (the debt contract economy and the optimal contract economy) the steady-state equilibrium, risk-free interest rate is lower than that in the complete markets economy. However, the aggregate stock of capital is lower than in the complete markets economy; i.e., there is under-accumulation of capital.

(ii) Even with very large moral-hazard problems, the availability of optimal state-contingent contracts brings the aggregate stock of capital and the equilibrium riskless interest rate very close to the corresponding levels in the complete markets economy. As a result, the availability of optimal state-contingent contracts increases welfare significantly. More specifically, the average welfare gains from the debt contract economy to the optimal contract

economy are more than 2 per cent of aggregate consumption.

The intuition behind the under-accumulation of capital results from the fact that the accumulation of capital is risky, and agents require a risk premium when markets are incomplete. The availability of optimal state-contingent contracts allows better insurance against investment risks and, as a result, the risk premium decreases and the demand for capital increases. Consequently, the use of state-contingent contracts can lead to an aggregate stock of capital that is very close to that in complete markets and substantially higher than the stock of capital that would prevail when only non-contingent debt contracts are feasible. The provision of better risk sharing, coupled with the resulting increase in aggregate capital, leads to a significant increase in welfare.

Discussion

This result illustrates the importance of factors that make state-contingent contracts feasible. Among these factors, formal and informal institutions play a central role. State-contingent contracts may not be extensively used in practice because enforcement may be highly inefficient and costly. For instance, the resolution of contractual disputes might be extremely long and uncertain. Substantial cross-country evidence indicates that the degree of contract enforcement is correlated with the degree of financial development.⁴ In this study, the economy with state-contingent contracts can be interpreted as an economy in which financial markets are more developed, partly because of more efficient institutional enforcement. Thus, we argue that institutional reforms—for example, well-developed legal systems—that lead to greater contract enforceability can importantly improve welfare. Future research should establish which types of institutions facilitate or make possible the use of these contracts.

Policy Implication

Legal and regulatory policy should endeavour to create an environment where a wider variety of enforceable state-contingent contracts become available. This is one way that the Bank of

3. *The Economist* (2005) provides further examples of credit derivatives (contracts that, for a fee, allow lenders to transfer to another party the risk that a firm will default) to share the risk in business activity.

4. See Levine (1997) and Dolar and Meh (2002) for reviews of the empirical literature.

Canada can direct its efforts (through its advisory role) to promote the efficiency of the Canadian financial system (Dodge 2005).

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An Analysis of Bank Closure Policy under Alternative Regulatory Structures

*Greg Caldwell**

Many countries have multiple regulatory agencies that oversee the activities of deposit-taking institutions (DTI). In Canada, for example, the Office of the Superintendent of Financial Institutions (OSFI) is responsible for prudential supervision, while the Canadian Deposit Insurance Corporation (CDIC) is responsible for managing the deposit insurance fund and for the resolution decision for a failed DTI. Multiple agencies are by no means the rule, however, and numerous countries have chosen to consolidate their bank regulatory regime. This raises the question of what trade-offs there might be from maintaining separate agencies versus amalgamation.

This study develops a theoretical model of banking under alternative regulatory regimes. These regimes are defined by their organizational structure, as well as by the closure and resolution policy. Closure policy is a set of rules that describe the conditions under which a regulator or supervisor will intervene in the operations of a bank. Resolution policy describes the way in which a bank will be wound up in the event that it is closed. Various resolution options are described below.

The study's purpose is to determine which delegation of responsibilities between supervisory authorities facilitates an efficient allocation of credit and proper risk management among banks. The effect of separating the closure and resolution decisions between two agencies (a dual regime) instead of keeping both decisions within a single institution (a meta-regulatory regime) is analyzed.

The study incorporates two standard features of banking models: moral hazard and market

discipline. Moral hazard exists because the owners of a bank can be tempted to choose an excessively risky loan portfolio. When the majority of its creditors (i.e., depositors) are insured by a third party (the deposit insurer), then the bank bears little of the downside risk associated with its lending choice and has an incentive to take such risks. If its loans perform badly, the owners of the bank have the option to exit, leaving the deposit insurer to bear the residual costs of the bank's failure.

A supervisor can mitigate these incentives by establishing capital requirements for banks. Binding capital requirements provide the bank with an incentive to more efficiently manage the risk inherent in its assets. In this case, if the loans perform poorly, the owners' capital will be exhausted first, before the deposit insurer incurs any losses. This study finds that higher capital requirements do, indeed, reduce risk shifting. However, the cost of increasing capital requirements is reduced intermediation. Namely, some welfare-enhancing projects will be abandoned by banks that are not willing to set aside the requisite amount of capital.

Market discipline, the second feature modelled in this study, is represented by the amount of uninsured deposits that a bank accepts relative to the amount of its insured deposits. Uninsured depositors bear some of the risk in a bank's lending decision, while insured depositors do not. Consequently, uninsured depositors will demand greater compensation for that risk. Since this increases the bank's cost of funding, it may reduce its incentives towards excessive risk taking.

Combinations of market discipline and capital regulation are interwoven in the various regulatory regimes. This research shows that although regulatory structure is important, effectiveness requires the presence of market discipline.

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

Closure and Resolution Policy

Regardless of the regulatory regime, regulators are modelled in this study as having to choose conditions under which a bank will be closed. The same factors that determine insolvency in a commercial enterprise affect the decision to shut down a bank. But concerns about financial stability, together with the perceived “specialness” of the banking sector further complicate the policy for closing a bank. More recently, a trend in developed countries has been towards early-intervention policies, whereby the bank is shut down by supervisory authorities well before it becomes insolvent.¹ This trend reflects several factors, including historical experience with forbearance, by regulators; excessive gambling by banks that were, in fact, insolvent; and a recognition that accounting measures of bank capital, based on historical costs, may be inaccurate and potentially misleading.

Once a bank is closed, the model enables the regime to choose between two resolution options: *liquidation*, whereby the bank's assets are sold off and funds are retrieved by creditors based on a predetermined ordering; or *purchase and assumption*, where the bank is recapitalized by authorities and then merged with a healthy bank. With the second option, there is a multitude of possible acquirers, but this is left unmodelled.²

Either resolution option has its trade-offs. If a closed bank is liquidated, there is an assumed recovery cost. This could be explained by asymmetric information problems with bank loans. In particular, the purchaser of the failed bank's loans does not know the quality of the borrowers as well as the originating bank. Consequently, liquidation can be costly since assets are sold off. If, instead, the bank is merged with another, there is less need to sell off the entire portfolio of assets. Creditors tend to receive more favourable payoffs under mergers.

1. In an early-intervention regime, a bank is closed if its capital falls below a predetermined threshold or if the supervisor judges that insolvency is a material risk. For a discussion of the evolution of the safety net in Canada including the early-intervention framework, see Engert (2005).
2. The bank could remain separate but with new management; another private bank could acquire it; or it could be nationalized. Each of these options share some notion of recapitalization.

These arguments suggest that merging a failed bank after closure is efficient. But this does not necessarily imply that a merger policy is optimal. If a bank's creditors do not believe that it will be liquidated, if closed, they will not demand as much compensation for risks incurred by the bank. Consequently, the incentives for the bank to take risks are heightened by the implicit guarantee associated with a resolution policy of mergers. This leads to increased risk, since the lending decisions of the banks will not be as prudent as they would if banks faced a greater likelihood of liquidation after closure.

Choice of Regulatory Regime

Given the choices involved in closure and resolution, what is the socially optimal regulatory regime for the various agencies that make these decisions? The academic literature provides some guidance about when to close a bank (Acharya and Dreyfus 1989) and whether a central bank or supervisor should have this responsibility (Repullo 2000; Kahn and Santos 2001). There is little guidance about the optimal resolution regime, however. On the policy side, Garcia (1999) discusses issues concerning coordination between supervisors, central banks, and deposit-insurance agencies. He concludes that there is considerable heterogeneity in regime choice across countries.

This study endogenizes the choice between two regimes: a dual regime and a meta-regulatory regime. In a dual regulatory environment there is a separation of responsibilities between the supervisor and the deposit insurer. The former is responsible for establishing minimum capital requirements and thresholds for intervention (i.e., closure). The latter is responsible for the resolution decision. In a meta-regulatory regime, all these responsibilities lie with a single supervisory agency.

Although regime is important, the objective or mandates of the decision makers also affect the eventual outcome. This study assumes that the supervisor is concerned with choosing the regulatory regime that maximizes the expected overall wealth of all participants. Better regimes have better possibilities for expected wealth, since banks are given incentives to take on efficient levels of risk. Namely, the private gains of bank intermediation are aligned with the public benefits.

Conversely, the deposit insurer's objective is to protect insured depositors but also to resolve closed banks in a manner that is the least costly to the agency. The result of these separate mandates is that when a deposit insurer must determine the resolution decision, it tends to lean more towards liquidation than a bank supervisor would. This tendency reflects the deposit insurer's narrower mandate for protecting insured depositors and itself from losses.

Conclusion

This study found that regimes that separate the supervisor from the deposit insurer always perform at least as well as the amalgamated meta-regulatory regime. The meta-regulator's objectives increase its proclivity towards the choice of merger for a failed bank. This weakens the incentives of uninsured creditors to discipline the bank's risk taking. The consequence is a greater likelihood of bank failure, unless the meta-regulator imposes stronger capital requirements.

The least costly resolution (the resolution objective of an independent deposit insurer) might not be as efficient a choice in a world where a bank has actually failed; however, this study found it to be more efficient prior to indications of a bank failure, since it mitigated excessive risk taking by banks. A further benefit is that the supervisor need not impose strong capital requirements to get the most efficient level of risk taking and credit allocation.

The dominance of the dual regulatory regime over meta-regulation was found to rest on the exercise of market discipline. If the proportion of uninsured to insured deposits reached a critical mass, then the dual regulatory regime outperformed the meta-regulator. Until this threshold was achieved, the greater threat of liquidation under a dual regulatory regime failed to have any impact on the incentives for risk taking by banks.

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An Empirical Analysis of Foreign Exchange Reserves in Emerging Asia

Marc-André Gosselin and Nicolas Parent

Over the last few years, the U.S. ability to finance its current account deficit has been facilitated by massive purchases of U.S. Treasury Bonds and agency securities by Asian central banks. As a result, Asian central banks have accumulated large stockpiles of U.S.-dollar foreign exchange reserves.

In theory, a country holds reserves as a buffer stock to smooth unexpected and temporary imbalances in international payments. In determining the optimal level of reserves, the monetary authority will seek to balance the costs of macroeconomic adjustment incurred if reserves are exhausted with the cost of holding reserves. Reserve hoarding entails sterilization costs stemming from the negative spread between the interest earned on reserves and the interest paid on the country's public debt. Moreover, if capital flows are not sterilized, sustained accumulation of reserves will, at some point, generate inflationary pressures that could threaten domestic financial stability. If Asian central banks decide to stop accumulating U.S.-dollar reserves, they could trigger an abrupt depreciation of the U.S. dollar. Given the potential impact on global interest rates, economic growth, and financial stability, the issue of Asian reserve accumulation is of considerable importance.

Our objective is to assess the degree to which the current level of foreign exchange reserves held by Asian central banks diverges from that predicted by the standard macroeconomic determinants.¹ To do so, we estimate a long-run demand function for reserves in a panel of eight Asian economies: China, India, Indonesia,

South Korea, Malaysia, the Philippines, Singapore, and Thailand.

The International Monetary Fund (IMF 2003) uses a simple empirical model based on various determinants of reserve holdings to study a panel of 122 newly industrialized emerging-market countries. Predicted values from the Fund's model indicate that the acceleration in reserve accumulation in emerging Asia in 2002 was well in excess of expectations based on fundamentals.

The IMF study suffers from a number of shortcomings in our view. First, although the time series used are clearly not stationary, statistical inference is based on the assumption that the data are stationary.² Second, although there is evidence that Asian countries have increased their level of reserves for self-insurance purposes in the aftermath of the Asian financial crisis (Mendoza 2004; Aizenman, Lee, and Rhee 2004; Aizenman and Lee 2005), the IMF model does not allow for a structural break in the estimated demand for reserves. By using the panel cointegration tests of Pedroni (1999) as the basis for the specification and estimation of our long-run demand function for reserves and by allowing for structural breaks, we formally address these issues.

Results

Using data from 1980 to 2003, we find that the level of reserve holdings is a function of GDP, the ratio of imports to GDP, the ratio of broad money to GDP, the volatility of export receipts, as well as a break in the coefficient of imports to GDP, and a break in the coefficient of broad

1. In the literature, reserves are modelled as a function of economic size, current account vulnerability, capital account vulnerability, exchange rate flexibility, and opportunity cost.

2. It is well known in time-series econometrics that t-statistics of spurious regressions are invalid. Statistical inference in the existing literature on foreign exchange reserves ignores this fact.

money to GDP in the post-crisis period. By accounting for a positive structural break in the demand for international reserves by Asian central banks in the aftermath of the financial crisis of 1997–98, our model allows for a higher level of long-run reserves in the post-crisis period. While the Fund concludes that reserves in emerging Asia were in excess of their long-run level by US\$73 billion in 2002, we find that reserves were essentially in line with their determinants that year. Nevertheless, our model cannot explain the large accumulation of international reserves by these countries in 2003 and 2004.

Reserve holdings in emerging Asia as a whole were above the level predicted by their determinants by US\$52 billion in 2003 and by US\$112 billion in 2004. China accounts for most of the increase in the reserves gap from 2003 to 2004. Furthermore, the error-correction equation associated with this cointegrating vector reveals that the reserves gap closes at an average rate of 56 per cent per year over the sample. These results suggest that, everything else remaining the same, a slowdown in the speed of accumulation of reserves is likely.

Implications for the U.S. Dollar

Our findings imply potential downward pressures on the U.S. dollar. But although the error-correction model suggests that adjustment could be relatively quick, changes in holding policies might actually be very gradual in the current context. Indeed, the amount of reserve assets held by Asian central banks is so large that any change in holding policies could have a substantial impact on the U.S. dollar and, consequently, on the balance sheets of Asian central banks. To avoid large capital losses, Asian central banks will be very cautious when slowing the rate of reserve accumulation. The recent announcement by the Bank of China to peg its currency against a basket of currencies reflects this cautious approach. As a result, the chance of a rapid depreciation of the U.S. dollar triggered by Asian central banks is not very high.

The currency composition of reserve stocks may pose an additional risk for the U.S. dollar. Diversifying away from the dollar would reduce capital losses in the event of a reduction in reserve holdings (autonomous or coming from

a currency revaluation). But the currency composition of reserves in developing countries is remarkably stable over time. It is determined by factors that display substantial inertia, such as the choice of currency peg, the identity of the dominant trade partner, and the composition of foreign debt (Eichengreen and Mathieson 2000). A radical currency reallocation of reserves is thereby not very likely to happen within a short time. Hence, although the outlook for the U.S. dollar may not be favourable from the perspective of the currency composition of reserves, risks of an abrupt depreciation in the U.S. dollar coming from this source remain limited.

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