

Global monitoring with the BIS international banking statistics

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Abstract

This paper illustrates various applications of the BIS international banking statistics. We first compare international bank flows to measures of real activity and liquidity and show that the international banking system is becoming a more important conduit for the transfer of capital across countries. We then use network analysis tools to construct a bird's eye view of the structure of the international banking market and to identify key financial hubs. Linking this information with balance of payments statistics helps to better understand the role of banks in the financing of current account flows, for example the recycling of petrodollars and Asian surpluses. Finally, the paper illustrates how the BIS statistics can be used to analyse internationally active banks' foreign exposures to credit risk and, thus, spot vulnerabilities in the international banking market.

1. Introduction

The international banking market is a primary conduit through which funds are transferred among countries. Since 2002, cross-border lending and deposits have risen, both in absolute terms and relative to aggregate measures of real economic activity and liquidity. The structure of the international banking market has evolved over the past 30 years. While London has remained a primary financial centre, Asian and Caribbean offshore centres have expanded their global presence, and are important in the global channelling of funds. The growth in both the size and the complexity of international banking has financial stability implications at both the domestic and the international level.

This paper uses the BIS international banking statistics to address these issues. The first section, which relies primarily on the BIS locational banking statistics, places into perspective the growth in international banking activity in recent years by showing how it has increased in size relative to measures of economic activity and liquidity. It discusses the importance of offshore banking in the United Kingdom and Asian and Caribbean offshore centres, and provides a convenient graphical representation of the structure of the international banking market. The first section also analyses the net flow of bank credit between ultimate lenders and borrowers. Internationally active banks are important in the transfer of credit between developed countries, but play a somewhat smaller role in the recycling of petrodollars and Asian surpluses.

After describing the global flow of funds through the international banking system, the paper examines internationally active banks' foreign positions from a credit risk perspective. To this end, it is necessary to refocus the discussion away from the geographical distribution of flows

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and towards an analysis of banks' foreign exposures, grouping banks not according to their location but according to their nationality (ie the country in which they are headquartered).

Banks' foreign exposures can be usefully analysed in the context of banks' capital adequacy ratios. Such an analysis can help to quantify the degree to which a major low-probability event – such as the Asian financial crisis or the Argentine or Russian default – would stress the financial system, and can help to identify pockets of systemic risk in the interbank market. Systemic implications arise when the shock is common to banks headquartered in several countries, or if "second-round" effects occur, whereby the failure of a group of banks generates a cascade of bank failures across countries.

These issues are examined, at a broad level, in the second half of the paper, and make use of the BIS consolidated banking statistics, the most comprehensive source of information about banks' foreign exposures.¹ Foreign exposures are large for some national banking systems, accounting for more than 50% of their reporting banks' total balance sheet assets. As a result, large, low-probability shocks to banks' foreign exposures could have a discernible effect on their capital adequacy. In this section, we propose a simple capital adequacy ratio for national banking systems and then ask how this ratio would change given various hypothetical shocks to these banks' foreign exposures. Evaluating the impact of such shocks on a regular basis promises to provide important information about the evolution of the risk profile of internationally active banks.

The preliminary estimates – based on data for a limited number of reporting countries – suggest that shocks to banks' exposures to emerging markets have only a modest impact on reporting banks' capital adequacy. In contrast, a large loss on interbank exposures could conceivably push capital adequacy below the required 8% for banks headquartered in some reporting countries.

That said, the analysis in this section of the paper is incomplete in that it relies on data for only a subset of the total international banking market. Constructing the simple capital ratios requires, in addition to banks' foreign exposures, information on their total capital and risk-weighted assets. Such information is confidential for many reporting countries. Thus, the analysis below is a mechanical use of the data that are available, and sheds light on how such measures *could be* useful in tracking vulnerabilities in the interbank market. Only by incorporating data for a broader set of countries can concrete conclusions be drawn.

1.1 Growth in international banking

International banks play an increasingly important and complex role in the global financial system. In part, this growing complexity is the result of consolidation within the banking industry, globalisation and capital market integration. Cross-border claims today are over 30 times larger in absolute terms than 30 years ago. Relative to monetary aggregates or measures of global macroeconomic activity, international activity grew robustly in the 1980s, slowed somewhat in the 1990s and has trended upwards again since 2000.

The international banking market took off in the 1960s, when banks in London were permitted to accept foreign currency (ie non-sterling) deposits. These banks were able to attract US dollar deposits, or eurodollars, because they faced lower regulatory costs than their counterparts in the United States, which were subject to reserve requirements. The political climate at the time also helped this process along, as the former Soviet Union and

¹ As discussed in more detail below, such an analysis has been possible only since the 2005 enhancements to the *BIS consolidated banking statistics*. These enhancements provide information on banks' ultimate risk exposures that is crucial for evaluating capital adequacy ratios.

oil-exporting states, in search of a store of hard currency outside the United States, deposited a significant amount of US dollars in banks in London.²

Since then, international banking activity has grown significantly, in all major currencies. The BIS international banking statistics – the most comprehensive source of information on banks' international assets and liabilities – indicate that the outstanding stock of international claims,³ primarily loans, increased from \$684 billion at end-1977 to \$23 trillion in the second quarter of 2006.^{4, 5} The growth in this market is evident even when scaled by measures of overall economic activity. Figure 1 portrays cross-border claims of banks in all reporting countries as a ratio of world GDP, as well as a decomposition of this ratio by currency. Total international claims of BIS reporting banks rose from roughly 10% of world GDP in 1980 to 28% at end-1990. This ratio stagnated over the 1990s, in part reflecting the retrenchment of Japanese banks, but has been on the rise since end-1999, reaching 48% by early 2006.⁶

Banks' liabilities, primarily deposits, have grown along with their claims. Cross-border liabilities can be combined with domestic liabilities (eg domestic currency deposits in resident banks) to yield a measure of "liquidity" in a particular currency.⁷ Figure 2 plots banks' international liabilities – to (i) non-banks, (ii) non-banks and other banks or (iii) all counterparties (ie including inter-office deposits) – as a fraction of the sum of total international liabilities in that currency and the corresponding monetary aggregate M2.⁸ In each of the major currencies, international liabilities have risen as a share of liquid funds in recent years, in line with the GDP-based ratios reported in Figure 1. US dollars held in banks outside the United States are 30–50 percentage points larger than the corresponding ratios for the euro or the Japanese yen, underscoring the importance of the US dollar as an international currency.

² For a thorough treatment of the development of the international banking market, see Mayer (1979), McKinnon (1979), Johnston (1983), Niehans (1984) and Krugman and Obstfeld (1991).

³ International claims (liabilities) are defined as cross-border claims (liabilities) in all currencies plus foreign currency claims (liabilities) vis-à-vis domestic residents. The BIS locational banking statistics follow balance of payments concepts, and are hence based on the residency of the reporting bank. For a complete description of these statistics, see BIS (2003a,b) and Wooldridge (2002).

⁴ Part of this increase is due to a widening of the reporting area. In particular, data for the Cayman Islands, Hong Kong SAR, Singapore and other offshore financial centres became available only at end-1983. Australia, Bermuda, Greece, Guernsey, the Isle of Man and Portugal joined the reporting population in or after 1998. Banks located in these countries accounted for less than 5% of total claims of BIS reporting banks in 2006.

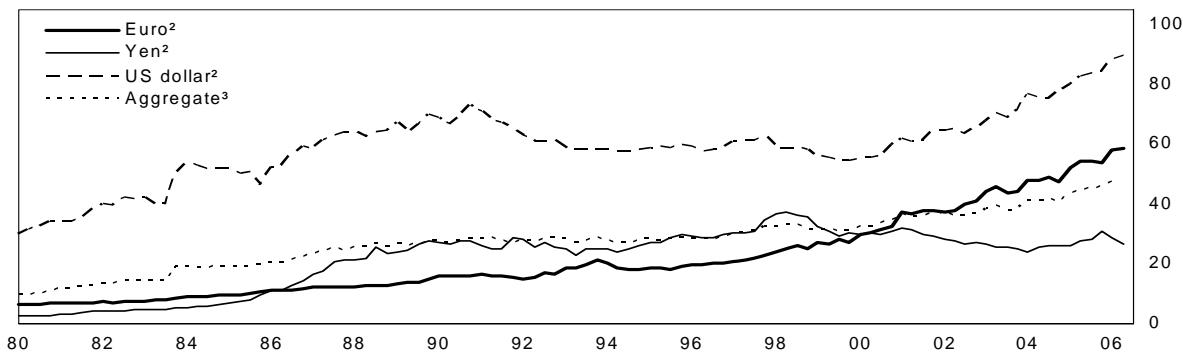
⁵ Throughout this feature, the term "euro area" refers to the group of 12 countries that adopted the euro in 1999. In addition, all calculations exclude euro-denominated cross-border positions within the euro area.

⁶ The currency distribution of international claims has also evolved. The US dollar share of international bank claims dropped from 73% in mid-1984 to 52% in mid-2006 (evaluated at constant 2006 Q2 exchange rates). Over the same period, the share of euro-denominated claims (including the euro legacy currencies prior to 1999) rose from 11% to 27%.

⁷ During the 1970s and 1980s, a relatively large literature on the growth of the eurocurrency market emerged. In part, this was driven by concerns that US dollars placed in banks outside the United States would contribute to inflationary pressures in the United States and dull the effect of domestic monetary policy. See McKinnon (1979), Niehans and Hewson (1976) and Mayer (1979).

⁸ The definition of M2 varies slightly by country but generally includes domestic currency in circulation, demand deposits, savings deposits, small-denomination time deposits and balances in retail money market mutual funds. Importantly, M2 is in domestic currency and excludes domestic interbank deposits and all eurocurrency deposits.

Figure 1
BIS reporting banks' international claims relative to GDP¹
 In per cent



¹ International claims comprise cross-border claims in all currencies and claims on residents in foreign currencies. Euro-denominated claims among countries that form the euro area are excluded. ² Stocks outstanding of claims, as a percentage of the annualised GDP of the issuing country or country group. ³ Total stocks outstanding of claims, in all currencies, as a percentage of annualised world GDP.

Sources: IMF; national data; BIS.

Figure 2 also indicates that there has been a sustained shift towards greater liabilities to non-banks since the mid-1990s.⁹ In the US dollar market, for example, positions vis-à-vis these entities in the United Kingdom and Caribbean offshore centres, which host many non-bank financial entities, accounted for much of this. Across all currencies, liabilities to non-banks currently account for 29% of total international liabilities, up from 22% in 1996 and 18% in 1988.

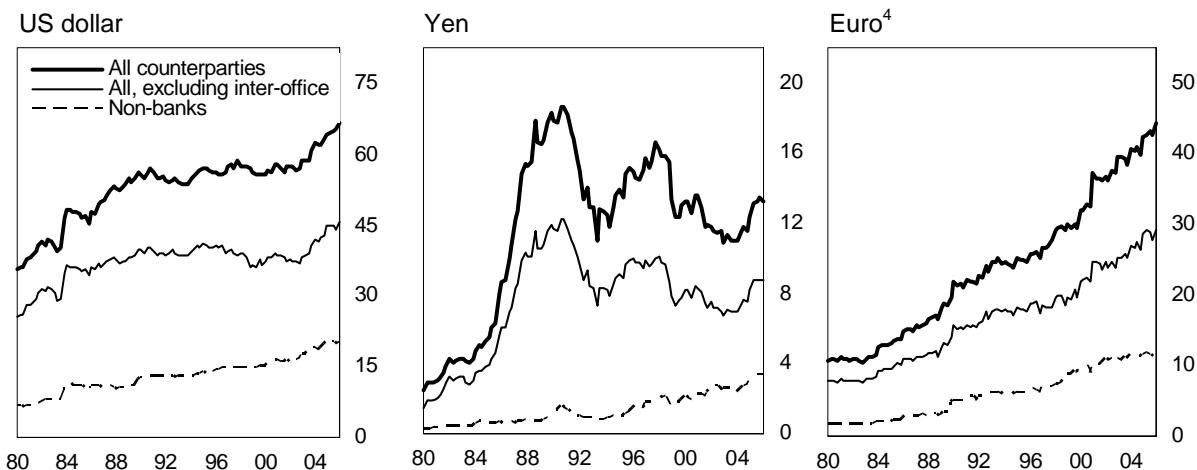
1.2 The structure of the market

Banks located in a few countries constitute the core of the international banking market. The United Kingdom has been the largest international banking centre (IBC), a focal point for the lending and depositing of foreign currencies. Asian and Caribbean offshore centres later emerged as regional banking hubs, and currently rival the United Kingdom in terms of overall activity.

On the whole, however, interbank activity dominates both the claims and the liabilities side of banks' balance sheets. Short-term misalignments in the demand for and supply of funds to end-use borrowers can mean that deposits in banks may be temporarily passed on to other banks. If so, each leg of this chain is reflected in the aggregate claims figure, and can generate what appear to be swellings in interbank loan flows. In mid-2006, inter-office claims accounted for an estimated 32% of total cross-border deposits, while lending to other banks accounted for an additional 39%.

⁹ See McGuire (2004) for a discussion of the shift towards lending to non-bank borrowers in the United States by banks in the United Kingdom.

Figure 2
BIS reporting banks' international liabilities¹ relative to M2^{2,3}
 By currency and counterparty, in per cent



¹ International liabilities comprise cross-border liabilities in all currencies and liabilities to residents in foreign currencies. ² In general, M2 includes domestic currency in circulation plus bank liabilities to non-banks denominated in the domestic currency, eg demand deposits, savings deposits, small-denomination time deposits and balances in retail money market mutual funds. For the United States and Japan, M2 includes liabilities to both residents and non-residents. Liabilities to non-residents are subtracted from US and Japanese M2. Euro area M2 includes liabilities to euro area residents only. ³ International liabilities to all counterparties, to all counterparties excluding inter-office (ie to non-banks and other banks) or to non-banks only as a fraction of the sum of international liabilities to all counterparties and M2. ⁴ The pre-1999 portion of the euro area M2 series is estimated by the ECB. Cross-border liabilities vis-à-vis euro area residents denominated in euros or in the legacy currencies are excluded.

Sources: IMF; national data; BIS.

The size and scope of the operations of banks located in these IBCs are large relative to aggregate economic activity in the host countries. Table 1 illustrates this point by reporting international liabilities of banks located in a particular country or country group, as a proportion of GDP. The United Kingdom and Asian and Caribbean offshore centres (as well as Luxembourg and Switzerland) clearly stand out, with liabilities/GDP ratios of 285% or more in 2006. Elsewhere, these ratios were 62% or less.

Activity in some IBCs is dominated by internationally active foreign banks. In the United Kingdom and Caribbean and Asian offshore centres, for example, banks headquartered in the United States, the euro area (primarily Germany) and Switzerland account for the bulk of international claims (Figure 3, top row). Japanese banks were once dominant in London and Hong Kong, although their cross-border claims declined in the 1990s with the downturn in the Japanese economy and the deterioration in the health of the domestic banking sector. In contrast to the experience in these IBCs, domestic banks (ie banks headquartered in the reporting country) tend to be dominant in other countries (Figure 3, bottom row).

Table 1
Identifying international banking centres

In per cent

	Liabilities to total ¹			Liabilities to GDP		
	1990	1998	2006	1990	1998	2006
Euro area ²	16	23	26	21	36	62
United States ³	10	10	11	11	11	20
Japan	20	9	4	45	22	23
Other developed countries ⁴	4	4	5	22	27	44
United Kingdom	21	21	27	143	154	285
Luxembourg	3	4	2	1,834	2,127	1,324
Switzerland	5	5	5	165	207	317
Caribbean offshore centres ⁵	9	9	7	–	4,787	5,608
Asian offshore centres ⁶	10	12	5	628	491	386
Developing countries ⁷	0	0	3	–	–	16

¹ International liabilities of banks located in each country or country group at the beginning of the year, as a share of all BIS reporting banks' total international liabilities. International liabilities comprise cross-border liabilities in all currencies and liabilities to residents in foreign currencies. ² Excludes Greece and Luxembourg. Euro-denominated cross-border liabilities contracted within the euro area are excluded. ³ Excluding liabilities to residents in all currencies. ⁴ Australia, Canada, Denmark, Norway and Sweden. ⁵ The Bahamas, the Cayman Islands and the Netherlands Antilles. ⁶ Hong Kong SAR and Singapore. ⁷ Brazil, Chile, India, Korea, Mexico, Taiwan (China) and Turkey.

Sources: IMF; national data; BIS.

The structure of the global banking system can be viewed as a network of interconnected nodes, each representing a hub or particular geographical region.¹⁰ Figure 4 provides one representation of the network of bilateral linkages between regions. The size of each node corresponds to the share of resident banks' cross-border claims in total cross-border claims of BIS reporting banks, and is thus an indicator of the relative importance of particular countries.¹¹ The thickness of the lines (or links) between regions corresponds to the sum of cross-border claims between the regions, and is a gauge of the size of aggregate cross-border positions.

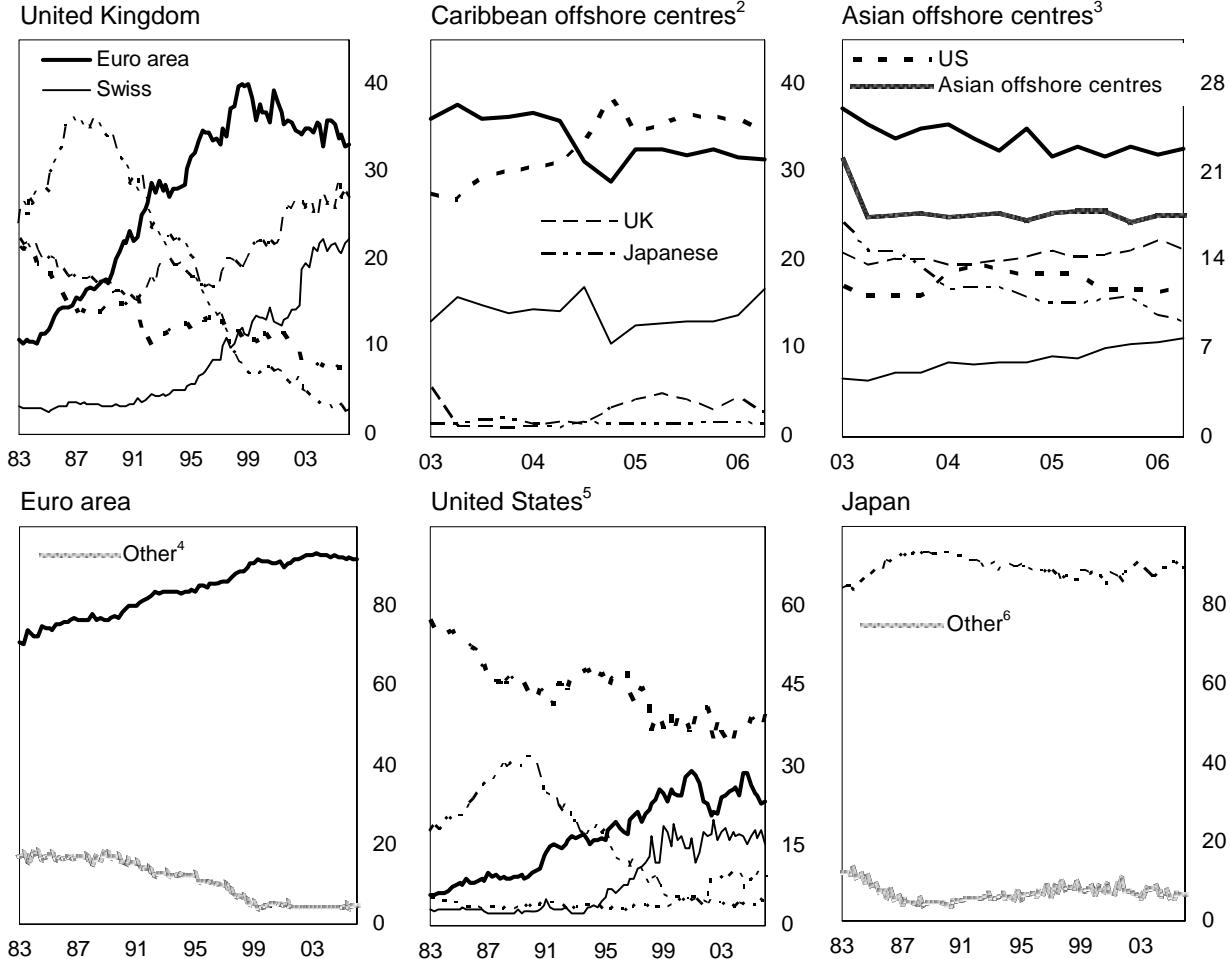
Bilateral linkages vary significantly between country pairs. For much of the last 20 years, the links between banks in the United Kingdom and the euro area (at roughly \$4 trillion), and between banks in the United States and the Caribbean (roughly \$2 trillion), were the largest. Aggregate positions between the United States and the United Kingdom, and between Switzerland and the euro area, were relatively significant as well. At the onset of the Asian financial crisis in 1997, Japanese banks still had significant positions vis-à-vis their offices in

¹⁰ The country groups OIL, LAT, EM EUROPE and ASIA PAC in Figures 4 and 5 include both reporting and non-reporting countries. Bahrain (OIL), Brazil, Chile and Mexico (LAT), Turkey (EM EUROPE) and Taiwan (China) (ASIA PAC) all started to report data after 2000. Similarly, UK includes positions of banks in the United Kingdom as well as Guernsey, the Isle of Man and Jersey for 2006.

¹¹ Foreign currency claims on residents are not included in Figure 4.

Hong Kong and the United Kingdom. By mid-2006, their cross-border positions vis-à-vis banks in Asian offshore centres had declined in relative terms.

Figure 3
International claims of foreign and domestically headquartered banks¹
 By reporting country, in per cent



¹ Lines indicate international claims of banks headquartered in various parent countries (identified by legend labels) as a share of total international claims of banks located in the reporting country or country group (identified by panel title). International claims comprise cross-border claims in all currencies and claims on residents in foreign currencies. ² The Bahamas, Bermuda, the Cayman Islands and Panama. ³ Hong Kong SAR and Singapore. ⁴ Japan, Switzerland, the United Kingdom and the United States. ⁵ Excludes foreign currency claims on residents of the United States. ⁶ The euro area, Switzerland, the United Kingdom and the United States.

Source: BIS.

1.3 Tracking the flow of capital through banks

Through lending, accepting deposits, or purchases of foreign securities, banks play a role in the transfer of capital between countries. The above analysis touches only indirectly on the United Kingdom's and Asian and Caribbean offshore centres' role as redistributors of financial capital. This section attempts to fill this gap by analysing net flows of funds among banks in different geographical regions, with a focus on the flows through banks in these IBCs.

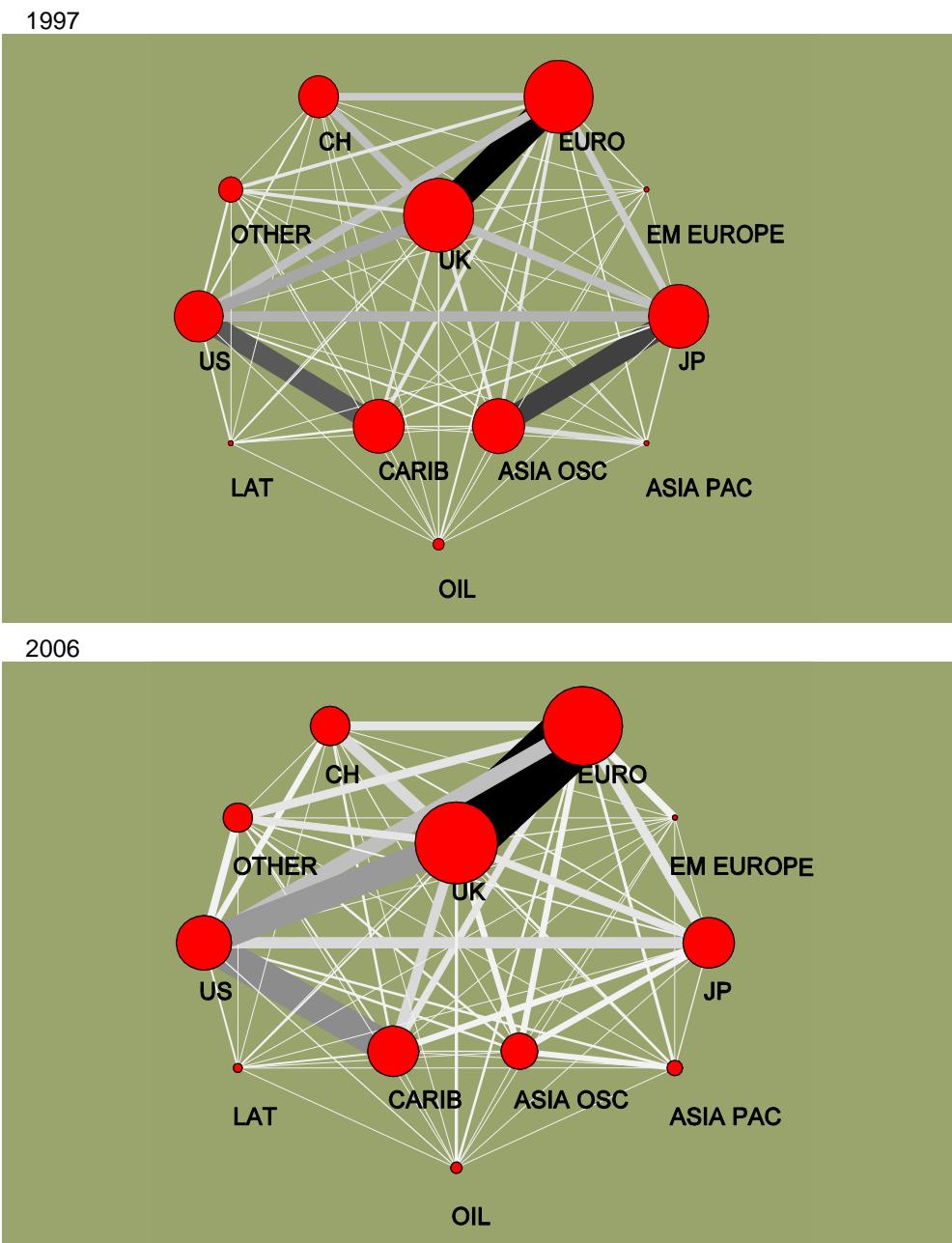
The BIS locational banking statistics track the net flow of financial capital between any two regions which is channelled through the banking system. For concreteness, consider measuring the cumulative net flow of funds over a given period between the residents of country A and the residents of country B. A portion of funds transferred between these residents will be external to the banking system – the purchase of a US Treasury by a non-bank outside the United States, for example – and thus is not covered by the BIS international banking statistics. The portion which is routed through the banking system equals the sum of three components. The first is the cumulative net claim flows (claims minus liabilities) to non-banks in country A reported by banks located in country B. The second is the counterpart to this, the cumulative net flows reported by banks in country A to non-banks in country B. Finally, there is the net interbank component.¹²

Figure 5 presents the net flow of capital channelled through banks, cumulated over two periods (1990–97 and 1998–2006). This allows for a comparison of the net flow of funds through banks before and after the Asian financial crisis. Each arrow in Figure 5 provides two pieces of information: the direction of net capital flows between two given regions and the relative size of these flows (indicated by its thickness).

Between 1990 and 1997, the United States and emerging Asia-Pacific stood out as the main net borrowers on the international banking market, whereas Japan was the main provider of funds (Figure 5, top panel). In line with the renewed growth of its current account deficits over this period, the United States experienced a net inflow of \$433 billion via the banking market. Roughly 85% of this was provided by Japanese and UK residents. At the same time, residents of Japan and the countries that now comprise the euro area jointly exported \$195 billion to Asian offshore centres and emerging Asia-Pacific, accounting for 74% of the overall net banking flows into these economies.

¹² Unlike net flows to non-banks, the net interbank flows reported by any country pair should be roughly equal. A net inflow reported by banks in country A vis-à-vis banks in country B should be reported as a corresponding outflow by banks in country B. In practice, different populations of banks on the reporting and vis-à-vis side of the data can create some, albeit small, discrepancies. In calculating net interbank flows, we chose the larger asset and liability positions reported across the two sets of reporting banks. Some regions include countries which do not report data. If, for example, country B is not a reporter, then flows from banks in country B to non-banks in country A will be missed. This is potentially a large component of total flows through the banking system for some regions. Finally, a small portion of banks' total liabilities is debt securities liabilities, which are often not allocated to a particular vis-à-vis country.

Figure 4
Linkages in the international banking system¹



ASIA OSC = Hong Kong SAR, Macao SAR and Singapore; ASIA PAC = China, India, Indonesia, Korea, Malaysia, Pakistan, the Philippines, Taiwan (China) and Thailand; CARIB = Aruba, the Bahamas, Bermuda, the Cayman Islands, the Netherlands Antilles and Panama; CH = Switzerland; EM EUROPE = Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, Turkey and Ukraine; EURO = euro area countries; JP = Japan; LAT = Argentina, Brazil, Chile, Colombia, Mexico and Peru; OIL = OPEC member states (excluding Indonesia) plus Russia; OTHER = Australia, Canada, Denmark, New Zealand, Norway and Sweden; UK = the United Kingdom plus the offshore centres Guernsey, the Isle of Man and Jersey; US = the United States.

¹ The size of each red circle is proportional to the outstanding stock of cross-border claims of reporting banks located in the particular geographical region. Some regions include countries which do not report data. The thickness of a line between regions A and B is proportional to the sum of claims of banks in A on residents in B and claims of banks in B on residents of A. The size of the circles and thickness of the lines are scaled by the overall stock outstanding, and thus are not directly comparable across panels.

Source: BIS.

1.4 Global imbalances: tracking OPEC and Asian surpluses

Just how important is the international banking system in the global flow of capital? This question can be answered by tracking the flow of funds through banks *relative to* the total flow of capital to and from various regions. A country's total net financing requirement in a given period can be expressed as the sum of net financial outflows generated by the public and private sectors which, by the balance of payments identity, is equal to the current account balance. A comparison with the BIS international banking statistics will shed light on the portion of a country's net financing requirement which is routed via the banking system, as opposed to via financial markets.

Figure 6 presents this comparison for the United States, the euro area and Japan. By mid-2006, one quarter of the cumulative current account flows into the United States were routed through the international banking system. Similarly, only a small portion of Japan's current account surplus has been channelled through the banking system, although this share has increased substantially over the last decade, from 5% in 1997 to 32% at mid-2006. In the euro area, net bank flows closely tracked the movement of cumulative current account balances up to 1995 and between 1999 and mid-2006.¹³

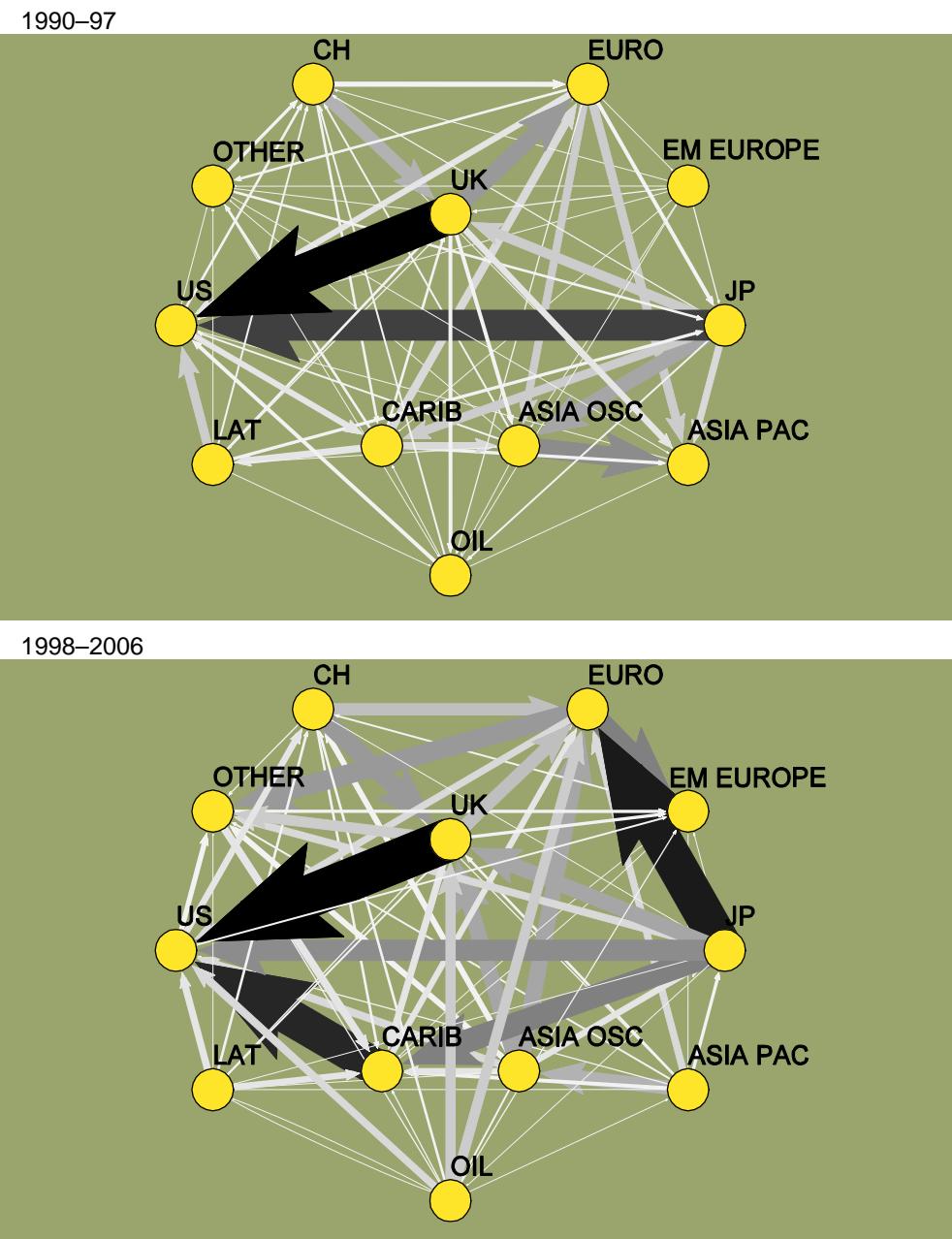
On a gross basis as well, there is some evidence that the international banking system is less important as a conduit for international capital flows than it once was. Indeed, as shown below, very little of the gross capital flows from two of the largest capital exporting groups of countries – OPEC member states and emerging Asian countries – is transferred through the international banking system. At the same time, these regions are important sources of funds for internationally active banks.

One measure of a country's total foreign financial investment – or “invested funds” – is the change in its total reserves plus gross financial outflows (ie foreign direct investment (FDI) abroad and gross portfolio and other investment).¹⁴ Invested funds, by definition, show up as claims on the rest of the world, through purchases of foreign securities (debt and equity), FDI abroad or deposits in foreign banks. As shown below, what appear to be large changes in BIS reporting banks' deposit liabilities actually account for a rather small share of the total investment abroad by the major emerging Asian economies and OPEC member states.

¹³ By contrast, from end-1995 to mid-1998, net inflows via banks to the euro area, mainly from the residents of the United Kingdom, Japan and Asian offshore centres, coincided with current account surpluses and the accumulation of reserves in this region.

¹⁴ Alternatively, the balance of payments identity implies that invested funds are the sum of current account surpluses and gross financial inflows. Some items in the balance of payments data for some countries are not available, and are estimated by extrapolating from earlier periods. This analysis does not include derivative assets and liabilities.

Figure 5
Net flow of funds through the international banking system¹

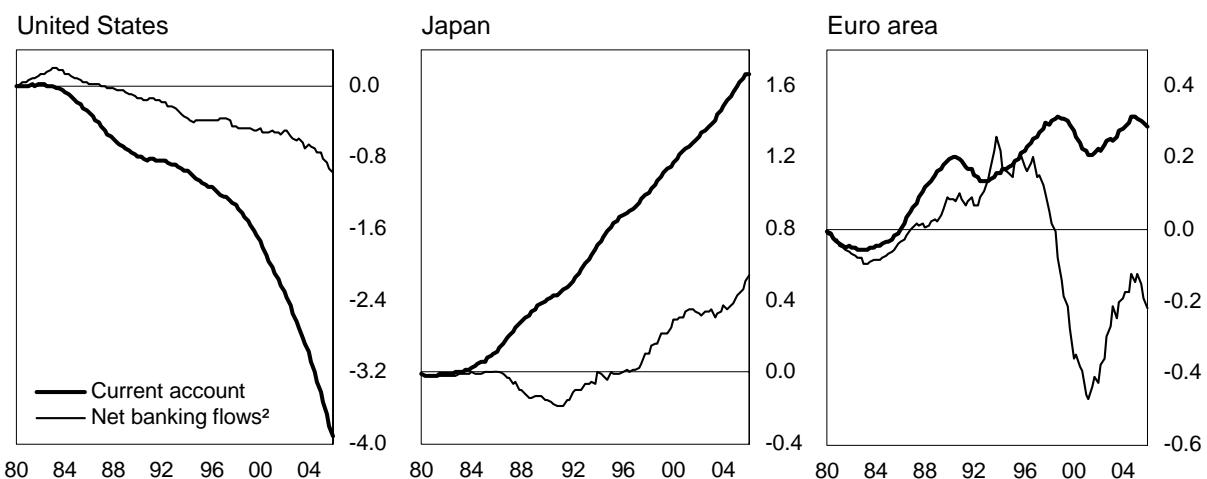


ASIA OSC = Hong Kong SAR, Macao SAR and Singapore; ASIA PAC = China, India, Indonesia, Korea, Malaysia, Pakistan, the Philippines, Taiwan (China) and Thailand; CARIB = Aruba, the Bahamas, Bermuda, the Cayman Islands, the Netherlands Antilles and Panama; CH = Switzerland; EM EUROPE = Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, Turkey and Ukraine; EURO = euro area countries; JP = Japan; LAT = Argentina, Brazil, Chile, Colombia, Mexico and Peru; OIL = OPEC member states (excluding Indonesia) plus Russia; OTHER = Australia, Canada, Denmark, New Zealand, Norway and Sweden; UK = the United Kingdom plus the offshore centres Guernsey, the Isle of Man and Jersey; US = the United States.

¹ The thickness of an arrow is proportional to the amount of cumulative net bank flows between regions. Net flows between regions A and B equal the sum of: (1) net claims (assets minus liabilities) of banks in A on non-banks in B; (2) net claims of banks in B on non-banks in A; and (3) net interbank flows between A and B. Some regions include countries which do not report data. The thickness of the arrows is scaled by the overall flows cumulated over the respective period, and thus is not directly comparable across panels. In contrast to Figure 4, the size of the circles has no significance.

Source: BIS.

Figure 6
External positions and the international banking market
 In trillions of US dollars¹



¹ Flows are scaled by the US GDP deflator (set to 100 in 1985 Q1) and are cumulated from 1980 Q1 onwards.

² A positive flow signifies an outflow from the country or region to the rest of the world. See Figure 5 for a definition of net bank flows.

Sources: ECB; IMF; BIS.

The most recent oil price cycle started in 1999, and has generated substantial inflows into oil-exporting countries.¹⁵ Relative to previous oil cycles, the propensity for OPEC countries to invest these oil revenues abroad seems to have risen. OPEC's total invested funds,¹⁶ as a share of net oil revenues, were higher in the 1999–2005 cycle than in the 1978–82 cycle, implying a higher rate of foreign placements.

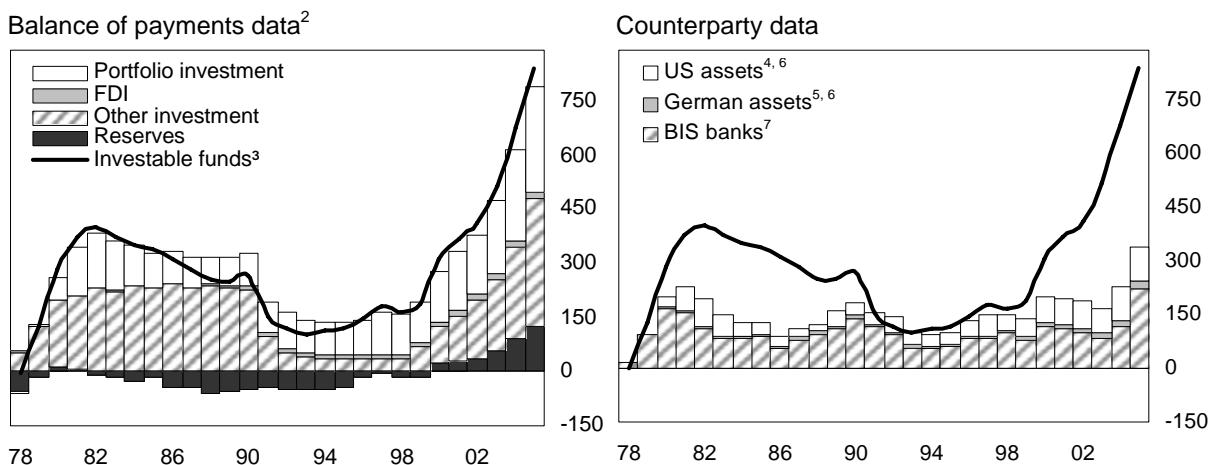
The left-hand panel of Figure 7 decomposes OPEC countries' investable funds into the change in foreign exchange reserves and the various components of the financial account. These data indicate a marked change in the types of foreign investment across the two cycles. Between 1999 and end-2005, 28% of cumulative investable funds had been channelled into portfolio investment – or net purchases of foreign financial assets by non-monetary authorities – compared with 38% in the 1978–82 cycle. "Other investment", which primarily constitutes deposits in foreign banks but also investment not classified elsewhere, has fallen as a share of investable funds, from 58% in the previous cycle to 47% in the current one.¹⁷

¹⁵ By end-2005, OPEC members had earned an estimated \$1.3 trillion in petrodollars since end-1998, while the world's other large exporters, Russia and Norway, had received \$403 billion and \$223 billion respectively.

¹⁶ Gross financial inflows are partially based on estimated data. Some items in the balance of payments data for several countries are not available for recent quarters, and are estimated by extrapolating from earlier periods. In addition, no data on gross financial inflows are available for the United Arab Emirates, Qatar and Iraq. Estimates for these countries are based on their current account and foreign exchange reserve data. These estimates imply that cumulative financial inflows accounted for 18% of cumulative investable funds over the 1999–2005 cycle, but were negligible in the previous cycle.

¹⁷ Foreign exchange reserves rose by an estimated \$136 billion between end-1998 and end-2005, accounting for 19% of cumulative investable funds. In contrast, reserves accounted for a negligible fraction of cumulative investable funds in the earlier cycle. Most OPEC member countries' oil industries are at least partially state-owned. See the 2004 OPEC Annual Statistical Bulletin for details.

Figure 7
Cross-border investment by OPEC countries¹
Cumulative flows since 1977 Q4



Note: Data are in billions of real 2005 Q2 US dollars, deflated by the US consumer price index.

¹ Excluding Indonesia. ² Outflows from OPEC member countries, as implied by the financial accounts in their balance of payments data. Balance of payments data for 2005 are estimated on the basis of EIA data on OPEC net oil revenues. ³ Defined as the sum of the current account balances of and financial inflows into OPEC countries. ⁴ Purchases of US long-term securities and FDI in the United States by "Other Asia", and Venezuela. ⁵ Purchases of German securities and FDI in Germany by OPEC countries. ⁶ The available data may underestimate OPEC's true net purchases of foreign securities to the extent that these purchases are effected through financial intermediaries in third countries. ⁷ Total claims of OPEC countries on BIS reporting banks, primarily bank deposits.

Sources: IMF; Deutsche Bundesbank; US Treasury; BIS.

A more detailed tracking of where these investable funds are placed is difficult because OPEC member countries generally do not provide a finer breakdown of their capital outflows. The right-hand panel of Figure 7, however, splices various sources of *counterparty* data in order to obtain a better understanding of what is known about aggregate outflows from OPEC countries. Cumulative net purchases of US and German securities are combined with OPEC FDI in these countries. This, coupled with the gross deposits placed in BIS reporting banks worldwide, provides an estimate of OPEC's investable funds based on publicly available counterparty data.¹⁸

While this combination of counterparty data roughly matches the outflow of investable funds from OPEC member countries in the late 1980s and early 1990s, it tracks the surges in these funds during periods of high oil prices far less accurately.¹⁹ Several possible explanations for

¹⁸ In addition to the United States, France, Japan and the United Kingdom also provide some information on the geographical breakdown of their international investment position. By end-2005, the stock of OPEC's portfolio investment in France had increased by \$25 billion since 2000, the earliest date for which such data are available. Data on OPEC's investment in Japan are available since 2005 only. OPEC investment in the United Kingdom is negligible relative to the other identified investment according to the available data, which cover 1997–2003 (for FDI) and 2001–03 (for portfolio investment). These data, however, underestimate the true OPEC net purchases of securities to the extent that these purchases are conducted through financial intermediaries in third countries.

¹⁹ Almost 70%, or \$486 billion, of cumulative investable funds cannot be identified in the counterparty data in the most recent cycle, compared with 51%, or \$103 billion, in the previous one.

the current large gap come to mind. First, the available counterparty data do not capture offshore purchases of securities. For example, the estimate of OPEC's cumulative net purchases of US securities based on the TIC data would tend to underestimate the total to the extent that these securities are purchased in London or other financial centres outside the United States. Second, cross-border investment in regional stock and bond markets is likely to have become a more important outlet for petrodollars than before.²⁰ Finally, there is some evidence that petrodollars are being invested more broadly – more diversified geographically and across the asset spectrum – than they once were. For instance, hedge funds and private equity funds, which have experienced large inflows worldwide in recent years but are not required to release information on the positions of their investor base, are one possible home for these investments. This expansion across the asset spectrum has led to a smaller share of invested funds being channelled into BIS reporting banks.²¹

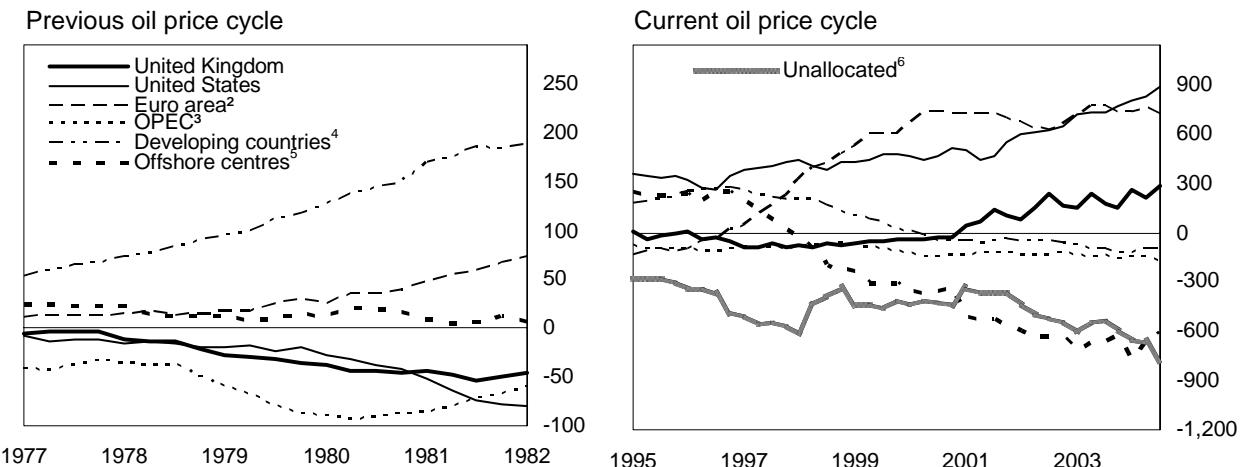
Even as a smaller share of this investment is channelled through banks, petrodollars remain an important source of funding for the international banking system, although not as important as they once were. In the earlier cycle (1978–82), BIS reporting banks' net liabilities to OPEC member countries roughly doubled, making OPEC countries one of the largest net suppliers of funds to the international banking system (Figure 8, left-hand panel). Funds from these oil-producing countries fuelled the growth in BIS reporting banks' net long positions elsewhere, in particular vis-à-vis emerging economies, which eventually culminated in the 1980s debt crisis. Since this earlier cycle, significant changes in global financial flows have reduced the relative influence of petrodollars on the supply of funds flowing through banks. The most striking change is that BIS reporting banks currently have much larger net short (liability) positions vis-à-vis *offshore centres* and *non-OPEC emerging economies*, and net long (asset) positions vis-à-vis the United States and the euro area, than they did previously (Figure 8, right-hand panel).²²

²⁰ Up to end-2005, many countries in the Middle East had experienced, by some measures, an economic boom; the stock market indices in Saudi Arabia, Kuwait and the United Arab Emirates more than quadrupled between end-2001 and end-June 2005.

²¹ Deposits placed in these banks between 1978 and 1982 accounted for 28% of investable funds accumulated over the same period, but only 20% of the cumulated funds between 1999 and 2005.

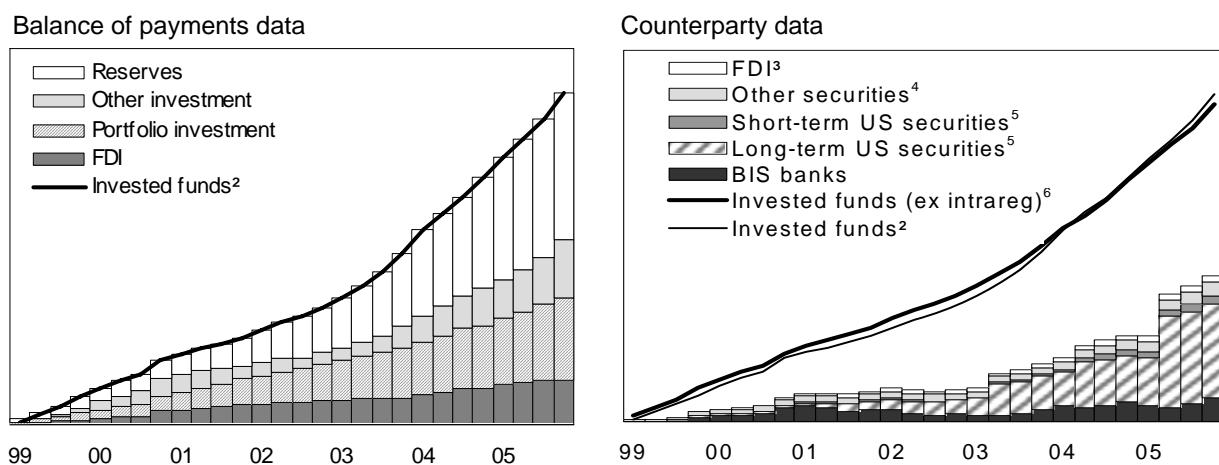
²² The figures used in the right-hand panel of this figure are estimated. A large portion of reporting banks' liabilities is not allocated to a particular country because, unlike *deposit* liabilities, reporting banks often do not know who holds their *debt security* liabilities. BIS reporting banks' liabilities for which the *residence of the counterparty* is unknown have grown to \$1.96 trillion, or 10% of reporting banks' total liabilities (from 2% in 1983). However, data on BIS reporting banks' *debt security claims on banks* are used to reallocate much of these unallocated claims by vis-à-vis country.

Figure 8
Net claims of BIS reporting banks, by vis-à-vis region¹
 In billions of US dollars



¹ Net claims equal the stock of total claims minus the stock of total liabilities. ² Excluding intra-euro area net claims. ³ Excluding Indonesia. ⁴ Excluding OPEC countries. ⁵ Excluding intra-offshore centre net claims. ⁶ Unallocated liabilities of BIS reporting banks have been allocated to individual vis-à-vis regions to the extent that these liabilities correspond to debt security assets of other BIS reporting banks. The remaining unallocated liabilities drive the plotted series of unallocated net claims.

Figure 9
Tracking Asia's invested funds¹
 Cumulative flows since 1998 Q1



¹ From China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan (China) and Thailand. ² Defined as the sum of the changes in reserves, FDI abroad and gross portfolio and other investment. ³ Cumulative FDI flows into Australia, France, Germany, Japan, the Netherlands, New Zealand, Switzerland, the United Kingdom and the United States. Data for 2004 and 2005 are partly estimated. ⁴ Cumulative portfolio investment in Germany and Japan. ⁵ Estimated from US TIC data. ⁶ Invested funds excluding intraregional flows through banks in Hong Kong SAR, India, Korea, Singapore and Taiwan (China).

Sources: IMF; UNCTAD; Bank of Japan; US Treasury; BIS.

The 1997 Asian financial crisis seems to have been a turning point. Prior to the crisis, Asia-Pacific was a large net debtor region. However, since 1999, a portion of the combined funds generated from current account surpluses and capital inflows into the (major) emerging Asian economies²³ has been placed as deposits in BIS reporting banks. This rise in deposits, coupled with a drop in cross-border credit from BIS banks since 1997, has led to a reversal in the net claim position of BIS reporting banks vis-à-vis emerging economies.²⁴

As with petrodollars, the available counterparty data provide an incomplete picture of where the gross flow of capital from Asia is invested. Asia's total invested funds, cumulated over 1999–2005, are estimated to have been roughly \$2.8 trillion. The left-hand panel of Figure 9 decomposes these invested funds into the change in foreign exchange reserves and the various components of the financial account. By far, official investment has been the major component of these countries' invested funds.^{25,26} The right-hand panel of Figure 9, which splices various sources of counterparty data, provides some indication of where Asia's invested funds have gone.²⁷ Combined, these data can account for almost 46%, or \$1.25 trillion, of Asia's invested funds (net of intraregional banking flows) cumulated since end-1998. The bulk of Asia's *identified* invested funds have been channelled into US securities.²⁸ In contrast, a relatively small share of their invested funds has been channelled into BIS reporting banks. Deposits placed in these banks had accounted for as much as 20% of invested funds cumulated between end-1998 and the first quarter of 2001, but this ratio had fallen to less than 10% by end-2005.

2. Stress testing with the BIS banking statistics

The above analysis relied on the BIS locational statistics to explore the structure and size of the international banking market from a *geographical* perspective. However, as highlighted in Figures 3 and 5, the nationality of a bank (identified by the location of its headquarters) and

²³ For the purposes of this exercise, the major Asian countries are taken to be China, Hong Kong, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand.

²⁴ The stock of BIS reporting banks' net claims on borrowers in emerging Asia fell from \$220 billion in the second quarter of 1997 to -\$97 billion four years later.

²⁵ Reserve accumulation has accounted for 44% of Asia's total cumulative invested funds since end-1998. This is primarily accounted for by China, although reserve accumulation has been the major factor behind the rise in Korea's and Taiwan's invested funds as well.

²⁶ Intraregional investment should be removed from the estimate of invested funds for the region as a whole, so as to better approximate gross financial investment elsewhere in the world. The thick blue line in the right-hand panel of Figure 8 gives the estimate of invested funds from the region after stripping out intraregional flows reported by banks in Hong Kong, India, Korea, Singapore and Taiwan. Invested funds *net of intraregional banking flows* cumulated up to early 2004 were actually somewhat larger – by about \$90 billion in 2002 – than the estimate implied by the balance of payments statistics alone.

²⁷ These counterparty data comprise estimated portfolio investment in Japan and the United States, FDI in the United States and other developed countries, and deposits placed in BIS reporting banks worldwide. The estimate of investment in US securities is constructed by using the TIC transactions data and the total holdings of long-term and short-term securities reported in the benchmark surveys. For long-term securities, the total stock of holdings by the major Asian countries is first estimated by taking the holdings as of the benchmark surveys, and tracking changes through time using the cumulative net purchases from the transactions data. Cumulative investment is then generated by subtracting the stock of holdings of long-term securities at end-1998. The stock of holdings of short-term securities is estimated assuming a value of 0 for 1985 and then interpolating between the benchmark survey dates. Cumulative investment in short-term securities since 1998 is then generated by subtracting the estimated holdings at end-1998.

²⁸ Accumulation of US short-term and long-term securities by residents of these countries since end-1998 totalled an estimated \$871 billion, or 32% of their invested funds.

its location are very different things. For example, UK-headquartered banks account for roughly 25% of the total international claims of all banks located in the United Kingdom. Only by understanding the foreign exposures of national banking systems – eg UK-headquartered banks' *global* cross-border and local positions – can we begin to understand how shocks to the banking system are transmitted between banks.

Consider, for example, Japanese banks, which are funded to a large extent by Japanese residents. Much of the funds provided by these residents are routed through Japanese banks' offices in the United Kingdom (or other IBCs) before being distributed to borrowers around the world. An adverse shock to this source of funds might thus be expected to have a larger impact on Japanese banks than a shock affecting only the residents of the United Kingdom. Put differently, flows into and out of banks located in an IBC tend to depend only weakly on the economic conditions in that centre.²⁹ Shocks to the banks' global balance sheets, when considered on a consolidated basis, often have a bigger impact on the flow of funds through banks.

For this reason, it is important to consider the overall credit risk profile of internationally active banks when trying to understand what drives flows through the banking system. The BIS *consolidated* banking statistics, which group banks according to their nationality and net out inter-office positions, are useful in this regard, and make it possible to evaluate the credit and counterparty risk in internationally active banks' foreign exposures.³⁰

The purpose here is to examine whether shocks to banks' foreign exposures have systemic risk implications. Broadly speaking, such shocks come in various flavours. Examples are government debt defaults (Russia and Argentina), moratoriums on the repayment of debt (Mexico), capital flight following changes in market perceptions (the Asian currency crisis) or possibly through disruptions in the interbank market caused, for instance, by the collapse of individual banks and a drying-up of liquidity. Credit events can be of systemic importance if they affect several national banking systems simultaneously (because of similar foreign exposures), or because they generate a contagion effect across national banking systems. The full impact of such credit events can be evaluated only by taking into account the potential "second-round" effects, whereby the failure of a particular national banking system results in a cascade of bank failures across reporting countries. The study of these two types of channels of systemic risk is similar in spirit to existing stress tests that have been limited to domestic banking systems.

The following three subsections outline how the BIS banking statistics can be used in assessing stability in the interbank market. The first section describes the relevant features of the BIS consolidated banking statistics, and presents estimates of national banking systems' foreign exposures. The following sections describe our proposed measure of capital adequacy, and one possible way of estimating banks' foreign exposures expressed on a *risk-weighted basis* (a necessary component of our capital adequacy measure). The final section presents these estimated capital adequacy ratios (for banks headquartered in seven reporting countries), and examines their sensitivity to various hypothetical shocks to foreign exposures and to various assumptions about loss-given-default.

The preliminary estimates – based on data for a limited number of reporting countries – suggest that shocks to banks' exposures to *emerging markets* have only a modest impact on reporting banks' capital adequacy. In contrast, a serious loss on these banks' exposures in

²⁹ This fact makes the interpretation of gravity models which rely on the BIS locational banking statistics difficult. Such models attempt to relate claim flows between banks in "host" countries to borrowers in "home" countries to home and host country GDP and "distance" measures.

³⁰ See McGuire and Wooldridge (2005) for a complete description of the BIS consolidated banking statistics.

the interbank market could conceivably push capital adequacy below the required 8% for banks headquartered in some reporting countries.

2.1 A snapshot of banks' foreign exposures

The BIS consolidated banking statistics match closely banks' risk management practices by throwing light upon a wide range of exposures. Whereas the BIS locational statistics in previous sections are strictly tied to geography, the consolidated statistics include the *worldwide* claims (ie claims of home offices and foreign branches) of banks' headquartered in a particular country.³¹

Until recently, the consolidated statistics included only sectoral claims on an *immediate borrower basis* (IB basis), or claims allocated to the country and sector of the contractual counterparty. Since March 2005, the data have included a sectoral breakdown of foreign claims on an *ultimate risk basis* (UR basis), or claims reallocated to the country where the ultimate obligor resides (Table 2).³² These claims are broken down by sector, ie bank, public and non-bank private sectors, which allows for a finer evaluation of the credit risk in foreign claims. This change now makes it possible to measure interbank exposures, since the data better capture the *nationality* of the borrower rather than the borrower's country of residence. That is, the data now provide information on UK-headquartered banks' global exposure to US-headquartered banks.³³

In addition, the new statistics now include information on banks' contingent facilities and derivative positions, which are potential foreign exposures. *Foreign claims*, which refers to items on the *assets side* of banks' balance sheets (traditionally loan and securities claims in the context of the BIS statistics), are a subset of banks' total *foreign exposure*, which also includes *contingent* positions booked on both the *assets and the liabilities side* of the balance sheet, specifically derivatives and credit commitments (contingent assets) and guarantees (contingent liabilities).^{34, 35}

³¹ In other words, the consolidated statistics contain claims of "UK banks" as opposed to claims of "banks in the United Kingdom".

³² Previously, a sectoral breakdown (IB basis) was available for only *international* claims but not for *local claims in local currency*. For example, interbank lending from a German bank to the branch of a US-headquartered bank in London would, on an immediate borrower basis, be reported as a claim on the banking sector in the United Kingdom. On an ultimate risk basis, however, this would be reported as a claim on *US banks*.

³³ Note the difference from the BIS locational banking statistics used in previous sections, which contain data on claims of banks *located in the United Kingdom* on borrowers *located in the United States*.

³⁴ The contingent positions are reported on an ultimate risk basis. Guarantees are contingent *liabilities* arising from an obligation to pay to a third-party when a client fails to perform some contractual obligation. Credit commitments are irrevocable obligations to extend credit at the request of a borrower. Derivative claims (ie positive market values) include, forwards, swaps, options and those credit derivatives held for trading by the reporting bank (independent of whether these are booked as off- or on-balance sheet items). Credit derivatives not held for trading are reported as risk transfers by protection-buying banks, and as guarantees by protection-selling banks.

³⁵ These contingent exposures totalled \$7.5 trillion in the third quarter of 2005, compared to \$17.7 trillion in loan and securities claims (UR basis). Derivatives are reported at market value, while guarantees and credit commitments are reported at book value. Thus, only if the market value is not significantly different from book value would an aggregation of these positions yield a measure of total contingent exposures.

Table 2
**Consolidated foreign claims and other
contingent exposures on an ultimate risk basis**

In billions of US dollars

Provisional data

	Vis-à-vis developed countries		Vis-à-vis offshore centres		Vis-à-vis emerging markets		Total ¹	
	2005 Q2	2005 Q3	2005 Q2	2005 Q3	2005 Q2	2005 Q3	2005 Q2	2005 Q3
<i>Memo: Foreign claims (after net risk transfers, Table 2)</i>	(16,978)	(17,681)	(1,141)	(1,123)	(1,983)	(2,151)	(20,174)	(21,030)
Foreign claims after net risk transfers ²	14,033	14,667	1,048	1,019	1,816	1,985	16,943	17,719
o/w: local claims	5,824	6,174	352	364	1,029	1,130	7,211	7,679
As % of foreign claims	(41.5)	(42.1)	(33.6)	(35.7)	(56.7)	(56.9)	(42.6)	(43.3)
By sector								
Banks	4,474	4,622	118	118	358	386	4,955	5,133
As % of foreign claims	(31.9)	(31.5)	(11.3)	(11.6)	(19.7)	(19.4)	(29.2)	(29.0)
Public sector	2,641	2,719	48	50	406	429	3,130	3,234
As %	(18.8)	(18.5)	(4.5)	(4.9)	(22.4)	(21.6)	(18.5)	(18.3)
Non-bank private sector	6,560	6,891	844	810	835	937	8,249	8,651
As %	(46.7)	(47.0)	(80.5)	(79.5)	(46.0)	(47.2)	(48.7)	(48.8)
Unallocated	359	435	39	40	217	233	608	701
As %	(2.6)	(3.0)	(3.7)	(3.9)	(11.9)	(11.8)	(3.6)	(4.0)
Other exposures								
Derivatives contracts ³	2,150	2,069	70	70	94	112	2,322	2,258
Guarantees extended ⁴	1,070	1,205	107	126	118	133	1,301	1,470
Credit commitments ⁵	2,783	3,055	324	344	292	337	3,406	3,747

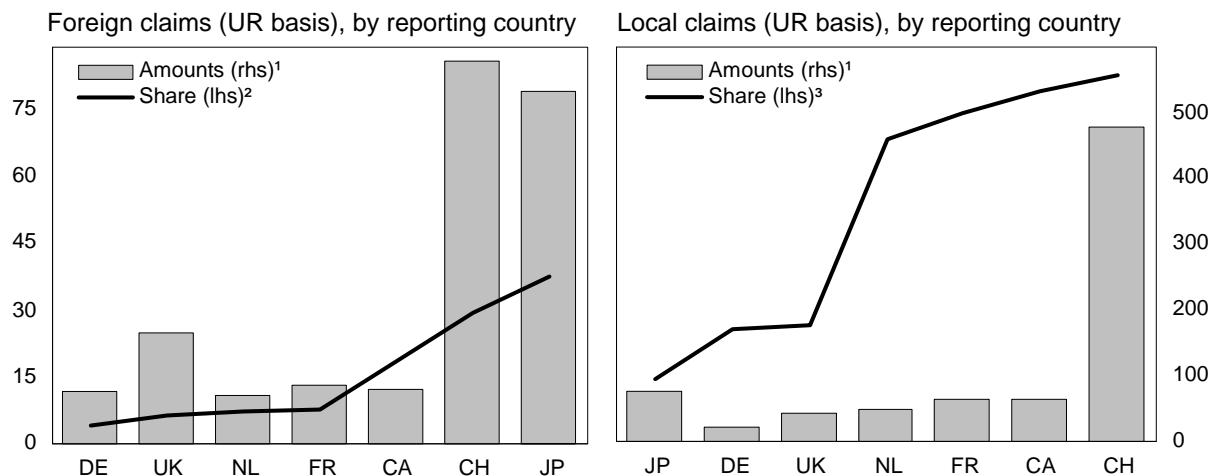
¹ Includes positions vis-à-vis international organisations and unallocated. ² Based on data reported by 24 countries which submitted both sets of data in 2005 Q2 and Q3 and also provide risk transfers and detailed breakdown and contingent exposures. Greece and Ireland are semiannual reporters (Q2 and Q4); data for these two countries relate to 2005 Q2. The data for Spain are carried forward from 2005 Q2 for the preliminary release. ³ Excluding Austria and Chile. Positive market values only. ⁴ Excluding the United States. ⁵ Excluding Chile.

Overall, foreign exposures are sizeable relative to reporting banks' total assets. Foreign claims (consisting of loan and securities claims) accounted for almost 40% of the total assets reported on the balance sheets of internationally active banks headquartered in 10 of the BIS reporting countries.^{36, 37} As of the third quarter of 2005, outstanding foreign claims amounted to less than 20% of US, Australian and Italian banks' total balance sheet assets. By contrast, they amounted to more than 50% for UK and Belgian banks, and to more than 60% for Swiss banks.

Assets carrying low credit risk play an important role in banks' portfolio management, and are often used as collateral in financial transactions. Thus, banks are naturally expected to absorb a significant share of the supply of low-risk government debt (ie debt issued by governments in industrialised countries). Yet BIS reporting countries exhibit disparate propensities to hold low-risk claims on foreign public sectors (Figure 10, left-hand panel). For example, one third of Swiss banks' and almost 45% of Japanese banks' total foreign exposures are claims on the public sector in industrialised countries. Combined, these reporting banks account for roughly 60% of the \$1.9 trillion in all reporting banks' foreign claims on the public sector in industrialised countries.

Figure 10
Bank claims on the public sector of industrialised countries

As of 2005 Q3, in per cent



CA = Canada; CH = Switzerland; DE = Germany; FR = France; JP = Japan; NL = Netherlands; UK = United Kingdom.

¹ Claims of BIS reporting banks, in billions of US dollars. ² Claims on the public sector in industrialised countries in total foreign claims, in per cent. ³ Estimated local claims in all public sector claims on industrialised countries.

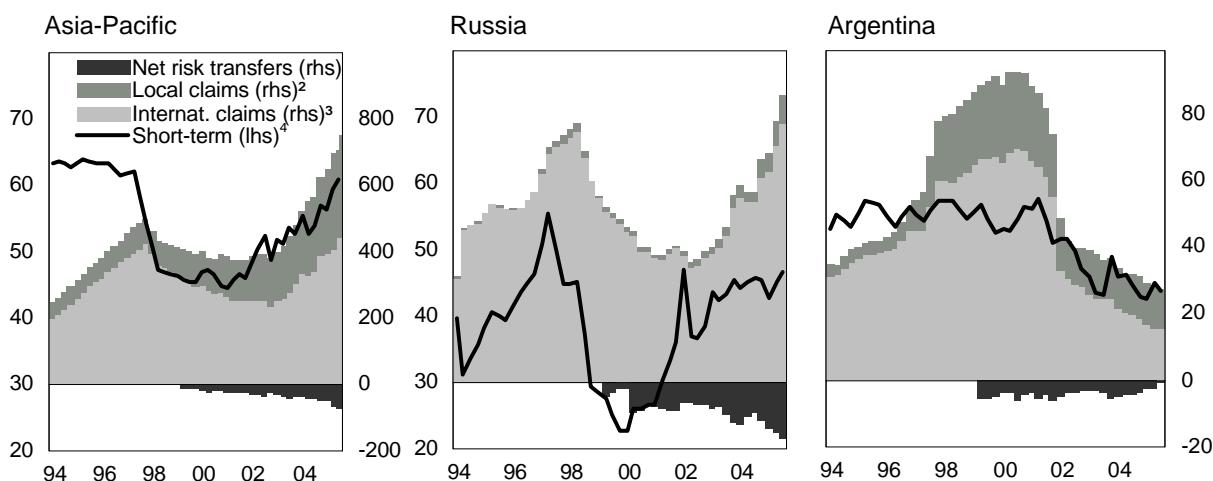
Sources: ECB; Board of Governors of the Federal Reserve System; Bank of Japan; BIS.

³⁶ This share drops by only about 6 percentage points if intra-euro area exposures are netted out from total foreign exposures. These 10 reporting countries are Australia, Belgium, Canada, Finland, France, Italy, the Netherlands, Switzerland, the United Kingdom and the United States.

³⁷ Across all of the 10 reporting countries, the share rises to almost 60% if banks' estimated foreign exposures are considered, ie their derivative and contingent exposures are included in the numerator.

Banks also have large exposures to emerging markets, which have fluctuated significantly during periods of market stress. In the fourth quarter of 2005, foreign claims on emerging economies stood at \$2.3 trillion, or 12% of reporting banks' total foreign claims (IB basis). As shown in Figure 11, periods of financial turbulence, such as the Asian crisis (1997) or the sovereign debt crises in Russia (1998) and Argentina (2001), were seen to induce dramatic swings in claims when measured on an immediate borrower basis.

Figure 11
Foreign claims on selected emerging economies, by sector and type¹
 In billions of US dollars



¹ BIS reporting banks' consolidated foreign claims (IB basis). ² Foreign offices' local currency claims on local residents. ³ Cross-border and foreign offices' local claims in foreign currencies. ⁴ As a share of total international claims.

Claims on borrowers in emerging markets sometimes have third-party guarantors, leading to net risk transfers out of the borrowing country. A portion of foreign claims (mainly loan and securities claims (IB basis)) on emerging markets is transferred to the major developed countries, as are claims on borrowers in international hubs of financial intermediation (eg London and offshore centres) (Figure 12). Expressing banks' foreign claim positions on emerging markets on an *ultimate risk* basis, ie taking these net risk transfers into account, provides a more accurate picture of banks' true exposure. Measured in this way, foreign claims (ie excluding contingent exposures) stood at \$2 trillion, or 11% of total foreign claims (UR basis), although differences across reporting countries are apparent (Figure 13).³⁸

2.3 Foreign exposures and capital adequacy ratios

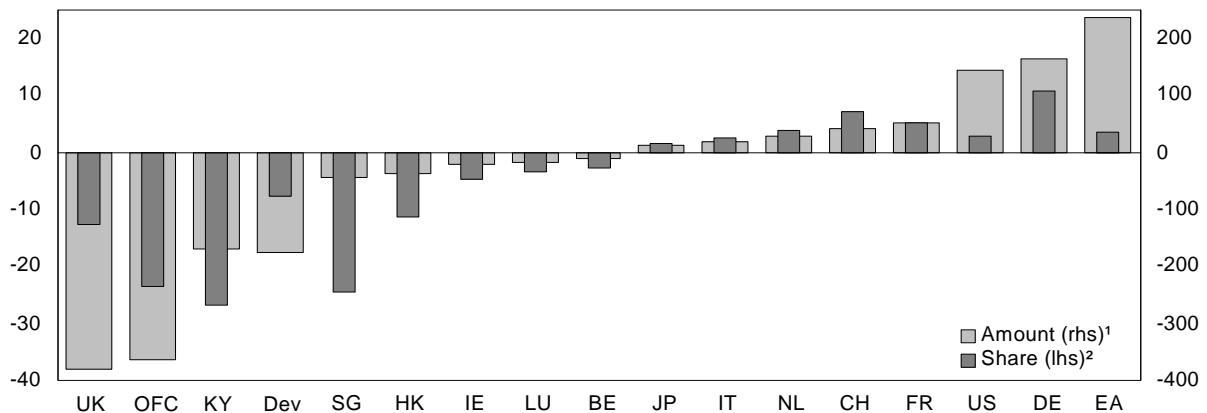
What effect would a major shock to emerging markets or a drying-up of liquidity in the interbank market have on the capital adequacy position of a particular banking system? To begin to answer this question, we need an appropriate measure of the *aggregate* capital adequacy ratio of the banks headquartered in a particular reporting country. One simple

³⁸ For example, Austrian, US and Spanish banks' foreign claims (UR basis) on emerging markets accounted for 43%, 29% and 27% respectively of their total foreign claims. By contrast, this share is below 10% for other major reporting countries. Virtually all of Austrian and Spanish banks' foreign claims (loans and securities) on emerging markets are on borrowers in emerging Europe and Latin America, whereas US banks' foreign claims are split roughly equally between borrowers in Latin America and Asia-Pacific.

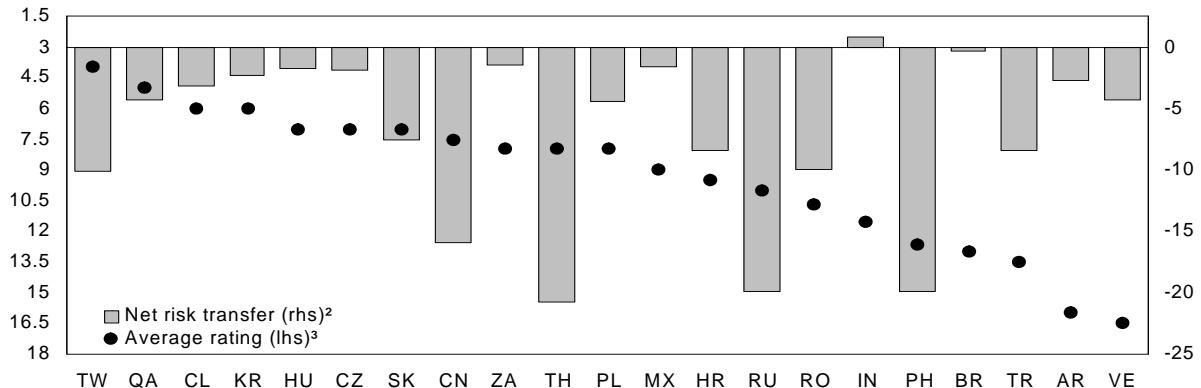
measure is the ratio of these banks' total Tier 1 and Tier 2 capital to their total risk-weighted assets.

Figure 12
Net risk transfers by vis-à-vis country

From selected countries and regions



From emerging markets, by debtor country



AR = Argentina; BE = Belgium; BR = Brazil; CH = Switzerland; CL = Chile; CN = China; CZ = Czech Republic; DE = Germany; Dev = developing countries; EA = euro area; FR = France; HK = Hong Kong SAR; HR = Croatia; HU = Hungary; IE = Ireland; IN = India; IT = Italy; JP = Japan; KR = Korea; KY = Cayman Islands; LU = Luxembourg; MX = Mexico; NL = Netherlands; OFC = offshore centres; PH = Philippines; PL = Poland; QA = Qatar; RO = Romania; RU = Russia; SG = Singapore; SK = Slovakia; TH = Thailand; TR = Turkey; TW = Taiwan (China); UK = United Kingdom; US = United States; VE = Venezuela; ZA = South Africa.

¹ In billions of US dollars. ² As a share of foreign claims of all reporting countries on that country, on an IB basis. A negative number implies a transfer away from the residents of a vis-à-vis country. ³ Standard & Poor's foreign currency sovereign ratings as of January 2006.

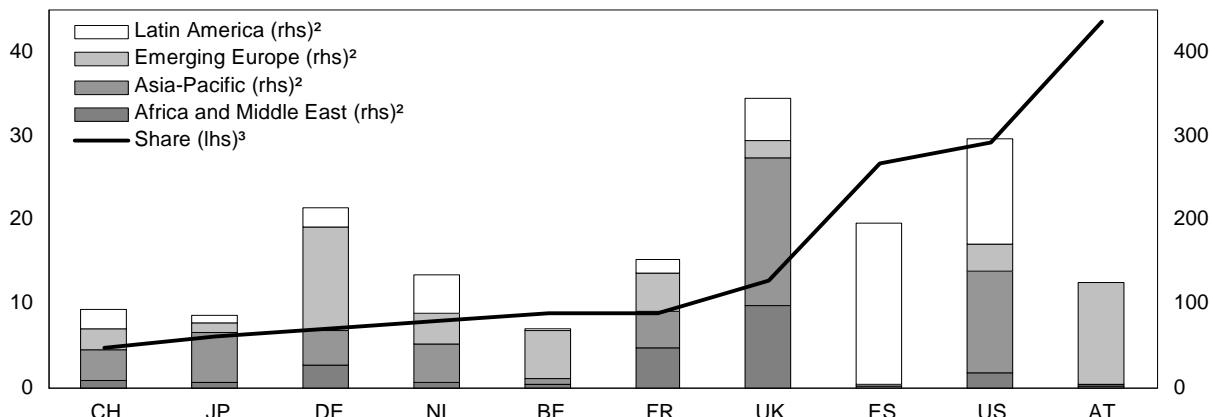
Formally, the aggregate ratio for banks headquartered in reporting country i is

$$CAR_i = \frac{Tier_{1,i} + Tier_{2,i}}{RWA_i^{for} + RWA_i^{dom}}$$

where RWA_i^{for} is risk-weighted foreign assets and RWA_i^{dom} is risk-weighted domestic assets.

Figure 13

Foreign claims (UR basis) on emerging economies, by region¹



AT = Austria; BE = Belgium; CH = Switzerland; DE = Germany; ES = Spain; FR = France; JP = Japan; NL = Netherlands; UK = United Kingdom; US = United States.

¹ Reporting countries listed on horizontal axis. ² Includes loan and securities claims, in billions of US dollars. ³ Foreign claims on emerging markets in total foreign claims, in per cent.

A negative shock to banks' foreign exposures would lead to a fall in this ratio through at least two channels. The first effect – the “direct effect” – is the change in the ratio which results from losses on the direct exposures to the borrower. Consider a negative shock to banks' foreign assets of size ΔA , and suppose that the loss-given-default (LGD) is $\lambda \in (0,1)$. The new level of reporting banks' capital adequacy ratio can be estimated by subtracting off the *ultimate risk* value of these foreign exposures ($\lambda * \Delta URA_i^{for}$) from the numerator, and the *risk-weighted* value of these foreign exposures ($\lambda * \Delta RWA_i^{for}$) from the denominator. The second effect – the “ratings effect” – is the decline in the ratio due to a reduction in the credit quality of the borrower. As credit quality declines, the risk weights applied in calculating risk-weighted assets would increase, leading to a rise in the denominator.³⁹

2.4 Estimating risk-weighted foreign assets

Actually computing this aggregate measure of capital adequacy poses some challenges. First, it requires data on the risk-weighted assets and equity capital of internationally active banks (ie banks which report in the consolidated data). This is confidential information in many countries. We have received data on total (domestic and foreign) risk-weighted assets and equity capital (for the third quarter of 2005), aggregated across individual banks

³⁹ As a concrete example, consider a case where a borrowing country's sovereign rating is downgraded in anticipation of a default. Under the standardised approach of Basel II, a lowering of the borrowing country's sovereign rating may require that banks' apply higher risk weights to their exposures to the *banking* and the *non-bank private sectors*, as well as to their exposure to the public sector. This change in the value of risk-weighted foreign exposures can be approximated by taking the difference in the risk-weighted exposure (calculated as described above) to the borrower under the original and default status sovereign ratings.

reporting in the consolidated statistics, for the following reporting countries.⁴⁰ The remainder of this analysis relies on these data alone, and thus constitutes only a partial investigation of contagion in the international banking market. Absent data on other large national banking systems, it is impossible to gauge the full effect of shocks.

A second challenge is the estimation of risk-weighted *foreign* assets for these banking systems. The Basel II guidelines provide banks with several different choices on how they can calculate risk-weighted assets. The most sophisticated of these methodologies, the internal ratings-based approach (IRB approach), allows individual banks to assign ratings to individual borrowers based on internal estimates of probability of default (PD) and LGD. This approach is likely to be used by the large internationally active banks which report in the BIS consolidated banking statistics. However, these statistics are aggregated, across both borrowers and lenders, at the country level and do not allow the researcher to estimate exposure-specific PDs and LGDs. As a result, our estimates of risk-weighted foreign assets are based on the simpler standardised approach of Basel II. Under this approach, risk weights rely solely on borrower ratings provided by external rating agencies.

For banks' foreign exposures to the banking and public sectors, the application of the standardised approach is fairly straightforward. The Basel II guidelines provide a simple mapping from the sovereign rating of the country of residence of the ultimate obligor to risk weights for each of these sectors.⁴¹

In contrast, the risk weights applied to BIS reporting banks' exposure to corporate borrowers (ie the non-bank private sector) must be estimated. Under the Basel II standardised approach, banks should use external corporate ratings – on a borrower by borrower basis – in calculating risk-weighted assets. However, such fine detail is not available at the aggregated level of the BIS consolidated banking statistics. Simply using the sovereign rating of the country where the corporate borrower resides would lead to a downward bias in risk-weighted exposures since, in most countries, the sovereign rating represents an unofficial ceiling on that country's corporate ratings. Moreover, claims on the non-bank private sector include everything from corporate loans to mortgage and other secured lending.

We draw on information contained in data on international syndicated loans to help in creating more accurate risk weights for the non-bank private sector in individual borrowing countries. The syndicated loan database contains borrower-specific information from the tombstones for all international loan syndicates. Thus, the average credit rating across all individual corporate borrowers in a particular country can be constructed. That rating is then translated into an average risk weight for the non-bank private sector in each borrowing country using the mapping in the Basel II guidelines.⁴² This approach will tend to underestimate the risk weight in countries where only highly rated borrowers participate in the syndicated

⁴⁰ Combined, these seven countries account for 43% of all BIS reporting countries' foreign exposures (excluding derivative and contingent claims). Total capital for these banks stood at \$945 billion in the third quarter of 2005, or 3% of their \$34.8 trillion in total balance sheet assets. Total foreign exposures (UR basis), at \$7.363 trillion, accounted for 21% of their total assets.

⁴¹ This analysis relies on Standard & Poor's sovereign rating for end-Sept 2005 for over 125 countries. Exposure to these sectors in unrated countries is given a risk weight of 100%. Unrated countries account for only 4% of total foreign claims (UR basis) on all borrowers, and only 6% of total foreign claims (UR basis) on emerging markets.

⁴² Specifically, for each borrowing country, the syndicated loan data are first used to estimate the share of borrowers without a corporate credit rating. This share is then applied to each reporting country's exposures to the non-bank sector in the borrowing country, and assigned a risk weight of 100%. The remaining share is given a risk weight which corresponds to the average rating of those corporates in the borrowing country which do have an external rating. In many cases, the information on the borrower's rating is often missing in the syndicated loan database. As a result, the risk weight applied to the non-bank private sector in most emerging markets is very close to 100%.

loan market. Conversely, it will tend to overstate the risk weight in countries where mortgage and other collateralised lending is a significant portion of foreign exposures. For these reasons, the analysis below focuses primarily on the public and banking sectors.

Our estimates of risk-weighted exposures allow us to gauge the riskiness of the portfolios of national banking systems. Expressed on a risk-weighted basis, exposures to less risky obligors contract more (or expand less) than exposures to riskier obligors. Reporting banks' largest claims are on highly rated borrowers and thus carry small risk weights. In particular, roughly 80% of BIS reporting banks' total exposures to the public sector (\$3.2 trillion) and to the banking sector (\$5.1 trillion) is concentrated in the United States, the United Kingdom, the euro area and Japan. Most of these claims receive a zero or 20% risk weight under the standardised approach of Basel II and, consequently, require small capital charges. By contrast, exposures to lower-rated borrowers, which can carry a risk weight equal to or greater than 100%, are fairly limited.

Reporting banks' emerging market portfolios carry higher credit risk. Converted on a risk-weighted basis, banks' aggregate foreign claims on emerging economies contract by 18%, while the corresponding contraction in banks' overall portfolios is 54%. That said, individual banking systems differ with respect to the risk profile of their emerging market exposures (Figure 14). For example, Belgian, Irish and Australian banks' emerging market portfolios contract by roughly 30% on a risk-weighted basis. In contrast, German, French and UK banks see a somewhat smaller contraction.⁴³

The least risky portion of banks' exposures to emerging markets consists of claims on the public sector. Foreign claims on this sector in Korea, Poland, Malaysia, the Czech Republic, Taiwan (China), Hungary, Mexico and China – all investment grade countries – totalled \$275 billion, or two thirds of total foreign claims on emerging market public sectors. These claims receive a risk weight of 50% or less, leading to a 46% contraction in the overall exposure to emerging market public sectors on a risk-weighted basis. By contrast, exposures to banking sectors in emerging markets are deemed considerably riskier and contract by roughly 25%.

2.5 Shocks to banks' capital adequacy

Using our estimates of risk-weighted foreign assets described in the previous section, we now turn to an investigation of the sensitivity of banks' capital adequacy ratios to various shocks. In this analysis, we present the results from only two hypothetical shocks – a loss on exposures to emerging market borrowers, and a loss on exposures in the interbank market – in order to illustrate how the BIS banking statistics can be used to identify vulnerabilities in the international banking system. A host of alternative scenarios could also be investigated using this framework.

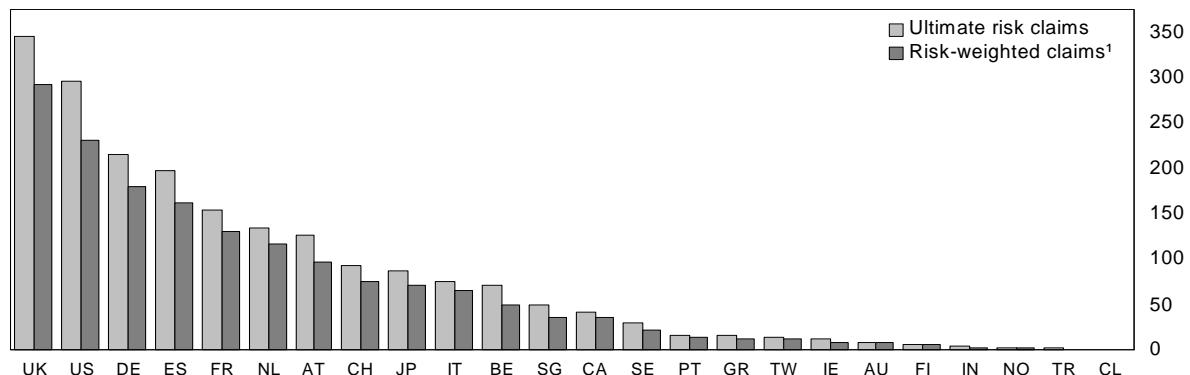
Overall, our preliminary analysis indicates that only very large shocks to emerging markets can lead to the collapse of national banking systems. Banks' exposures to individual emerging markets are small relative to their total capital. Thus, exposures to any single emerging market are not large enough to have a substantial effect on the estimated capital adequacy ratios. In contrast, larger shocks *can* have an effect. To illustrate, consider a shock to banks' foreign exposures to *all* emerging markets simultaneously, an admittedly extreme scenario. The lines in Figure 15 trace out the aggregate capital adequacy ratio for banks headquartered in particular reporting countries as a sliding scale of LGD on their exposures to these borrowers. As shown in the left-hand panel, which considers a shock to public sector

⁴³ The estimate for banks headquartered in the United States is particularly poor because as much as 45% of these banks' foreign claims are not allocated to a particular sector. These unallocated claims were risk-weighted the same as claims on the banking sector in the borrowing country.

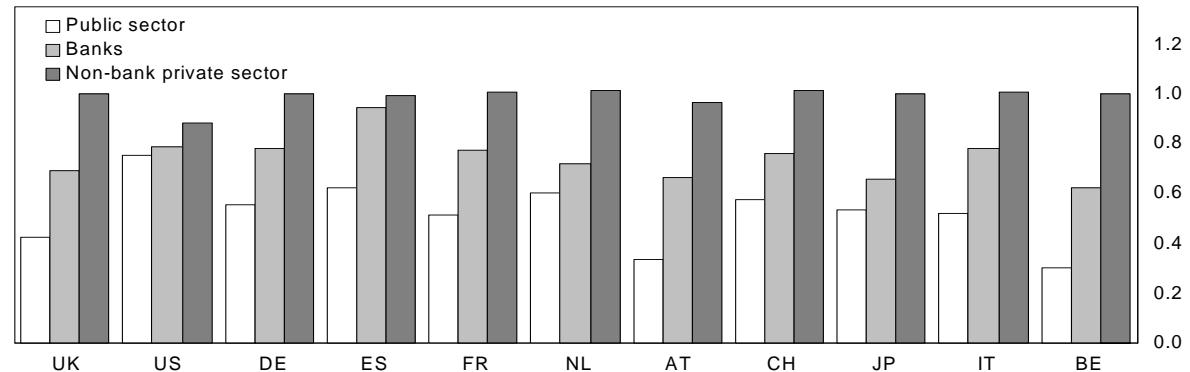
and banking sector exposures only, LGD would have to exceed 60% before any of the estimated capital adequacy ratio for any national banking system dipped below 8%. Moreover, even a 100% LGD on these exposures would still leave these banking systems with a *positive* ratio, implying that total capital has not been driven to zero. The more extreme case, in the right-hand panel, does lead to the collapse of several banking systems, but only at LGDs beyond 70%.

Figure 14
Foreign claims (risk-weighted and UR basis) on emerging economies

Total claims



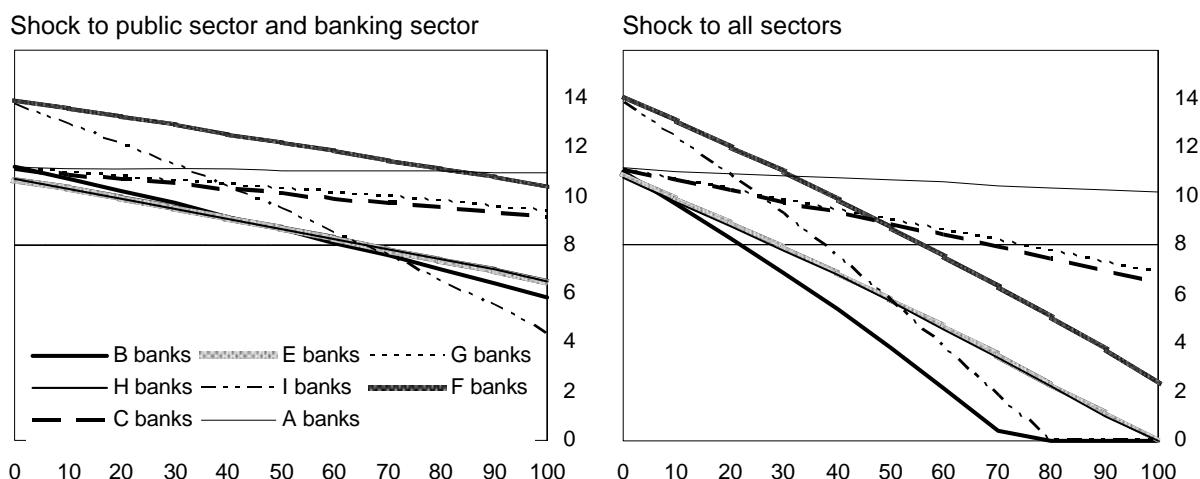
By sector



AT = Austria; AU = Australia; BE = Belgium; CA = Canada; CH = Switzerland; CL = Chile; DE = Germany; ES = Spain; FI = Finland; FR = France; GR = Greece; IE = Ireland; IN = India; IT = Italy; JP = Japan; NL = Netherlands; NO = Norway; PT = Portugal; SE = Sweden; SG = Singapore; TR = Turkey; TW= Taiwan (China); UK = United Kingdom; US = United States.

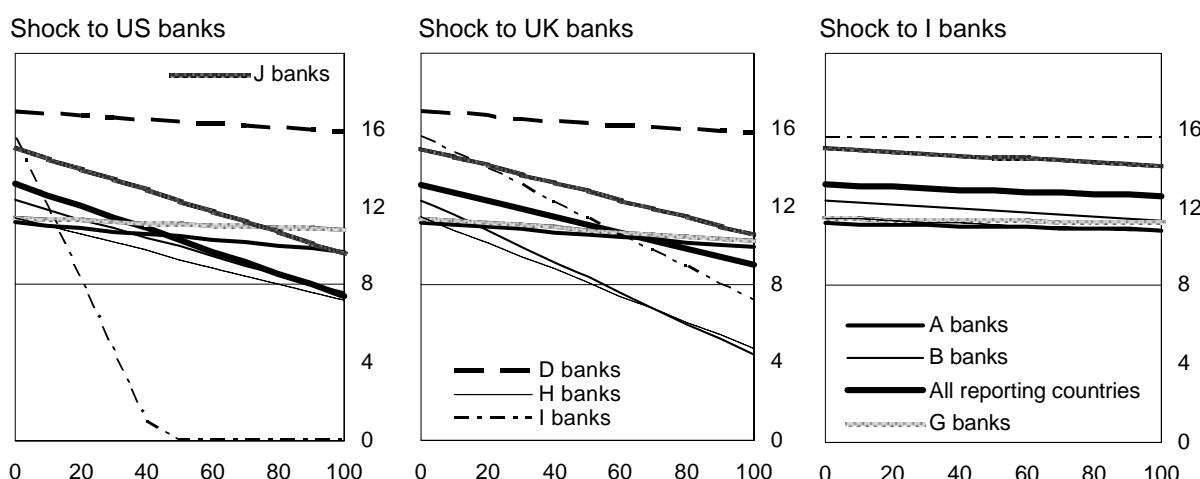
¹ Calculated by applying risk weights to the foreign claims of banks headquartered in a particular reporting country. The risk weights vary by vis-à-vis country and by sector, and are based on the standardised approach under the Basel II guidelines.

Figure 15
Response of banks' capital ratios to shock to emerging markets
 In per cent



Note: The vertical axis measures the change in reporting countries' banks' estimated capital adequacy ratio for a range of LGD on their exposures to residents in emerging markets. LGD is measured on the horizontal axis.

Figure 16
Response of banks' capital ratios to interbank shocks
 In per cent



Note: The vertical axis measures the change in reporting countries' banks' estimated capital adequacy ratio for a range of LGD on their exposures to US, UK and I banks. LGD is measured on the horizontal axis.

A similar analysis is presented in Figure 16, which shows the response of banks' capital adequacy ratios to hypothetical shocks in the interbank market. Interbank exposures are the vehicle through which shocks to individual countries or banking systems are transmitted to other banking systems

Thus, whether or not interbank exposures themselves are large enough to drive capital to zero for any particular banking system will determine, in this framework, whether “second-round” effects are even possible.

The three panels in Figure 16 show, respectively, the effect that a collapse in the market value of exposures to US banks, UK banks and I banks would have on capital adequacy ratios for banks headquartered in particular reporting countries. As shown in the left-hand panel, I banks’ capital ratio would fall below 8% at just over a 30% loss on their exposures to US banks. In contrast, a total loss of 80% or more would be required to drive the capital ratio of H banks and B banks to 8%. A shock to UK banks has an equally large effect on some banking systems: capital ratios for B banks, I banks and H banks fall below 8% at total losses on exposures to UK banks of 50% or more. In contrast, exposures to I banks appear to be limited. Even a total loss on exposure to these banks would have only a modest effect on reporting banks’ capital ratios.

As mentioned above, restricting the exercise to seven countries makes it impossible to accurately quantify the scope of a shock to the interbank market. Thus, the above exercise should be viewed as an illustration of what can be done with the BIS banking statistics, rather than an accurate description of the vulnerabilities in the international banking market. Data for a broader sample of reporting countries would, for example, shed light on the fraction of the *overall* capital of internationally active banks that would be wiped out by the collapse of a particular banking system.

Likewise, richer data would facilitate a more comprehensive analysis of possible contagion in the international banking system due to “second-round” effects. As shown in Figure 16, I banks’ capital would be wiped out by a 50% loss on their exposure to US banks. This does not generate second-round failures across the remaining banking systems for which we have data because of the limited exposure of these banking systems to I banks. Whether this remains true for other banking systems is not known.

References

- Bank for International Settlements (2003a): "Guide to the international financial statistics", *BIS Papers*, no 14, February.
- (2003b): "Guide to the international banking statistics", *BIS Papers*, no 16, April.
- Grabbe, O (1986): *International financial markets*, Elsevier Science Publishing Co Inc, New York.
- Johnston, R B (1983): *The economics of the euromarket: history, theory and practice*, Macmillan, New York.
- Krugman, P and M Obstfeld (1991): *International economics, theory and policy*, second edition, HarperCollins Publishers Inc.
- Mayer, H (1979): "Credit and liquidity creation in the international banking sector", *BIS Economic Papers*, no 1.
- McCauley, R and Y K Mo (2000): "An update on developments in Hong Kong's international banking business", *BIS Quarterly Review*, February, p 19.
- McGuire, P (2004): "A shift in London's eurodollar market", *BIS Quarterly Review*, September, pp 67–78.
- McGuire, P and P Wooldridge (2005): "The BIS consolidated banking statistics: structure, uses and recent enhancements", *BIS Quarterly Review*, September, pp 73–86.
- McKinnon, R (1979): *Money in international exchange, the convertible currency system*, Oxford University Press, New York, Oxford.
- Niehans, J (1984): *International monetary economics*, Johns Hopkins University Press, Baltimore, Maryland.
- Niehans, J and J Hewson (1976): "The eurodollar market and monetary theory", *Journal of Money, Credit and Banking*.
- Wooldridge, P (2002): "Uses of the BIS statistics: an introduction", *BIS Quarterly Review*, March, pp 75–92.