Banking Crises, Contagion, and Foreign-Asset Exposures of Canadian Banks

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Introduction

The role of banks as intermediaries in global financial markets continues to evolve as regulatory reform, financial product innovation, and information technology allow them to further broaden the scope of intermediation activity. A popular perception of this process is that banks have become more "globalized," as witnessed by their ever-increasing operations in foreign jurisdictions. Canadian banks are no exception. At the same time, this perceived rise in the global nature of banks has occurred during a period of increased financial fragility. The 1990s, in particular, witnessed a plenitude of banking, currency, financial, and sovereign debt crises. Naturally, the growing frequency of crises, and the possibility that these crises could lead to contagion through the banking system, have received considerable attention from policy-makers and academics alike.

Despite the growing concern of the effect of financial crises and the possibility of contagion within globally integrated financial markets, little is known regarding the behaviour of Canadian banks' foreign-asset exposures. Similarly, despite numerous empirical investigations, there is little evidence to support the notion that contagion exists (Karolyi 2003). Although a few studies have explored the potential for contagion and systemic risk in payment systems, the question of how banks' foreign-asset exposures

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respond to crisis events remains largely unanswered. The objective of this paper is to address these two issues: first, to what extent have Canadian banks become increasingly globalized; and second, do Canadian banks' foreign-asset exposures respond to contagious crisis events?

Firm-level panel data on Canadian banks are used to describe the behaviour of the foreign-asset exposures of Canadian banks, and to assess the existence and impact of contagion. This unique Bank of Canada data set extends from 1984 to 2003 on a quarterly basis for a set of Canadian banks with claims in over 150 foreign jurisdictions. Specifically, banks' foreign-asset exposures include loans and deposits to foreign firms, banks, and public sector entities, and holdings of public and private securities. The panel nature of the data permits tests of the existence of information-based contagion and for its possible impact on the foreign-asset portfolios of Canadian banks. Specifically, do banks reduce their foreign claims to countries that appear to be similar to those that have experienced a banking crisis? Preliminary results find that, conditional on fundamentals, banks do not adjust their portfolios immediately in crisis events. Thus, information-based contagion plays only a small role in determining the asset portfolios of banks.

The paper will proceed as follows. Section 1 reviews the literature on the foreign-asset exposure of Canadian banks and the empirical literature on banking crises and contagion. Section 2 offers a theoretical framework for assessing the behaviour of banks during crisis episodes, while section 3 presents the empirical model. Section 4 describes the data, and section 5 presents descriptive statistics. Section 6 offers regression results of the effect of banking crises on the behaviour of Canadian banks' foreign-asset exposures. The final section concludes and offers avenues for future research.

1 Literature Review

There are few, if any, studies that detail the extent and determinants of Canadian banks' foreign-asset exposures over time. Freedman (1998) and Armstrong (1997) explore the level of Canadian banks' foreign-currency exposures from the 1950s to the early 1990s, but this phenomenon was not the main focus of their work.[1] Neither study assesses the nature of foreign claims, only the currency of exposure.

1. Recent work by Goldberg (2001), Palmer (2000), and Bomfin and Nelson (1999) provides extensive analysis of the foreign-asset exposure of U.S. banks, but no such analysis exists for the Canadian case.

Moreover, few empirical studies examine the existence of contagion and banking crises.[2] Contagion can be defined in two ways: fundamentals-based contagion and information-based contagion. The former describes shocks that affect markets through economic linkages, such as common shocks, trade linkages, and financial linkages (Dornbusch, Park, and Claessens 2000). This type of contagion should be more accurately defined as "interdependency." The second type of contagion, and the focus of this study, is information-based contagion. Information-based contagion describes the process by which shocks that affect one market are transmitted to related markets, despite the lack of fundamental relationships between the respective markets, or over and above those relationships. Needless to say, distinguishing between the two types of contagion is difficult in practice.

Several studies have tried to simulate the occurrence of contagion by assessing the impact of the failure of a bank in the payments system. For instance, Furfine (2001) uses Fedwire data to show how the failure of the largest bank(s) in the payments system would affect the liquidity position of its counterparties. Northcott (2002) follows a similar strategy to assess the likelihood of contagion in the Canadian Automated Clearing Settlement System (ACSS). Upper and Worms (2000) conduct an analysis using simulated interbank exposures in the German banking system. They estimate the optimal exposure of interbank market participants and simulate the effect of a failure of the largest interbank participant.[3] The striking result of these simulation studies is that it is difficult to induce large-scale operational contagious banking failures through a default in the payments system or interbank market.

At the macro level, Santor (2003) finds that banking crises are more likely to occur if a country shares similar characteristics with a country experiencing a crisis, conditional on fundamentals. While suggestive of the existence of

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2. Substantial empirical literature seeks to determine whether banking crises can be characterized and/or predicted. Demirgüç-Kunt and Detragiache (1997, 1998, 2002); Eichengreen and Rose (1998); Eichengreen and Arteta (2000); Glick and Hutchinson (1999); Hardy and Pazarbasioglu (1998); Kaminsky and Reinhart (2000); and Hernandez and Valdés (2001), among others, provide mixed evidence for the determinants of banking crises. Banking crises are related to slow economic growth, high inflation, high real interest rates, declining terms of trade, poor legal and accounting standards, and lower per-capita income. With respect to institutional features, Demirgüç-Kunt and Detragiache (1998, 2002) find that deposit insurance is positively related to banking crises, as is financial liberalization. There is considerable empirical literature on the incidence of contagion in financial markets and with respect to currency crises. See Rigobon (2003) for a standard treatment.

3. Their study, however, relies on strong assumptions with respect to market structure (since it cannot be observed).

information-based contagion, the study relies on macroeconomic data, and the pathway of contagion is not explored. With a different approach, using aggregate bank data on bank capital flows, Van Rijckeghem and Weder (2000) provide evidence that a banking crisis in one country predicts capital flows to other countries. They show that the onset of a crisis affects the flow of capital to other countries if those countries share common lenders. Similarly, using aggregate Bank for International Settlements (BIS) data, Peria, Powell, and Hollar (2002) also show that shocks experienced by banks in their home countries are transmitted to the level of foreign claims held by the affected banks. Interestingly, they find that host-country conditions matter more over time, as lending has become less "indiscriminate" to developing countries. That is, banks take country effects into account, and not just regional effects. Jeanneau and Micu (2002) explore the determinants of international bank lending, again with aggregate BIS data. They find "significant" evidence of herding, as European banks followed U.K. and U.S. bank behaviour. They also find evidence of regional contagion, as lenders tended to substitute lending from crisis areas to non-crisis areas in the late 1990s.

Empirical evidence of the effect of contagion on the behaviour of banks at the micro level is also limited. Goldberg (2001) examines the behaviour of U.S. banks' foreign-asset exposures from a portfolio perspective. She posits that exposures to foreign countries should react to changes in macro-economic fundamentals. Specifically, she argues that home-country real GDP growth and real interest rates should affect foreign-asset positions. She finds that the level of foreign exposures of U.S. banks is sensitive to changes in U.S. macroeconomic conditions for a set of developing countries. Higher real U.S. interest rates are correlated with lower claims in industrialized countries, but also with higher claims in Latin America. Interestingly, while exposures to industrialized countries are sensitive to domestic macroeconomic conditions, this does not hold for developing countries. Peek and Rosengreen (2000) also provide evidence of how shocks can be transmitted through banking systems: they show that Japanese banks transmitted shocks to the U.S. economy through the commercial real estate sector. However, none of these studies explicitly examines the effect of contagion on bank portfolios at the micro level.

An obvious shortcoming of the contagion literature described above is the inability to distinguish between the effects of contagion and simple inter-dependence (Karolyi 2003). Much of the current literature on banking crises and contagion often confounds the effects of real-side interdependencies, such as trade links, financial system integration, and common lenders, with the effects of "pure contagion." For instance, studies that use aggregate-level BIS data cannot distinguish between contagion that results from changes in

information and simple common shocks. The objective of this paper is to attempt to distinguish between the notion of fundamentals-driven contagion and pure information-based contagion. That is, can one find empirical evidence that the arrival of information that is orthogonal to observed fundamentals leads to a change in the foreign-asset exposure of Canadian banks?

2 Theoretical Framework

Underlying the existing empirical work on contagion and banking capital flows is the assumption that banks adjust their portfolios of foreign assets in response to changes in fundamentals and, to some extent, to information. For example, empirical work by Goldberg (2001) is grounded in the assumption that banks follow a portfolio rule to determine the level and change in foreign-asset exposures: banks adjust their foreign-asset exposures in response to changes in the returns of those assets. Specifically, foreign-asset exposures vary according to innovations in changes in foreign and domestic interest rates, and foreign and domestic GDP growth rates. Similarly, aggregate-level studies of foreign-bank exposures invoke the notion that banks respond to crises by adjusting their foreign-asset exposures. The argument here is that the arrival of information from the crisis events may cause banks to reduce not only their asset position in the event country, but in related countries as well. This presupposes, however, that banks follow an optimal portfolio rule that would predict such behaviour. The question then arises as to what kind of rules generate the responses typically cited in the contagion literature. To this end, an exposition of a simple portfolio model will help ground the empirical work to follow.

Schinasi and Smith (1999) present a simple model where banks choose a portfolio V_t, with the size of the position in the risky asset, W_t. Banks can borrow B_t (or lend if B_t is negative) and therefore $W_t = B_t + V_t$.[4] The risky assets can be thought of as the foreign-asset claims of banks to various countries. The risky asset i pays realized gross returns $R_{i,\,t+1}$ and the bank can lend/borrow at the gross rate r. Given information at time t, the risky assets have conditional joint normal returns, where $\mu_{i,\,t+1}$, $\sigma^2_{i,\,t+1}$ and $c^{ij}_t = \rho^{ij}_{t+1}\sigma_{i,\,t+1}\sigma_{j,\,t+1}$ are the means, variance, and covariances, and the conditional correlation between assets i and j is ρ^{ij}_{t+1}. Portfolio managers choose portfolio weights $\{w_{i,\,t}\}^N_{i=0}$, with $i = 0$ denoting borrowing or lending in a riskless asset. For the purposes of their analysis, without loss of generality, Schinasi and Smith restrict the number of risky assets to two.

4. This section follows Schinasi and Smith (1999) directly.

The authors then describe three portfolio rules that bank managers could potentially follow: the expected return benchmark rule, the trade-off rule, and the loss-constraint rule. They are described as follows.

2.1 Benchmark rule

Denote the expected return of the portfolio $\mu_{i,\,t+1}$, and its standard deviation $\sigma_{p,\,t+1}$. The manager chooses the portfolio according to the following objective:

$$\min \quad \sigma_{p,\,t+1}$$

$$\text{subject to} \quad \mu_{p,\,t+1} \geq k,$$

where k is the minimum return set by the bank.

2.2 Trade-off rule

Similarly, a rule that allows the manager to trade risk for return, given a tolerance for risk τ, can be expressed as follows:

$$\max \quad \mu_{p,\,t+1} - \frac{1}{2}\tau\sigma^2_{p,\,t+1}.$$

2.3 Loss-constraint rule

This rule is the basis for the standard Value at Risk model utilized by banks. Here, banks maximize the return of the portfolio, subject to the constraint that the potential losses cannot exceed a certain level with a given probability. Thus, banks

$$\max \quad \mu_{p,\,t+1},$$

$$\text{subject to} \quad Prob[R_{p,\,t+1} < \hat{R}] \leq m,$$

where m and $\hat{R}$ are set by the bank manager. The usefulness of defining these three portfolio rules is seen when Schinasi and Smith assess the impact of a change in the variance of one asset, and how each portfolio rule requires the bank to alter its weight in both the event asset and the other asset in the portfolio. For example, what would happen if the bank held claims against Colombia and Mexico, and Mexico then suffered a banking crisis? Naturally, the crisis would lead to an increase in the volatility of returns in Mexico. The question Schinasi and Smith wish to evaluate is what kind of

portfolio rule would induce the bank to reduce (or raise) its foreign-asset exposures to Colombia.

Given a "volatility event" (such as a banking crisis), which is defined as an event at time t that increases the variance of the asset at time $t + 1$, Schinasi and Smith show that different portfolio rules yield different portfolio rebalancing responses. For instance, under both the benchmark and trade-off rules, given that the correlation between the two assets is positive, a volatility event in asset i will lead to a decrease in the position of asset i and an increase in asset j. If the correlation is negative, then under the benchmark rule, the same result holds, while under the trade-off rule, the portfolio manager will reduce the position in both risky assets. Conversely, the authors then show that under the loss-constraint rule with positive correlation between assets, a volatility event in asset i can lead to a decrease in the position of asset j.

The consequences of their analysis have significant implications for how one views the possible effects of crisis events on the foreign-asset exposures of Canadian banks. Previous literature that has explored the effect of contagion has posited that investors (banks included) respond to crisis events in one asset class by reducing their positions in other similarly risky asset classes. But how a bank responds to an increase in volatility (or a capital event) due to a crisis in country i depends heavily on the portfolio rule used by banks. The consequences of Schinasi and Smith's results is that one cannot make simple claims with respect to the responses of banks to crisis events. Depending on the rule used by the bank, if one country suffers a crisis, the foreign-asset exposures of the other countries in the bank's portfolio may rise or fall. The current contagion literature presupposes, if not explicitly, that investors/banks tend to follow rules that lead to a reduction in the position in foreign risky assets when crises occur. But one cannot assume, a priori, that banks follow any one rule at any given time.[5] Consequently, one of the tasks of the empirical framework is to determine if one can identify whether banks are using a particular rule. That is, do they raise or lower their exposure to the foreign assets in countries where no crisis has occurred when there is a crisis in another country in the same asset portfolio?

5. The portfolio rules followed by banks are highly guarded secrets, and, thus, it is not possible to identify the rules for empirical testing.

3 Empirical Model of Foreign-Bank Exposures

3.1 Empirical concerns

Goldberg (2001) offers a simple micro-level empirical model of foreign-asset exposures. Utilizing basic portfolio theory, she posits that a bank's exposure to a particular foreign country will be a function of the return of investment of that country, relative to the bank's domestic-country portfolio. Empirically, foreign-country fundamentals can be proxied by the country's real interest rates and real GDP growth, while domestic fundamentals are captured by Canadian real interest rates and GDP growth. Thus, the foreign-asset exposures of Canadian banks can be characterized by the following equation:

$$Exp_{ijt} = \alpha_{1i} + \alpha_{2r} + \beta_1 i_{jt} + \beta_2 i_{ct} + \beta_3 GGDP_{jt} + \beta_4 GGDP_{ct} + \varepsilon_{ixt}, \quad (1)$$

where Exp_{ijt} is the log of real foreign-asset exposure of bank i, for foreign country j at time t, i_{jt} is the foreign-country real interest rate and i_{ct} is the Canadian real interest rate, and $GGDP_{jt}$ and $GGDP_{ct}$ represent the foreign and Canadian growth rate of real GDP, respectively. Regional and bank fixed effects a_r and a_i are entered to account for regional and bank-specific differences: some foreign regions may, regardless of fundamentals, attract larger claims. Similarly, some banks may simply have higher foreign claims owing to portfolio preferences that cannot be accounted for by changes in macro conditions. Equation (1) then estimates in first differences to remove the I(1) nature of the macro data:[6]

$$\Delta Exp_{ijt} = \alpha_{1i} + \alpha_{2r} + \beta_1 \Delta i_{jt} + \beta_2 \Delta i_{ct} + \beta_3 \Delta GGDP_{jt} + \beta_3 \Delta GGDP_{ct} + \varepsilon_{ixt}. \quad (2)$$

Again, there are bank and regional fixed effects to account for trends in lending behaviour. The empirical framework suggested by Goldberg, however, may not adequately address the nature of foreign-bank exposures. Specifically, there are four major concerns: misspecification of the fixed effects, and the resulting error structure and estimation technique, state dependence, and omitted variables. Each will be considered in turn.

The estimation of equation (1) and/or equation (2) assumes that there are bank-specific fixed effects that can account for the level and/or trend of

6. Goldberg (2001) assumes that the macro variables are I(1). This assumption is confirmed by augmented Dickey-Fuller tests conducted by the author.

foreign-bank exposures. Empirical implementation of this fixed effect takes the role of a different constant for each bank: a bank that is more predisposed to foreign exposures will be predisposed to higher levels for all countries where it has claims. Similarly, the regional fixed effect supposes that certain regions may be more "favourable" than others, leading to higher exposures. Unfortunately, this specification of regional and bank-specific effects does not consider directly the fact that banks may target specific countries, not just regions. That is, the "regional" fixed effect presumes a level of non-discrimination at the country level within a region. Rather, banks may actively target certain countries as part of an overall portfolio strategy, as opposed to others, on country characteristics that are not easily observable to the researcher. For instance, a bank's preference for Mexico (due to some unobservable characteristic of Mexico) would lead to higher exposures than would be suggested by the macro variables.

A second concern is that the nature of the panel being estimated consists of bank i's exposure to country j at time t. Given the three-dimensionality of the panel, it is not clear how the suspected correlation in the error terms can be accounted for in this setting using simple ordinary least squares on first-differenced data. For example, it is plausible to argue that there will be a country-fixed effect and a bank effect that are correlated within panels but not across panels. How this is handled in the empirical implementation is not described, and thus clear distinctions of the panel-data properties need to be made. Similarly, it is not clear which asymptotic properties of the panel are being exploited. Is it across i, j, or t? Given the predominance of a few large banks in the sample, there may also be small-sample issues to consider.

Another shortcoming of the Goldberg framework is the notion that the level of exposures (and the changes) are not a function of the previous level. However, the level of exposures may exhibit considerable inertia. If there are fixed costs to booking claims on foreign residents, i.e., collecting expertise and knowledge, opening local offices, and so on, the path of foreign exposures may be more persistent than suggested by equation (1). Furthermore, given the often lengthy terms of many claims, particularly loans, banks may not be able to adjust their portfolios rapidly. In the presence of negative shocks, for instance, the rapid disposal of securities may result in poor asset returns, and the immediate calling of loans may not maximize the returns of the loan portfolio. Consequently, inclusion of lagged levels of the foreign exposure may be required.

The estimation of equation (1) may suffer from an omitted-variable problem that is not addressed by the inclusion of macro variables or mitigated by first differencing. That is, the portfolio decisions of banks are not only affected by changes in fundamentals, but are also affected by other features. Two

additional sources of variation can be considered: first, the effect of political characteristics, such as the degree of political stability, corruption, investor protection, and law and order; and second, the occurrence of a crisis in a country that is similar to the country where the bank has claims. That is, inclusion of the omitted variable in this instance is a test of the existence of information-based contagion.

3.2 Empirical solutions

To account for the econometric issues just raised, I propose to modify the Goldberg approach in the following manner. Instead of specifying bank and regional effects, the data are broken down into country-bank observations across time. Thus, bank i's exposure to country j across time t is one panel, where the error term can be correlated within the panel. Similarly, bank i's exposure to country k across time t is a separate panel, with error terms that are correlated within the panel. This assumption reduces the dimensionality of the panel to two, and ensures sufficient cross-sectional variation. Likewise, the implied fixed effect may be a more accurate representation of reality. The bank-country fixed effect, ij, captures the notion that bank i may have a predisposition to have claims on country j. Thus, equation (1) can be rewritten as follows:

$$Exp_{ijt} = \alpha_{1ij} + \beta_1 i_{jt} + \beta_2 i_{ct} + \beta_3 GGDP_{jt} + \beta_4 GGDP_{ct} + \varepsilon_{ijt}, \quad (3)$$

where α_1 captures the effect of the country-bank fixed effect.

To account for the possibility of state dependence in foreign-asset exposures, equation (3) can be augmented as follows to account for the fixed costs of commencing foreign claims and the adjustment costs associated with their disposal:

$$Exp_{ijt} = \alpha_{1ij} + \lambda_k \sum_{k=1}^{K} Exp_{ijt-k} + \beta_1 i_{jt} + \beta_2 i_{ct} + \beta_3 GGDP_{jt} + \beta_4 GGDP_{ct} + \varepsilon_{ijt}. \quad (4)$$

Estimation of equation (4) is complicated by the inclusion of lagged dependent variables, which would necessarily be correlated to the error term. However, utilization of standard generalized method of moments (GMM) estimation techniques can mitigate this problem. Additionally, in this instance, GMM would first difference the data by the ij dimension, thus accounting for the I(1) nature of the data.

To account for potential omitted variables, one needs to include the effect of institutional characteristics. King and Levine (1993), Rajan and Zingales

(1998), and many others have shown how better institutions are positively correlated to economic growth. The pathway of this effect is typically through its impact on financial development. For instance, in economies with high levels of investor protection, bureaucratic quality, and law and order, the standard problems of moral hazard, adverse selection, contract enforcement, and state verification would be mitigated. Similarly, financial intermediation would benefit from political stability and low levels of corruption. One could therefore expect that the foreign-asset exposures of banks would be related to the degree of political risk. Equation (4) can be augmented as follows:

$$Exp_{ijt} = \alpha_{1ij} + \lambda_k \sum_{k=1}^{K} Exp_{ijt-k} + \beta X_{jt} + \delta Z_{jt} + \varepsilon_{ijt}, \qquad (5)$$

where X is a vector of the macroeconomic characteristics of the foreign country and Canada as listed before, and Z_{jt} is a measure of the political and institutional characteristics of the foreign country. This vector could include measures of political risk, bureaucratic quality, corruption, democracy, investor protection, law and order, and stability. For instance, one would expect that positive changes in the level of investor protection would lead to higher levels of foreign claims, while controlling for fundamentals. Finally, to account for the I(1) nature of the macro data, equation (5) can be estimated in first differences.[7]

The second influence on the degree of foreign exposure is the effect of crisis events and contagion. Chen's (1999) theoretical model suggests possible empirical tests of the effect of crises through information-based contagion.[8] For instance, if the Mexican banking system fails, it may cause banks to reassess the viability of their portfolios in other countries, such as Colombia or Argentina, since they may believe that there is a positive correlation between the loan portfolios of the respective countries.[9] Subsequently, banks will adjust their portfolio in the other countries, depending upon the portfolio rule that is used, despite the non-existence of any real or financial connections to the country that is experiencing a failing banking system. This is consistent with the model proposed by Schinasi and Smith (1999).

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7. If there is an equilibrium level of foreign-asset exposures, then an error-correction specification may be warranted. The equilibrium level could be based on the notion that banks hold a certain percentage of their portfolio in foreign assets, for the purposes of optimal portfolio diversification. However, there is no reason to suggest that the exposure to a particular country must be a certain level. Nevertheless, future research will need to consider this equation.
8. See Chen (1999) for a description of the model.
9. The existence of correlated projects across banks (or, in this case, banking systems) is an assumption of the model.

Finding appropriate measures of information contagion is problematic. Ideally, the researcher would like to use a measure that captures a flow of information that would inform (rightly or wrongly) investors/banks about the conditional moments of the return of assets, but at the same time, a measure is not correlated closely to changes in fundamentals in the affected country. This is crucial in order to identify a "contagion" effect, and not simply a common shock or response to changes in fundamentals. Measuring contagion in this context proceeds as follows. Given that a crisis occurs in country i, does the bank change its exposure to country j, conditional on the fundamentals that the crisis in i has on j? The idea is that the crisis in i reveals information about the volatility and mean of returns on country j's assets, above and beyond what can be detected from changes in fundamentals. Then, the direction of the change in exposures, as noted by Schinasi and Smith, would be determined by the portfolio rule being used by the bank.

I propose two possible measures for examination. The first measure of information-based contagion (C_1) is constructed as follows. The contagion measure takes a positive value of one for country i if country j experiences a banking crisis and country i and j are in the same region. Simple inspection would suggest, however, that if there were a common shock that caused the crisis in j, the contagion measure may simply be proxying for this effect, even when controlling for fundamentals. A potential solution is to introduce an interaction term. The interaction-contagion measure takes a value of one if country j experiences a banking crisis and country i and j are in the same region, and the bank has exposures in both countries. If the additional information of joint exposure induces changes in exposures over and above the simple crisis event, this would suggest that information is causing a change in behaviour. This test can be implemented by augmenting the benchmark model of foreign-asset exposures (equation (5)) with a proxy of informational contagion:

$$Exp_{ijt} = \alpha_{1ij} + \lambda_k \sum_{k=1}^{K} Exp_{ijt-k} + \beta X_{jt} + \delta Z_{jt} + \theta C_{1jt-1} + \varepsilon_{ixt}, \quad (6)$$

where C_1 is a measure of contagion.[10]

A second measure (C_2) builds on the visible-similarities argument: if two economies share similar characteristics, then the occurrence of a crisis in

10. The measure can be further refined by only allowing the contagion measure to take a value of one if the two countries do not have significant trade linkages to each other. This would help isolate the information effect from any real-side linkages.

one country may predict a change in the portfolio being held by the bank in the other country, even if there are no real linkages between the countries. The measure of information-based contagion can be defined, as suggested by Ahluwalia (2000), by the following contagion index:

$$C_{2jt} = \sum_{m=1}^{n} CRI_{mt} \times I[\sum_{k=1}^{K} I(X_{kjt} > \bar{X}_{kj}) \times I(X_{kmt} > \bar{X}_{km})], \quad (7)$$

where j indexes the non-crisis country, m indexes all the countries other than j, k indexes the macro variable from a set of K macro variables, X_{jkt} are macro fundamentals for the year t, $\bar{X}_{jt}$ is the threshold value of X, I is an indicator function that takes a value of one if the argument $X_{jkt} > \bar{X}_{km}$ and $X_{kmt} > \bar{X}_{km}$ is true, and CRI_{mt} is a dummy variable that takes the value of one if the country experiences a banking crisis in period t. The indicator variable determines whether the macro variable takes a value greater than some threshold value that would indicate that a crisis is occurring. In this case, whether the variable is one-and-a-half or more standard deviations greater than its mean is the measure of a "crisis" value for that variable.[11] The crisis index adds a value of one if the non-crisis country shares a crisis indicator in common with the crisis country. Thus, if there are four countries in crisis with a macro variable above the threshold, and country j's macro variable is also above the threshold, then C_2 takes a value of four. Alternatively, the index can be constructed to capture the number of macro variables that are similar to the crisis country. The index can be further refined to account for similarities only when the countries come from the same region.[12]

The intuition underlying contagion indexes is simple: if a country experiences a banking crisis, investors will be "awakened" and prompted to reassess the viability of their portfolios in countries that share similar traits. If countries share "visible similarities," banks will have to adjust their portfolios accordingly. Interestingly, this analysis precludes the need for any change in fundamentals (although they are controlled for the regressions). That is, if contagion occurs simply as a result of the effect of the crisis, and not because of a change in fundamentals, then information-based contagion potentially exists.

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11. For variables where low values are a sign of crisis, I assume that the indicator function includes a "less than" operator. Varying the threshold does not qualitatively affect the results. Using 1.5 standard deviations as the threshold level generates stress for 3 to 7 per cent of the total observations.
12. See Santor (2003) for a full discussion.

4 Data

The foreign claims exposure data come from the consolidated quarterly banking statistics collected by the Bank of Canada. Every bank that operates in Canada is required to provide quarterly statistics of their total asset exposure to each foreign jurisdiction in which it operates, on a fully consolidated basis.[13] This covers all claims, 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 all Canadian banks' exposures to over 150 jurisdictions from 1984 to 2003.[14] Additional bank balance-sheet data are collected, including assets, market capitalization, and other bank-specific characteristics.

The macroeconomic data are taken from the *World Economic Outlook* and *International Financial Statistics*. They include data on GDP growth rates, interest rates, inflation, government finances, current account, money supply, and private credit. The data on political institutions are from the International Country Risk Guide. This guide includes measures of bureaucratic quality, corruption, democracy, investor protection, law and order, and stability, which are combined in an overall measure of political risk from 1984 to the present.

Banking crisis dates are initially taken from Glick and Hutchison (1999) and updated by the author to the current period. However, official crisis dates may not be the relevant measure of when "information" becomes available to banks, and they are only reported yearly. To better capture the timing of the crisis dates, an alternative dating system is used. Using Dow Jones Fortiva, the date of a crisis is determined by the occurrence of the first event that is mentioned in the Dow Jones Fortiva database of newspapers. This has the advantage of being able to specify the exact quarter when the crisis began and is more likely to reflect the timing of the information available to bank managers.

13. Consolidation is conducted according to guidelines in the guide from *Canadian Institute of Chartered Accountants* (CICA 2003).

14. While there are over 50 banks operating in Canada, six banks account for 92 per cent of the assets and 96 per cent of all foreign exposures. The focus of this analysis is on the six largest banks in Canada.

5 Descriptive Statistics

5.1 Have Canadian banks become more global?

The descriptive statistics would suggest, at a glance, that Canadian banks are extensively globalized. Table 1 lists the countries to which at least one Canadian bank has a foreign-asset claim in 2002. The results are striking, with over 150 countries listed. However, the extent of exposures has actually declined, relative to its peak in the 1980s. Table 2 lists the average, mean, and median number of countries that each Canadian bank had foreign claims on from 1984 to the present. For the five largest banks, the trend is clear. In 1984, large banks had claims on an average on 80 countries, while in 2002, this has fallen to an average of only 60 countries.[15] The size and extent of these foreign claims are considerable: total foreign claims, in constant 1997 dollars, were over $477.2 billion in 2002 (out of total assets of $1,702.5 billion—see Table 3). The evolution of claims over time reveals several important trends. First, total claims fell in the late 1980s, as banks wrote off their investments in Latin America (Powell 1990), but have risen quickly since in absolute terms (except for a small drop in the aftermath of the Asian crisis). Banks have altered the composition of these claims over time. In 1984, loans constituted the largest proportion of foreign exposures, followed by deposits and securities. Since the 1990s, foreign deposits and loans have fallen relative to securities. By 2002, foreign securities represented 37 per cent of total exposures, up from 6 per cent in 1984 (see Table 4).

The value of foreign exposures by region is shown in Table 5 and in Figures 1 through 4. The United States accounts for the majority of exposures at $295.7 billion in 2002, accounting for 60 per cent of total foreign exposures.[16] The increase in total claims can be seen in Figure 1 and is attributable to larger holdings of securities, particularly after 1994. The balance of remaining exposures occurs in the industrialized countries, Latin America, and East Asia. The evolution of foreign claims to the industrialized countries follows that of the United States somewhat, with all claim types showing significant growth after 1993 (see Figure 2). Also, securities constitute a larger part of claims than ever before. Interestingly, exposures to Latin America fell as a share of total foreign exposures in the 1980s and early 1990s, but have risen substantially in the past few years (see

15. In terms of the panel to be estimated, this means that there will be at least 360 *ij* panels with a time dimension *t* of 76.

16. The secular increase, absolutely and proportionally, in U.S. assets, suggests that Canadian banks are not holding these assets simply because of their higher returns. Rather, it could be the case that U.S. assets, in particular, Treasury bills, are held for other reasons, such as collateral or for derivative trading purposes. Future research on the determinants of these holdings of U.S. assets is warranted.

Table 1
Countries reporting a foreign-asset exposure to Canadian banks (selected countries)

Industrialized countries	Latin America	Asia	Middle East
United States	Argentina	Sri Lanka	Bahrain
United Kingdom	Brazil	India	Cyprus
Austria	Chile	Indonesia	Israel
Belgium	Colombia	Korea	Jordan
Denmark	Ecuador	Malaysia	Syria
France	El Salvador	Nepal	Egypt
Germany	Guatemala	Philippines	
Italy	Honduras	Singapore	
Netherlands	Mexico	Thailand	
Norway	Paraguay		
Sweden	Peru		
Switzerland	Uruguay		
Japan	Venezuela		
Finland	Guyana		
Ireland	Jamaica		
Portugal			
Turkey			
Australia			
New Zealand			

Table 2
Foreign-asset exposures: Number of countries per bank reporting exposures > $1 million

	All banks		Five largest banks	
Year	Mean	Median	Mean	Median
1984	41	33	85	81
1985	40	30	84	80
1986	38	31	79	79
1987	36	28	74	72
1988	33	22	68	63
1989	31	20	64	64
1990	28	15	60	59
1991	27	15	58	63
1992	28	16	58	64
1993	27	17	58	64
1994	27	18	57	62
1995	30	22	63	69
1996	32	23	67	75
1997	33	21	70	79
1998	33	22	71	79
1999	32	18	68	72
2000	31	21	66	69
2001	30	23	63	65
2002	30	20	62	57

Source: Bank of Canada.

Table 3
Foreign-asset exposures, all Canadian banks
(Can$ billions constant)

Year	Foreign deposits	Foreign loans	Foreign securities	Total foreign claims
1984	67.0	167.8	14.1	248.9
1985	63.2	179.8	20.2	263.2
1986	65.5	171.0	22.5	259.0
1987	53.4	161.3	19.1	233.9
1988	40.5	138.7	15.8	195.0
1989	38.3	135.6	15.3	189.2
1990	40.7	144.8	23.0	208.5
1991	39.4	139.6	23.6	202.5
1992	40.8	150.9	31.3	222.9
1993	44.1	144.0	41.0	229.1
1994	57.3	154.0	47.8	259.0
1995	66.7	152.9	55.3	274.9
1996	74.7	175.2	76.3	326.2
1997	90.4	206.2	92.3	389.0
1998	75.1	265.1	124.5	464.7
1999	70.7	219.9	136.1	426.8
2000	66.5	238.3	149.4	454.2
2001	71.5	267.0	185.4	523.9
2002	66.3	236.3	174.6	477.2

Source: Bank of Canada.

Table 4
Foreign-asset exposures, all Canadian banks

Year	Foreign deposits/ Total claims	Foreign loans/ Total claims	Foreign securities/ Total securities
1984	0.27	0.67	0.06
1985	0.24	0.68	0.08
1986	0.25	0.66	0.09
1987	0.23	0.69	0.08
1988	0.21	0.71	0.08
1989	0.21	0.72	0.08
1990	0.20	0.69	0.11
1991	0.19	0.69	0.12
1992	0.18	0.68	0.14
1993	0.19	0.63	0.18
1994	0.22	0.59	0.18
1995	0.24	0.56	0.20
1996	0.23	0.54	0.23
1997	0.23	0.53	0.24
1998	0.16	0.57	0.27
1999	0.17	0.52	0.31
2000	0.15	0.52	0.33
2001	0.14	0.51	0.35
2002	0.14	0.50	0.37

Source: Bank of Canada.

Table 5
Foreign-asset exposures, all Canadian banks
(Can$ billions constant)

Year	United States	Industrialized countries	Asia	Latin America	Japan
1984	72.5	58.4	13.4	37.2	4.3
1985	85.0	55.8	13.1	36.5	4.4
1986	95.6	50.3	11.7	34.7	5.7
1987	90.3	43.3	8.0	31.8	7.7
1988	77.3	35.2	5.7	24.8	6.5
1989	77.5	35.3	5.2	21.2	5.8
1990	86.7	40.3	6.3	17.5	7.5
1991	87.8	39.6	6.7	14.8	6.4
1992	98.4	38.0	8.0	15.7	6.1
1993	99.7	38.9	8.7	17.1	5.6
1994	118.3	47.8	10.6	18.3	5.5
1995	121.3	53.0	14.3	18.5	9.6
1996	150.8	73.5	17.6	19.5	9.6
1997	175.8	90.7	21.5	24.4	16.3
1998	227.7	104.1	18.0	30.0	16.5
1999	219.4	92.0	14.7	28.0	10.9
2000	231.7	99.7	14.3	29.2	10.9
2001	256.3	113.1	13.8	53.6	10.2
2002	229.5	113.6	10.7	43.7	9.4

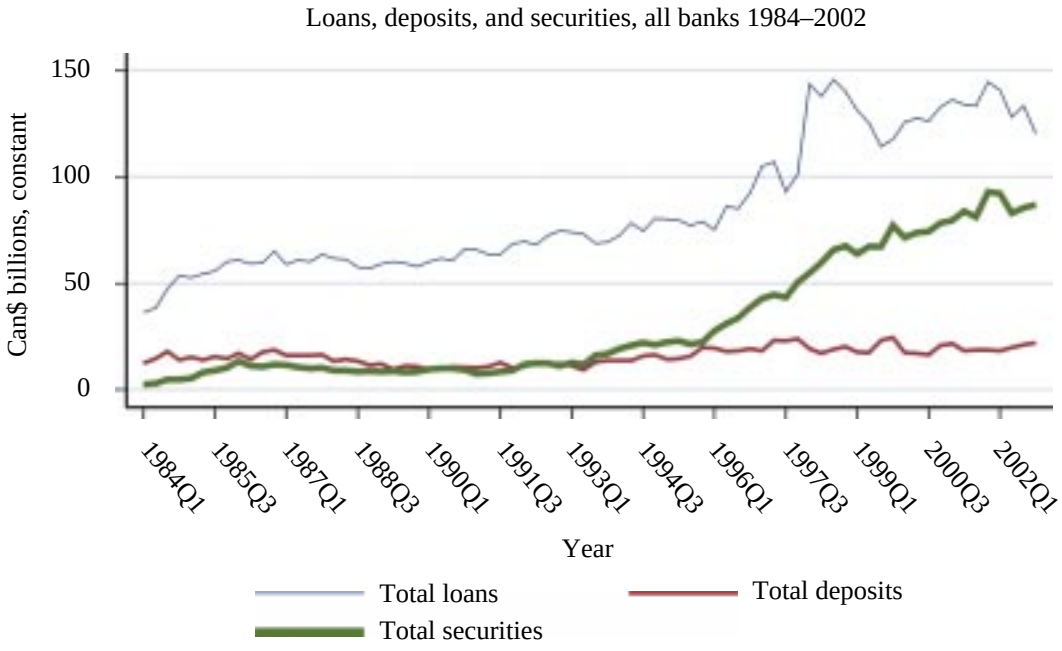
Source: Bank of Canada.

Figure 3). Loan exposures fell sharply in the 1980s and early 1990s, but then grew quickly, along with deposits and securities. A similar pattern for Asia emerges, with decreases in the 1980s followed by increases in the 1990s, after 1993 (see Figure 4). However, the impact of the Asian crisis is felt as loans eased and deposits plummeted after 1997.[17]

The descriptive statistics would suggest that Canadian banks are very globalized, and have become increasingly so over the 1990s. However, the extent of foreign-asset exposures as a percentage of total bank assets suggests a different conclusion. Table 6 shows that foreign-asset exposures in 2002 constituted 33 per cent of total assets for Canadian banks and represented over 600 per cent of bank capital (see Table 7). This is similar to respective numbers from 1994, when foreign-asset exposures accounted for 33 per cent of assets and 425 per cent of bank capital. It would thus appear that Canadian banks are not becoming more exposed to foreign markets in terms of assets, but are more exposed in terms of bank capital. However, the foreign exposure-to-asset ratio of recent times is consistent with the average of the 1980s, and is below its peak in 1984. Furthermore, the change in the

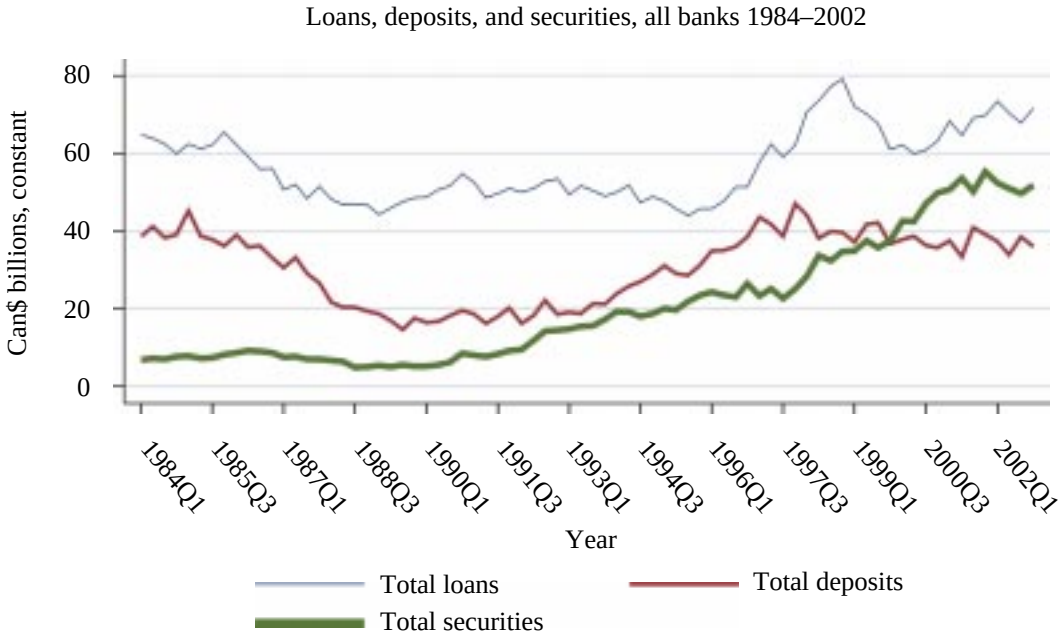
17. The level of exposures to Africa and the Middle East is negligible.

Figure 1
Foreign-asset exposures, United States



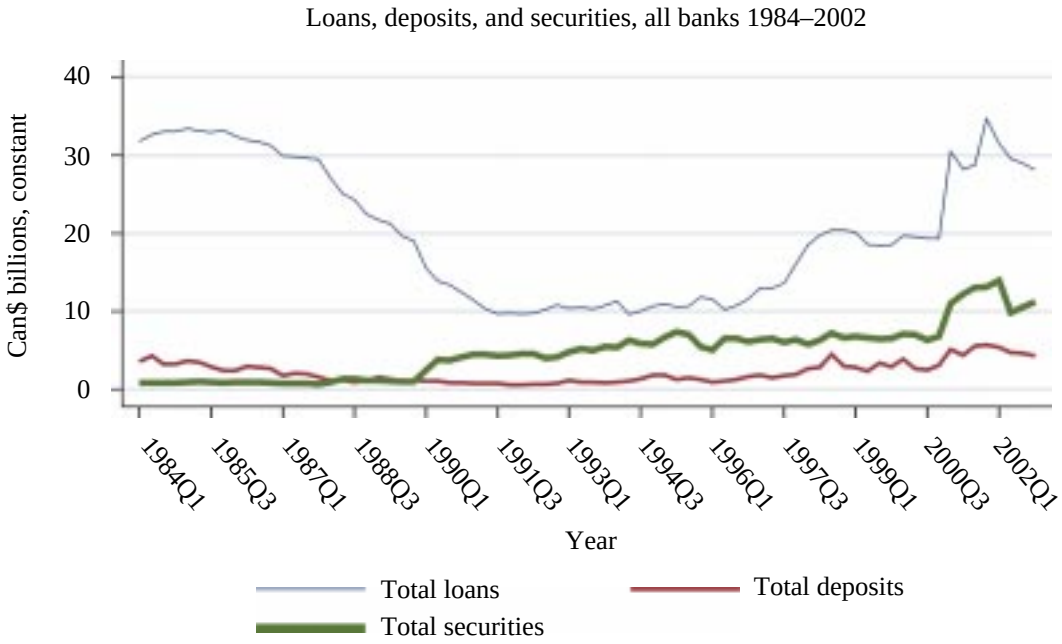
Source: Bank of Canada.

Figure 2
Foreign-asset exposures, other industrialized countries



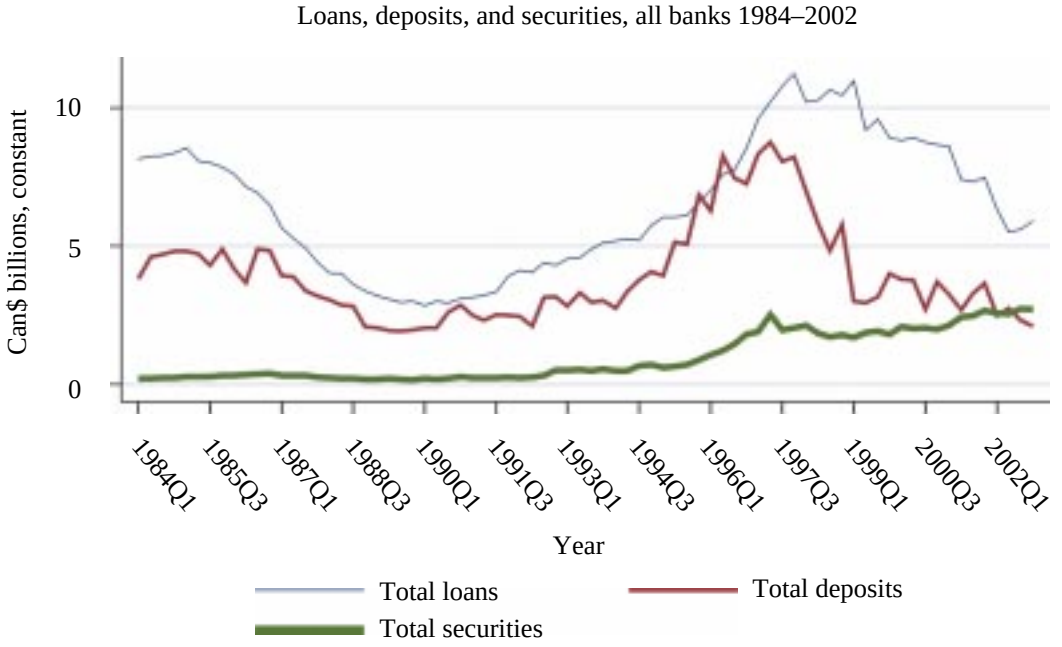
Source: Bank of Canada.

Figure 3
Foreign-asset exposures, Latin America



Source: Bank of Canada.

Figure 4
Foreign-asset exposures, East Asia



Source: Bank of Canada.

composition of foreign-asset exposure is important to consider. In the case of deposits and loans, the proportion of exposures to assets has fallen from 42 per cent to only 21 per cent from 1984 to 2002. The rise in the holding of foreign securities accounts for much of the rise in the 1990s. Since foreign securities are dominated by U.S. treasuries, it would be hard to argue that banks have become more exposed to foreign risk (at least if one considers U.S. Treasury bills as the most risk-free security in existence). Consequently, the descriptive statistics suggest that Canadian banks have not become more globalized than before, but less so.

Finally, the variation across countries and time of measures of political risk is presented in Table 8. Higher scores of the variables indicate "better" institutional qualities. The first measure, political risk, is a summation of the overall risk that politics and institutions can affect economic outcomes. As is clearly seen, industrialized countries have much higher levels of political stability (high values indicate lower risk) than developing countries. This is also true for measures of bureaucratic quality, corruption, democracy, investor protection, law and order, and stability. The change over time reveals some interesting trends. On average, developing countries have become less risky, with high average positive changes in political risk, investor protection, and stability, across all regions (see Table 9). However, corruption tended to worsen over time. The crisis dates are listed in Table A1.1 of the Appendix.

6 Does Contagion Exist? Regression Results

The results of estimating the benchmark model of foreign-asset exposures (see equation (5)) by GMM in first differences is presented in Table 10. The GMM estimation technique is that developed by Arellano and Bond (1991) and Anderson and Hsiao (1981). All regressions include time dummies, and the right-hand-side macro variables are treated as exogenous. This latter claim is reasonable, given that it is unlikely that the volume of Canadian banks' asset exposures is sufficiently large to affect output and interest rates in the countries considered.[18] Four lags of the dependent variables are included in order to remove autocorrelation in the error term. Lagged levels of the dependent and exogenous macro variables are used as instruments for the endogenous lagged dependent variables, and the maximum number of lagged instruments is set at six. For the entire sample of developed and developing countries, the results show that previous levels of exposures are significant determinants of changes in the level of foreign-asset exposures,

18. One-step estimates are conducted for all regressions, for inference purposes.

Table 6
Foreign-asset exposures, all Canadian banks (claims/total assets)

Year	Foreign deposits/ Assets	Foreign loans/ Assets	Foreign securities/ Assets	Foreign total claims/ Assets
1984	0.12	0.30	0.03	0.45
1985	0.11	0.31	0.03	0.45
1986	0.11	0.29	0.04	0.44
1987	0.09	0.27	0.03	0.39
1988	0.07	0.24	0.03	0.34
1989	0.06	0.22	0.03	0.31
1990	0.06	0.23	0.04	0.33
1991	0.06	0.22	0.04	0.30
1992	0.06	0.22	0.05	0.33
1993	0.07	0.20	0.06	0.33
1994	0.08	0.19	0.06	0.33
1995	0.07	0.18	0.06	0.31
1996	0.07	0.17	0.07	0.31
1997	0.06	0.17	0.08	0.31
1998	0.06	0.20	0.09	0.35
1999	0.05	0.18	0.11	0.34
2000	0.05	0.18	0.11	0.34
2001	0.05	0.18	0.13	0.36
2002	0.05	0.16	0.12	0.33

Source: Bank of Canada.

Table 7
Foreign-asset exposures, all Canadian banks (claims/bank capital)

Year	Deposits/ Bank capital	Loans/ Bank capital	Securities/ Bank capital	Total claims/ Bank capital
1994	0.98	2.54	0.73	4.25
1995	1.13	2.55	0.84	4.52
1996	1.37	2.40	1.02	4.79
1997	1.50	3.21	1.33	6.04
1998	1.29	3.84	1.56	6.69
1999	1.00	3.40	1.71	6.11
2000	0.92	2.95	1.72	5.59
2001	0.94	3.18	1.90	6.02
2002	0.83	3.14	2.06	6.03

Source: Bank of Canada.

Table 8
Measures of political risk (average, 1984–2003)

Variable	United States	Industrialized countries	Africa	Asia	Middle East	Latin America
Political risk	83.9	81.2	51.7	61.4	57.7	59.6
Bureaucratic quality	4.0	3.7	1.3	2.5	2.3	1.7
Corruption	4.7	4.9	2.5	3.0	3.2	2.7
Democracy	5.9	5.5	2.8	3.8	3.1	3.6
Investor protection	8.8	8.0	5.8	6.9	3.1	6.3
Law and order	6.0	5.4	2.5	3.4	6.4	2.8
Stability	8.8	8.1	6.7	7.2	3.7	6.8

Source: *International Country Risk Guide*.

Table 9
Measures of political risk
(average change in index, 1984–2003)

Measure	United States	Industrialized countries	Africa	Asia	Middle East	Latin America
Political risk	–0.82	0.12	0.33	0.27	1.20	0.66
Bureaucratic quality	0.00	0.01	0.00	0.03	0.04	0.04
Corruption	–0.11	–0.05	–0.01	–0.05	–0.02	–0.01
Democracy	–0.03	–0.01	0.03	0.03	0.05	0.08
Investor protection	0.05	0.14	0.13	0.03	0.13	0.16
Law and order	–0.05	0.01	0.03	0.04	0.13	–0.01
Stability	0.00	–0.01	0.15	0.09	0.17	0.11

Source: *International Country Risk Guide*.

suggesting that there is a large degree of inertia.[19] This could be due to the existence of fixed costs for commencing claims on foreign residents in a country, and the adjustment costs for altering the level of those claims. The degree of inertia is larger for securities than for loans and deposits. The influence of macro variables is not strong. For total claims, foreign and domestic macro variables do not influence foreign exposures. Interestingly, there are significant but different impacts when claims are disaggregated into their respective types. For deposits, higher Canadian GDP growth leads to lower foreign deposits.[20] This suggests that as the Canadian economy

19. Inclusion of four lags of the dependent variable was sufficient to remove second-order autocorrelation for most specifications. Contact author for further details.
20. Only the largest 73 countries, in terms of exposures, are considered.

Table 10
Benchmark model: GMM estimates
Dependent variable: Δ claims (by type)

Variable	Deposits (1)	Loans (2)	Securities (3)	Total claims (4)
$Claims_{t-1}$	0.1640*	0.2247*	0.3152*	0.2918*
	(0.0199)	(0.0190)	(0.0211)	(0.0177)
$Claims_{t-2}$	0.0336*	0.0763*	0.0338*	0.0991*
	(0.0144)	(0.0127)	(0.0145)	(0.0118)
$Claims_{t-3}$	–0.0036	–0.0073	0.0392*	0.0545*
	(0.0125)	(0.0113)	(0.0137)	(0.0106)
$Claims_{t-4}$	0.0067	–0.0012	–0.0175	0.0253*
	(0.0122)	(0.0113)	(0.0130)	(0.0104)
Political risk	0.0043	0.0085	0.0065	–0.0037
	(0.0092)	(0.0065)	(0.0061)	(0.0050)
$Interest\ rate_{FOR}$	0.3234	0.0162	0.2994**	0.1266
	(0.2366)	(0.1153)	(0.1339)	(0.0991)
GDP_{FOR}	0.0350	0.0012	–0.3535	–0.0126
	(0.4723)	(0.2811)	(0.3156)	(0.2214)
$Interest\ rate_{CAN}$	1.7865	–0.5843	–2.2964**	–0.7858
	(2.0015)	(1.4505)	(1.3936)	(1.0897)
GDP_{CAN}	–1.8861**	0.8517	–1.2001**	–0.4445
	(1.1216)	(0.7662)	(0.7158)	(0.5934)
AR (2)	0.7706	0.0839	0.1257	0.1424
N	9,345	9,527	5,625	11,341

Notes:
* indicates significance at the 5 per cent level; ** indicates significance at the 10 per cent level. Time dummies included. All independent variables are first differenced. Instrument matrix is limited to four lags. Right-hand-side variables are treated as exogenous. AR (2) is the Arellano-Bond test for autocorrelation.

offers higher returns to domestic lending, funds lent to other countries are reduced. The effect of the macro variables on loans is not significant, which suggests that banks do not respond to quarterly changes in fundamentals. Foreign exposures in the form of securities respond positively to increases in foreign interest rates but negatively to higher Canadian GDP growth and interest rates.[21] This suggests a substitution towards higher returns. Banks may have also had to reduce exposure to riskier foreign markets in order to meet their capital requirements, since bank capital is more likely to be binding during periods of slow economic growth and high interest rates, as in 1991. Finally, changes in political risk have no effect on foreign exposures.

21. Preliminary results indicate that inclusion of lagged values of the macro variables does not alter the results.

The sample is then broken into two groups to examine whether banks respond differently to changes in fundamentals, depending on whether the foreign market is a developed or developing country (Table 11). For developed countries, lagged foreign exposures are positively related to current exposures, as before. Deposits and loans do not respond to changes in fundamentals, while securities respond positively to higher foreign GDP growth and negatively to higher Canadian GDP growth. This is consistent with a substitution towards higher returns. For developing countries, loans and deposits do not respond to macro variables in developing countries. As with the whole sample, securities' claims on developing countries are negatively correlated with higher foreign GDP growth. Similarly, total claims to developing countries are negatively related to higher Canadian interest rates. Two effects are present: first, a substitution effect, and second, higher interest rates are related to slower economic growth in Canada, particularly during the 1991 recession. Banks may have had to reduce their exposure to riskier foreign markets in order to meet their capital requirements, since bank capital was falling at the time. Political risk matters for developing countries, and less political risk translates into higher foreign exposure in the form of loans and deposits.

The impacts of banking crises and contagion are presented in Table 12. For all specifications, the occurrence of a banking crisis does not affect foreign-asset exposures.[22] In terms of the theoretical model, a banking crisis can be considered to be a "volatility event" that contains information. However, it appears that this information does not affect the level of exposures, which could be due to the fact that banks do not adjust their exposures immediately, but only slowly over time.[23] When the contemporaneous contagion index (C_1) is entered, there is no evidence of contagion. That is, when a country in the same region experiences a crisis and the bank has an exposure to the crisis country, the crisis does not affect the foreign-asset exposures in other countries in that region for the bank. The lack of a significant relationship may be due to the lag in reaction to the crisis event. To account for this effect, the contagion index is entered with a lag. Strikingly, the effect is positive. A crisis in another country in the region leads to higher deposits and loans in the non-crisis countries. To verify the robustness of this result, the second contagion index (C_2) is estimated (see Table 13). Two variations are considered. The first variation (C_{2A}) creates the index such that it takes a value of one for each country in the region that

22. Inclusion of lagged values of the occurrence of a banking crisis does not affect the results.

23. Another possible explanation is that asset exposures that are booked in the foreign country react differently than exposures booked in the country of the head office of the bank (Goldberg 2001). A closer examination of this issue is considered for future research.

Table 11
Benchmark model: GMM estimates
Dependent variable: Δ claims (by type)

	Developed countries				Developing countries			
Variable	**Deposits (1)**	**Loans (2)**	**Securities (3)**	**Total claims (4)**	**Deposits (5)**	**Loans (6)**	**Securities (7)**	**Total claims (8)**
$Claims_{t-1}$	0.1549*	0.2048*	0.2790*	0.2714*	0.2030*	0.2624*	0.5551*	0.3305*
	(0.0199)	(0.0207)	(0.0221)	(0.0166)	(0.0327)	(0.0239)	(0.0344)	(0.0244)
$Claims_{t-2}$	0.0203	0.0941*	0.0228	0.0948*	0.0772*	0.0143	0.0872	0.0851*
	(0.0162)	(0.0156)	(0.0169)	(0.0138)	(0.0231)	(0.0192)	(0.0278)	(0.0171)
$Claims_{t-3}$	0.0082	–0.0210	–0.0012	0.0583*	–0.0321	0.0393*	0.0254	0.0617*
	(0.0147)	(0.0141)	(0.0161)	(0.0130)	(0.0215)	(0.0184)	(0.0275)	(0.0168)
$Claims_{t-4}$	0.0235	0.0110	–0.0058	0.0304*	–0.0331	–0.0365**	–0.0533*	–0.0022
	(0.0146)	(0.0142)	(0.0157)	(0.0127)	(0.0211)	(0.0187)	(0.0256)	(0.0161)
Political risk	–0.1169	–0.0003	–0.0029	–0.0112	0.0214	0.0227*	0.0099	–0.0030
	(0.0117)	(0.0120)	(0.0088)	(0.0072)	(0.0147)	(0.0077)	(0.0080)	(0.0065)
$Interest\ rate_{FOR}$	0.5578	0.2379	–1.1329	0.5906*	–0.0141	–0.1413	0.0917	–0.0492
	(0.5321)	(0.2948)	(1.4266)	(0.2198)	(0.2566)	(0.0998)	(0.1301)	(0.0986)
GDP_{FOR}	–0.1905	–0.7565	2.1978*	–0.5483	0.0294	–0.1202	–0.8207*	0.1100
	(0.8836)	(0.6579)	(0.8905)	(0.4903)	(0.5425)	(0.2560)	(0.2798)	(0.2250)
$Interest\ rate_{CAN}$	0.7954	0.5977	–2.3423	0.4418	6.0355	–2.8485	–1.8095	–3.5183*
	(2.2707)	(1.9001)	(1.7255)	(1.4184)	(4.1940)	(2.1135)	(2.3599)	(1.7227)
GDP_{CAN}	–1.2631	1.2258	–2.5495*	–0.3694	–2.2559	–0.3370	0.8016	–0.6681
	(1.1316)	(1.0751)	(0.9330)	(0.7958)	(2.0848)	(0.0077)	(1.1341)	(0.8721)
AR (2)	0.2806	0.9279	0.0766	0.0476	0.3453	0.1312	0.5845	0.5767
N	6,878	5,988	3,821	7,248	2,467	3,539	1,804	4,058

Notes:
* indicates significance at the 5 per cent level; ** indicates significance at the 10 per cent level. Time dummies included. All independent variables are first differenced. Instrument matrix is limited to four lags. Right-hand-side variables are treated as exogenous. AR (2) is the Arellano-Bond test for autocorrelation.

Table 12
Benchmark model: GMM estimates, contagion index C_1
Dependent variable: Δ claims (by type)

Variable	Deposits (1)	Loans (2)	Securities (3)	Total claims (4)	Deposits (5)	Loans (6)	Securities (7)	Total claims (8)
Claims_{t-1}	0.1696*	0.2367*	0.3207*	0.2941*	0.1692*	0.2366*	0.3220*	0.2941*
	(0.0199)	(0.0188)	(0.0212)	(0.0175)	(0.0199)	(0.0188)	(0.0212)	(0.0175)
Claims_{t-2}	0.0408*	0.0835*	0.0371*	0.1081*	0.0410*	0.0834*	0.0373*	0.1080*
	(0.0144)	(0.0129)	(0.0147)	(0.0120)	(0.0145)	(0.0129)	(0.0147)	(0.0120)
Claims_{t-3}	–0.0014	–0.0030	0.0041	0.0490*	–0.0010	–0.0032	0.0036	0.0491*
	(0.0126)	(0.0115)	(0.0140)	(0.0109)	(0.0126)	(0.0115)	(0.0140)	(0.0109)
Claims_{t-4}	0.0087	0.0010	–0.0170	0.0273*	0.0088	0.0009	–0.0170	0.0273*
	(0.0124)	(0.0115)	(0.0137)	(0.0108)	(0.0124)	(0.0116)	(0.0137)	(0.0108)
Political risk	0.0060	0.0065	0.0051	–0.0010	0.0061	0.0063	0.0047	–0.0011
	(0.0094)	(0.0067)	(0.0063)	(0.0051)	(0.0094)	(0.0066)	(0.0063)	(0.0051)
Banking crisis	–0.2314	0.0644	–0.0283	–0.0789	–0.2612	0.0553	–0.0380	–0.0826
	(0.1625)	(0.1208)	(0.1441)	(0.0926)	(0.1628)	(0.1209)	(0.1443)	(0.0927)
Regional crisis × Bank exposure	0.0005	–0.0247	–0.0480	–0.0025				
	(0.0608)	(0.0448)	(0.0468)	(0.0356)				
Regional crisis × $\text{Bank exposure}_{t-1}$					0.1123*	0.0746**	0.0552	0.0170
					(0.0561)	(0.0431)	(0.0435)	(0.0334)
Macro variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR (2)	0.7047	0.0921	0.0907	0.0013	0.6089	0.0805	0.1128	0.1240
N	9,169	9,188	5,449	7,248	9,169	9,188	5,449	7,248

Notes:
* indicates significance at the 5 per cent level; ** indicates significance at the 10 per cent level. Time dummies included. All independent variables are first differenced. Instrument matrix is limited to four lags. Right-hand-side variables are treated as exogenous. AR (2) is the Arellano-Bond test for autocorrelation.

is having a crisis and has a macro characteristic beyond its threshold. The second variation (C_{2B}) of the index takes a value of one for each macro characteristic that the non-crisis country has in common with the country having a crisis.[24] The contemporaneous contagion index (C_{2A}) is only significant for loans, while (C_{2B}) is not. Inclusion of the lagged values is also considered (see Table 14). The results are remarkable. Both variations of the lagged (C_2) indexes are positively related to higher deposits, loans, and total claims (securities are unaffected). This result has two potential implications. The first is that banks react to information from crises in the same region, but only slowly, when conditioning on macro fundamentals, political risk, and the state-dependent nature of foreign claims. The second implication is that the reaction leads to higher exposures. This suggests that banks do not "panic" in the presence of crisis events. This result bears further investigation regarding the sensitivity of the results to alternative specifications of the "contagion" indexes and tests of the orthogonality of the indexes from macro fundamentals.

Conclusions

The objective of this paper was to examine the foreign-asset exposures of Canadian banks and to determine whether they react to information-based contagion. This study found that while Canadian banks are very active globally, they are less so than in the 1980s. Canadian banks have a lower proportion of exposures in the form of deposits and loans than in the 1980s, but higher levels of foreign securities. The reaction of Canadian banks' foreign exposures to crisis events is then explored. Banks' foreign exposures display considerable inertia, as banks only slowly adjust their portfolios. However, they react only weakly to changes in macro variables and political risk. This also translates into a lack of the effect of crises on their level of exposures, at least in the short run. There is preliminary evidence, however, that when countries share similar characteristics to countries in crisis, banks react to the event by raising the level of exposure. This result is noteworthy, since it suggests that banks do not panic in the face of crises.

This study raises a number of questions for future research. The most obvious extension is to explore why Canadian banks do not adjust their portfolios of foreign assets rapidly in response to crisis events or changes in macro fundamentals. It could be the case that the adjustment occurs either on their domestic balance sheet or off balance sheet. Second, the declining

24. The second contagion index, in this case, uses yearly data to compare threshold values of the macro variables. Ideally, quarterly data would be used, but they are not available for many of the relevant series.

Table 13
Benchmark model: GMM estimates, contagion index C_2
Dependent variable: Δ claims (by type)

	Contagion index C_{2A}: Similarly by number of countries in crisis in region				Contagion index C_{2B}: Similarly by number of macro variables in crisis in region			
Variable	**Deposits (1)**	**Loans (2)**	**Securities (3)**	**Total claims (4)**	**Deposits (5)**	**Loans (6)**	**Securities (7)**	**Total claims (8)**
$Claims_{t-1}$	0.1419*	0.2939*	0.3726*	0.3154*	0.1406*	0.3019*	0.3752*	0.3161*
	(0.0207)	(0.0198)	(0.0241)	(0.0190)	(0.0207)	(0.0198)	(0.0240)	(0.0190)
$Claims_{t-2}$	0.0285**	0.0945*	0.0536*	0.1120*	0.0278**	0.0983*	0.0535*	0.1123*
	(0.0153)	(0.0143)	(0.0179)	(0.0138)	(0.0153)	(0.0143)	(0.0179)	(0.0134)
$Claims_{t-3}$	–0.0071	0.0102	0.0124	0.0661*	–0.0073	–0.0130	0.0123	0.0662*
	(0.0135)	(0.0131)	(0.0170)	(0.0122)	(0.0135)	(0.0131)	(0.0170)	(0.0122)
$Claims_{t-4}$	0.0140	–0.0131	–0.0261	0.0293*	0.0139	–0.0103	–0.0260	0.0293*
	(0.0133)	(0.0132)	(0.0168)	(0.0120)	(0.0133)	(0.0132)	(0.0168)	(0.0120)
Political risk	0.0063	0.0069	–0.0059	0.0048	0.0063	–0.0061	–0.0061	0.0047
	(0.0102)	(0.0077)	(0.0091)	(0.0060)	(0.0103)	(0.0091)	(0.0091)	(0.0060)
Banking crisis	–0.2352	0.06551	–0.0049	–0.0870	–0.2294	–0.0063	–0.0063	–0.0883
	(0.1624)	(0.1236)	(0.1641)	(0.0946)	(0.1622)	(0.1642)	(0.1643)	(0.0946)
Contagion index	–0.0674	–0.1559*	–0.0289	0.0541	0.0054	0.0118	0.0118	0.0245
	(0.1054)	(0.0768)	(0.0981)	(0.0647)	(0.0544)	(0.0556)	(0.0556)	(0.0340)
Macro variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR (2)	0.2623	0.0678	0.1684	0.0500	0.2737	0.1674	0.1674	0.0052
N	9,169	9,188	5,449	7,248	9,169	9,188	5,449	7,248

Notes:
* indicates significance at the 5 per cent level; ** indicates significance at the 10 per cent level. Time dummies included. All independent variables are first differenced. Instrument matrix is limited to four lags. Right-hand-side variables are treated as exogenous. AR (2) is the Arellano-Bond test for autocorrelation.

Table 14
Benchmark model: GMM estimates, contagion index C_2
Dependent variable: Δ claims (by type)

	Contagion index C_{2A}: Similarly by number of countries in crisis in region				Contagion index C_{2B}: Similarly by number of macro variables in crisis in region			
Variable	**Deposits (1)**	**Loans (2)**	**Securities (3)**	**Total claims (4)**	**Deposits (5)**	**Loans (6)**	**Securities (7)**	**Total claims (8)**
$Claims_{t-1}$	0.1460*	0.2973*	0.3764*	0.3425*	0.1465*	0.3060*	0.3763*	0.3440*
	(0.0205)	(0.0196)	(0.0238)	(0.0186)	(0.0205)	(0.0196)	(0.0238)	(0.0186)
$Claims_{t-2}$	0.0304**	0.0938*	0.0538*	0.1190*	0.0311*	0.0971*	0.0538*	0.1205*
	(0.0152)	(0.0142)	(0.0177)	(0.0133)	(0.0152)	(0.0142)	(0.0177)	(0.0133)
$Claims_{t-3}$	–0.0050	0.0058	0.0109	0.0695*	–0.0050	0.0081	0.0107	0.0702*
	(0.0135)	(0.0131)	(0.0169)	(0.0122)	(0.0135)	(0.0131)	(0.0169)	(0.0122)
$Claims_{t-4}$	0.0161	–0.0119	–0.0258	0.0275*	0.0161	–0.0100	–0.0258	0.0277*
	(0.0132)	(0.0132)	(0.0165)	(0.0120)	(0.0132)	(0.0132)	(0.0165)	(0.0120)
Political risk	0.0064	0.0066	–0.0058	0.0041	0.0066	0.0070	–0.0058	0.0042
	(0.0103)	(0.0077)	(0.0090)	(0.0060)	(0.0103)	(0.0077)	(0.0090)	(0.0060)
Banking crisis	–0.2418	0.0526	–0.0076	–0.0949	–0.2537	0.0273	–0.0003	–0.1077
	(0.1625)	(0.1241)	(0.1631)	(0.0955)	(0.1627)	(0.1248)	(0.1633)	(0.0966)
Contagion $index_{t-1}$	0.1720*	0.1242**	–0.0301	0.1496*	0.1234*	0.0932*	–0.0443	0.1161*
	(0.0854)	(0.0711)	(0.0816)	(0.0546)	(0.0468)	(0.0398)	(0.0482)	(0.0300)
Macro variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AR (2)	0.3994	0.0554	0.1570	0.1280	0.3652	0.0484	0.1594	0.0495
N	9,169	9,188	5,449	7,248	9,169	9,188	5,449	7,248

Notes:
* indicates significance at the 5 per cent level; ** indicates significance at the 10 per cent level. Time dummies included. All independent variables are first differenced. Instrument matrix is limited to four lags. Right-hand-side variables are treated as exogenous. AR (2) is the Arellano-Bond test for autocorrelation.

level of internationalization also raises the question of why banks are accumulating higher claims on securities and lower claims in the form of deposits and loans. The exploration of these issues has important consequences for the Canadian financial system.

Appendix 1
Quarterly Crisis Dates (Preliminary)

Table A1.1

Country	Quarterly crisis dates
United States	
United Kingdom	84Q1
Austria	
Belgium	
Denmark	87Q2
France	94Q1
Germany	
Italy	90Q1
Netherlands	
Norway	87Q4
Sweden	91Q3
Switzerland	
Canada	83Q4
Japan	92Q4
Finland	91Q2
Ireland	
Portugal	86Q3
Turkey	82Q2
	91Q2
	94Q2
Australia	
New Zealand	87Q3
South Africa	85Q3
	89Q3
Chile	81Q3
Colombia	82Q2
Ecuador	80Q2
	95Q4
El Salvador	89Q1
Guatemala	91Q3
Honduras	
Mexico	82Q3
	84Q4
	94Q4
Paraguay	95Q2
Peru	83Q2
Uruguay	81Q3
Venezuela	94Q1
Guyana	93Q1
Jamaica	94Q4
Bahrain	
Cyprus	
Israel	77Q1
Jordan	89Q3

(cont.)

Table A1.1 (cont.)

Country	Quarterly crisis date
Syria	
Egypt	91Q2
Sri Lanka	89Q1
India	93Q2
Indonesia	94Q1
	97Q3
Korea	97Q4
Malaysia	85Q2
	97Q2
Nepal	88Q4
Philippines	81Q1
	97Q3
Singapore	82Q1
Thailand	83Q3
	97Q1
Burundi	94Q2
Congo	92Q3
Congo DR	91Q4
Kenya	85Q3
	91Q4
Mali	87Q2
	95Q2
Niger	83Q1
Nigeria	93Q2
Seychelles	
Senegal	88Q1
Swaziland	95Q1
Tanzania	
Uganda	94Q3
Zambia	95Q1
Papua New Guinea	

Source: Dow Jones Fortiva.

References

Ahluwalia, P. 2000. “Discriminating Contagion: An Alternative Explanation of Contagious Currency Crises in Emerging Markets.” International Monetary Fund Working Paper No. 00114.

Anderson, T.W. and C. Hsiao. 1981. “Estimation of Dynamic Models with Error Components.” *Journal of the American Statistical Association* 76 (375): 598–606.

Arellano, M. and S. Bond. 1991. “Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations.” *Review of Economic Studies* 58 (2): 277–97.

Armstrong, J. 1997. “The Changing Business Activities of Banks in Canada.” *Bank of Canada Review* (Spring): 11–38.

Bomfin, A.N. and W.R. Nelson. 1999. “Profits and Balance Sheet Developments at U.S. Commercial Banks in 1998.” *Federal Reserve Bulletin* 85 (6): 369–95.

Canadian Institute of Chartered Accountants. 2003. “CICA Handbook.” Toronto: Canadian Institute of Chartered Accountants.

Chen, Y. 1999. “Banking Panics: The Role of the First-Come, First-Served Rule and Information Externalities.” *Journal of Political Economy* 107 (5): 946–68.

Demirgüç-Kunt, A. and E. Detragiache. 1997. “The Determinants of Banking Crises: Evidence from Developing and Developed Countries.” International Monetary Fund Working Paper No. 97/106.

_____. 1998. “Financial Liberalization and Financial Fragility.” International Monetary Fund Working Paper No. 98/83.

_____. 2002. “Does Deposit Insurance Increase Banking System Stability? An Empirical Investigation.” *Journal of Monetary Economics* 49 (7): 1373–406.

Dornbusch, R., Y.C. Park, and S. Claessens. 2000. “Contagion: How It Spreads and How It Can Be Stopped.” *The World Bank Research Observer* 15 (2): 177–97.

Eichengreen, B. and C. Arteta. 2000. “Banking Crises in Emerging Markets: Presumptions and Evidence.” UC Berkeley. Photocopy.

Eichengreen, B. and A.K. Rose. 1998. “Staying Afloat When the Wind Shifts: External Factors and Emerging-Market Banking Crises.” National Bureau of Economic Research Working Paper No. 6370.

Freedman, C. 1998. *The Canadian Banking System*. Bank of Canada Technical Paper No. 81.

Furfine, C.H. 2001. “The Interbank Market During a Crisis.” Bank for International Settlements Working Paper No. 99.

Glick, R. and M. Hutchison. 1999. "Banking and Currency Crises: How Common Are Twins?" Center for Pacific Basin Monetary and Economic Studies Working Paper Series No. PB99–07. Federal Reserve Bank of San Francisco.

Goldberg, L.S. 2001. "When Is U.S. Bank Lending to Emerging Markets Volatile?" Federal Reserve Bank of New York Staff Report No. 119.

Hardy, C. and C. Pazarbasioglu. 1998. "Leading Indicators of Banking Crises: Was Asia Different?" International Monetary Fund Working Paper No. 98/91.

Hernandez, L.F. and R.O. Valdés. 2001. "What Drives Contagion: Trade, Neighborhood, or Financial Links?" International Monetary Fund Working Paper No. 01/29.

Jeanneau, S. and M. Micu. 2002. "Determinants of International Bank Lending to Emerging Market Countries." Bank for International Settlements Working Paper No. 112.

Kaminsky, G.L. and C.M. Reinhart. 2000. "On Crises, Contagion, and Confusion." *Journal of International Economics* 51 (1): 145–68.

Karolyi, G.A. 2003. "Does International Financial Contagion Really Exist?" *International Finance* 6 (2): 179–99.

King, R.G. and R. Levine. 1993. "Finance and Growth: Schumpeter Might Be Right." *Quarterly Journal of Economics* 108 (3): 717–37.

Northcott, C.A. 2002. "Estimating Settlement Risk and the Potential for Contagion in Canada's Automated Clearing Settlement System." Bank of Canada Working Paper No. 2002–41.

Palmer, D.E. 2000. "U.S. Bank Exposure to Emerging-Market Countries during Recent Financial Crises." *Federal Reserve Bulletin* 86 (2): 81–96.

Peek, J. and E.S. Rosengren. 2000. "Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States." *American Economic Review* 90 (1): 30–45.

Peria, M., A. Powell, and I. Hollar. 2002. "Banking on Foreigners: The Behavior of International Bank Lending to Latin America, 1985–2000." World Bank Working Paper No. 2893.

Powell, J. 1990. "The Evolving International Debt Strategy." *Bank of Canada Review* (December): 3–26.

Rajan, R.G. and L. Zingales. 1998. "Financial Dependence and Growth." *American Economic Review* 88 (3): 559–86.

Rigobon, R. 2003. "On the Measurement of the International Propagation of Shocks: Is the Transmission Stable?" *Journal of International Economics* 61 (2): 261–83.

Santor, E. 2003. "Banking Crises and Contagion: Empirical Evidence." Bank of Canada Working Paper No. 2003–01.

Schinasi, G.T. and R.T. Smith. 1999. “Portfolio Diversification, Leverage, and Financial Contagion.” International Monetary Fund Working Paper No. 99/136.

Upper, C. and A. Worms. 2000. “Estimating Bilateral Exposures in the German Interbank Market: Is There a Danger of Contagion?” Prepared for the BIS Autumn Central Bank Economists’ Meeting of the BIS on *Marrying the Macro- and Microprudential Dimensions of Financial Stability.* Bank for International Settlements.

Van Rijckeghem, C. and B. Weder. 2000. “Spillovers Through Banking Centers: A Panel Data Analysis.” International Monetary Fund Working Paper No. 00/88.