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PURE CONTAGION EFFECTS IN INTERNATIONAL BANKING: THE CASE OF BCCI'S FAILURE

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We test for pure contagion effects in international banking arising from the failure of the Bank of Credit and Commerce International (BCCI), one of the largest bank failures in the world. We focused on large individual banks in three developed countries where BCCI had established operations, namely the UK, the US, and Canada. Using event study methodology, we tested for contagion effects using time windows surrounding several known BCCI-related announcements. Our analysis provides strong evidence of pure contagion effects in the UK, which have arisen prior to the official closure date. In contrast, there is no evidence of pure contagion effects in the US and Canada.

JEL classification codes: G21, G28
Key words: bank failures, pure contagion effects, event study methodology, abnormal returns

I. Introduction

The failure of a large bank can undermine public confidence in the banking system as a whole, which may in turn threaten the stability of the financial system by causing runs on other banks. Such runs may be reflected in the form of negative abnormal returns or higher volatility of the stock returns of

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the banks concerned, known as ‘contagion’ effects. Benston (1973), and Aharony and Swary (1983) suggest two major causes for bank failures, namely fraud and internal irregularities that are unrelated across banks, and losses due to risky loans and investments. Contagion effects arising from a bank failure caused by fraud and internal irregularities are known as ‘pure’ contagion effects.

BCCI’s failure was due to massive fraud,[1] and is one of the largest bank failures that have taken place worldwide. BCCI was ranked the 7th largest private bank, the 83rd largest in Europe and the 192nd worldwide, with total assets which amounted to $20billion located in more than 400 offices in 73 countries (The Banker, September 1991, page 12). It was the largest bank registered in Luxembourg and the Cayman Islands. It traded internationally through companies registered in these two countries, each of which was audited by different accountants. The BCCI group was managed from its headquarters in London.[2] At the end of 1986, the Capital Intelligence of Switzerland rated it as ‘Beta’. Anecdotal evidence of contagion effects due to the BCCI’s collapse appeared in several financial press reports. For instance, according to a Financial Times article (24/7/91), the ‘…ripple effect from the BCCI closure washed over National Homes Loans whose shares fell from 69p to 38p’.[3] As BCCI was a multinational bank, the repercussions of its failure were truly international in scope. With branches and subsidiaries being located in many countries, the regulation and supervision of its activities were undertaken by different national supervisory bodies across countries. Communication and

[1] Hall (1991).

[2] On 5 July 1991, the BCCI group comprised: 1. BCCI Holdings (Luxembourg) S.A. (BCCI Holdings) incorporated in Luxembourg, the holding company of the group. 2. BCCI S.A., one of the principal operating subsidiaries of BCCI Holdings, with 47 branches located in 15 countries. 3. BCCI (Overseas) Ltd. (BCCI Overseas), the other principal operating subsidiary of BCCI Holdings, with 63 branches located in 28 countries. 4. Other affiliates and subsidiaries of BCCI Holdings, which operated 255 banking offices in about 30 countries, including Credit and Finance Corporation. ICIC Overseas and ICIC Holdings were companies incorporated in the Cayman Islands. They were not subsidiaries of BCCI Holdings but had a close working relationship with the BCCI group.

[3] Also, the Observer (28/7/91) reported that shares of three banks fell significantly after BCCI’s collapse.

action coordination of the home supervisor with other supervisors may affect the effectiveness in preventing contagion effects arising from the failure of a multinational bank.

The paper focuses on three developed economies where BCCI had established operations, namely the US, the UK and Canada. The analysis considers the three largest individual banks in each country, and examines whether there are pure contagion effects using event study methodology, namely considering time windows surrounding known BCCI-related events and announcements. Although the closure of BCCI was announced on 5 July 1991, earlier events might well have signaled that the closure was imminent, causing negative abnormal returns (ARs) and cumulative abnormal returns (CARs) to arise prior to the closure date. We identify such earlier events and test for contagion effects, which might have arisen at these earlier dates. We have found strong evidence of pure contagion effects in the UK and no evidence in the US and Canada. Importantly, for the US and the Canadian banks, there is no evidence of contagion effects either in terms of negative ARs and CARs or in terms of volatility increase. The contagion effects in the UK have arisen prior to the closure date, following a BCCI-related announcement in October 1990, which suggested fraud of a large scale in the bank's operations. Capital markets in the UK appear to have reacted negatively to this announcement, fully impounding this information into all three UK banks' share prices. Our UK results are in line with the Bingham Report commissioned in the UK following BCCI's closure, which raised several issues regarding the supervision of BCCI in the UK. The event of the closure on 5 July 1991 does not appear to convey new information about BCCI. The lack of contagion effects in the US and Canada suggests that the regulatory measures in these countries are sufficient to prevent contagion effects arising from the failure of a dishonestly run bank, even a large one. Our results should be of interest to the international banking community given the increasing emphasis on coordination of regulatory policy at an international level. Similar analysis could be useful regarding events after BCCI's failure, including the collapse of Baring's Bank in 1995 as well as the collapse of several Japanese banks.

The remainder of the paper is as follows. The next section outlines the theory and empirical evidence on contagion effects and pure contagion effects.

Section III outlines the data and the model specification. Section IV discusses the empirical findings. Finally, section V concludes.

II. Bank Failures and Contagion Effects: Theory and Empirical Evidence

Contagion effects arise due to the heterogeneity of bank assets. Banks assets have unique characteristics, so monitoring of these assets by depositors may be expensive. When a bank encounters financial difficulties, depositors find it easier to withdraw their funds completely from the banking system, rather than investigate whether the problems faced by one bank are common to other banks as well. Consequently, if one bank fails, the others can be affected rapidly and perhaps severely. In efficient capital markets, the spillover effect will be reflected in negative abnormal returns generated by adverse movements in the price of stock in all banks in the sector.[4] The negative stock returns experienced by other banks are known as contagion effects. In terms of the origins of contagion effects, Diamond and Dybvig (1983) demonstrate that contagion effects can develop from random shocks that induce some depositors to withdraw funds, even when no fundamental change in a bank's prospects has occurred. Depositor perceptions about the ability of a given bank to meet its obligations affect expectations about the condition of the banking sector as a whole.[5] Contagion effects arising from a bank failure caused by fraud and internal irregularities are known as 'pure' contagion effects. The pure contagion effects hypothesis does not examine contagion effects arising from failure due to activities that are not unique to the bank in question, such as risky lending or investment policies.

To prevent contagion effects, Diamond and Dybvig (1983) and Chan et al. (1992) argue in favor of stronger government regulation to protect

[4] This study assumes that capital markets are efficient. Murphy (1979) and Pettway and Sinkey (1980) have found evidence in support of the efficiency of markets for actively traded bank securities.

[5] Jacklin and Bhattacharya (1988) address the question of what triggers a bank run by explicitly modelling interim information about the bank's investment in risky assets. The authors show that the welfare consequences of such behavior have important implications for the choice between nontraded deposits contracts and traded equity contracts.

depositors and counteract perverse incentives at distressed banks in which uninformed investors hold deposits. Deposit Insurance Schemes (DIS), capital requirements and supervision are the standard regulatory mechanisms. Dothan and Williams (1980) and Calomiris and Kahn (1991) take a different line by arguing that the holders of claims against banks are the most effective monitors of banks' activities. Furthermore, Flannery (1995) argues that regulation to mitigate contagion effects may be inefficient and counterproductive.

Empirical studies on contagion effects have focused mainly on US bank failures. Aharony and Swary (1983) focus on the failure of FNB in 1974 and find evidence of contagion effects. Lamy and Thompson (1986), and Peavy and Hempel (1988) examine contagion effects caused by Penn Square's failure, with mixed results. Swary (1986) examines the Continental Illinois' failure and finds evidence of significant contagion effects. Furfine (1999) explores the likely contagious impact of a significant bank failure using data on credit exposures arising from overnight federal funds transactions. Using these exposures to simulate the impact of various failure scenarios, Furfine (1999) found that the risk of contagion is economically small. Dickinson et al. (1991) fail to find evidence of contagion effects arising from the failure of First Republic Bank. Finally, Saunders and Wilson (1996) found evidence of contagion for the 1930-1932 period, by analyzing the behavior of deposit flows in a sample of failed and healthy banks. Empirical studies on pure contagion effects are rather limited. Aharony and Swary (1983) focus on the failure of two US banks, namely USNB in 1973 and HNB in 1976, and fail to find evidence of pure contagion effects. Jayanti et al. (1996) focus on the failure of two Canadian banks, namely the Canadian Commercial Bank (CCK) and Northland Bank (NB), as well as on the failure of the British bank Johnson Matthey Bankers (JMB) Limited. Their results indicate that there is some evidence of pure contagion effects in Canada, but no evidence of such effects in the UK. There are, however, several characteristics, which differentiate CCK, NB, and JMB from BCCI. First, CCK, NB, and JMB were relatively small banks compared to BCCI. Second, the BCCI was a multinational bank, whereas CCK, NB and JMB did not have any international banking operations. Third, BCCI posed particular supervisory problems because the two companies through which it carried out its international business were registered in Luxembourg and the Cayman Islands, its principal shareholders were latterly based in Abu Dhabi, while the group was managed from its headquarters in London.

III. Methodology

A. Data

We consider the banking sectors of three developed economies where BCCI had established banking operations, namely the US, the UK and Canada.[6] For each of these three countries, we consider the three largest individual banks or banking institutions in terms of assets size.[7] The sample of banks includes Barclays, National Westminster (Nat West), and Midland for the UK; Citicorp, Bank of America, and Chase Manhattan for the US; and the Royal Bank, the Canadian Imperial Bank of Commerce, and the Bank of

[6] We could have also added Japan in our sample. However, it was decided for Japan to be ruled out because there were several reports regarding banking scandals, which appeared around the same dates as the dates of the BCCI-related events outlined in the previous section. Several major Japanese banks were involved in these reports. On 8 October 1990 (two days prior to the first BCCI-related event considered in this study), the chairman of Sumitomo, Japan's most profitable commercial bank, resigned over a stock market scandal (The Times, 8 October 1990, Section: Business). On 12 October 1990, it was reported that another Japanese major bank, Sanwa, was 'linked to scandal' (The Independent, 12 October 1990, Section: Business and City Page, page 22). Both Sanwa and Sumitomo were among the three largest Japanese banks at that time. On 15 October 1990, there are further reports regarding banking scandals in Japan involving several major banks (The Guardian, 15 October 1990, 'Japanese banking scandal could extend'). On 3 March 1991 (one day prior to the second BCCI-related event of 4 March 1991), there were reports that several major Japanese banks '…offered several hundreds billion yen in loans' to a speculative stock investment house, whose chief was arrested on 3 March 1991 (The Daily Yomiuri, 3 March 1991, page 6). On 6 July 1991 (one day after the official closure of BCCI), there were further reports of scandals in Japanese banking involving major banks (The Nikkei Weekly, 'Securities scandal reveals cancer in Japan's economy,' page 6). These reports may be considered as confounding events with regard to the effects which could potentially arise from the BCCI-related reports, as it is unclear whether possible negative stock returns in the Japanese banking sector are attributed to the BCCI-related events or to the events discussed above.

[7] The list of the largest banks at the time of BCCI's closure, which we used to choose the individual banks, is published at The Banker (July 1991), 'Top 1000 Banks by country.'

Montreal for Canada. Daily stock price data for all banks were obtained from Datastream, and span the period from 1 January 1989 to 31 December 1991.[8] For each country, we also consider the market stock index constructed by Datastream. Stock returns are computed as the first difference of the natural logarithm of two consecutive daily stock prices. All stock return series have been confirmed as stationary processes using the augmented Dickey-Fuller test.[9]

B. Model Specification

To test for contagion effects, i.e. negative abnormal returns and negative cumulative abnormal returns for each bank in each country, we employ event study methodology based on the market model (Smirlock and Kaufold, 1987).[10] In order to specify an empirical model, it is necessary to investigate which of the events prior to BCCI's closure seem most likely to have affected other banks' stock returns. Although the closure of BCCI was announced on 5 July 1991, earlier events might well have signaled that the closure was imminent, causing negative abnormal returns prior to this date. Although BCCI made several announcements in May and June 1990 of significant losses and job cuts, it was not until 10 October 1990 that the first Price Waterhouse report was published raising suspicions of fraud. As the cause of BCCI's collapse was fraud and 10 October 1990 was the first date when an official report was published raising suspicions of fraud, we consider this date as the first candidate event date. A second candidate date is 4 March 1991, when the Bank of England, aware that significant accounting transactions '…may have been either false or deceitful,' appointed Price Waterhouse to investigate

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[8] Masulis (1980) points out the advantage of using daily data rather than weekly or monthly data.

[9] Unit root test results are not reported to save space, but are available upon request.

[10] Event study methodology is used extensively in corporate finance, to investigate the stock price effects of firms' financing decisions. The extensive use of event study methodology can be in part attributed to its implicit acceptance by the US Supreme Court in determining materiality in insider trading cases, and for determining appropriate disgorgement amounts in cases of fraud.

these allegations.[11] A third candidate date is 21 June 1991, when the Price Waterhouse report to the Bank of England was published, documenting evidence of large-scale fraud over several years. The fourth candidate date is 5 July 1991, the date of closure.

For each candidate event date *k* (*k* = 10 October 1990, 4 March 1991, 21 June 1991, and 5 July 1991), we define a 7-day event window starting 3 trading days prior to the event (day *k*-3) and ending 3 trading days after the event (day *k* + 3). For each of the 7 trading days within each event window, we define a dummy variable $D_{k,j}$ for *j* = -3, -2, -1, 0, +1, +2, +3, taking a value of 1 on day *j*, and 0 elsewhere. For each event date *k* and bank return series *i*, the following model is specified:

$$R_{i,t} = \alpha_i + \beta_{1i} M_t + \beta_{2i} M_{t-1} + \sum_{j=-3}^{+3} \delta_{i,k,j} D_{k,j} + \varepsilon_{i,t} \quad (1)$$

where:

$R_{i,t}$ is the continuously compounded daily return of bank *i* on day *t* (expressed in percentage form).

α_i is the constant term for bank *i*.

M_t is the continuously compounded return on the market index corresponding to day *t* (expressed in percentage form).

β_{1i} is the response of bank *i*'s return to the current market return.

β_{2i} is the response of bank *i*'s return to the lagged market return.

$D_{k,j}$ for j = -3, -2, -1, 0, +1, +2, +3 are the event window dummy variables for candidate event date *k*.

$\delta_{i,k,j}$ is bank *i*'s abnormal return *j* days before/after event date *k*.

$\varepsilon_{i,t}$ is the stochastic error term for bank *i* on day t.

The inclusion of the market return (M_t) controls for movements in the returns of bank *i*, which are attributable to fluctuations in the corresponding market stock price index. Following Saunders and Smirlock (1987), and Madura et al. (1992), the lagged market return (M_{t-1}) is also included, to correct for no synchronous trading. The event window dummies capture the unique (abnormal) response of each bank's returns on the days immediately surrounding the event (Smirlock and Kaufold, 1987).

[11] The Banker, September 1991, pages 12-13.

Given that for each country we consider three banks, a system of three equations is estimated for each country for each candidate event date, containing one separate version of equation (1) for each bank. The system can be written in matrix form as follows:

$$\boldsymbol{R} = \boldsymbol{C} + \boldsymbol{Mb} + \boldsymbol{Dd} + \boldsymbol{U} \tag{2}$$

where:

R is a T x 3 matrix for the returns of the three banks in each country. T is the sample size.

C is a T x 3 matrix of constants.

M is a T x 2 matrix containing the market index returns and the lagged market index returns.

b is a 2 x 3 matrix of coefficients to be estimated.

D is a T x 7 matrix containing the 7 dummy variables for each candidate event date.

d is a 7 x 3 matrix of coefficients to be estimated.

U is the error terms matrix.

We follow Madura et al. (1992), Smirlock and Kaufold (1987), Slovin and Jayanti (1993), and Jayanti et al. (1996) in using the Seemingly Unrelated Regression (SUR) method (Zellner, 1962) to estimate the system in (2). The SUR method has the advantage of taking account of the heteroscedasticity and cross-correlation of errors across equations of the system, and results in more efficient estimates than ordinary least squares (Jayanti et al., 1996).

Testing for statistically significant abnormal returns (AR) for bank *i*, *j* days before/after event date *k*, is equivalent to testing for the significance of parameters $d_{i,k,j}$ on the basis of a t-test. To test for statistically significant cumulative abnormal returns (CARs) for bank *i* over specific day intervals, we focus on each equation of the estimated system. Consider equation (1) that corresponds to bank *i*. For instance, to test for statistically significant CARs for bank *i* over the day interval (-2, +2), i.e. from 2 trading days prior to the event until 2 trading days after the event, we test for the following hypothesis:

$$H_0: d_{i,k-2} + d_{i,k-1} + d_{i,k} + d_{i,k+1} + d_{i,k+2} = 0 \quad (3)$$

The Wald statistics for this hypothesis are distributed as c^2 with n-degrees of freedom, where n is the number of restrictions under the null hypothesis. In our case, n = 1. A similar procedure is employed for other day intervals. The magnitude of the CARs is simply the sum of the estimated coefficients of the corresponding dummies. In the example, the CARs over the day interval (-2, +2) equal $\hat{\delta}_{i,k-2} + \hat{\delta}_{i,k-1} + \hat{\delta}_{i,k} + \hat{\delta}_{i,k+1} + \hat{\delta}_{i,k+2}$.

IV. Empirical Findings

The empirical results for the UK banks are reported in Tables 1 and 2, for the US banks in Tables 3 and 4, and for the Canadian banks in Tables 5 and 6. Tables 1 and 2 report the UK results for abnormal returns and cumulative abnormal returns, respectively.[12] As shown in Table 1, statistically significant (at the 5% level) negative abnormal returns exist for all three banks for the event on 10 October 1990, the date of publication of the initial Price Waterhouse report outlining suspicions of large scale fraud in BCCI's operations.

Importantly, for all three banks, the statistically significant (at the 5% level) negative abnormal returns arose on day *k*, that is, on the date of the event. The daily abnormal returns on that day were –4.0% (for Nat West and Midland) and –2.8% (for Barclays). Furthermore, as shown in Table 2, there is evidence of statistically significant (at the 5% level) negative CARs for all three banks for the event on 10 October 1990 over the interval (0, +2), and some evidence of statistically significant negative CARs over the day intervals (-1, 0) and (-2, +2). There is no evidence of statistically significant (at the 5% level) negative abnormal and cumulative abnormal returns for the other event dates. These results suggest that the UK market appears to have responded to the news of the report on 10 October 1990, fully impounding this information into British

[12] To save space, Table 1, 3 and 5 report the coefficients of the event date dummies for those dates for which there were significant. Though not reported, the market index estimated coefficient is significant at 1% for any event date (i.e., 10 October 1990, 4 March 1991, 21 June 1991, and 5 July 1991).

Table 1. UK Banks: Abnormal Returns

	Barclays 10 October 1990	Nat West 10 October 1990	5 July 1991	Midland 10 October 1990	4 March 1991
Constant	-0.001	-0.001	-0.0004	- 0.001	-0.001
	(0.32)	(-0.75)	(-0.90)	(-1.36)	(-1.52)
Market index	1.28***	1.43***	1.44***	1.34***	1.39***
	(24.83)	(23.28)	(23.73)	(17.93)	(18.78)
Lagged market	0.05	-0.02	0.01	-0.01	-0.08
index	(0.87)	(-0.31)	(0.19)	(-1.27)	(-1.10)
k - 3	0.010	0.001	0.001	0.002	0.001
	(0.79)	(0.06)	(0.10)	(0.10)	(0.03)
k - 2	0.01	-0.001	0.004	0.026	0.03*
	(1.02)	(-0.07)	(0.29)	(1.57)	(1.94)
k - 1	-0.001	-0.005	0.01	-0.03*	0.02
	(-0.17)	(-0.41)	(0.61)	(-1.75)	(1.39)
k	-0.028**	-0.04***	-0.03*	-0.04**	-0.03
	(-2.57)	(-3.08)	(-1.73)	(-2.48)	(-1.48)
k + 1	-0.01	-0.02	-0.02	-0.002	-0.02
	(-0.82)	(-1.48)	(-1.60)	(-0.13)	(-1.19)
k + 2	-0.01	-0.005	0.003	-0.03	-0.01
	(-1.02)	(-0.39)	(0.23)	(-1.58)	(-0.60)
k + 3	0.01	-0.001	0.003	-0.001	-0.006
	(0.30)	(-0.24)	(0.12)	(-0.10)	(-0.19)
DW	1.83	1.91	1.90	1.86	1.85
R^2	0.46	0.43	0.42	0.32	0.32

Notes: Heteroscedasticity robust t-statistics in the parentheses. *, **, *** denotes statistical significance at the 10%, 5%, and 1% level respectively. DW denotes the Durbin-Watson statistic.

banks' share prices. The later events, including that of the official closure, appear to be of no importance in terms of market reaction. Overall, there is strong evidence of pure contagion effects in the UK banking sector caused by

Table 2. UK Banks: Cumulative Abnormal Returns

	10 October 1990			5 July 1991		
	Barclays	Nat West	Midland	Barclays	Nat West	Midland
(-1, 0)	3.24*	6.13**	9.10***	0.29	0.33	0.46
	[0.07]	[0.013]	[0.00]	[0.59]	[0.56]	[0.49]
(+1, +2)	1.70	1.75	1.48	1.10	0.82	0.87
	[0.20]	[0.18]	[0.22]	[0.30]	[0.36]	[0.35]
(0, +2)	5.89**	8.14***	5.87**	1.68	3.50*	2.25
	[0.015]	[0.00]	[0.015]	[0.20]	[0.06]	[0.13]
(-2, +2)	2.26	5.97**	3.88**	0.0001	0.64	0.64
	[0.13]	[0.014]	[0.048]	[0.99]	[0.42]	[0.42]

Notes: The table entries are Wald statistics for testing the hypothesis that the CARs at the respective day interval are equal to zero against the alternative that they are negative. The Wald statistics are distributed as a c^2 distribution with 1 degree of freedom. The 5% critical value is 3.84. Marginal significance levels of the Wald statistics are reported in squared brackets. *, **, *** denote statistically significant (different from zero) CARs at the 10%, 5%, and 1% level of statistical significance.

the publication of the initial Price Waterhouse report on 10 October 1990.[13] Our results for the UK differ from those of Jayanti et al. (1996), who failed to find evidence of contagion effects in the UK following the failure of Johnson Matthey Bankers (JMB). This discrepancy may be attributed to the relatively large size of BCCI in comparison with JMB, whose size was not exceeding US$1 billion. Evidence by Aharony and Swary (1996), and Akhibe and Madura (2001) has indicated that the magnitude of contagion effects is positively related to the size of the failed bank. Furthermore, in contrast to JMB, BCCI was a large bank owning several other smaller banks. Akhibe and Madura (2001) have shown that the degree of contagion effects is stronger when the failed bank owns multiple banks and subsidiaries.

[13] We have checked whether there have been other events on 10 October 1990, related specifically to Nat West, Barclays and Midland, by searching the Financial Times for the period around 10 October 1990. We found that there is no other event or news related to these three banks to justify the negative returns in that time interval.

Table 3. US Banks: Abnormal Returns

	Citicorp	Bank of America		Chase Manhattan	
	10 October 1990	10 October 1990	5 July 1991	10 October 1990	21 June 1991
Constant	-0.002 ***	-0.005	-0.0001	-0.001 *	-0.001 *
	(-2.65)	(-0.06)	(-0.14)	(-1.83)	(-1.65)
Market index	1.51 ***	1.45 ***	1.470 ***	1.29 ***	1.29 ***
	(17.06)	(18.68)	(19.18)	(15.68)	(15.76)
Lagged market	-0.13	0.25 ***	0.23 ***	-0.03	-0.04
index	(-1.38)	(3.11)	(3.03)	(-0.26)	(-0.48)
k - 3	0.01	-0.01	0.012	0.007	-0.003
	(0.32)	(-0.120)	(0.98)	(0.51)	(-0.54)
k - 2	-0.01	-0.01	-0.04	-0.02	-0.01
	(-0.38)	(-0.44)	(-1.25)	(-0.79)	(-0.30)
k - 1	0.04 **	-0.03 *	0.01	0.03 *	-0.03
	(2.04)	(-1.72)	(0.14)	(1.78)	(-1.27)
k	0.02	-0.01	0.03	0.001	-0.01
	(1.04)	(-0.20)	(1.46)	(0.04)	(-0.32)
k + 1	-0.01	-0.01	-0.03	-0.01	0.02
	(-0.57)	(-0.04)	(-1.37)	(-0.42)	(0.90)
k + 2	-0.02	0.010	0.04 **	0.02	-0.04 *
	(-1.02)	(0.55)	(2.02)	(1.06)	(-1.82)
k + 3	0.04	-0.001	-0.012	-0.015	-0.01
	(0.21)	(-0.30)	(-0.21)	(-0.09)	(-0.22)
DW	1.96	1.78	1.77	1.70	1.71
R^2	0.25	0.33	0.34	0.24	0.25

Note: See notes in Table 1.

We next turn to the results for the US banks. There is no evidence of statistically significant (at the 5% level) negative abnormal returns for any of the three US banks at any of the four event dates, thereby indicating that there are no contagion effects in the form of negative abnormal returns (see

Table 3). To explore if contagion effects in the three US banks stock returns might have arisen in the form of higher volatility around each of the four events dates, instead of negative abnormal returns, we estimated an EGARCH(1,1) model for the conditional volatility of each of the three banks returns.[14] This model was estimated for each of the four event dates by including the 7 dummy variables as exogenous variables in the conditional variance equation.[15] The results for the four event dates were all very similar and thus, we only report the results for the event of the 10th October 1990, the event for which contagion effects were found in the UK. These results are reported in Table 4. As shown in this table, all of the 7 dummy variables in the conditional variance equation are statistically insignificant, suggesting that the event of the 10th October 1990 did not cause an increase in the volatility of each of the three US banks. Similar conclusions can be drawn from the results for the other event dates, which were similar to the results for the 10th October 1990. These findings indicate that there are no contagion effects even in terms of the volatility of stock returns of the US banks.[16]

Table 4. US banks: Testing for Contagion Effects in Terms of Volatility of Stock Returns (Event: 10 October 1990)

Parameter	Citicorp	Bank of America	Chase Manhattan
a_0	0.001	0.001	0.001
	(0.98)	(0.25)	(1.50)
a_1	0.05	0.21***	0.06*
	(1.51)	(5.65)	(1.65)
a_2	-0.06*	-0.03	0.05*
	(-1.85)	(-0.97)	(1.80)

[14] We preferred an EGARCH to a GARCH model, as the EGARCH captures the well known asymmetric effect in the volatility of stock returns. Also, previous studies (Engle and Ng, 1993; Nelson, 1991) have shown that the EGARCH model performs better than other asymmetric models of the GARCH family.

[15] A similar approach has been followed by Bomfim (2003).

[16] Following the suggestion of an anonymous referee, we have also estimated EGARCH-in-Mean models. By en large, the empirical results were qualitative similar to those reported here.

Table 4. (Continued) US banks: Testing for Contagion Effects in Terms of Volatility of Stock Returns (Event: 10 October 1990)

Parameter	Citicorp	Bank of America	Chase Manhattan
a_3	0.003	-0.02	-0.02
	(0.09)	(-0.70)	(-0.80)
b_0	-7.74 ***	-7.72 ***	-7.20 ***
	(-3.93)	(-11.17)	(-11.80)
b_1	0.12 **	0.40 ***	0.64 ***
	(2.14)	(6.19)	(11.00)
b_2	-0.14 ***	-0.09 *	0.11
	(-3.49)	(-1.92)	(1.30)
d_0	-1.09	0.01	0.03
	(-0.01)	(0.10)	(0.01)
d_1	0.46	0.02	-0.12
	(0.01)	(0.03)	(-0.50)
d_2	0.32	-0.01	-0.77
	(0.02)	(-0.17)	(-0.45)
d_3	-0.08	-0.02	-0.15
	(-0.10)	(-0.18)	(-0.60)
d_4	-0.03	0.08	0.10
	(-0.10)	(0.01)	(0.85)
d_5	0.02	0.07	0.03
	(0.32)	(0.02)	(0.75)
d_6	-0.01	0.03	0.02
	(-0.20)	(0.03)	(0.10)

Notes: *, **, and *** denote statistical significance at the 10%, 5%, and 1% level respectively.

The estimated model is: $R_t = a_0 + \sum_{r=1}^{3} a_r R_{t-r} + \varepsilon_t,\ \varepsilon_t / \Omega_{t-1}$

$$\log(\sigma_t^2) = \exp\{b_0 + b_1 \log(\sigma_{t-1}^2) + b_2 g(z_{t-1}) + d_0 D_t + d_1 D_{t-1} + d_2 D_{t-2} + d_3 D_{t-3} + d_4 D_{t+1} + d_5 D_{t+2} + d_6 D_{t+3}\}$$

$$g(z_t) = \theta\, z_t + [|\, z_t \,| - E\,|\, z_t \,|]$$

where R_t is each bank's stock returns, e_t is the error, W_{t-1} is the information set at *(t-1)*, σ_t^2 is the time varying variance, z_t is the standardized residual (e_t / s_t), D_t is the event dummy for the 10th October 1990, D_{t-i}, i = 1, 2, 3, are the dummies for each of the three days prior to the event, and D_{t+i}, i = 1, 2, 3 are the dummies for each of the three days following the event. Statistical inference is based on robust t-statistics (Bollerslev and Wooldridge, 1992).

These results indicate that there is no evidence of pure contagion effects in the US banking sector due to BCCI's failure, and are in line with the findings of Aharony and Swary (1983), who failed to find evidence of pure contagion effects in the US following the collapse of USND of San Diego. The lack of contagion effects in the US can be attributed to several factors. One such factor is the relatively large size of the US deposit insurance coverage, and the perception that even uninsured depositors will not lose in the case of a bank failure. In the US, the Federal Deposit Insurance Corporation (FDIC) insures deposits up to a maximum of US$ 100,000 per depositor per bank, while in the UK the maximum amount insured is Pound Sterling 10,000 per depositor per institution. According to Jayanti et al. (1996), the market's perception of the extent to which uninsured depositors are likely to suffer losses may significantly influence the market reaction. The extent of losses to bank creditors depends on the speed and method employed by regulators to resolve bank failures. In the US, when regulators adopted the pay-off method, uninsured depositors received 90 per cent of their deposits. Also, in the wake of the Continental Illinois crisis in 1984, US bank regulators adopted the 'too big to fail doctrine' and paid off both insured and uninsured depositors (Jayanti et al., 1996). Another factor is the relatively large distance of BCCI's headquarters, located in London, from the headquarters of the US banks. Evidence by Aharony and Swary (1996) has indicated that the smaller the distance of a solvent bank's headquarters from the headquarters of a large failing bank, the weaker will be the negative impact on the solvent bank's stock returns.

Results for the abnormal returns for the Canadian banks are reported in Table 5. We found no evidence of statistically significant negative abnormal returns for any of the three banks at any candidate event date. Similarly, there is no evidence of statistically significant negative CARs.[17] In order to explore if there are contagion effects in terms of higher volatility of returns, we also estimated an EGARCH(1,1) model for each of the three Canadian banks. For each event date, we estimated an EGARCH(1,1) model by including the 7 event dummy variables as exogenous variables in the conditional variance equation. The results for the event of the 10th October 1990 are reported in

[17] The results on CARs are not reported here to save space, but are available on request.

Table 5. Canadian Banks: Abnormal Returns

	Canadian Imperial Bank of Commerce	Bank of Montreal	Royal Bank of Canada		
	10 October 1990	10 October 1990	10 October 1990	4 March 1991	5 July 1991
Constant	0.001	0.0004 *	0.0004	0.0004	0.0004
	(1.06)	(1.79)	(1.63)	(1.54)	(1.51)
Market index	1.39 ***	0.98 ***	1.18 ***	1.19 ***	1.19 ***
	(24.75)	(18.95)	(22.76)	(22.99)	(23.11)
Lagged market	0.03	0.04	-0.01	-0.03	-0.02
index	(0.549)	(0.71)	(-0.22)	(-0.48)	(-0.33)
k - 3	0.012	0.006	-0.002	0.003	0.001
	(0.40)	(0.02)	(-0.03)	(0.51)	(0.21)
k - 2	-0.01	-0.0004	-0.0004	0.02 *	-0.0003
	(-0.03)	(-0.05)	(-0.06)	(1.94)	(-0.04)
k - 1	0.02 **	0.01	-0.002	-0.01	0.01 *
	(2.20)	(1.07)	(-0.32)	(-1.22)	(1.74)
k	0.01	0.01 *	-0.01	-0.001	0.01
	(0.85)	(1.83)	(-0.87)	(-0.12)	(0.75)
k + 1	-0.01	-0.01	-0.01	0.01	-0.002
	(-1.61)	(-0.19)	(-1.45)	(0.76)	(-0.35)
k + 2	0.026 ***	0.01	0.02 **	0.001	0.001
	(3.21)	(1.58)	(1.99)	(0.19)	(0.21)
k + 3	0.007	0.01	0.003	-0.001	0.001
	(0.02)	(0.15)	(0.14)	(-0.08)	(0.11)
DW	1.84	1.64	1.81	1.80	1.82
R^2	0.47	0.34	0.42	0.42	0.42

Note: See notes in Table 1.

Table 6. The results for the other three events are qualitatively similar to those for the 10th October 1990. As shown in this table, no one of the 7 dummy

Table 6. Canadian Banks: Testing for Contagion Effects in Terms of the Volatility of Stock Returns (Event: 10 October 1990)

Parameter	Canadian Imperial Bank of Commerce	Bank of Montreal	Royal Bank of Canada
a_0	0.01	0.01	0.01
	(1.21)	(0.60)	(1.08)
a_1	0.15***	0.21***	0.17***
	(3.77)	(5.75)	(4.44)
a_2	0.07**	0.04	0.07**
	(2.21)	(1.25)	(2.10)
a_3	0.001	-0.04	-0.02
	(0.03)	(-1.30)	(-0.53)
b_0	-9.15***	-9.40	-9.23***
	(-4.45)	(-1.19)	(-3.90)
b_1	0.37***	0.05	0.23***
	(5.51)	(0.82)	(3.27)
b_2	0.01	0.03	0.01
	(0.17)	(0.69)	(0.29)
d_0	-0.07	-0.09	0.03
	(-0.10)	(-0.05)	(0.10)
d_1	-0.50	-0.01	0.07
	(-0.40)	(-0.38)	(0.01)
d_2	-0.01	-0.04	-0.03
	(-0.19)	(-0.09)	(-0.04)
d_3	-0.60	-0.02	0.07
	(-0.03)	(-0.04)	(0.50)
d_4	0.02	0.015	0.02
	(0.01)	(0.02)	(0.25)
d_5	0.02	0.08	0.01
	(0.01)	(0.30)	(0.08)
d_6	-0.01	0.08	-0.01
	(-0.01)	(0.20)	(-0.99)

Note: See notes in Table 4.

variables is statistically significant, thereby suggesting that the event of the 10th October 1990 did not cause a volatility increase in the stock returns of each of the three Canadian banks. A similar conclusion can be drawn for the other three events. Therefore, there is no evidence of contagion effects for the Canadian banks even in terms of volatility.

These results are in contrast to the findings of Jayanti et al. (1996), who found some evidence of negative abnormal returns and negative cumulative abnormal returns on the Canadian banking sector following the collapse of two domestic banks, namely the Canadian Commercial Bank (CCB) and the Northbank. This differing reaction may be accounted for by the fact that CCB and Northbank were relatively larger banks in Canada than BCCI-Canada, and by the large distance of BCCI's headquarters from the headquarters of the Canadian banks.[18] According to Akhibe and Madura (2001), the smaller the relative size of the assets of the failed bank in one country, the higher the ability of 'rival' banks to withstand financial distress. In addition, the difference of our results for Canada from those for the UK can be attributed to the relatively higher size of the deposit insurance coverage in Canada, which is up to US$ 52,000.[19]

Overall, the results for the US and Canada suggest that the failure of a dishonestly run bank, even a large one, does not cause loss of confidence in the integrity of the banking system as a whole. The standard regulatory measures available, such as deposit insurance, appear to be sufficient in protecting against contagion effects. In the UK, the existence of pure contagion effects may be interpreted as an indication that UK capital markets were concerned about the supervision of BCCI and the adequacy of the regulatory system to prevent the collapse of the bank. This interpretation is in line with the Bingham Report commissioned in the UK after BCCI's failure. This report raised several issues in relation to the supervision of BCCI in the UK, and offered a number of detailed suggestions to strengthen it, including the need for greater cooperation, greater sharing of information, strengthening of

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[18] CCB and Northbank were ranked 10th and 11th in Canada; BCCI-Canada was at a much lower rank.

[19] The Banker, 1 September 1991, 'BCCI: How safe is your money?', vol. 141, no 787.

internal communications, and more efficient supervision of internationally spread banking groups like BCCI.[20]

V. Conclusions

This study has examined the issue of contagion effects in international banking arising from the failure of BCCI, one of the largest multinational banks. As the failure of BCCI was due to fraud, this study offers an empirical assessment of the 'pure' contagion effects hypothesis. We focused on the three largest banks in three developed countries where BCCI had established operations, namely the UK, the US, and Canada. Using event study methodology, we tested for negative abnormal returns and negative cumulative abnormal returns on individual banks surrounding several BCCI-related announcements. Our analysis provides strong evidence of pure contagion effects in the UK which have arisen prior to the official closure date, following a BCCI-related announcement raising suspicions of irregularities and fraud on a large scale in the bank's operations. Our results suggest that stock prices of all three UK banks reacted negatively to information about fraud in a large bank's activities. There is no evidence of pure contagion effects in the US and Canada, even in terms of the volatility of bank stock returns, which suggests that the regulatory measures available in these two countries appear to be sufficient in preventing contagion effects arising from the failure of a large bank with fraudulent activities. Our results for the UK are in line with the Bingham Report, which offered several recommendations to strengthen the supervision of internationally spread groups like BCCI.

[20] Further recommendations included the establishment of a trained and qualified special investigations unit to consider all warnings of malpractice, strengthening of the Bank of England's legal unit, and strengthening of the Bank's powers to refuse authorisation on the grounds that a bank cannot be effectively supervised. (Financial Times, 23 October 1992, 'Bingham report – Investigation into the BCCI scandal: The main recommendations', page 8). In response to this report, several measures were announced to strengthen the supervision in the future. (Financial Times, 23 October 1992, 'Bingham report – Investigation into the BCCI scandal: Governor outlines stronger measures', page 8).

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