

# **The exposure of international bank loans to third-country risk: an empirical analysis of overdue claims**

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## **Abstract**

The paper analyses the performance outcomes on foreign credits made by UK-owned banks to borrowers in 17 foreign countries between 1991 and 2000. The analysis is unique in its use of bank-specific data on overdue credits in individual countries. Results indicate that credit repayment in a given country is influenced by exports to, and economic activity in, another country linked by trading relationships. The observed cross-country interdependence is relevant to the understanding of risk management practices of international banks.

JEL classification: F34, G21, G28.

Key words: Banking, international lending, trade.

## Summary

The paper investigates whether the credit quality of UK-owned banks' international lending is sensitive to conditions in borrower countries' largest trading partners. Borrowers may be dependent on export earnings or other income generated by economic activity in the third country to repay the loan. A deterioration in economic conditions in the third country could impair borrowers' ability to meet their loan obligations.

The existence of trade-based interdependencies has implications for banks' risk management and the authorities. Interlinkages limit banks' ability to diversify away credit risk by lending to different countries. Moreover, banks' risk management techniques will need to address the cross-country correlations in borrowers' ability to repay. Central banks and banking regulators with responsibility for financial stability or prudential supervision also need to take account of the impact of trade-based spillovers. In the Bank of England's case, any judgment of the likely impact of an adverse shock to a particular country on UK financial institutions and markets will need to factor in the knock-on effects on borrowers in third countries.

The paper has some similarities with previous empirical studies on interdependencies in international lending. One branch of the literature focuses on how the quantity of credit supplied by international banks in a country varies with financial conditions in other countries. Another investigates whether risk in international bank lending is systematic (global) or diversifiable (local). A problem in applying these studies to the issue of interdependencies, however, is that they view risk from a global perspective. They do not explore the direction or strength of interdependencies between countries and do not use a direct measure of performance.

The measure of credit quality used in this study is the proportion of the principal of cross-border and overseas operations' non-local currency loans that is in arrears. The data are annual, bank specific and disaggregated by country. This means that we have information on the credit performance of individual banks in a particular country in a given year. We are unaware of any prior empirical study that identifies performance outcomes in different countries for individual creditors. The data are confidential and collected as part of the Bank of England's suite of monetary and banking returns.

The study focuses on the credit quality of 28 of the largest UK-owned banks' international loans to 17 countries between 1991 and 2000. The 17 countries selected are those to which UK-owned banks had the greatest exposure in 2002 and for which the relevant macroeconomic data were available. They are predominately large industrialised countries. The banks included held virtually all of the foreign assets and 96% of total assets owned by UK-owned banks. The banks are important lenders within Europe — which, in turn, accounts for the majority of worldwide international lending — and have country-exposure rankings that are highly correlated with other BIS-area banks. To this extent, the results for our sample of UK-owned banks are applicable to banks in other countries.

We model overdue credit as a function of credit composition, bank characteristics and situational factors and macroeconomic conditions in the largest export market country. Two indicators of financial condition in the linked country are used. The first measures the percentage change in merchandise exports from the country of the borrower to the linked country. The second measures the percentage change in output in the linked country. This effect could encompass merchandise exports, but also trade in services or other international transactions. It may also capture effects unrelated to trade (such as collateral).

We find that economic conditions in a country are transmitted to another country whose borrowers have obtained credit from international banks. As exports to a linked country increase, or gross domestic product in the linked country increases, repayment performance in the country of the borrower improves. We find that this relationship is pronounced in countries, such as Ireland and Mexico, that have close ties to a larger economy and during the later years of our sample period (1997 to 2000).

## 1. Introduction

At the end of 2003, banks reporting to the Bank for International Settlements (BIS) recorded nearly \$16 trillion in foreign claims to borrowers in more than 200 countries. The magnitude of these claims, and their diversity across countries, has heightened interest in how banks manage international credit risk. In the United States, for instance, bank regulators and central banks ‘have become concerned’ in recent years about lending risks ‘that arise when economies are linked by international trade’ (Curry *et al* (1998)). Similarly, the BIS (2001) contend that, while the exposure of banks to individual regions ‘seems manageable, joint exposures need more careful examination’.

Joint exposures may arise from the normal interdependencies among market economies (Dornbusch *et al* (2000) and Forbes and Rigobon (2002)).<sup>(1)</sup> Buckle *et al* (2000) state that a direct loss on a bank loan in a given country may increase the probability of losses on loans to other countries if the initial default triggers further instability elsewhere. The instability could be spread through trade credit if a bank made a loan to a firm, or to a bank, in a country which supplied credit to customers in another country (Giesecke and Weber (2002)). It also could spread as result of conditions in export markets (Walter (1981)) or *conditions* affecting the value of collateral located in other countries (Sbracia and Zaghini (2001)). Curry *et al* (1998) conclude that ‘adverse economic events in one nation may spill over to, and compound problems for, that nation’s trading partner(s)’, which, in turn, ‘influence the ability of borrowers in these nations to repay loans’ to foreign creditors.

Interdependencies may be predicated on the existence of what Dornbusch *et al* (2000) refer to as ‘real and financial linkages’ that are transmitted across countries. Such linkages, however, have not been empirically documented in the context of performance outcomes on international lending. This paper will do so. That is, it will determine whether default on credit extended in country A by an international bank domiciled in country B is dependent upon macroeconomic conditions in country C. Our analysis considers the role of exports to, and economic output in, the linked country (C). The country is selected on the basis of the closeness of trade relationships with the country of the borrower (A).

Repayment problems are measured as the amount of the principal overdue on loans and other related claims extended by UK-owned banks to foreign borrowers. The data are annual, bank

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<sup>(1)</sup> Forbes and Rigobon (2002) define interdependence to be ‘strong linkages’ between the economies of two countries ‘that exist in all states of the world’.

specific and disaggregated by country, which means that we have information on the credit performance of individual banks' loans to a particular country in a given year. We are unaware of any prior empirical study that identifies performance outcomes in different countries for individual creditors. This is noteworthy because most prior evidence on international interdependencies rely on secondary market data for which it is difficult to disentangle real and financial linkages from informational effects related to investor behaviour (Dornbusch *et al* (2000) and Forbes and Rigobon (2002)).

We conduct statistical tests using a pooled, time-series and cross-sectional analysis of overdue credit to borrowers in 17 countries, 1991 to 2000, made by 28 of the largest banks in the United Kingdom. Results indicate that exports to a linked country, and economic output in that linked country, are inversely related to the level of overdue credit for most, but not all, of the countries in our sample. It underscores the existence of cross-country interdependencies that risk management techniques in banking have been 'more often than not incapable of addressing' (Hammes and Shapiro (2001)).

The paper is organised as follows. Section 2 reviews related research on interdependencies among international claims. Section 3 presents the methodology. Section 4 describes our sample of more than 2,000 pooled time-series and cross-sectional observations on UK-owned banks. Section 5 presents results of our empirical tests and Section 6 concludes.

## **2. Related research**

Previous empirical studies on interdependencies in international lending can be divided into two categories. One category examines how the volume of credit supplied by international banks in a country varies with financial conditions in other countries. Another category examines whether risk in international bank lending is systematic (global) or diversifiable (local).

With respect to factors influencing credit volume, Peek and Rosengren (1997) show that domestic financial problems at Japanese banks influenced their lending to the United States. Dahl and Shrieves (1999) examine the extent to which international lending by US banks serves as a complement to, or substitute for, domestic lending. Jeanneau and Micu (2002) provide evidence that international bank lending varies procyclically with economic activity in major industrial countries. Van Rijckeghem and Weder (2001) find that the flow of bank credit supplied by 'common lenders' to a particular country is sensitive to credit conditions experienced by those lenders in other countries.

These studies, which support the existence of interdependence across countries in the *quantity* of international loans, contrast with studies focusing on the *quality* of international loans. Goodman (1986) and Palmer and Sanders (1996) find international lending risk to be systematic, significant in magnitude and an impediment to diversification. A problem in applying these studies to the issue of interdependencies, however, is that they view risk from a global perspective rather than from the perspective of bilaterally linked countries. Another disadvantage is that they do not directly quantify performance, but rather make inferences using macroeconomic proxies for rates of return on international loans (Goodman (1986)) or indices based on banker surveys of country risk ratings (Palmer and Sanders (1996)).

Saunders (1986) provides related evidence of significant systematic risk in international bank lending. Rather than simulating performance using macroeconomic proxies, or subjective surveys, he uses interest rate spreads observed on secondary markets for international loans. But his approach is incapable of differentiating between systematic risks based on real and financial linkages and informational linkages (as would occur if debt repayment problems in one country signal the existence of related but as yet unidentified problems in other countries). This criticism also is applicable to any study using secondary market prices as evidence of interdependence, systematic risk, contagion, spillovers, etc. As pointed out by Forbes and Rigobon (2002), it has been ‘extremely difficult’ to measure real and financial linkages directly because secondary market pricing data comingles real macroeconomic and informational effects.

Two recent studies of international bank lending circumvent secondary market information. Using a proprietary data set from McKinsey and Co, Hammes and Shapiro (2001) observe correlations of credit performance across countries that ‘are never systematically positive’, thus offering evidence that international lending risk is at least partly diversifiable. Further support is provided by Acharya *et al* (2001), who use data on non-performing loans at Italian banks to gauge the effect of diversification from Italy, to Europe and throughout the rest of the world. Neither study, however, offers direct tests of interdependencies that may exist between particular pairs of linked countries.

We note that interdependence is not necessarily unique to repayment on claims extended by international banks. It may affect domestic lending as well. But it is likely to be a particularly acute problem for international banks, rather than for domestic banks, for two reasons. First, international banks operating in a foreign country focus on non-domestic customers within that country (see, among others, Nigh *et al* (1986)). Second, even domestic customers of international banks are likely to depend upon economic conditions abroad to the extent that such customers



select international banks on the basis of ‘better international service capabilities and innovative international banking alternatives’ (DeYoung and Nolle (1996)). For these reasons we believe that a focus on international lending is insightful.

### 3. Model

Our model follows Claessens *et al* (2001) who, in a study of foreign presence in domestic banking markets, define financial characteristics (such as loan loss provisions) for bank  $i$  in country  $j$  at time period  $t$  as a function of independent variables including those specific to a particular bank and to a particular country. We express the amount of overdue claims for bank  $i$  on loans to country  $j$  in year  $t$  as a function of macroeconomic conditions in a linked country and bank-specific control variables:

$$\begin{aligned} \text{Overdue}_{(i,j,t)} = & a_0 + b_1\text{Link}_{(j,t)} + b_2\text{Bankclaim}_{(i,j,t-1)} + b_3\text{Pubclaim}_{(i,j,t-1)} \\ & + b_4\text{Assets}_{(i,t-1)} + b_5\text{Capratio}_{(i,t-1)} + b_6\text{Profit}_{(i,t-1)} + e_{(i,j,t)} \end{aligned} \quad (1)$$

where  $\text{Link}_{(j,t)}$  is the rate of change in a key economic measure in another country to which merchandise exports from the country of borrower are greatest.  $\text{Bankclaim}_{(i,j,t-1)}$ ,  $\text{Pubclaim}_{(i,j,t-1)}$ ,  $\text{Assets}_{(i,t-1)}$ ,  $\text{Capratio}_{(i,t-1)}$  and  $\text{Profit}_{(i,t-1)}$  are bank-specific variables. The  $b$ 's are coefficients,  $a_0$  is a constant and  $e_{(i,j,t)}$  is an error term. As in Claessens *et al* (2001), we include fixed effects (dummy variables) for both country and time.

$\text{Overdue}_{(i,j,t)}$ , the dependent variable, is standardised by total claims. Overdue claims are listed without regard to whether a provision for loan loss has been made or whether the delay in payment is caused by reasons outside the control of the debtor.<sup>(2)</sup> A claim is considered to be overdue when it is delayed 14 days or more. Claims are ‘total cross-border claims and non-UK offices’ non-local currency claims on local residents’. Although the claims can be denominated in any non-local currency, they are reported in sterling, and exclude local-currency exposures and off-balance sheet exposures.<sup>(3)</sup> They comprise loans, advances, acceptances, accounts receivable under finance leases and sale and repurchase agreements.<sup>(4)</sup>

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<sup>(2)</sup> The source of the data on overdue claims is the Bank of England. It is confidential.

<sup>(3)</sup> Overdue claims exclude those reported in local currency.

<sup>(4)</sup> We do not consider risk transfers, in which repayment on a loan to a borrower in one country is guaranteed by residents of a second country. This creates an inconsistency insofar as our measure of overdue claims is reported on the basis of country of location rather than country of guarantee.

Overdue claims are presumed to be an objective and non-discretionary indicator of the quality of a bank's portfolio (Wahlen (1994)). Acharya *et al* (2001) interpret a similar variable as 'capturing' expected losses. Non-performing loans, more generally, are correlated with bank examiner classifications of asset quality (Meeker and Gray (1987)), are widely used as a 'standard' measure of credit quality (Nolle (1995)) and are prominent in identifying banking crises (Sbracia and Zaghini (2001)).

$Link_{(j,t)}$ , the key independent variable, matches the country of the borrower with another country to which merchandise exports are the greatest.<sup>(5)</sup> Our selection of the linked country on the basis of exports was made, in part, because 'countries closely linked by direct trade are more likely to transmit economic disturbances — positive or negative — to each other' (Curry *et al* (1998)). Other studies of international comovements in exchange rates, stock prices, sovereign spreads and capital flows also emphasise the importance of trade links (Dornbusch *et al* (2000)).

We utilise two (alternate) variables as indicators of financial condition in the linked country. One variable is the percentage change in merchandise exports from the country of borrower to the linked country.<sup>(6)</sup> We hypothesise that exports will be negatively related to overdue claims. Curry *et al* (1998) argue that a reduction in import demand in Japan could jeopardise the loans of US banks to firms in countries that export to Japan.

The second variable is the percentage change in output in the linked country. We hypothesise that the ratio of overdue claims in country  $j$  will increase with decreases in economic activity in a linked country. This effect could encompass merchandise exports, but also trade in services or other international transactions. Effects unrelated to trade also are possible. If credit is backed by collateral located in other countries, for instance, economic problems in those other countries could cause banks to call in loans in the country of borrower, leading to a decline in creditworthiness (Sbracia and Zaghini (2001)).

Bank-specific variables are introduced to control for the heterogeneity of UK-owned banks. In a study of non-performing loans, Wahlen (1994) states that 'different types of loans involve different default risks'. Following this rationale, we include  $Bankclaim_{(i,j,t-1)}$  and  $Pubclaim_{(i,j,t-1)}$ , which represent, respectively, the percentage of a bank's claims on each borrower country which are in the bank sector and in the public sector (the non-bank private sector is the omitted

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<sup>(5)</sup> The linked countries were selected on the basis of export data from the International Monetary Fund for 1999.

<sup>(6)</sup> Data on output and exports are obtained from the International Monetary Fund.

category).<sup>(7)</sup> Buckle *et al* (2000) describe differences in the default risk on bank claims which vary by sector (public, corporate and bank) and by country categorisation (developed, developing and offshore financial centre).

Acharya *et al* (2001) use controls for size and capitalisation in their model of non-performing loans. We similarly employ  $Assets_{(i,t-1)}$ , the total assets for a bank, and  $Capratio_{(i,t-1)}$ , the ratio of a bank's capital to risk-weighted assets (multiplied by 100). We also include  $Profit_{(i,t-1)}$ , which is the ratio of a bank's net income to assets.

The sign on the coefficient for  $Assets_{(i,t-1)}$  should be positive if larger banks make riskier loans that, in turn, are more likely to become overdue. In this regard, Demsetz and Strahan (1995), among others, provide evidence that larger banks have a greater appetite for risk. The hypothesised sign on the coefficient for  $Capratio_{(i,t-1)}$  is negative since Berger (1995) and Sinkey and Greenawalt (1991) find that capital and loan quality are inversely related.  $Profit_{(i,t-1)}$  may reflect either *ex-post* performance (banks which generate more profit may assess credit risk more accurately) or *ex-ante* risk (banks with higher loan rates have greater subsequent problems in repayment). In support of the later interpretation, Sinkey and Greenawalt (1991) find that higher rates of return on loans are associated with higher levels of non-performing loans and loan charge-offs.

Because the dependent variable is truncated at zero, we use a Tobit estimation technique. Tests for unit roots in the dependent variable using augmented Dickey-Fuller tests indicated stationary, both for the sample as a whole and for each country individually. Hausman tests indicated that alternate random effects models, without fixed effects, were inappropriate (Greene (2000)).

It is possible that interdependencies are specific to certain countries, or periods, rather than being uniformly applicable in all situations. To more closely examine how links may vary country-by-country and year-by-year, we create alternate specifications of equation (1) substituting for  $Link_{(j,t)}$ , respectively, interactions of the link and dummy variables for country and interactions of the link and dummy variables for time (year). Interactions of link and country give:

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<sup>(7)</sup> For most banks, claims are reported on a consolidated basis within a banking group by a parent bank, rather than by the bank itself. In these cases we implicitly assume that claims for a banking group can be empirically associated with the lead bank in that group. Bank data are from the Bank of England.

$$\text{Overdue}_{(i,j,t)} = a_0 + \sum_{j=1}^{17} b_{1j}\text{Link}_{(j,t)} + b_2\text{Bankclaim}_{(i,j,t-1)} + b_3\text{Pubclaim}_{(i,j,t-1)} \\ + b_4\text{Assets}_{(i,t-1)} + b_5\text{Capratio}_{(i,t-1)} + b_6\text{Profit}_{(i,t-1)} + e_{(i,j,t)} \quad (2)$$

and interactions of link and time give:

$$\text{Overdue}_{(i,j,t)} = a_0 + \sum_{t=1}^{10} b_{1t}\text{Link}_{(j,t)} + b_2\text{Bankclaim}_{(i,j,t-1)} + b_3\text{Pubclaim}_{(i,j,t-1)} \\ + b_4\text{Assets}_{(i,t-1)} + b_5\text{Capratio}_{(i,t-1)} + b_6\text{Profit}_{(i,t-1)} + e_{(i,j,t)} \quad (3)$$

For both equations, we expect a negative relationship between overdue claims and the interaction variables for those countries or years in which linked-country economic condition influences claim repayment.

#### 4. The sample

The countries consist of 17 among the top 20 to which all UK-owned banks had the largest exposures in 1999.<sup>(8)</sup> Eight countries (France, Germany, Ireland, Italy, Netherlands, Spain, Sweden and Switzerland) are in the European BIS reporting area, three are in the non-European BIS reporting area (Canada, Japan and the United States), two are offshore banking centres (Hong Kong and Singapore) and three are developing (Argentina, Brazil and Mexico). The final country is Australia.<sup>(9)</sup>

In 2002, these banks held nearly 100% of the assets located abroad, and 96% of the total assets, of all UK-owned banks. The banks are important lenders within Europe — which, in turn, accounts for the majority of worldwide cross-border lending — and have risk exposure ratings that are highly correlated with other BIS-area banks (Buckle *et al* (2000)). To this extent, results for our sample of UK-owned banks are applicable to banks in other countries.

Information on claims is presented by year in Table A and by country in Table B. Claims over the sample period total nearly £1 trillion, increasing from £43 billion in 1991 to £157 billion in 2000.

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<sup>(8)</sup> Belgium, Cayman Islands and Luxembourg were omitted because of an inability to get consistent macroeconomic or trade data over time from the International Monetary Fund.

<sup>(9)</sup> Observations on merged institutions were deleted in the year of the merger and observations on Germany were deleted in the year of unification. Observations were deleted for banks with fewer than ten extensions of credit over the entire sample period.

**Table A: Claim description, by year**

	<u>Obs.</u>	<u>Claims</u> <sup>(a)</sup> (£ million)	<u>Overdue claims</u> <sup>(a)</sup> (£ million)	<u>Overdue claim ratio</u> <sup>(b)</sup>	<u>Public claim ratio</u> <sup>(b)</sup>	<u>Bank claim ratio</u> <sup>(b)</sup>	<u>Other claim ratio</u> <sup>(b)</sup>
1991	211	43,267	325	0.0146	0.10	0.59	0.31
1992	220	53,881	312	0.0070	0.11	0.59	0.29
1993	219	57,550	328	0.0050	0.12	0.58	0.30
1994	238	90,655	466	0.0035	0.09	0.63	0.28
1995	186	85,907	469	0.0040	0.09	0.60	0.31
1996	203	95,835	420	0.0030	0.10	0.54	0.35
1997	202	118,269	1,777	0.0105	0.10	0.56	0.34
1998	227	114,177	1,365	0.0033	0.11	0.52	0.37
1999	229	126,331	1,815	0.0050	0.10	0.50	0.40
2000	192	157,504	1,480	0.0050	0.11	0.45	0.44
Total	2,127	943,376	8,757	--	--	--	--

Source: Bank of England.

<sup>(a)</sup> Claims and overdue claims refer to the stock of UK-owned banks' international loan claims at each year-end and the amounts of such claims which are 14 days or more past due on that date.

<sup>(b)</sup> Public claims, bank claims, and other claims are, respectively, claims to the public, bank and non-bank private sectors. All ratios are unweighted averages measured with respect to claims.

**Table B: Claim description, by country**

	<u>Obs.</u>	<u>Claims</u> <sup>(a)</sup> (£ million)	<u>Overdue claims</u> <sup>(a)</sup> (£ million)	<u>Overdue claim ratio</u> <sup>(b)</sup>	<u>Public claim ratio</u> <sup>(b)</sup>	<u>Bank claim ratio</u> <sup>(b)</sup>	<u>Other claim ratio</u> <sup>(b)</sup>
United States	175	179,611	1,936	0.0108	0.05	0.49	0.46
Hong Kong	130	113,352	2,660	0.0040	0.04	0.57	0.39
France	181	103,604	476	0.0058	0.07	0.65	0.28
Singapore	119	97,734	284	0.0007	0.01	0.80	0.19
Japan	134	97,490	241	0.0021	0.02	0.74	0.24
Germany	131	55,934	58	0.0037	0.13	0.61	0.26
Italy	141	52,940	192	0.0024	0.17	0.63	0.20
Netherlands	129	44,967	194	0.0060	0.03	0.53	0.44
Canada	117	38,526	1,189	0.0080	0.22	0.38	0.40
Switzerland	147	25,482	306	0.0078	0.02	0.51	0.47
Spain	130	24,340	54	0.0091	0.14	0.55	0.31
Ireland	131	24,099	14	0.0002	0.04	0.65	0.31
Brazil	78	18,744	303	0.0264	0.33	0.37	0.30
Sweden	122	18,198	1	0.0000	0.09	0.67	0.24
Australia	118	16,995	101	0.0025	0.05	0.45	0.49
Argentina	61	15,725	722	0.0300	0.23	0.36	0.41
Mexico	83	15,635	26	0.0005	0.44	0.26	0.30
Total	2,127	943,376	8,757	--	--	--	--

Source: Bank of England.

<sup>(a)</sup> Claims and overdue claims refer to the stock of UK-owned banks' international loan claims at each year-end and the amounts of such claims which are 14 days or more past due on that date.

<sup>(b)</sup> Public claims, bank claims, and other claims are, respectively, claims to the public, bank and non-bank private sectors. All ratios are unweighted averages measured with respect to claims.

Defaulted claims are about £9 billion, or less than 1% of the total. Most claims are in the banking sector. The United States is the most prominent country of borrower, with nearly 19% of the total claims made by UK-owned banks over the sample period. The countries with the highest ratios of defaulted claims to claims are Argentina and Brazil. For developed countries, most debt is to the private sectors, while in developing countries (Argentina, Brazil and Mexico), the public sector is more important.

Less than 10% of the claims in our sample are made to developing countries. In this regard, the sample reflects worldwide allocations, insofar as nearly 90% of all foreign claims reported by the BIS (2002) are made to developed countries. Our analysis concerning the effects of interdependence on bank lending risk, therefore, appears applicable to most international banks. We note also that Dungey *et al* (2002) show that the transmission of economic disturbances internationally occurs across both developed and developing countries.

Descriptive statistics are presented in Table C. The overall sample consists of 28 banks and 2,127 observations (pooled by bank, year and country). For the links, changes in output range from a 3% decline to a 13% expansion, while changes in exports range from a 26% decline to a 100% increase.

**Table C: Descriptive statistics**

<u>Dependent variable</u>	<u>Mean</u>	<u>Standard deviation</u>	<u>Min</u>	<u>Max</u>
Overdue <sub>(i,j,t)</sub>	.0061	.0393	0	1
<u>Linked-country factors</u> (Link <sub>(j,t)</sub> )				
Change in gross domestic product	.0027	.0262	-.0290	.1321
Change in exports	.0922	.1402	-.2632	.1000
<u>Control variables</u>				
Bankclaim <sub>(i,j,t-1)</sub>	.5592	.3515	0	1
Pubclaim <sub>(i,j,t-1)</sub>	.1100	.2269	0	1
Assets <sub>(i,t-1)</sub> <sup>(a)</sup>	65,300	79,100	108	360,000
Capratio <sub>(i,t-1)</sub> <sup>(b)</sup>	15.49	10.271	8.317	148.05
Profit <sub>(i,t-1)</sub>	.0169	.0257	-.0346	.3208

Source: Bank calculations.

<sup>(a)</sup> Asset sizes are expressed in £ millions.

<sup>(b)</sup> The capital ratio is expressed as a percentage.

## 5. Results

Table D presents the estimation of overdue claims, as depicted in equation (1), using exports and output, respectively, as the link. For both estimations, coefficients on the dummy variables for time and country fixed effects are suppressed to conserve space. The models are statistically significant and explain a substantial proportion of the variation of the dependent variable.

Among the control variables, the coefficients on capitalisation ( $Capratio_{(i,t-1)}$ ) are negative and significant, which is consistent with the finding of Berger (1995) that capital-increasing banks tend to reduce levels of non-performing loans. The coefficients on  $Profit_{(i,t-1)}$  are positive and significant, as in Sinkey and Greenawalt (1991), which may be related to managerial policies that increase credit availability, and income, but also increase portfolio risk, leading to subsequent overdue credits. The coefficients on  $Assets_{(i,t-1)}$  are positive and significant, which parallels the finding of Demsetz and Strahan (1995) that risk is greater at larger banks. The variables representing claims to the bank sector and to the public sector are insignificant.

For the estimations using exports as the measure of real and financial conditions in the linked country, the coefficient on  $Link_{(j,t)}$  is negative and marginally significant (t-statistic of 1.91), which suggests that decreasing exports to a linked country tends to increase overdue claims in the country of borrower. This offers some support for the argument that borrowers in a country are dependent for claim repayment on revenues generated abroad. For the estimations using output as the measure of real and financial conditions, the coefficient on  $Link_{(j,t)}$  is negative and significant (t-statistic of 2.45). This supports the hypothesis that performance outcomes on claim repayment in a country are affected by the level of economic activity in another country that is closely linked by trade. It does not, however, distinguish among such possible rationales due to merchandise trade, trade in services, liquidity constraints or reduction in collateral value.

Our results, overall, appear relevant in identifying countries from which disturbances in credit performance may emanate (Curry *et al* (1998)). This shifts the focus on bank credit performance from a systematic, or global, perspective (Goodman (1986), Saunders (1986), and Palmer and Sanders (1996)) to the perspective of interdependencies between bilaterally linked countries. And it illustrates how the transmission of financial shocks from one country to another encompasses the quality, as well as the quantity, of credit (Peek and Rosengren (1997)).

**Table D: Tobit regression results – with single link variable**

	Dependent variable: Overdue $(i,j,t)$	
	Export link <sup>(a)</sup>	Output link <sup>(a)</sup>
Constant	0.052* (0.023)	-0.041 (0.023)
Link $_{(j,t)}$	-0.070 (0.037)	-0.431* (0.176)
Bankclaim $_{(i,j,t-1)}$	-0.011 (0.016)	-0.014 (0.016)
Pubclaim $_{(i,j,t-1)}$	0.034 (0.022)	0.033 (0.023)
Assets $_{(i,t-1)}$	7.12** (0.590)	7.10** (0.588)
Capratio $_{(i,t-1)}$	-0.002* (0.001)	-0.002* (0.001)
Profit $_{(i,t-1)}$	0.958** (0.209)	0.959** (0.207)
Log likelihood	-68	-67
Pseudo R <sup>2</sup>	0.75	0.75
Observations	2,127	2,127

Source: Bank calculations.

\* and \*\* indicates significance at the .95 and .99 levels, respectively.

<sup>(a)</sup> Standard errors are in parentheses.

<sup>(b)</sup> For Assets $_{(i,t-1)}$ , the coefficients and standard errors are expressed as E-10.



### 5.1 *Specific effects of country and time*

The results in Table D are useful in describing how credit performance in all countries in our sample, collectively, can be influenced by external economic conditions in a linked country. Greater insight into the nature of cross-country interdependency can be gained by identifying specific countries or years that may be affected more than others. This is done with estimations of equation (2), presented in Table E, which replace the link variables with interactions of the links and dummy variables for each country, and estimations of equation (3), presented in Table F, which replace the link variables with interactions of the links and dummy variables for each year.<sup>(10)</sup>

In Table E, the coefficients on the variables representing interactions of the link and country variables are correctly signed in most cases. Only for the United States, and only for exports (not for output), was the coefficient positive and statistically significant. This may be related to idiosyncrasies of the US economy. Exports as a per cent of gross domestic product in the United States were about 10%, as opposed to an average of nearly 40% for all other countries in our sample. The BIS (2001) states that countries less open to trade are ‘less exposed to a downturn in demand elsewhere’.

The coefficients are statistically significant at the 95% level for either exports or output in 9 of the 17 countries (Germany, Italy, Japan, Singapore, Canada, Ireland, Spain, Sweden and Mexico). These countries are regionally concentrated in Europe or North America (Singapore and Japan excepted), and have developed, rather than developing, economies (Mexico excepted). They are relatively dependent on primary trading partners; most of them, in fact, are above the median for the sample in exports to their linked countries as a per cent of gross domestic product.

On the other hand, there is no statistically significant relationship observed in Table E for Hong Kong, which is the single country most dependent on its trading partner (China). It is tempting to attribute this lack of a result to Hong Kong’s status as an offshore financial centre, but Singapore, another such centre, is not similarly affected. It appears that ‘normal interdependencies’ among countries in our sample, as described in Dornbusch *et al* (2000), are attributable to some linkages unrelated to trade.

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<sup>(10)</sup> Linear dependencies prevented inclusion of the 170 dummy variables needed to examine simultaneous effects of country and time.

**Table E: Tobit regression results – with link variable interacted with country dummies**

	Dependent variable: <i>Overdue</i> $(i,j,t)$			
	Export link		Output link	
	Coefficient	Standard error	Coefficient	Standard error
Constant	-0.122**	0.019	-0.129**	0.019
Links $_{(j,t)}$ :				
Link $_{(j,t)}$ x United States	0.160*	0.064	0.454	0.391
Link $_{(j,t)}$ x Germany	-0.216	0.170	-1.906*	0.795
Link $_{(j,t)}$ x France	-0.031	0.152	0.102	0.309
Link $_{(j,t)}$ x Italy	-0.258	0.181	-2.777**	1.003
Link $_{(j,t)}$ x Hong Kong	0.091	0.096	0.000	0.437
Link $_{(j,t)}$ x Japan	-0.149	0.143	-1.226*	0.520
Link $_{(j,t)}$ x Netherlands	-0.036	0.101	-0.124	0.364
Link $_{(j,t)}$ x Singapore	-0.417*	0.179	-1.483**	0.555
Link $_{(j,t)}$ x Canada	-0.195	0.126	-1.180*	0.527
Link $_{(j,t)}$ x Ireland	-0.278**	0.086	-2.189**	0.600
Link $_{(j,t)}$ x Australia	-0.118	0.144	0.476	0.727
Link $_{(j,t)}$ x Spain	-0.189	0.150	-1.860*	0.811
Link $_{(j,t)}$ x Switzerland	-0.133	0.190	-0.435	0.427
Link $_{(j,t)}$ x Argentina	0.072	0.052	0.432	0.556
Link $_{(j,t)}$ x Sweden	-0.419	0.240	-6.867**	1.697
Link $_{(j,t)}$ x Brazil	-0.134	0.112	-0.240	0.508
Link $_{(j,t)}$ x Mexico	-0.513**	0.149	-3.873**	0.883
Bankclaim $_{(i,j,t-1)}$	-0.022	0.015	-0.009	0.015
Pubclaim $_{(i,j,t-1)}$	0.038	0.020	0.052*	0.021
Assets $_{(i,t-1)}$ <sup>(a)</sup>	5.72**	0.511	6.14**	0.530
Capratio $_{(i,t-1)}$	-0.003**	0.001	-0.003**	0.001
Profit $_{(i,t-1)}$	0.806**	0.214	0.817**	0.212
Log likelihood		-128		-111
Pseudo R <sup>2</sup>		0.53		0.59
Observations		2,127		2,127

Source: Bank calculations.

\* and \*\* indicates significance at the .95 and .99 levels, respectively.

<sup>(a)</sup> For Assets $_{(i,t-1)}$ , the coefficients and standard errors are expressed as E-10.

**Table F: Tobit regression results – with link variable interacted with year dummies**

	Dependent variable: <i>Overdue</i> $(i,j,t)$			
	Export link		Output link	
	<u>Coefficient</u>	<u>Standard error</u>	<u>Coefficient</u>	<u>Standard error</u>
Constant	-0.125**	-0.019	-0.121**	-0.019
Links $_{(j,t)}$ :				
Link $_{(j,t)}$ x 1991	-0.094	0.154	-0.222	0.201
Link $_{(j,t)}$ x 1992	-0.050	0.071	0.069	0.616
Link $_{(j,t)}$ x 1993	0.030	0.046	0.238	0.623
Link $_{(j,t)}$ x 1994	0.063	0.066	-0.091	0.391
Link $_{(j,t)}$ x 1995	-0.112	0.084	-0.531	0.646
Link $_{(j,t)}$ x 1996	-0.284	0.148	-1.108	0.594
Link $_{(j,t)}$ x 1997	-0.257*	0.121	-0.241	0.454
Link $_{(j,t)}$ x 1998	-0.203	0.121	-1.173**	0.397
Link $_{(j,t)}$ x 1999	-0.162	0.087	-1.128*	0.445
Link $_{(j,t)}$ x 2000	-0.159*	0.075	-1.510**	0.430
Bankclaim $_{(i,j,t-1)}$	-0.029*	0.146	-0.028*	0.014
Pubclaim $_{(i,j,t-1)}$	0.021	0.019	0.018	0.019
Assets $_{(i,t-1)}$ <sup>(a)</sup>	5.19**	0.534	6.36**	0.555
Capratio $_{(i,t-1)}$	-0.003**	0.001	-0.003**	0.001
Profit $_{(i,t-1)}$	0.802**	0.218	0.869**	0.218
Log likelihood		-147		-146
Pseudo R <sup>2</sup>		0.46		0.46
Observations		2,127		2,127

Source: Bank calculations.

\* and \*\* indicates significance at the .95 and .99 levels, respectively.

<sup>(a)</sup> For Assets $_{(i,t-1)}$ , the coefficients and standard errors are expressed as E-10.

The coefficients are statistically significant at the 99% level, for both export and output interactions, in the cases of Ireland and Mexico. These countries are heavily reliant on their closest trading partners, with exports to the United Kingdom constituting 16% of output for Ireland and exports to the United States constituting 25% of output for Mexico. Thus, bilateral linkages appear to be particularly important for credit repayment in relatively small countries that are dependent on the economy of a larger and a neighbouring trading partner.

Interactions of the link and year variables (equation (3)) are presented in Table F. Coefficients on the variables for 1997, 1998, 1999 and 2000 are negative and significant (at the 95% level or better in one or both models). This may be symptomatic of a ‘growing tendency’ for bond rates, stock prices, credit spreads and risk premia in various markets to show similar movements, which increases the likelihood ‘that any failure in the functioning of one market will quickly be manifested elsewhere (BIS (2001))’.

## 5.2 Robustness

We undertook a variety of tests on alternate specifications of equation (1) to determine if our reported results for  $\text{Link}_{(j,t)}$  were sensitive to omitted independent variables, estimation procedure or measurement of the independent variable. One specification added an independent variable representing the percentage change in domestic output in the country of borrower. This was intended to control for possible collinearity of output in the country of borrower and exports to the linked country — ie, if linked-country output is highly collinear with output in the country of borrower, an inferred interdependency in equation (1) may be identified when none exists. The sign and significance of the coefficient on the link variables were unaffected.

Claessens *et al* (2001) define the dependent variables in their models as first differences rather than as levels. We tested an ordinary least squares regression model of equation (1) using the change in the overdue claim ratio, rather than the level of the overdue claim ratio, as the dependent variable. The sign and significance of the coefficient on the link variables were unaffected. We prefer levels, rather than changes, because they generate higher explanatory power.<sup>(11)</sup>

Another specification of equation (1) scaled the data to control for the size of linked-country economies. Results were similar to those reported. Another specification used ordinary least

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<sup>(11)</sup> Dahl and Shrieves (1999), in model defining bank credit as a function of bank-specific variables and country variables such as growth in GDP, similarly use levels rather than changes in the dependent variable.

squares regression on a subsample that excluded observations for which the overdue claim ratios were zero. In this case, the results again were similar to those reported, although the levels of significance on the coefficients for the links were lower and the overall explanatory power of the model declined. We prefer using the full sample because observations at zero convey valuable information on credit quality.

Our analysis is subject to caveats. First, our focus on bilateral linkages does not consider how income on claims may be related to the level of overdue claims nor does it consider how exposures to multiple countries may interact within a bank's overall portfolio. This means that our results are inapplicable to the general issue of cross-country diversification and bank financial condition. Second, alternative specifications using exchange rates, bank credit flows, stock market changes and interest rates for  $\text{Link}_{(j,t)}$  failed to offer evidence that any of these factors served as mechanisms for interdependence. Therefore, our findings with respect to output and exports cannot necessarily be generalised to other macroeconomic phenomena.

## **6. Conclusions**

We conduct statistical tests of the performance outcomes on foreign claims made by UK-owned banks. They are important insofar as our data source is unique, is suited to identification of cross-country interdependence and has never before been used in the analysis of international lending.

The key finding is that repayment on claims extended by international banks in a country can be influenced by economic conditions in another country closely linked by trade. As exports to, or gross domestic product in, the linked country decreases, repayment performance in the country of the borrower tends to deteriorate. Although this result holds for a majority of the countries in our sample, it is particularly pronounced in countries, such as Ireland and Mexico, that are dependent on a larger economy and during the later years of our sample period (1997 to 2000).

Our results are important because they extend prior research on bank credit performance by Goodman (1986), Saunders (1986) and Palmer and Sanders (1996) from a global perspective to the perspective of interdependencies between bilaterally linked countries. And they extend prior research on the transmission of financial shocks (Peek and Rosengren (1997) and Van Rijckeghem and Weder (2001)) from the analysis of the quantity of credit to the quality of credit.

Finally, we note that our results corroborate earlier evidence on international interdependencies within an environment uncontaminated by the informational effects of investor behaviour

(Dornbusch *et al* (2000) and Forbes and Rigobon (2002)). This is noteworthy insofar as prior evidence on interdependencies in the transmission of various crises from country to country have focused on secondary markets — for currencies, stocks, bonds and other financial assets — which are influenced by rational or irrational investor behaviour. The linkages observed herein, by contrast, indicate that cross-country interdependence can be attributed to real and financial, as opposed to informational, influences.

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