Research Summaries

Introduction

Bank of Canada staff undertake research designed to improve the 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.

This issue of the *Financial System Review* highlights research that addresses the changing structure of the Canadian financial services industry, as well as aspects of the structure and functioning of the Canadian foreign exchange market. Linkages are also emphasized. These include the relationship between the structure of the financial system and economic growth and the links between the banking systems of different countries when a serious disturbance arises in one of them.

Innovation and change in the provision of financial services has been a hallmark of the industry for many years. *The Financial Services Sector: An Update on Recent Developments* reviews developments in the Canadian financial services sector. With a number of forces continuing to spur rapid innovation, the pace of change has, if anything, accelerated. Within this context, Canadian financial service providers are examining the profitability of individual business lines more closely and developing new ways to deliver financial products.

The Canadian foreign exchange market involves a number of financial institutions and participants, together with large trading flows. In *Canadian Foreign Exchange Market Liquidity and Exchange Rate Dynamics*, a market-microstructure approach is used to examine how market participants use certain types of information and, in turn, how this affects the exchange rate and the underlying liquidity in the foreign exchange market. This approach can also be used to study the effect of the risk-management practices of banks on market liquidity.

It is readily accepted that a well-functioning financial system is an important contributor to an environment of sustained economic growth, but there is less agreement on which specific structure of the financial system contributes to growth most strongly. In *Financial Structure and Economic Growth: A Non-Technical Survey*, the authors identify the two main types of financial structure and discuss whether one of them is more beneficial to long-run growth than the other. They conclude that different structures can, in fact, be complementary, and that it is the overall level and quality of financial services that is most important. To enhance the latter, policy-makers should focus on pursuing supportive legal, regulatory, and other policy reforms.

Fortunately, serious disturbances in the Canadian banking system are rare. Nevertheless, from a global perspective, post-war history has produced a number of banking crises in both the industrialized and emerging economies. When problems arise in the banking sector of one country, how are the banking systems of other countries affected? *Banking Crises and Contagion: Empirical Evidence* examines this issue based on an empirical model of contagion and finds that contagion is more likely to occur between two countries if they share similar macroeconomic characteristics. It is important that policy-makers understand how information from the occurrence of a banking crisis affects the behaviour of market participants.

The Financial Services Sector: An Update on Recent Developments

Charles Freedman and Clyde Goodlet

An updated review of the Canadian financial industry shows that it continues to experience significant changes.[1] In an earlier Bank of Canada technical report, the driving forces behind the developments that had been taking place over the previous decade or so were examined, and some of the challenges that these forces would pose for financial service providers (FSPs) were indicated. The key factors identified were technological change, the changing nature of competition in the financial services sector, and changes in household demographics. The challenges facing the financial services industry were discussed under two main headings—the importance of size and the choice of the range of services and products that an FSP would provide.

This update builds on the previous work and, in particular, highlights the role of economies of scale and scope,[2] mergers and concentration, the strategies being followed by FSPs, and the role of changes in information technology on service delivery. Developments in these areas continue to pose significant challenges for FSPs as they attempt to develop strategies to maintain their profitability and long-run viability. While change in the financial sector is not new, the current period is noteworthy because of the pace and the scope of change, which appear to be greater than ever.

Canadian financial service providers continue to search for ways to operate at an efficient scale in their back-office activities. They are following three different strategies to achieve this scale: (i) creating or building it; (ii) buying it; or (iii) borrowing it. Because of technological change, the optimum scale of activities in many back-office operations has increased. As a result, some FSPs are trying to gain the largest market share in Canada in particular activities (for example, transactions processing). Other FSPs are exiting these same areas, having decided that they will not be able to achieve a sufficient size of operations to be efficient. They are then purchasing these services from low-cost providers. Specific examples of back-office activities where technological change has significantly increased the scale at which FSPs must operate to be efficient include credit card processing and payment processing activities, such as debit card acceptance services.

With regard to involvement in existing and new financial instruments, FSPs continue to emphasize the need for each product or service to be profitable. Some FSPs have rigorously assessed the profitability of each business activity in an attempt to allocate balance sheet resources towards activities of high strategic value and sustainable profitability. A consequence of such assessments is that the FSP will exit areas that do not meet the test; for example, selling non-core subsidiaries or getting out of certain lending activities. This development has been facilitated and accompanied by an unbundling of activities. One example of unbundling is the further separation of loan-origination activities from the ongoing credit-risk exposure to the borrower, resulting from the development and spread of various credit-risk-transfer arrangements.

At the same time, some FSPs have announced strategies that involve the rebundling of products and services, particularly where economies of scope are significant. This can be seen in the areas of consumer lending and corporate lending. For example, some banks are linking their willingness to extend corporate loans to

1. This note summarizes the recently published Bank of Canada Technical Report No. 91, Freedman and Goodlet (2002), which updates Technical Report No. 82, published in 1998.
2. Economies of scale and scope refer to the possibility that a firm will realize a reduction in the cost of producing goods and services as a result of an increase in the size or breadth of its activities.

customers to the readiness of those customers to undertake their capital market business (such as underwriting) with the bank.

Electronic money, which was introduced a number of years ago with great fanfare, has been shown to be technically feasible but not economically viable at this time. The potential revenues from a fully functioning arrangement appear to be insufficient to offset the high costs of establishing a national infrastructure capable of supporting such a scheme. Expectations of a rapid deployment of electronic money schemes, either using stored-value cards or network money, have all but disappeared.

Mechanisms used to deliver financial services and products continue to evolve. A broader range of delivery channels has been developed, including expanded use of Automated Banking Machines, computer banking, and the use of the Internet, to handle routine, low-margin financial transactions. Nevertheless, branches continue to play a very central role in the plans of FSPs, but their nature is changing (a strategy characterized as "bricks and clicks"). Branch staff must now have different qualifications, be better trained, and have access to much better information technology. Branches are also being opened on the premises of non-financial companies. Some FSPs are placing increasing emphasis on the revenues to be earned from the distribution of financial services or products (their own and others) and from the development and operation of Web-based auction sites. But there continue to be significant barriers to the use of information technology by FSPs in the innovation of products and services and their delivery channels.

With regard to the size of institutions, it is important to distinguish between the business lines of FSPs and the size of a financial institution as a whole. The recent literature seems to suggest that economies of scale in a number of business lines extend further than previous empirical work had indicated. Evidence of this is seen in the growth of financial firms that specialize in a small number of product areas (the so-called "monolines"). These firms exploit scale economies in process-intensive or information-intensive areas such as credit card processing. The growing importance of outsourcing in certain areas is also in part a recognition that significant scale economies exist. The benefits from the overall size of a financial institution come from somewhat different sources, such as an increased possibility of economies of scope in institutions with multiple business lines and the ability to engage in activities that require more capital. In addition, diversification across business lines can lead to smoother revenue flows.

The prevalent view is that Canadian markets for financial services are too small for even the largest FSPs to operate in at an efficient scale in certain lines of business. Large Canadian FSPs believe that they must operate as North American entities. Indeed, there are a number of recent examples of Canadian FSPs implementing such a strategy. The key questions for these FSPs are the extent of the economies of scale in their various areas of specialization and, where the economies of scale are important, whether the FSPs can achieve the size necessary to realize them and to be competitive with the very large FSPs in the United States. Regulatory restrictions may limit the ability of FSPs to realize these economies. Finally, there continue to be questions regarding the importance of economies of scope or synergies. In the non-financial sector, there have been waves of conglomeration and divestiture as views about the benefits and costs of size change. It will be interesting to see whether the financial sector experiences a similar pattern.

References

Freedman, C. and C. Goodlet. 2002. *The Financial Services Sector: An Update on Recent Developments*. Bank of Canada Technical Report No. 91.

Canadian Foreign Exchange Market Liquidity and Exchange Rate Dynamics

Chris D'Souza

A liquid financial market is a market in which supply and demand can be matched at a low cost. It is important that there be ample liquidity in the Canadian foreign exchange market, since a poorly functioning foreign exchange market will create additional costs for companies engaged in international trade or investments, thereby adversely affecting the economy. One way to analyze liquidity in the foreign exchange market is through market-microstructure research, which focuses on market arrangements and practices.

The foreign exchange (FX) market in Canada consists of a network of financial institutions linked together by a high-speed communications system. The participants in the FX market include dealers, customers, and brokers. Dealers continuously supply bid and ask quotes to both customers and other dealers. Through the course of the day, they stand ready to buy and sell foreign exchange, thus providing liquidity to the market. Brokers in the FX market are those intermediaries who match the best buy and sell orders of dealers. Unlike dealers, who sometimes take speculative positions, brokers act as pure matchmakers. In Canada, most of the actual trading in the foreign exchange spot market is handled by the top Canadian banks through their foreign exchange operations. Customers in these markets are those financial and non-financial corporations that need foreign currencies for financing international trade, investing overseas, hedging cross-currency transactions, or pursuing short-term investment opportunities, and those corporations that have supplies of foreign exchange.

Dealers in the foreign exchange market distinguish between two types of trades: customer trades[1] and proprietary trades. For customers, the ability to complete trades quickly is important when adjusting their FX position. Dealers provide this fundamental element of liquidity to the market by trading with the customer. In providing these liquidity services, however, dealers may take on an undesired amount of exposure to foreign exchange risk. Proprietary trades are trades on a dealer's own account to adjust its own FX portfolio position. These trades are undertaken to help dealers manage their exposure to foreign exchange risk in a profitable fashion. Proprietary trades are typically undertaken on the basis of available information about likely changes in foreign exchange rates. To achieve their foreign exchange investment objectives, dealers must be assured that their information is at least as good as that of their trading counterparty, since trading against better-informed traders is a losing proposition.

One way that dealers gauge market information is to observe order flow. One measure of order flow is the aggregate value of buy orders relative to sell orders that have been completed or that are "queued up" for future trades. An excess quantity of net buy (sell) orders for the Canadian dollar suggests that other market participants have a positive (negative) impression about the future prospects of the Canadian dollar based on available information. Dealers acquire order-flow information from customer trades and through their communications with brokers. In this last case, they may have electronic access to broker "screens," which contain a part of the order flow.

Order flow is one key component of the market-microstructure approach,[2] and is found to explain a large proportion of the short-term (daily, weekly, or even quarterly) variation in nominal exchange rates. In contrast to traditional models of the exchange rate, which rely on factors such

1. Customers include the Bank of Canada, commercial client businesses, and non-dealer financial institutions. Canadian chartered banks also trade with each other as part of the interdealer market.

2. See O'Hara (1995) for a review of market-microstructure models.

as interest rates, money supply, rates of inflation, gross domestic product, the trade account balance, and commodity prices to explain exchange rate movements, order flow focuses on changes in the market expectations of changes in these factors. Therefore, it often performs more favourably than the individual factors themselves in empirical studies of short-term FX rate movements.

While recent market-microstructure studies of the FX market have had some preliminary success empirically in explaining exchange rate movements using order-flow information, the underlying determinants of order flow and the behaviour of the dealers who provide liquidity to this market have not been tested explicitly. According to the microstructure view, liquidity will be affected by the institutional features and information flows of the foreign exchange market. It is therefore of interest to examine whether access to private information via customer trades, and the management of their own FX positions affect a dealing bank's willingness to supply liquidity to the Canadian FX market.

Some researchers (e.g., Lyons 1997) have argued that customer trades are the catalyst for profitable dealer strategies. Our work suggests that dealers behave similarly in response to all types of trades, independent of where trades originate. This indicates that valuable private information about the fundamentals that may affect the value of the exchange rate is not obtained only from individual customer trades. Instead, it appears that dealers use private information about their inventories, which are affected partly by their own customer orders, as a profitable avenue for speculation in the interdealer market.

This has direct implications for liquidity in the FX market. Providing liquidity to customers allows dealers the opportunity to speculate in the interdealer market. The more profitable such speculative opportunities are, the more competitive dealers will become in attracting customer orders. Consequently, the spreads between their bid and ask quotes for customer trades will be smaller. Furthermore, our work suggests that liquidity in the Canadian FX market is not affected by the type of trading with the dealer, i.e., it occurs from both customer trades and trades in the interdealer market.

Daily hedging and risk-management practices of banks with dealing operations can also be examined. Information about each dealer's net trading position over the course of a day, in both spot and forward contract FX markets, suggests that financial institutions operating in the FX market behave in a similar way when managing their exposure to market risk. In particular, dealing banks do not fully hedge their spot market risk. The amount of hedging depends on market volatility, the magnitude of banks' risk exposure, and their comparative advantage in bearing risk, especially compared with their customers.

There are various sources of comparative advantage for dealing banks in bearing risk: First, reciprocal agreements between dealing banks guarantee that these market-makers have access to liquidity. Customers, however, do not have this same access. Second, banks allocate capital across business lines in order to diversify risk and return. This allows intermediaries to bear risk with a higher tolerance than the customers at non-financial institutions that may be specialized in relatively few business lines.[3] Hedging by dealers is found to depend on the overall risk-bearing capacity of dealers in the market and on each dealer's individual access to order flow. Analysis suggests that liquidity provision in spot and derivatives markets is determined interdependently, since prices in these markets are correlated, and dealers are able to hedge risk across markets.

Interpreting FX trading data through market-microstructure models helps characterize some of the factors that determine liquidity in the FX market. Results obtained to date suggest that dealers with greater opportunities for profitable speculation and a larger appetite for risk will provide greater liquidity to the market. More generally, a focus on the institutional features of the market that determine its dynamics is critical to understanding market liquidity. Policy-makers and researchers can use the tools developed in the field of market-microstructure finance to determine the effects of various factors on liquidity. These factors include the increased utilization of electronic brokering systems, a declining number of reciprocal agreements among dealing banks to provide liquidity, possible consolidation of dealing banks, and the greater participation of foreign dealers in the Canadian FX market.

3. D'Souza and Lai (2002) show that a decentralized capital-allocation function can reduce the overall risk of a financial institution with business lines that have correlated cash flows.

References

D'Souza, C. 2002a. "A Market Microstructure Analysis of Foreign Exchange Intervention in Canada." Bank of Canada Working Paper No. 2002-16.

———. 2002b. "How Do Canadian Banks That Deal in Foreign Exchange Hedge Their Exposure to Risk?" Bank of Canada Working Paper No. 2002-34.

D'Souza, C. and A. Lai. 2002. "The Effects of Bank Consolidation on Risk Capital Allocation and Market Liquidity." Bank of Canada Working Paper No. 2002-5.

Lyons, R. 1997. "A Simultaneous Trade Model of the Foreign Exchange Hot Potato." *Journal of International Economics* 42: 275–98.

O'Hara, M. 1995. *Market Microstructure Theory.* Cambridge, Mass.: Blackwell Business.

Financial Structure and Economic Growth: A Non-Technical Survey

Veronika Dolar and Césaire Meh

In any modern economy, a primary economic function of the financial system (financial markets, intermediaries such as commercial banks, and payments systems) is to transform household savings into productive investments. This function can be separated into three basic subfunctions: the mobilization of savings, the acquisition of information, and the management of risk. Financial markets (stock and bond markets) and intermediaries (which include banks, insurance companies, and mutual funds) are two alternative types of agents that perform more or less the same functions but in different ways and with different degrees of success. Financial systems that rely mainly on the former are deemed market-based, while those that rely mainly on the latter are called intermediary-based.

Many researchers have presented evidence from cross-country, industry-level, firm-level, and time-series studies to show that financial development exerts a positive impact on long-run economic growth. This raises an important question: Which specific types of financial systems are more growth-enhancing? There are four competing views of financial structure and its relationship to long-run economic growth:

- The *intermediary-based view* asserts that intermediary-based systems are more growth-promoting than market-based systems. This is mainly explained by the fact that close relationships between intermediaries and firms reduce information costs and ease financing constraints on firms, with positive ramifications for investment spending and economic growth.
- The *market-based view* argues that market-based systems encourage long-run economic growth better than intermediary-based systems. This view stems primarily from the fact that markets, by allowing people with similar views to join together to finance projects, are effective at financing new technologies which, in turn, boost economic growth.
- According to the *financial services view*, the issue is not intermediaries *versus* markets, but rather the creation of an environment for the optimal functioning of intermediaries *and* markets, or for the efficient provision of financial services generally, regardless of the mixture of intermediaries and markets. What matters for growth is the overall level and quality of financial services and not the distinction between markets and intermediaries.
- The *law and finance view*, a subset of the financial services view, also rejects the intermediary-versus-market-based distinction, but instead emphasizes that legal and regulatory systems play the key role in determining growth-fostering financial services. For example, a well-developed legal system that enforces property rights and contracts reduces the cost of external financing by lowering the costs of acquiring information about firms. This increases external financing and enhances economic growth.

According to the first two views, markets and intermediaries are *substitutes*, whereas the last two views stress the *complementarity* of markets and intermediaries in providing growth-promoting financial services.

Which of these competing views of the link between financial structure and growth are consistent with the data? Investigating the link between financial structure and long-run growth involves complex relationships, and it is therefore not surprising that there are no straightforward conclusions. A survey of the literature, however, suggests that there is more empirical support for the financial services and the law and finance views than for either the intermediary-

based view or the market-based view. The majority of empirical researchers on this topic argue that financial structure (the degree to which the financial system of a country is intermediary-based or market-based) is not important for explaining differential growth rates across economies. For example, countries do not grow faster, and firms' access to external financing is not systematically easier, in either system. This conclusion is in line with the broad empirical analysis of financial structure and economic growth by Demirgüç-Kunt and Levine (2001), who use the most complete existing data set and a variety of econometric methods and yet consistently find that financial structure is not important for economic development. They argue that "through a diverse set of analyses, the answers are surprisingly clear.... Overall financial development [efficient financial services, well-developed intermediaries and well-functioning markets] matters for economic success, but financial structure per se does not seem to matter much" (p. 12).

Another reason to view markets and intermediaries as complements is that intermediaries are key participants in markets, and they tend to play a supporting role in ensuring that financial markets function properly. Investors need considerable expertise to participate in financial markets, which makes their participation costly in terms of time and money. Financial intermediaries help to reduce these costs. More precisely, by bundling investors' funds together, the costs of participation in markets for each investor are smaller (*economies of scale*). That is, because of the economies of scale, there is a reduction in the cost per dollar of investment as the size of transactions increases. In facilitating participation in financial markets, financial intermediaries contribute substantially to the effective functioning of markets. The most obvious example of a financial intermediary that emerged because of economies of scale and that supports markets is the mutual fund. Because the mutual fund buys large blocks of stocks or bonds, it can take advantage of lower transactions costs. This argument is supported by Allen and Gale's (2001) survey of financial systems. They present evidence on the ownership of corporate equities in the U.S. economy. They find that in the year 2000, households held less than 40 per cent of corporate equities, while intermediaries, particularly pension funds and mutual funds, held over 40 per cent of total corporate equities. They conclude that "it is no longer possible to consider the role of financial markets and financial institutions (intermediaries) separately. Rather than intermediating *directly* between households and firms, financial institutions have increasingly come to intermediate between households and markets, on the one hand, and between firms and markets, on the other" (p. 1).

We argue that the relationship between financial structure and financial stability provides another reason for focusing on the need for both well-developed intermediaries *and* markets. In the event of a crisis in one system, the other system can perform the function of the "spare wheel." Greenspan (1999) advocates this view and argues persuasively that

> What we perceived in the United States in 1998 may reflect an important general principle: multiple alternatives to transform an economy's savings into capital investment act as backup facilities should the primary form of intermediation fail. In 1998 in the United States, banking replaced the capital markets. Far more often it has been the other way around, as it was most recently in the United States a decade ago. When American banks stopped lending in 1990, as a consequence of a collapse in the value of real estate collateral, the capital markets were able to substitute for the loss of bank financial intermediation. Interestingly, the then recently developed mortgage-backed securities market kept residential mortgage credit flowing, which in prior years would have contracted sharply. Arguably, without the capital market backing, the mild recession of 1991 could have been far more severe (p.1).

These arguments suggest that it is not a question of markets *versus* intermediaries but of markets *and* intermediaries.

This implies an important policy message. Policy-makers should focus their attention on legal, regulatory, and other policy reforms that encourage the effective functioning of both markets *and* intermediaries, rather than concerning themselves with the degree to which their national financial system is market-based or intermediary-based.

References

Allen, F. and D. Gale. 2001. "Comparative Financial Systems: A Survey." Manuscript, New York University.

Demirgüç-Kunt, A. and R. Levine. 2001. *Financial Structure and Economic Growth: A Cross-Country Comparison of Banks, Markets, and Development*. Cambridge, Mass.: MIT Press.

Dolar, V. and C. Meh. 2002. "Financial Structure and Economic Growth: A Non-Technical Survey." Bank of Canada Working Paper No. 2002-24.

Greenspan, A. 1999. "Do Efficient Financial Markets Mitigate Financial Crises?" Remarks before the 1999 Financial Market Conference of the Federal Reserve Bank of Atlanta. http://www.federalreserve.gov/boarddocs/speeches/1999/19991019.htm

Banking Crises and Contagion: Empirical Evidence

Eric Santor

Financial deregulation and the global integration of markets have heightened the awareness of the potential fragility of banking systems in the face of external crises. From a global perspective, banking crises are numerous: Glick and Hutchison (1999) document 90 crises since 1975 across a sample of 90 developing and developed countries.[1] High-profile events such as the U.S. Savings and Loan, Mexican, Scandinavian, East Asian, and Argentinian crises reinforce this perception. Unfortunately, despite considerable efforts to empirically model the nature of banking crises, current analyses do not provide uniform conclusions regarding the determinants of crises.[2] Likewise, little is known with respect to the presence and effect of contagion across banking systems.

This leaves several questions unanswered in the empirical literature:

- First, does the theoretical literature on banking crises and contagion provide suitable testable hypotheses with respect to the likelihood of a banking crisis when interbank markets exist, and can these hypotheses be empirically assessed?
- Second, given the limitations of the data, can the onset of a banking crisis be accurately predicted?
- And third, conditional on the ability to robustly predict banking crises, can the existence of contagion be assessed? Moreover, does the occurrence of a crisis in one market allow the prediction of crises in other markets, over and above the effects of macroeconomic interconnections?

With regard to the first of these questions, contagion can be defined in terms of "fundamental" and "informational" channels. Fundamentals-based contagion is used to describe shocks that affect markets because of common components, such as changes in U.S. interest rates, the price of oil, or the growth rate of the OECD countries (Dornbusch, Park, and Claessens 2000). These shocks lead to contagion because of the normal interdependence of banks and real-side markets. Information-based contagion occurs when the onset of a crisis in one market leads investors to re-assess the risks associated with investments in other markets, regardless of whether or not there are any real-side linkages between the respective markets. The subsequent impact on asset prices from changes in investor behaviour can negatively affect the balance sheets of banks and, ultimately, the stability of the banking system.

In both cases, there are several pathways by which these shocks can lead to banking crises within and across banking systems. It is therefore interesting to consider how contagion is modelled in the theoretical literature and whether the predictions can be empirically tested. For instance, Allen and Gale (2000) show that the likelihood and effect of contagion depends on the degree of interbank market completeness; i.e., the extent to which banks are interconnected with other banks. But the data required to assess their model simply do not exist. Alternatively, Chen (1999) shows that the failure of one bank can lead to the failure of other banks simply because of informational

1. Banking crises are defined when one or more of the following events occur: the ratio of non-performing loans to total assets is greater than 10 per cent, the cost of rescue operations is more than 2 per cent of GDP, and/or banks are nationalized, a bank holiday, or a guarantee of deposits, or loan losses and the erosion of bank capital exceed defined thresholds.
2. Given the current emphasis of the International Monetary Fund and central banks on constructing "stress indicators" and "early-warning systems" to quantify the potential risks in the financial system, it is important to be confident of the methods of empirical assessment used in these processes.

contagion. This suggests that crises can be propagated without any real-side links among banks. This notion of informational contagion can be empirically assessed.

With regard to the second question, the empirical literature on banking crises does not adequately address the issue of how to choose an appropriate sample of countries to test hypotheses. Most studies arbitrarily choose the sample of crisis and non-crisis countries, neglecting the potential impact of sample selection on the appropriate estimation procedure. It would be preferable to pay particular attention to the construction of the cross-country sample: matching-method techniques should be used to construct a suitable control group analogue to the set of crisis countries. This would allow the probability of the occurrence of a banking crisis and of banking-system contagion to be quantified more accurately. Sample selections in previous studies introduced bias into the estimates of the probability of the occurrence of a banking crisis, because of differences between the characteristics of the crisis and non-crisis country groups.

Finally, in terms of the third and final question, given a clearly defined empirical benchmark, an empirical model of contagion can be estimated. Following Ahluwalia (2000), it is possible to construct contagion indexes to capture the notion of "informational contagion," reflecting the extent to which a country shares macroeconomic characteristics with a country that previously experienced a banking crisis: the index takes positive values proportional to the degree of similarity. The contagion index does not require the respective countries to share any real-side links; rather, the empirical specification suggests that the information associated with the crisis leads to changes in investor behaviour that may affect banks' balance sheets. This allows a simple empirical test to be conducted: Do lagged values of the contagion index accurately predict the occurrence of a banking crisis in the current period, conditional on macroeconomic fundamentals? The analysis indicates that the probability of a banking crisis increases when countries have characteristics similar to those that have experienced a crisis, regardless of the degree of actual economic linkages between the respective countries.

In conclusion, the implications of these results are intriguing. If the fundamentals are controlled, then the occurrence of a banking crisis in the previous period in one country predicts the onset of a banking crisis in another country, if the countries have similar macroeconomic characteristics. This suggests that informational contagion plays a larger role than previously suspected, since the onset of a crisis is related to the information provided by the initial crisis event, over and above macroeconomic effects. The existence of informational contagion raises many issues for policy-makers. In particular, institutions that oversee, supervise, or regulate financial institutions need to account for the process by which information from the occurrence of one banking crisis affects the behaviour of market participants, and how market completeness propagates or mitigates the transmission of macroeconomic effects.

References

Ahluwalia, P. 2000. "Discriminating Contagion: An Alternative Explanation of Contagious Currency Crises in Emerging Markets." International Monetary Fund Working Paper No. WP0014.

Allen, F. and D. Gale. 2000. "Financial Contagion." *The Journal of Political Economy* 108: 1–33.

Chen, Y. 1999. "Banking Panics: The Role of the First-Come, First-Served Rule and Information Externalities." *The Journal of Political Economy* 107: 946–68.

Dornbusch, R., Y. Park, and S. Claessens. 2000. "Contagion: How It Spreads and How It Can Be Stopped?" World Bank. Photocopy.

Glick, R. and M. Hutchison. 1999. "Banking and Currency Crises: How Common Are the Twins?" Center for Pacific Basin Monetary and Economic Studies. Working Paper No. 99-07. Federal Reserve Bank of San Francisco.

Santor, E. "Banking Crisis and Contagion: Empirical Evidence." Bank of Canada Working Paper (forthcoming).