Contagion and the composition of Canadian banks' foreign asset portfolios: do financial crises matter?

Eric Santor*

Abstract

This paper uses a unique Bank of Canada panel data set to assess the impact of information-based contagion on the foreign asset exposures of Canadian banks. Specifically, banks' foreign asset exposures include loans, deposits and holdings of public and private securities from 1984 to 2003 on a quarterly basis vis-à-vis over 150 foreign jurisdictions. Preliminary results find that, conditional on fundamentals, banks do not adjust their overall asset portfolios immediately in the presence of crisis events. However, there is weak evidence that the composition of foreign claims adjusts in the presence of informational contagion.

1. 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 globalised, 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 witnessed a plenitude of banking, currency, financial and sovereign debt crises (Glick and Hutchinson (1999)). In particular, the recent Asian, LTCM and Russian crises focused the attention of policymakers and academics alike on the notion that contagion may have disruptive effects on global financial markets and ultimately, financial stability.

Unfortunately, little progress has been made on empirically identifying the existence of contagion (Karolyi (2003)). Simply, it is difficult to determine if the response of financial market participants to crisis events reflects the effects of interdependency, ie fundamentals, or that of "informational contagion." The objective of this paper is to address whether financial intermediaries respond to informational contagion above and beyond what is warranted by fundamentals. Three questions are considered. First, do Canadian bank's total foreign asset exposures respond to contagious crisis events? Second, do these banks adjust the composition of their portfolios? And third, does local information matter? That is, in response to crisis events, do locally booked claims respond more adversely than claims booked in the banks' head office?

* Eric Santor, International Department, Bank of Canada 234 Wellington, Ottawa, Canada K1A 0G9 Tel: (613) 782-7017 Fax: (613) 782-7658 Email: esantor@bankofcanada.ca. I would like to thank Jeannine Bailliu, Raphael Solomon and Larry Schembri for helpful comments. All remaining errors are my own. This paper reflects the views of the author, and not those of the Bank of Canada or its staff.

In order to address these questions, this paper uses a unique Bank of Canada panel data set on Canadian banks' foreign asset exposures. The data extend from 1984 to 2003 on a quarterly basis for a set of Canadian banks with claims in over 150 foreign jurisdictions. Banks' foreign asset exposures include loans and deposits vis-à-vis foreign firms, banks, and public sector entities, and holdings of public and private securities. Additionally, foreign asset exposures can be disaggregated into claims booked in the foreign jurisdiction and those booked in Canada. I find that, conditional on fundamentals, banks do not adjust their portfolios immediately in the presence of crisis events. This suggests that informational contagion is not an important determinant of Canadian bank portfolio behaviour. However, the composition of bank foreign asset portfolios adjusts in response to crisis events.

The paper will proceed as follows. Section 2 reviews the empirical literature on banking crises and contagion. Section 3 offers a theoretical framework for assessing the effects of crisis events on the composition of Canadian banks' portfolios. Section 4 presents the empirical model and Section 5 describes the data. Section 6 presents descriptive statistics and offers regression results of the effect of banking crises on the behaviour of Canadian banks' foreign asset exposures. Section 7 concludes and offers future avenues for research.

2. Literature review

The effect of crisis events and contagion on the behaviour and composition of Canadian foreign bank exposures has not been examined in the economics literature.[1] More generally, there are few empirical studies that examine the existence of contagion and banking crises.[2] The definition of contagion is, naturally, a source of some contention. For the purposes of this study, contagion will be defined in terms of "informational" contagion. In this case, informational contagion is the process by which the occurrence of an event in one market affects other markets, above and beyond the effect consistent with fundamentals. This definition of contagion seeks to distinguish itself from simple "interdependency", or "fundamentals-based" contagion.[3]

The evidence of informational contagion and bank behaviour is limited. At the macro-level, Santor (2003) assesses whether a banking crisis is more likely to occur when a country shares similar characteristics with another country experiencing a crisis. On average, the occurrence of a banking crisis leads to the higher likelihood of a future crisis if the countries appear similar in terms of macro fundamentals. However, the use of macroeconomic data prevents identification of the contagion effect separately from the common shocks that may be driving fundamentals.

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[1] Freedman (1998) and Armstrong (1997) describe Canadian banks' aggregate foreign currency exposures from the 1950s to the early 1990s, but the analysis does not extend to the level and composition of foreign asset exposures.

[2] Substantial empirical literature seeks to determine whether banking crises can be characterised and/or predicted. Demirgüç-Kunt and Detragiache (1997, 1998 and 2002), Eichengreen and Rose (1998), Eichengreen and Arteta (2000), Glick and Hutchinson (1999), Hardy and Pazarbasioglu (1998), Kaminsky and Reinhart (1998), and Hernandez and Valdes (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 and 2002) find that deposit insurance is positively related to banking crises, as is financial liberalisation. There is considerable empirical literature on the incidence of contagion in financial markets and with respect to currency crises. See Rigobon (1999) for a standard treatment.

[3] "Fundamentals-based" contagion is the process by which common shocks are propagated by real-side economic activity (Dornbusch, Park and Claessens (2000)).

Similarly, Van Rijckeghem and Weder (2000) provide evidence that capital flows to emerging markets are affected by the occurrence of banking crises, given that the affected countries share common lenders with the crisis country. Similarly, Peria, Powell and Hollar (2002) show that contagion can affect capital flows to emerging markets through the impact of domestic shocks. Specifically, the foreign claims of domestic banks are affected by shocks to the domestic economy. However, this effect has diminished over time, since they find that host country conditions matter more, and thus lending has become less "indiscriminate". This is due to the fact that an increasing proportion of foreign claims are booked in the foreign jurisdiction, and thus banks are more apt to take country effects into account. Lastly, 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 UK and US 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.[4]

A shortcoming of the studies cited above, and more generally for the current literature on banking crises and contagion, is that the empirical methodology often confounds the effects of real-side interdependencies with informational contagion (Karolyi (2003)). The objective of this paper is to mitigate this shortcoming: that is, to try to distinguish between the notion of "fundamentals-driven" contagion, and pure "informational" contagion. Simply, can one find empirical evidence that the arrival of information that is orthogonal to observed fundamentals leads to a change in the level and composition of foreign asset exposures of Canadian banks?

3. Theoretical framework

The motivating assumption of most empirical work on contagion and bank capital flows is that banks follow an optimal portfolio rule that responds to changes in fundamentals and, to some extent, to information. For example, Goldberg's (2001) framework is predicated on the assumption that banks follow a portfolio rule to determine the level and change in foreign asset exposures. Specifically, foreign asset exposures vary according to innovations in changes in foreign and domestic interest rates, and foreign and domestic GDP growth rates. Similarly, the aggregate level studies of foreign bank exposures using BIS data also implicitly invoke a "portfolio" theory of banks' foreign asset exposures. For example, these studies rely on the argument 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. Thus, the question then arises as to what kind of portfolio rules generate the responses typically cited in the contagion literature.

Schinasi and Smith (1999) offer a useful framework in which to place the expected behaviour of banks during crisis events. In their model, banks choose a portfolio with a position in risky assets.[5] The risky assets can be thought of as the foreign asset claims of banks to various countries. Given information at time t regarding the conditional joint normal returns over the means, variance, covariances and conditional correlations of the risky assets i and j, portfolio managers choose portfolio weights accordingly. Schinasi and Smith then describe three portfolio rules that bank managers could potentially follow: the expected return benchmarking

[4] At the micro-level, Goldberg (2001), Palmer (2000) and Bonfin and Nelson (1999) analyse the behaviour of the foreign asset exposure of US banks, but do not explicitly explore the composition of foreign asset exposures, nor their response to crisis events. A related literature explores the effects of contagion within the interbank market. For example, see Upper and Worms (2004).

[5] This section follows Schinasi and Smith (1999) directly.

rule, the tradeoff rule and the loss constraint rule. 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 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 increase) its foreign asset exposures to Colombia.

Given a "volatility event" (such as a banking crisis) which is defined as an event at time t which increases the variance of the asset at time $t + 1$, Schinasi and Smith show that different portfolio rules yield different portfolio rebalancing responses (Table 1).

Table 1

Effects of increases in volatility on return on asset *i*

	Correlation of returns of asset *i* and *j*	
Rule	**Positive correlation between assets *i* and *j***	**Negative correlation between assets *i* and *j***
Benchmark	Decrease in asset *i* Increase in asset *j*;	Decrease in asset *i* Increase in asset *j*;
Trade off	Decrease in asset *i* Increase in asset *j*;	Decrease in asset *i* Decrease in asset *j*;
Loss constraint	Decrease in asset *i* Ambiguous effect on asset *j*;	Decrease in asset *i* Ambiguous effect on asset *j*;

For instance, under both the benchmark and tradeoff 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 increase in asset j. If the correlation is negative, then under the benchmark rule the same result holds, while under the tradeoff rule the portfolio manager will reduce the position in both risky assets. Conversely, they 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 banks. Previous literature that has explored the effect of contagion has posited the notion 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 due to the occurrence of a crisis depends heavily on the portfolio rule utilised. Additionally, the current literature does not account for the fact that banks may adjust the composition of their portfolios. Simply, one cannot make claims with respect to the responses of banks to crisis events. Rather, the question must be addressed from an empirical perspective.

4. Empirical model of foreign bank exposures

4.1 Benchmark model

The empirical model used to assess the effects of crises on the optimal portfolio behaviour of Canadian banks follows Goldberg (2001). Utilising 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 domestic real interest rates and GDP growth. Thus, the foreign asset exposures of Canadian banks can be characterised by the following equation:

$$Exp_{ijt} = \alpha_{1i} + \alpha_{2r} + \sum_{i=1}^{k} \beta_i X_{it} + \sum_{j=1}^{l} \beta_j X_{jt} + \varepsilon_{ijt} \quad (1)$$

where Exp_{ijt} is the log of the real foreign asset exposure of bank i to foreign country j at time t, X_{jt} is a vector of foreign country macroeconomic variables and X_{it} is a vector of Canadian macroeconomic variables. Regional and bank fixed effects α_r and α_i are entered to account for regional and bank specific differences: some foreign regions may, regardless of fundamentals, attract larger claims.

4.2 Econometric issues

This framework can be augmented to better reflect the portfolio decisions made by banks. First, instead of specifying bank and regional effects, the data are broken 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. Second, to account for the possibility of state dependence in foreign asset exposures, (1) can be augmented to account for the fixed costs of commencing foreign claims, and the adjustment costs associated with their disposal. Third, to account for potential omitted variables, institutional characteristics can be included since financial intermediation could benefit from political stability and low levels of corruption. Thus, (1) is augmented as follows:

$$Exp_{ijt} = \alpha_{ij} + \lambda_k \sum_{i=1}^{K} Exp_{ijt-k} + \beta_1 X_{it} + \beta_2 X_{jt} + \delta Z_{jt} + \varepsilon_{ijt} \quad (2)$$

where α_{ij} is a bank-country fixed effect, Exp_{t-k} is a vector of lagged exposures, the X's are vectors of the macroeconomic characteristics of the foreign countries and Canada, 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.[6] Estimation of (2) is complicated by the inclusion of lagged dependent variables, which would necessarily be correlated to the error term. However, utilisation of standard 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.[7]

4.3 Measures of contagion

The benchmark model described above can be augmented to include a measure of contagion. But finding appropriate measures of informational contagion is problematic.

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[6] 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.

[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 question.

Ideally, the researcher would like to utilise a measure that captures a flow of information which would inform (rightly or wrongly) banks about the conditional moments of the return of assets but, at the same time, 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, conditioning 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 a simple measure of informational contagion. 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. However, simple inspection would suggest that if there were a common shock that caused the crisis in j then 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, then 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 (2) with the measure of informational contagion:

$$Exp_{ijt} = \alpha_{ij} + \lambda_k \sum_{i=1}^{K} Exp_{ijt-k} + \beta_1 X_{it} + \beta_2 X_{jt} + \delta Z_{jt} + \theta C_{jt} + \varepsilon_{ijt} \quad (3)$$

where C is the contagion measure. The measure C can also be augmented to include the amount of information that is generated by the crisis event. In this case, one could include the number of times the crisis is mentioned (or mentioned at all) in the interaction term. Crises that receive a greater number of "hits" in a newspaper database would take higher values of the index C. Similarly, crises that are not mentioned would receive lower "information" scores, and thus a lower value of C.[8]

Alternative contagion measures can also be considered. As suggested by Ahluwalia (2000), a measure of "informational contagion" can be defined building on the visible similarities argument: if two economies share similar characteristics, then the occurrence of a crisis in 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. Two variations of this index can be considered. The first variation (C_{2A}) creates the index such that it takes a value of one for each country in the region that 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.[9] Each measure of contagion will be considered in turn.

Empirical estimation of the effects of contagion is complicated by the problem of identification. In most contagion studies, correlation between the measure of contagion and

[8] Clearly, countries that are more systemically important would receive more news coverage, and thus provide more information. However, identification can be achieved if the effect occurs even when fundamentals are controlled for.

[9] 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.

other independent variables (such as macroeconomic variables) is likely. That is, the occurrence of a crisis in the same region as the affected country is typically correlated with macroeconomic outcomes in the same region, thus complicating identification. However, identification of the individual country effects from the contextual effects (a regional crisis or contagion index, for example) is possible if there is a non-linear relationship between the respective effects (Brock and Durlauf (2001) and (2007)). Specifically, Brock and Durlauf show that if non-linearities exist, then this is a sufficient condition for identification. To test for the presence of non-linearities between the contagion index and the individual-level country effects, a RESET test can be conducted.

5. Data

The foreign asset exposures for all Canadian banks come from the consolidated quarterly banking statistics report compiled by the Bank of Canada.[10] Foreign asset exposures include all claims to every foreign jurisdiction where exposures exist. This includes deposits to other financial institutions, loans to financial institutions and firms, and securities, both government and corporate. These data are collected by location of booking: the foreign jurisdiction or at the Canadian head office. The data cover all Canadian banks' exposures to over 150 jurisdictions from 1984 to 2003.[11] Additional bank balance sheet data are collected, including assets, market capitalisation, and other bank specific characteristics.

The macroeconomic data are from the International Financial Statistics and include standard measures of 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 includes measures of bureaucratic quality, corruption, democracy, investor protection, law and order, and stability, which are combined into an overall measure of political risk from 1984 to the present.

Banking crisis dates are initially taken from Glick and Hutchinson (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 is only reported yearly. To better capture the exact timing of the crisis dates, an alternative dating system is used. Using Dow Jones Factiva, the date of a crisis is determined by the occurrence of the first event that is mentioned in the Dow Jones Factiva 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. Furthermore, the intensity of the information can be assessed by examining the number of "hits" in the database. That is, how many times the crisis event is mentioned, and how long it persists.

6. Descriptive statistics

The descriptive statistics would suggest, at a glance, that Canadian banks are extensively globalised. Table 2 lists a sample of the countries to which Canadian banks had foreign

[10] Consolidation is conducted as per guidelines in the Canadian Institute of Chartered Accountants Guide. Foreign claims of domestic Canadian banks are adjusted to account for exchange rate revaluation.

[11] While there are over 50 banks operating in Canada, six banks account for 92% of the assets and 96% of all foreign exposures. The focus of this analysis is on the six largest banks in Canada. For the United States, Goldberg finds that the largest 10 banks account for 86% of foreign exposures.

asset claims in 2002.[12] However, the extent of exposures has actually declined, relative to its peak in the 1980s. Table 3 lists the average, mean and median number of countries that each Canadian bank had foreign claims on from 1984 to 2002.[13] The size and extent of these foreign claims is considerable: total foreign claims, in constant 1997 dollars, were over $200 billion in 1984, rising to over $477.2 billion in 2002 (see Figure 1). As a percentage of total assets, however, the trend in foreign assets is quite stable. Figure 2 shows that foreign asset exposures in 2002 constituted 33% of total assets for Canadian banks. This is similar to the reported levels in the 1990s, but is considerably lower than the average of the 1980s, and is below its peak in 1984.

Table 2

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

Industrialised countries	Latin America	Asia	Offshore banking centres
United States	Argentina	Sri Lanka	Bahamas
United Kingdom	Brazil	India	Barbados
Austria	Chile	Indonesia	Bermuda
Belgium	Colombia	Korea	Cayman Islands
Denmark	Ecuador	Philippines	
France	El Salvador	Singapore	
Germany	Guatemala	Thailand	
Italy	Honduras		
Netherlands	Mexico		
Norway	Paraguay		
Sweden	Peru		
Switzerland	Uruguay		
Japan	Venezuela		
Finland	Guyana		
Ireland	Jamaica		
Portugal			
Turkey			
Australia			
New Zealand			

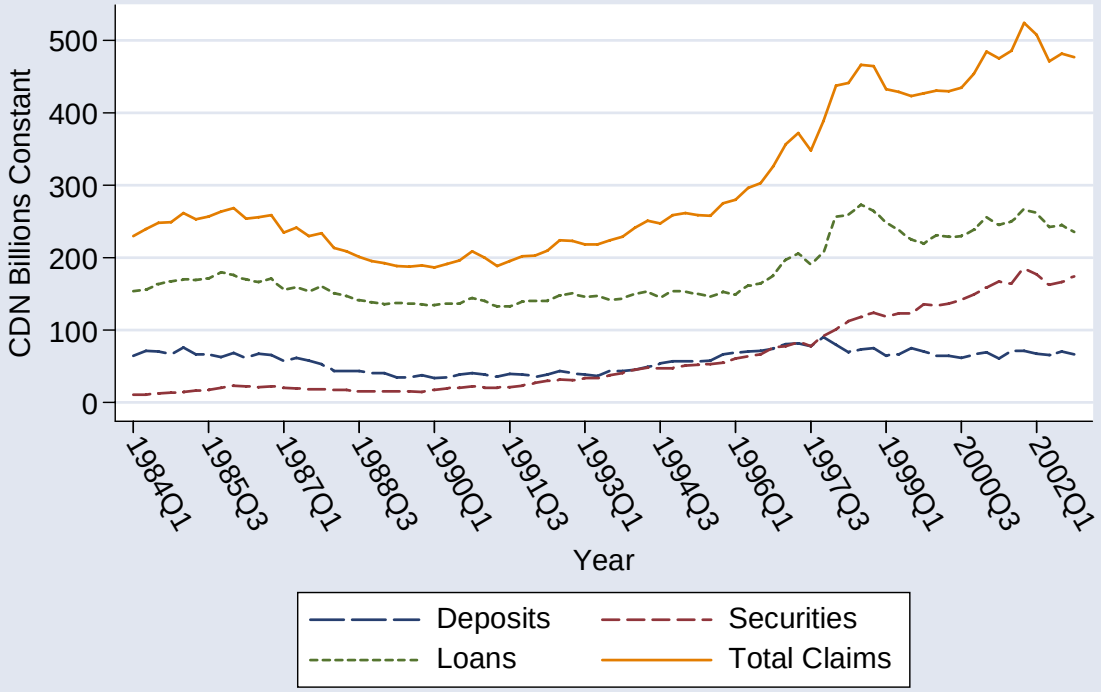
Source: Bank of Canada.

The composition of foreign asset exposures is also important to consider. Focusing only on deposits and loans, the proportion of exposures-to-assets has fallen, from 42% to only 21% from 1984 to 2002 (Figure 2). The rise in the holding of foreign securities accounts for much of the rise in total claims in the 1990s. Since foreign securities are predominated by US Treasuries, one could argue that banks have become less exposed to foreign risk (at least if one considers US T-Bills to be the most risk-free security in existence).

[12] Overall, banks reported claims to over 159 countries.

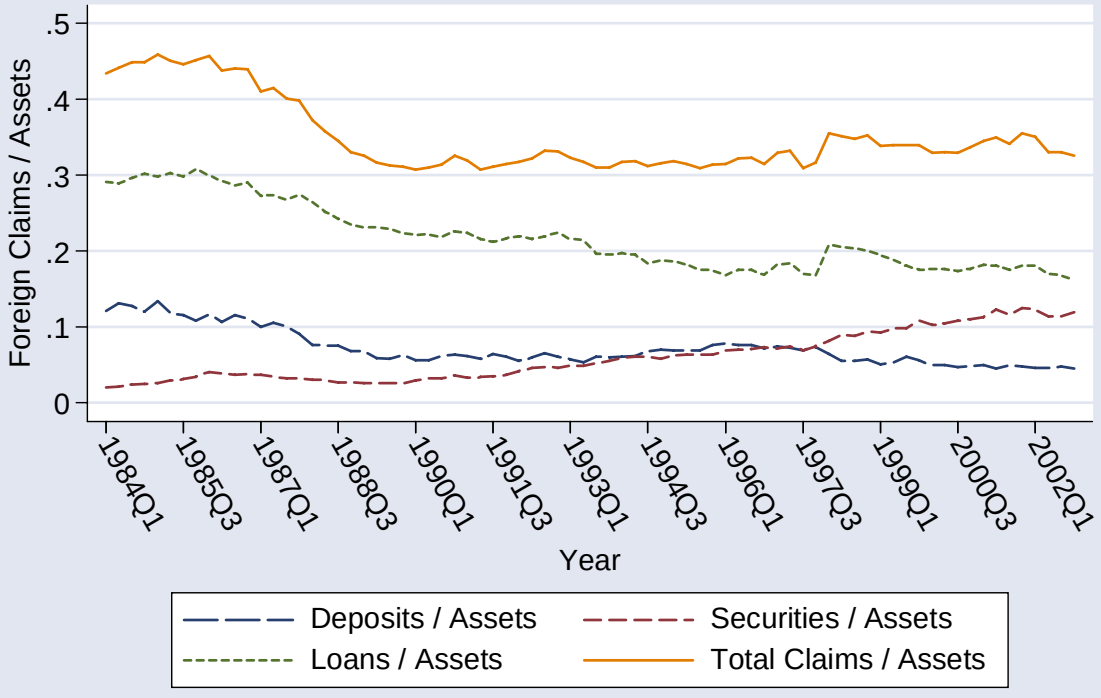
[13] In terms of the panel to be estimated, this means that there will be at least 360 ij panels with a time dimension t of 76.

Figure 1: Foreign Claims, All Banks 1984-2002



Source: Bank of Canada

Figure 2: Foreign Claims / Assets, All Banks 1984-2002



Source: Bank of Canada

Table 3

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

Year	All banks	
	Mean	Median
1984	41	33
1985	40	30
1986	38	31
1987	36	28
1988	33	22
1989	31	20
1990	28	15
1991	27	15
1992	28	16
1993	27	17
1994	27	18
1995	30	22
1996	32	23
1997	33	21
1998	33	22
1999	32	18
2000	31	21
2001	30	23
2002	30	20

Source: Bank of Canada.

The value of foreign exposures by region is shown in Figure 3. The United States accounts for the majority of exposures at $295.7 billion in 2002, which is around 60% of total foreign exposures.[14] The increase in total claims is attributable to larger holdings of securities, particularly after 1994. The balance of remaining exposures occurs in the industrialised countries, Latin America and East Asia. The evolution of foreign claims to the industrialised countries follows that of the United States somewhat, with all claim types showing significant growth after 1993. 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 last few years (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. However, the impact of the Asian crisis is felt, as loans eased and deposits plummeted after 1997.[15] Lastly, the origin of booking has

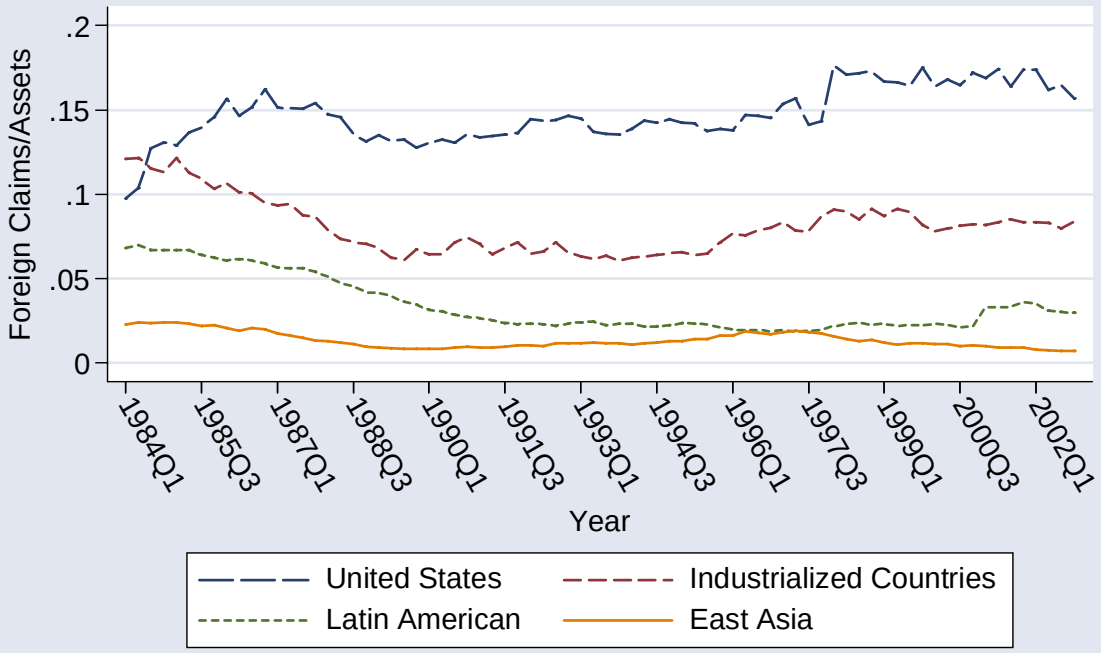
[14] The secular increase, absolutely and proportionally, in US assets suggests that Canadian banks are not holding these assets simply due to their higher returns. Rather, it could be the case that US assets, in particular T-Bills, are held for other reasons, such as collateral or for derivatives trading purposes. Future research on the determinants of these holdings of US assets is warranted.

[15] The level of exposures to Africa and the Middle East is negligible.

changed over the sample period. The ratio of claims booked inside Canada has fallen relative to the ratio of claims booked outside Canada (Figure 4).

Figure 3: Foreign Claims / Assets by Region

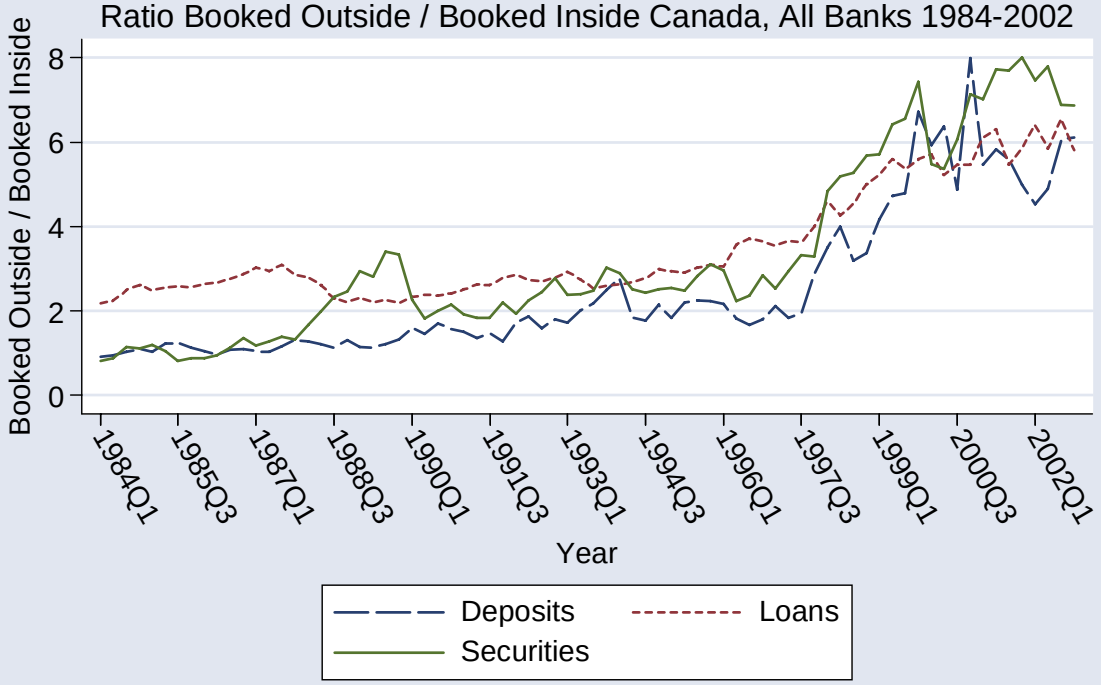
All Banks 1984-2002



Source: Bank of Canada

Figure 4: Foreign Asset Exposures

Ratio Booked Outside / Booked Inside Canada, All Banks 1984-2002



Source: Bank of Canada

The crisis dates, and additional information about the prominence of the crises are indicated by the number of "hits" in Dow Jones Factiva. The number of hits closely follows the occurrence of crises in the respective regions. For example, the number of hits for articles describing banking crises in East Asia rises sharply in 1997, and then slowly abates.[16] This information can be used in conjunction with the crisis dates to assess whether informational contagion exists.

7. Does contagion exist? Regression results

The results of estimating the benchmark model of foreign asset exposures (equation (2)) by GMM in first differences is presented in Table 4. 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 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.[17] Four lags of the dependent variable 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 variable, and the maximum number of lagged instruments is set at six.[18]

For the entire sample of countries, the results show that previous levels of exposures are significant determinants of changes in the level of foreign asset exposures, 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.[20]

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. This suggests that as the Canadian economy offers higher returns to domestic lending, funds lent to other countries' banks are reduced. Except for the foreign real interest rate, the effect of the macro variables on loans is not significant. Foreign exposures in the form of securities are not correlated to foreign or domestic interest rates, or foreign or Canadian GDP growth.[21] Lastly, changes in political risk have no effect on foreign exposures.

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16 The details of the search mechanism used are available from the author upon request.

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

18 Inclusion of four lags of the dependent variable was sufficient to remove second order autocorrelation for most specifications.

19 Only the largest 73 countries, in terms of exposures, are considered.

20 These differences are statistically significant when comparing loans and deposits to securities.

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

Table 4
Benchmark model: GMM estimates
Dependent variable: ΔClaims (by type)

Variable	Deposits (1)	Loans (2)	Securities (3)	Total claims (4)
Claims $_{t-1}$	0.1470*	0.1871*	0.3160*	0.2122*
	(0.0212)	(0.0192)	(0.0224)	(0.0194)
Claims $_{t-2}$	0.0260**	0.0944*	0.0233*	0.0670*
	(0.0148)	(0.0125)	(0.0144)	(0.0120)
Claims $_{t-3}$	–0.0083	–0.0298*	0.0460*	0.0399*
	(0.0126)	(0.0110)	(0.0135)	(0.0103)
Interest Rate$_{FOR}$	0.1206	0.6165*	–0.2708	0.3737
	(0.5628)	(0.2965)	(0.4026)	(0.2353)
GDP$_{FOR}$	–0.3041	–0.0485	–0.0560	–0.4301
	(0.568)	(0.3850)	(0.4259)	(0.2917)
Interest Rate$_{CAN}$	1.4606	0.8230	–1.9037	–0.5436
	(1.9680)	(1.4371)	(1.4095)	(1.0567)
GDP$_{CAN}$	–1.8887**	0.6195	–0.8466	–0.4393
	(1.0998)	(0.7915)	(0.7348)	(0.5794)
Political Risk	0.0042	0.0097	–0.0004	–0.0018
	(0.0090)	(0.0064)	(0.0062)	(0.0048)
AR(2)	0.6390	0.0000	0.0000	0.2238
N	9536	9522	5574	11508

* indicates significance at the 5% level, ** indicates significance at the 10% level. Time dummies included. All independent variables are first differenced. Instrument matrix is limited to 6 lags. Right-hand variables are treated as exogenous. *AR*(2) is the Arellano-Bond test for autocorrelation.

The sample is then broken down into two groups to examine whether banks respond differently to changes in fundamentals depending on whether the assets are booked in the head office of the Canadian bank (booked inside) or if the claim is booked locally in the foreign jurisdiction (booked outside). Recent anecdotal evidence has suggested that locally booked claims should be less sensitive to contagion and more reliant on fundamentals. Table 5 presents the results, by asset type, for claims booked inside and outside Canada. Deposits booked inside Canada have higher persistence than claims booked outside Canada – this may reflect the fact that booking at head office may be over longer maturities. With respect to fundamentals, deposits booked inside Canada do not respond to macro variables. However, deposits booked outside Canada respond negatively to changes in the real interest rate and Canadian GDP growth. The former is counterintuitive, as higher interest rates should draw more deposits. The latter suggests that higher Canadian GDP growth leads to a substitution away from foreign deposits for the higher returns to lending in Canada. Loans booked inside Canada are also more persistent that those booked outside. Interestingly, loans booked inside Canada fall as foreign interest rates rise, while the opposite is true for those booked in the foreign jurisdiction. There are no significant differences in the behaviour of securities by place of booking. Lastly, overall claims are less persistent when booked outside Canada. This stands in contradiction to the anecdotal evidence that claims booked locally will be less sensitive than claims booked inside Canada.

Table 5
Benchmark model: GMM estimates
Dependent variable: ΔClaims (by type)

	Booked inside Canada				Booked outside Canada			
Variable	**Deposits (1)**	**Loans (2)**	**Securities (3)**	**Total claims (4)**	**Deposits (1)**	**Loans (2)**	**Securities (3)**	**Total claims (4)**
Claims $_{t-1}$	0.2423*	0.2114*	0.2040*	0.3550*	0.0285*	0.1103*	0.3219*	0.1237*
	(0.0208)	(0.0241)	(0.0299)	(0.0198)	(0.0211)	(0.0216)	(0.0259)	(0.0180)
Claims $_{t-2}$	0.0231	0.0666*	0.0069	0.0370*	–0.0106	0.0200	–0.0024	–0.0060
	(0.0149)	(0.0165)	(0.0206)	(0.0132)	(0.0157)	(0.0129)	(0.0158)	(0.0119)
Claims $_{t-3}$	–0.0037	0.0306**	0.0432*	0.0445*	–0.0641*	–0.0918	–0.0122	–0.0029
	(0.0137)	(0.0143)	(0.0207)	(0.0121)	(0.0137)	(0.0118)	(0.0149)	(0.0107)
Int Rate$_{FOR}$	–0.2152	–0.0218	0.0559	–0.1278	–2.0188*	0.4729*	–0.5092	0.0560
	(0.6861)	(0.4761)	(0.3073)	(0.4174)	(0.7815)	(0.2381)	(0.4891)	(0.2550)
GDP$_{FOR}$	–0.5146	–1.1012**	0.6883	–0.4615	0.9024	0.4180	0.2042	0.0968
	(0.7247)	(0.6658)	(0.4401)	(0.5269)	(0.7306)	(0.3041)	(0.4616)	(0.3199)
Int Rate$_{CAN}$	2.8204	0.2699	–0.0810	4.8037*	0.3106	0.8680	–0.3046	0.1416
	(2.2556)	(2.3231)	(1.3195)	(1.8131)	(2.1643)	(1.1350)	(1.4437)	(1.1076)
GDP$_{CAN}$	1.4182	0.5547	–1.0698	–0.0846	–2.3541**	0.3378	–1.0573	–0.8502
	(1.3451)	(1.2930)	(0.6869)	(1.0086)	(1.2401)	(0.6230)	(0.7599)	(0.6146)
Pol Risk	0.0074	0.0065	0.0006	0.0059	0.0381*	–0.0009	–0.0002	0.0087**
	(0.0111)	(0.0109)	(0.0050)	(0.0085)	(0.0108)	(0.0052)	(0.0070)	(0.0052)
AR(2)	0.2489	0.8470	0.2849	0.9697	0.1237	0.5028	0.0000	0.0065
N	7720	6964	2029	10606	7320	7800	4688	9823

* indicates significance at the 5% level, ** indicates significance at the 10% level. Time dummies included. All independent variables are first differenced. Instrument matrix is limited to 6 lags. Right-hand variables are treated as exogenous. *AR*(2) is the Arellano-Bond test for autocorrelation. Booked inside Canada refers to claims booked at head office. Booked outside Canada refers to claims booked in the foreign jurisdiction at a branch of the bank.

The lack of significant relationships between macro fundamentals and claims may be related to the fact that banks' portfolio rules behave differently by market. Table 6 presents estimates of equation (2) with the sample divided by region. The most striking feature is the persistence of exposures to the United States and Japan when compared to the other industrialised counties. While Latin America has high initial persistence, this is short-lived. The results suggest varying effects for macro variables on exposures. For the United States, total claims only respond positively to higher Canadian interest rates – this may be because higher interest rates are related to slower economic growth in Canada, particularly during the 1991 recession. In this environment, banks may have substituted with US claims, and in particular, securities. For industrialised countries and Asia, higher foreign GDP is negatively related to total claims, a counterintuitive result. However, the positive coefficient on the foreign interest rate suggests substitution towards higher returns in the case of Asia. Overall, while there is some variation across regions, the effect of macro fundamentals on the level of exposures is not strong.

Table 6
Benchmark model: GMM estimates
Dependent variable: ΔTotal Claims (by type)

Variable	United States (1)	Industrialised countries (2)	Asia (3)	Latin America (4)	Japan (5)
Claims $_{t-1}$	0.5328*	0.1567*	0.0644*	0.4955*	0.3331*
	(0.0310)	(0.0193)	(0.0273)	(0.0312)	(0.0415)
Claims $_{t-2}$	0.2335*	0.0400*	0.0818*	0.0399	0.2254*
	(0.0299)	(0.0136)	(0.0209)	(0.0286)	(0.0422)
Claims $_{t-3}$	0.1608*	0.0140	–0.0088	0.0444	0.0859*
	(0.0290)	(0.0120)	(0.0202)	(0.0283)	(0.0410)
Int Rate$_{FOR}$	1.2965	0.2859	1.4656*	0.0126	–1.3624
	(2.5989)	(0.2915)	(0.5234)	(0.1527)	(3.9010)
GDP$_{FOR}$	–0.7154	–0.8396*	–0.6159**	0.3922	1.6076
	(1.8746)	(0.3940)	(0.3835)	(0.2521)	(2.1255)
Int Rate$_{CAN}$	2.9004**	1.2051	–3.4720	1.9297	–1.7145
	(1.7314)	(1.3536)	(2.5446)	(1.9427)	(2.7667)
GDP$_{CAN}$	–0.0152	–0.2241	0.4598	–0.5880	–3.6101*
	(0.8315)	(0.6602)	(1.1304)	(0.8704)	(1.4877)
Pol Risk	–0.0089	–0.0048	–0.0095	0.0053	–0.0064
	(0.0074)	(0.0059)	(0.0077)	(0.0067)	(0.0098)
AR(2)	0.0300	0.0003	0.1336	0.2523	0.0128
N	687	8652	2461	1642	640

* indicates significance at the 5% level, ** indicates significance at the 10% level. Time dummies included. All independent variables are first differenced. Instrument matrix is limited to 4 lags. Right-hand variables are treated as exogenous. *AR*(2) is the Arellano-Bond test for autocorrelation.

The impact of banking crises and contagion is presented in Table 7. For all countries (specifications (1) through (4)), the occurrence of a contemporaneous banking crisis does not affect foreign asset exposures. 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. When the contemporaneous contagion index (C_1) is entered, there is no evidence of contagion. This could be due to the fact that banks do not adjust their exposures immediately, but only slowly over time.[22] That is, when a country in the same region experiences a crisis and the bank has an exposure to the crisis country, it 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 the reaction to the crisis event. To account for this effect, the contagion index is entered with a lag. Strikingly, the effect is positive only for deposits: a crisis in another country in the region leads to higher deposits in the non-crisis countries.

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

Table 7
Benchmark model: GMM estimates, contagion index C_1
Dependent variable: ΔClaims (by type)

	All countries				Developing countries			
Variable	**Deposits (1)**	**Loans (2)**	**Securities (3)**	**Total Claims (4)**	**Deposits (5)**	**Loans (6)**	**Securities (7)**	**Total claims (8)**
Model 1								
Banking crisis	–0.0057	0.1159	0.2094	–0.0716	0.0417	0.0429	–0.2682	0.0180
	(0.1849)	(0.1406)	(0.1683)	(0.1062)	(0.2557)	(0.1629)	(0.2243)	(0.1352)
Regional Crisis x Bank Exposure (C_1)	0.0203	–0.0489	0.0000	–0.0348	–0.2375*	–0.0315	0.0977	–0.0740
	(0.0472)	(0.0381)	(0.0379)	(0.0286)	(0.0958)	(0.0623)	(0.0697)	(0.0515)
Model 2								
Banking crisis	–0.0155	0.0767	0.2112	–0.0950	0.0407	0.0266	–0.2945	0.0246
	(0.1866)	(0.1419)	(0.1699)	(0.1067)	(0.2539)	(0.1600)	(0.2223)	(0.0478)
Regional Crisis x Bank Exposure$_{t-1}$ (C_1)	0.0875*	0.0151	–0.0143	–0.0249	–0.2581*	0.0370	0.1748*	–0.0942*
	(0.0424)	(0.0340)	(0.0330)	(0.0252)	(0.0933)	(0.0585)	(0.0659)	(0.0478)

* indicates significance at the 5% level, ** indicates significance at the 10% level. Lagged claims, macroeconomic variables, political risk and time dummies included. All independent variables are first differenced. Instrument matrix is limited to 6 lags. Right-hand variables are treated as exogenous. C_1 is interaction of a regional crisis with shared exposures and the number of "hits" the crisis event received in the DJ Factiva database.

The lack of significance may be the result of sample choice: perhaps crises only matter for developing countries. The model is re-estimated for developing countries only (specifications (5) through (8)). For the lagged contagion index the effect on deposits is now negative, but securities are positive, leading to an overall negative effect for total claims. This suggests that the occurrence of a crisis in another country in the same region where the bank has claims, when controlling for fundamentals, leads to a reduction in those claims.

To check the robustness of this result, the second contagion index (C_2) is estimated (Table 8). 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 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.[23] For all countries, the contemporaneous contagion indices C_{2A} and C_{2B} are only significant for deposits (and are the opposite of the expected sign). Inclusion of the lagged values of the contagion index is also considered. Both variations of the lagged C_2 indices are negatively related to securities, but are insignificant for the other types of claims. This result has two potential implications. First, banks do react to information from crises in

[23] 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.

the same region, but only slowly, when conditioning on macro fundamentals, political risk and the state-dependent nature of foreign claims. And second, the reaction leads to lower exposures to securities. This suggests that banks do not "panic" in the presence of crisis events. The estimates are repeated for the developing countries with roughly similar results (Table 10), with the notable exception that there is a small, negative correlation between the lagged contagion index (C_{2A}) and total claims. However, for contagion C_{2B}, the effect is negative but insignificant. Interestingly, the effect on loans is positive in this latter case. Nevertheless, these results bear further investigation regarding the sensitivity of the results to alternate specifications of the "contagion" indices, and tests of the orthogonality of the indices from macro fundamentals.

Table 8
Benchmark model: GMM estimates, contagion index C_2
Dependent variable: ΔClaims (by type)

Variable	Contagion index C_{2A}: Similarity by number of countries in crisis in region				Contagion index C_{2B}: Similarity by number of macro variables in crisis in region			
	Deposits (1)	**Loans (2)**	**Securities (3)**	**Total claims (4)**	**Deposits (5)**	**Loans (6)**	**Securities (7)**	**Total claims (8)**
All countries								
Model 1								
Contagion Index (C_2)	0.0480*	–0.0092	–0.0271	–0.0101	0.0245*	–0.0034	–0.0093	0.0033
	(0.0239)	(0.0188)	(0.0213)	(0.0145)	(0.0120)	(0.0098)	(0.0119)	(0.0075)
Model 2								
Contagion Index$_{t-1}$ (C_2)	0.0098	0.0050	–0.0571*	–0.0027	0.0068	0.0080	–0.0304*	0.0085
	(0.0238)	(0.0187)	(0.0208)	(0.0144)	(0.0119)	(0.0096)	(0.0115)	(0.0073)
Developing countries only								
Model 1								
Contagion Index (C_2)	0.0900*	0.0293	–0.0103	–0.0250	0.0685*	0.0232	–0.0129	–0.0062
	(0.0445)	(0.0258)	(0.0293)	(0.0217)	(0.0299)	(0.0180)	(0.0229)	(0.0151)
Model 2								
Contagion Index$_{t-1}$ (C_2)	0.0195	0.0363	–0.0235	–0.0453*	0.0000	0.0399*	–0.0141	–0.0156
	(0.0453)	(0.0255)	(0.0290)	(0.0215)	(0.0295)	(0.0175)	(0.0216)	(0.0146)

* indicates significance at the 5% level, ** indicates significance at the 10% level. Lagged claims, macroeconomic variables, political risk, banking crisis dummies and time dummies included. All independent variables are first differenced. Instrument matrix is limited to 6 lags. Right-hand variables are treated as exogenous.

Table 9
Benchmark model: GMM estimates, contagion index C_1
Dependent variable: ΔClaims (by type)

	Booked in Canada				Booked in foreign jurisdiction			
Variable	**Deposits (1)**	**Loans (2)**	**Securities (3)**	**Total claims (4)**	**Deposits (5)**	**Loans (6)**	**Securities (7)**	**Total claims (8)**
All countries								
Banking crisis	0.2684*	–0.1907*	–0.1090**	0.1650*	–0.4239*	–0.0366	–0.0138	–0.1495*
	(0.0982)	(0.0892)	(0.0594)	(0.0730)	(0.1043)	(0.0497)	(0.0744)	(0.0489)
Regional Crisis x Bank Exposure $_{t-1}$ (C_1)	0.0214	–0.0071	0.0231**	0.0011	0.0478	0.0237	–0.0516*	0.0399*
	(0.0371)	(0.0317)	(0.0117)	(0.0252)	(0.0339)	(0.0165)	(0.0233)	(0.0155)
Developing countries								
Banking crisis	0.0427	–0.0359*	–0.0266	0.2977*	–0.5245*	0.0504	0.2117	–0.1171
	(0.2228)	(0.1523)	(0.0788)	(0.1225)	(0.2113)	(0.0848)	(0.1687)	(0.0826)
Regional Crisis x Bank Exposure$_{t-1}$ (C_1)	0.0921**	0.0278	0.0033	–0.0413	0.0794*	0.0574*	–0.0621	0.0680*
	(0.0497)	(0.0343)	(0.0096)	(0.0295)	(0.0473)	(0.0196)	(0.0389)	(0.0201)

* indicates significance at the 5% level, ** indicates significance at the 10% level. Lagged claims, macroeconomic variables, political risk and time dummies included. All independent variables are first differenced. Instrument matrix is limited to 6 lags. Right-hand variables are treated as exogenous. C_1 is interaction of a regional crisis with shared exposures and the number of "hits" the crisis event received in the DJ Factiva database.

8. Conclusions

The objective of this paper was to examine the foreign asset exposures of Canadian banks and to determine whether they react to informational 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: 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. However, there is preliminary evidence that when countries share similar characteristics to countries in crisis, banks react to the event by changing the composition of their exposures, but only slowly. This result is striking, as it suggests that banks do not panic in the face of crises. Interestingly, foreign claims booked inside Canada were more persistent than claims booked in the foreign country.

This study raises many 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 steady level of internationalisation also raises the simple question as to 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.

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