Order Details

Order Id	: 2115834922262246
Order Date	: 06 Mar 2020
Partner ID	: 200306537802
Booking Partner	cleartrip

Contact Details

Prasad Patankar

prasad.patankar9@gmail.com

(+91) 9833094490

BOOKING DETAILS

Hotel Name	: WelcomHotel Bengaluru - Member ITCHotel Group
Check-In	: 2020-03-12
Check-Out	: 2020-03-15
Address	: Richmond Road- Off M.G Road, Adjacent to Hosmat Hospital, Bengaluru 560 025, Karnataka

Mar 12	**3 Nights**	**Mar 15**	**2 Adults**	**1 Room**

FARE DETAILS

Basefare	Rs.7100
Total Tax	Rs.690
Discount	Rs.-1349
Net Pay	**Rs.18323**

Important Information

HDFC Bank SmartBuy will not be responsible for the change in the cancellation/modification charges revised by respective hotels.

All cancellation and amendment charges, taxes and surcharges are subject to change without notice and must be borne by the customer.

Please quote your cleartrip reference number/HDFC Bank SmartBuy reference number for all future communication with us on this booking.

Your Cleartrip reference number serves as a confirmation of your hotel booking.

Carry a print out of this Hotel Receipt and present it at the hotel reception.

Kindly carry photo identification proof along with your Hotel Receipt.

Attention! Please read important hotel booking information!

This hotel is booked through our partner Cleartrip.

For any query and/or activity related to the service and/or modification and cancellation, please contact Cleartrip at agencysupport@cleartrip.com and + 91 9595 333333. Refund on hotel booking will be as per the hotel rules.

You can also cancel your complete (Full ticket) Cleartrip hotel tickets, booked through website (not through APP), Online through "My Orders" in "Manage Booking" section after login.

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CHAPTER 4

HOW LINKAGES FUEL THE FIRE: THE TRANSMISSION OF FINANCIAL STRESS FROM ADVANCED TO EMERGING ECONOMIES

Against the backdrop of the biggest financial crisis since the Great Depression, this chapter studies how financial stress in advanced economies is transmitted to emerging economies. Crises in advanced economies have a large common effect on the banking sectors, stock markets, and foreign exchange markets of emerging economies. There is also a sizable country-specific effect, which appears to be magnified by the intensity of financial linkages. In more normal times, reducing individual countries' vulnerabilities, such as current account and fiscal deficits, can lower the level of financial stress in emerging economies, but such improvements provide little insulation from the transmission of a major financial shock from the advanced economies. Given the current banking crises in advanced economies, reductions in banking flows to emerging economies could be large and long-lasting. The major negative spillovers and repercussions of this for both advanced and emerging economies argue for a coordinated policy response.

The financial turmoil that erupted in the U.S. subprime mortgage market in 2007 has mutated into a full-blown global financial crisis. Indeed, the extraordinary intensification of the crisis since the collapse of Lehman Brothers in September 2008 has raised the specter of another Great Depression.

After an initial period of resilience, the turmoil has reached the emerging economies. In the final quarter of 2008, many emerging economies experienced major stress in their foreign exchange, stock, and sovereign debt markets (Figure 4.1). Exchange rates came under pressure in all regions, leading to a combination of depreciation and depletion of foreign reserves. Concerns about dwindling capital inflows and external sustainability drove up sovereign spreads, particularly in emerging Europe and Latin America. Moreover, the deteriorating economic outlook hit stock markets hard.

Significant withdrawals from emerging economy equity and debt funds suggest that investors in mature markets began to retract from emerging economies around the third quarter of 2008 (Figure 4.2, top panel). A broader high-frequency measure of private capital flows is issuance data on bonds, equity, and loans, which confirm the marked slowdown in funding in the third and fourth quarters of 2008 (middle panel). Borrowers in emerging Europe and Asia were especially affected. At the same time, bank lending was scaled back: liabilities shrunk by 10 to 20 percent of the receiving countries' GDP by the end of September, compared with their peak in late 2007 (bottom panel).[1]

Abrupt slowdowns in capital inflows ("sudden stops") have typically had dire consequences for activity in emerging economies. In fact, industrial production had already dropped precipitously during the last few months of 2008. The latest reading from February 2009 shows that the steepest decline—an annual contraction of 17.6 percent—was recorded in emerging Europe, reflecting waning import demand from advanced economies as a result of the credit crunch. During similar large-scale crises in emerging economies—notably the Latin American debt crisis and the 1997–98 Asian crisis—private capital inflows dried up for a substantial period of time, and output recovered only slowly to the levels prevailing before the crisis (Figure 4.3). Although the main trigger for these

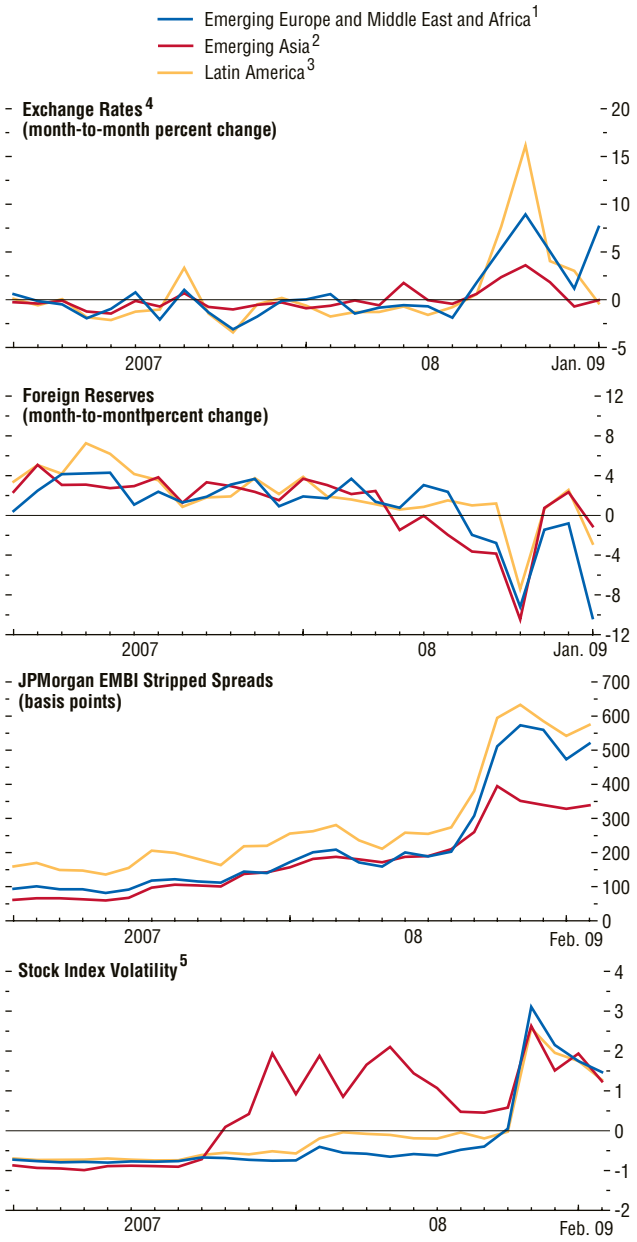
Note: The main authors of this chapter are Stephan Danninger, Ravi Balakrishnan, Selim Elekdag, and Irina Tytell. Menzie Chinn provided consultancy support, and Stephanie Denis and Murad Omoev provided research assistance.

[1]The decline was partly driven by exchange rate appreciation vis-à-vis the U.S. dollar during the first half of 2008.

Figure 4.1. Indicators of Financial Stress in Emerging Economies

(Purchasing-power-parity-weighted average)

Financial turmoil began to severely affect emerging economies in the second half of 2008, leading to exchange rate depreciations, reserve losses, a sharp rise in sovereign bond spreads, and heightened stock market volatility.



Sources: Datastream; IMF, *International Financial Statistics*; and IMF staff calculations.
[1]Emerging Europe and Middle East and Africa: Czech Republic, Egypt, Hungary, Israel, Morocco, Poland, Romania, Russia, Slovak Republic, Slovenia, South Africa, and Turkey.
[2]Emerging Asia: China, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Sri Lanka, and Thailand.
[3]Latin America: Argentina, Brazil, Chile, Colombia, Mexico, and Peru.
[4]Exchange rate is a nominal bilateral exchange rate of national currency against anchor currency.
[5]De-meaned volatility of monthly stock returns estimated using a GARCH (1,1) model.

two crises was not widespread financial stress in advanced economies—as explored in greater detail below—both crises overlapped with severe strains in the U.S. and Japanese banking sectors.

Given the potentially large implications of financial stress for the real economy and with the current crisis in mind, this chapter assesses the transmission of financial stress from advanced to emerging economies. The following questions are addressed:

- How severe is the current level of financial stress in advanced and emerging economies compared with past episodes?
- How strong is the link between stress in advanced economies and stress in emerging economies, and how do financial linkages affect the transmission? In particular, what is the impact on emerging economies of banking stress in advanced economies?
- What makes emerging economies more prone to stress, and can they protect themselves from the transmission of stress when advanced economies undergo a major financial crisis?

To answer these questions, this chapter analyzes episodes of financial stress since the early 1980s in 18 emerging economies. It employs a financial stress index, building on an index created for advanced economies in the October 2008 *World Economic Outlook*, to study transmission of stress from advanced to emerging economies. The chapter differentiates between *common* effects and *country-specific* effects, the latter depending on specific linkages and individual vulnerabilities, such as current account and budget deficits.[2]

These are the main findings of this chapter:

- The current crisis in advanced economies is much more severe than any since 1980, affecting *all* segments of the financial system in *all* major regions. For emerging economies, the current level of financial stress is already at the peaks seen during the 1997–98 Asian crisis.

[2]This chapter does not explicitly address the impact of advanced economy stress on trade financing.

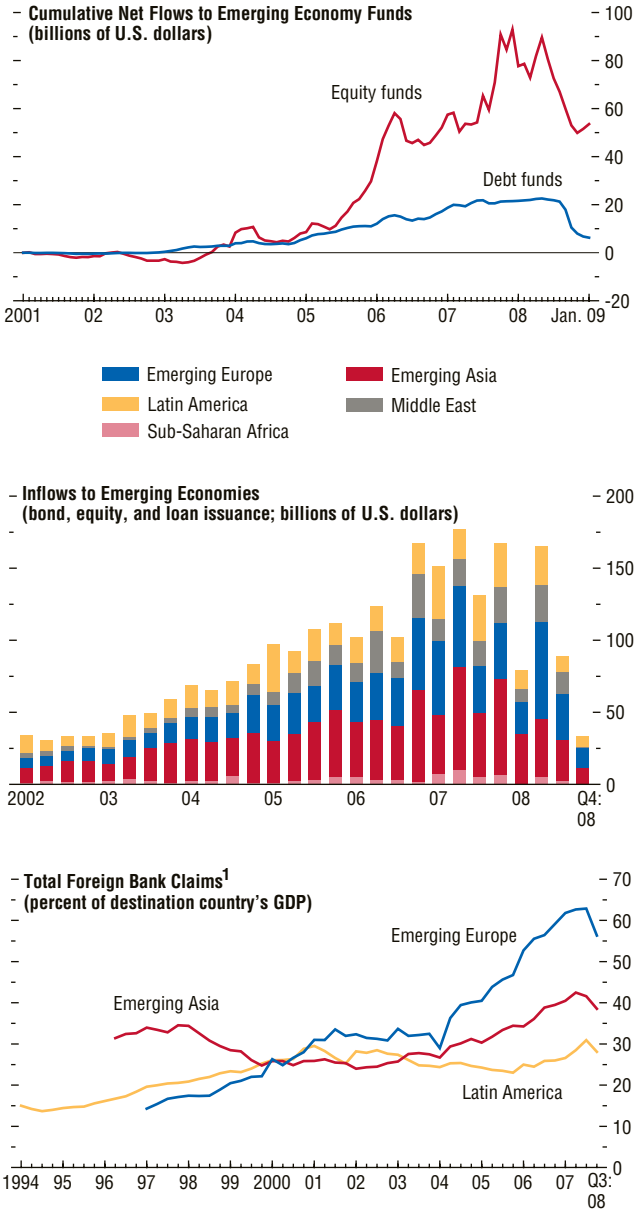
- There is a strong link between financial stress in advanced and emerging economies, with crises tending to occur at the same time in both. The large common impact of the current crisis, across all regions of emerging economies, is therefore not unexpected.
- Transmission is stronger to emerging economies with tighter financial links to advanced economies. In the current crisis, bank lending ties appear to have been particularly important.
- The current level of advanced economy stress and the fact that it is rooted in systemic banking crises suggest that capital flows to emerging economies will suffer large declines and will recover slowly, especially banking-related flows.
- Emerging economies obtain some protection against financial stress from lower current account and fiscal deficits and higher foreign reserves during calm periods in advanced economies. However, during periods of widespread financial stress in advanced economies, they cannot prevent its transmission, although they may limit the implications of financial stress for the real economy (for example, reserves can be used to buffer the effects from a drop in capital inflows). Moreover, once financial stress recedes in the advanced economies, lower current account and fiscal deficits can help reestablish financial stability and foreign capital inflows.

Although this chapter does not directly study the efficacy of various policies in mitigating the impact of financial stress on the *real economy*, it is clear that under current circumstances, policies will need to focus on averting further escalation of stress in emerging economies. This would not only limit the impact on the real economy in these countries, but also would thwart a second round of global deleveraging in the wake of damage to lenders' balance sheets in mature markets.

In light of cross-country spillovers, there is a strong case for a coordinated policy approach. Advanced economies need to continue efforts to stabilize their financial systems not just for

Figure 4.2. Capital Flows to Emerging Economies

High-frequency indicators show a drying up of capital flows to emerging economies reflected in lower debt, equity, and loan issuances. Bank lending from advanced economies began to shrink at around the same time, but indicators do not yet capture developments in the fourth quarter of 2008.

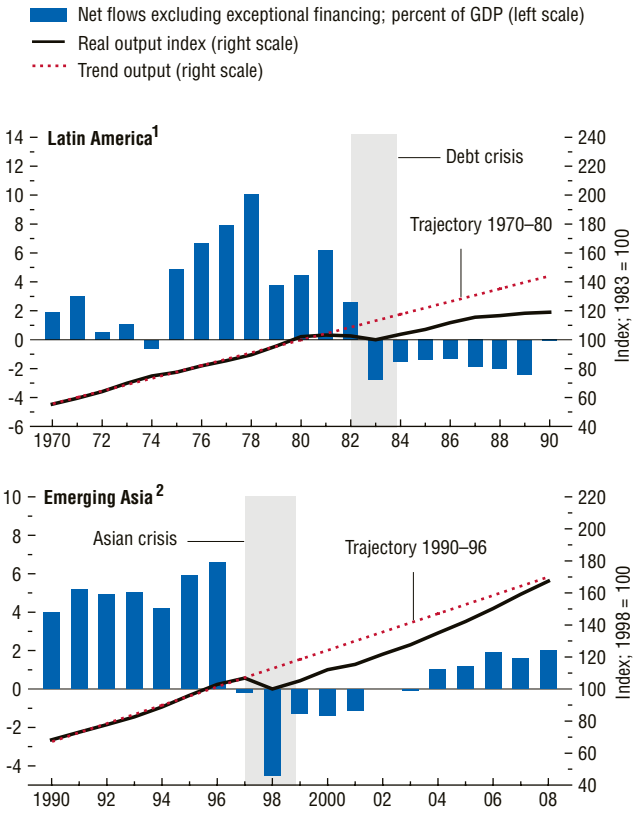


Sources: Bloomberg Financial Markets; EmergingPortfolio.com; Bank for International Settlements; and IMF staff calculations.

[1]Latin America consists of Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela. Emerging Europe contains Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovak Republic, Slovenia, and Turkey. Emerging Asia includes China, India, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan Province of China, and Thailand.

Figure 4.3. Sudden Stops and Activity
(Purchasing-power-parity-weighted average)

In the past, widespread financial stress in advanced economies was followed by reduced capital inflows—often abruptly through sudden stops—and lower growth. In the aftermath, capital inflows did not recover for a long time.



Sources: IMF, *Balance of Payments Statistics;* and IMF staff calculations.
[1] Includes Argentina, Bolivia, Brazil, Chile, Colombia, Dominican Republic, Ecuador, El Salvador, Jamaica, Mexico, Paraguay, Peru, Uruguay, and Venezuela.
[2] Includes Indonesia, Korea, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand, and Vietnam.

their own benefit, but also to foster a reduction of stress in emerging economies. Moreover, increased official access to external funding would help emerging economies avoid further sharp downturns or currency crises. Examples include the swap lines opened by the U.S. Federal Reserve and the European Central Bank with various emerging economies. These initiatives could be expanded and would complement financial support from international financial institutions, including the IMF.

Taking a longer-term perspective, financial integration is an essential part of a prospering world economy. As growing financial linkages increase the transmission of stress, there is a need to enhance multilateral insurance against external financial shocks, especially to well-governed countries that have opened their economies to the rest of the world.

The rest of this chapter is structured as follows. The next section discusses the financial stress measure for advanced economies and its recent trends. It then elaborates on how this measure is adapted to construct a measure of financial stress for emerging economies and documents important trends in the index across regions. The section that follows discusses the relationship between the two indices and why one would expect them to be linked. The chapter then presents a comprehensive analysis of stress transmission, by conducting an econometric analysis of factors driving financial stress in emerging economies—focusing on developments in the past decade—and by studying the impact on emerging economies of previous systemic banking crises in advanced economies. The concluding section outlines what can be expected from the current crisis and what policies can be implemented to alleviate its impact on emerging economies.

Measuring Financial Stress

A first step in gauging the impact of the current financial crisis on emerging economies is quantifying the intensity and scope of financial stress in both advanced and emerging economies.

How High Is Stress in Advanced Economies?

For advanced economies, the October 2008 *World Economic Outlook* introduced a monthly, market-based Financial Stress Index (AE-FSI). The index was calculated for 17 economies, covering about 80 percent of advanced economy GDP, for the years since 1981.[3] It comprises seven subindices, related to banking sectors, securities markets, and foreign exchange volatility.[4]

An update of the index to February 2009 illustrates the unprecedented breadth and intensity of the current crisis. Since the first quarter of 2008, nearly all the advanced economies have experienced unrelieved, exceptionally high stress (Figure 4.4, top panel).[5]

Some historical comparisons put the situation in perspective. In seven previous episodes, high stress affected at least 50 percent of advanced economies, weighted by GDP (Table 4.1). All but one of these episodes (the exchange rate mechanism, ERM, crisis) included the United States. Several large stress events were associated with severe banking sector dislocations (for example, the Latin American debt crisis of the early 1980s and the Japanese and Scandinavian banking crises of the 1990s). Given their potential relevance for understanding the current crisis, these episodes are the subject of a case study later in this chapter. More recent stress episodes in advanced economies have tended to be more related to securities markets (for example,

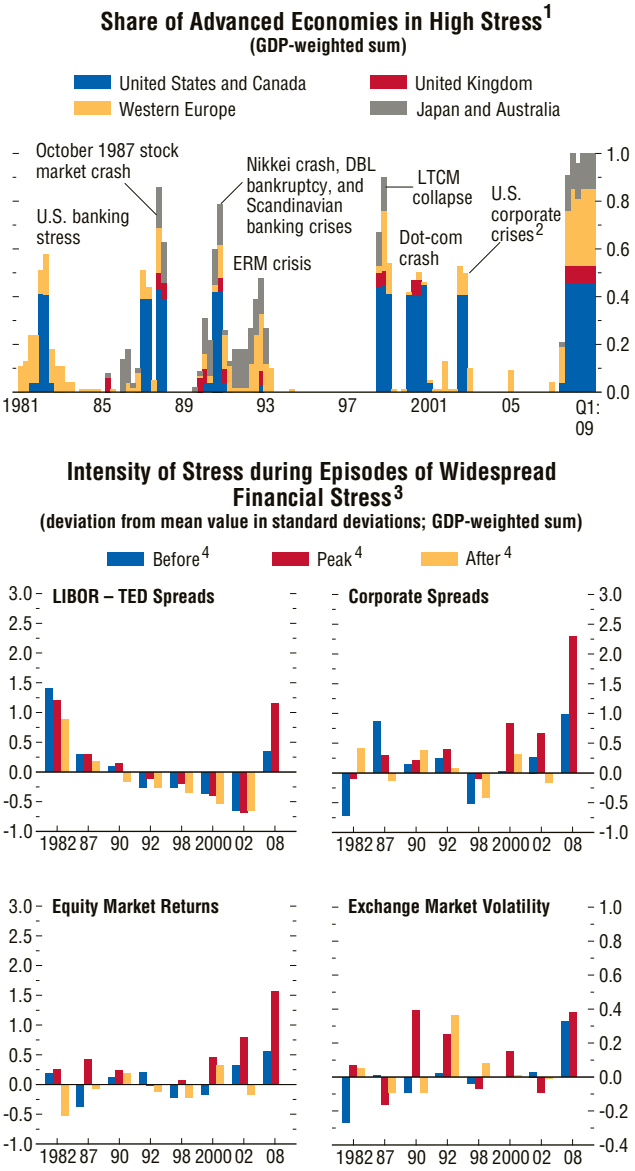
[3] *World Economic Outlook*, October 2008, Chapter 4, "Financial Stress and Economic Downturns."

[4] The AE-FSI for each advanced economy is a weighted average of the following indicators: three banking-related variables (banking-sector stock price volatility, the spread between interbank rates and the yield on treasury bills, and the slope of the yield curve); three securities-markets-related variables (corporate bond spreads, stock market returns, and stock return volatility); and exchange rate volatility. For further details, see Cardarelli, Elekdag, and Lall (forthcoming).

[5] The top panel reports only high-stress events, which are defined as periods of financial stress in which the measured stress level is more than one standard deviation above the Hodrick-Prescott trend level.

Figure 4.4. Financial Stress in Advanced Economies

Financial stress in advanced economies is currently more widespread across countries and sectors of the financial system than in earlier stress episodes.



Source: IMF staff calculations.

Note: DBL = Drexel Burnham Lambert; ERM = European exchange rate mechanism; LIBOR = London interbank offered rate; LTCM = Long-Term Capital Management.

[1] High stress defined as a stress index level of one standard deviation above its trend.

[2] WorldCom, Enron, and Arthur Andersen.

[3] Widespread stress is defined as periods during which 50 percent of advanced economies' GDP was in high stress. A total of seven episodes were identified with peak stress dates in 1982, 1987, 1990, 1992, 1998, 2000, 2002, and 2008. See Table 4.1 for a description.

[4] Non-overlapping averages of three quarters before, around, and following peak stress. The peak in the 2008 episode is assumed to be quarter four.

Table 4.1. Episodes of Widespread Financial Stress in Advanced Economies[1]

1982	U.S. Banking Sector Stress		
	Canada	United States	Following sovereign defaults in Latin America, a number of large U.S. banks experienced stress. During the 1970s, the largest U.S. banks became increasingly exposed to Latin America via syndicated loans to sovereign borrowers. By the end of 1978, such loans accounted for more than twice the capital and reserves of the major banks. Higher interest rates in advanced economies, a global downturn, and the attendant collapse in commodity prices severely affected emerging economies and in turn U.S. banks. Mexico declared a debt service moratorium. With the exceptions of Chile, Colombia, and Costa Rica, all Latin American countries defaulted. The U.S. savings and loan crisis began at about the same time, though it was largely unrelated to the Latin American debt crisis.
	Belgium France Germany	Italy Netherlands	
1987	U.S. Stock Market Crash		
	Canada	United States	The October 1987 U.S. stock market crash was the largest-ever one-day decline in stock market values. The Dow Jones Industrial Average fell by 23 percent. Repercussions were felt in virtually all advanced economies' equity markets. Brazil declared a debt service moratorium. At about the same time, the Louvre Accord was signed, prior to which the U.S. dollar hit record lows (a 50 percent decline from the 1985 peak).
	Belgium Germany Netherlands Norway	Spain Sweden Switzerland United Kingdom	
	Australia	Japan	
1990	Nikkei Crash		
	Canada	United States	The junk bond market collapsed in the United States, and the Nikkei index for the Tokyo stock market crashed, falling by 50 percent. There were other sources of financial stress. The continuing bailout of U.S. savings and loan institutions reached $150 billion. Drexel Burnham Lambert—the fifth-largest U.S. investment bank at the time—filed for bankruptcy. Systemic banking crises affected Argentina, Brazil, Hungary, and Romania.
	Austria Belgium Germany	Netherlands Switzerland United Kingdom	
	Australia	Japan	
1992	European Exchange Rate Mechanism (ERM) Crisis and Scandinavian Banking Crises		
	Canada		The ERM collapsed and the Japanese asset price bubble burst. Moreover, equity and commodity markets were rattled by the start of the First Gulf War. At about the same time, the Scandinavian banking crises affected Finland, Norway, and Sweden. There was a systemic banking crisis in India (1993) and debt restructuring arrangements in Argentina, Egypt, Jordan, Paraguay, the Philippines, Poland, and South Africa.
	Austria Denmark Finland Germany Italy	Norway Spain Sweden	
	Japan		
1998	Long-Term Capital Management (LTCM) Collapse		
	Canada		The collapse of U.S.-based hedge fund LTCM rattled stock markets. Even though it was preceded by the Russian default, LTCM had already experienced financial woes prior to that event. In May and June 1998, LTCM recorded losses of 6.4 percent and 10.1 percent, reducing its capital by $461 million. Margin calls and leveraged hedge funds fueled sell-offs in many risky asset classes, including emerging market instruments. Financial stress increased strongly in Mexico, and Brazil suffered a currency crisis that culminated in a 70 percent depreciation of the real starting in January 1999.
	Austria Denmark France Germany Netherlands	Norway Spain Switzerland United Kingdom	
	Japan		
2000	Dot-Com Crash		
	Canada	United States	Large declines in the U.S. Standard & Poor's stock market index began in August 2000, led by the technology sector. There was debt restructuring in Ecuador and Russia and a systemic banking crisis in Turkey.
	Finland Netherlands	United Kingdom	
2002	WorldCom, Enron, and Arthur Andersen Defaults		
	Canada	United States	Scandals wreaked havoc across global financial markets. The turmoil started with the demise of Arthur Andersen (then one of the "Big Five" international accounting firms), which was convicted on June 15, 2002, of obstruction of justice in conjunction with the Enron scandal. WorldCom filed for bankruptcy on July 21, 2002—the largest in U.S. history at the time. One of the most severe crises in emerging markets was experienced by Argentina, which abandoned its 10-year currency board.
	Belgium Germany	Netherlands	

Source: IMF staff.

[1]Widespread financial stress defined as periods during which at least 50 percent of advanced economies' GDP is in high financial stress measured by a stress index exceeding one standard deviation above its trend.

equity market crises in 1998, 2000, and 2002).[6] Ominously, the current crisis affects *all* financial segments, in *all* major regions, and it has already shown unusual persistence.

An analysis of components of the AE-FSI underlines the pervasiveness of the crisis. The bottom four panels of Figure 4.4 compare selected indicators before, during, and after the peak of various stress episodes. In 2008, banking stress—measured by the deviation from trend of the TED spread—reached levels previously seen only during the peak of the U.S. banking sector stress in 1982. During that year, however, securities markets were orderly, whereas they currently suffer major dislocations. Recent corporate spreads have been at unprecedented levels, reflecting the tight linkages between banking and securities markets. The collapse in equity markets has been larger than during the 2000 crash of the dot-com bubble and the corporate debacle of 2002 (which involved WorldCom, Enron, and Arthur Andersen). Finally, ballooning imbalances and uncertainty in international capital markets have raised exchange market volatility to the levels seen during the 1990 Nikkei/junk bond collapse and the 1992 ERM crisis.

Measuring Financial Stress in Emerging Economies

An abundant literature has sought to identify the occurrence and determinants of currency, banking, and debt crises in emerging economies. Academic studies have largely relied on historical narratives of well-known systemic banking crises, when bank capital was eroded, lending was disrupted, and public intervention was required (for a comprehensive survey, see Laeven and Valencia, 2008).[7] However, financial stress attributed primarily to securities markets has been examined less comprehensively, especially those episodes that involved multiple emerging economies.

These previous studies provide a rich database of financial stress episodes in emerging economies, but they are less well suited to the purposes of this chapter for two reasons. First, econometric work often uses *zero-one* binary variables: either *no crisis* or *crisis*. Such variables do not provide a measure of the intensity of stress and ignore the ambiguity of "near-miss" events.[8] Second, even the most comprehensive databases focus on banking, currency, and debt crises, and pay little attention to securities market stress. With banking sectors and securities markets more intertwined, it is important to simultaneously analyze the entire financial system.

To complement the indicators used in the literature, this chapter identifies episodes of financial stress in emerging economies using a composite variable—the *"Emerging Markets Financial Stress Index" (EM-FSI)*. This is the first such measure providing comparable high-frequency data on stress for emerging economies. It builds on the methodologies used to construct the AE-FSI. One important refinement for the EM-FSI is the inclusion of a measure of exchange market pressures, which are a more common source of stress in emerging economies than in advanced economies. [9,10]

[6]Given the better data coverage on the more recent stress events, their effect on transmitting stress to emerging economies is explored econometrically below.

[7]To identify currency crises, event narratives may be complemented with data on foreign exchange reserves, exchange rate fluctuations, and interest rate volatility, among others (see, for example, Eichengreen, Rose, and Wyplosz, 1996). Sovereign debt crises are relatively clear-cut because default and rescheduling dates are officially announced (Reinhart and Rogoff, 2008). Countries often suffer from a combination of the two—a "twin crisis" (Kaminsky and Reinhart, 1999)—that may be associated with contagion (Kannan and Köhler-Geib, forthcoming).

[8]Some episodes do not mutate into full-scale crises or have little macroeconomic impact. One such example includes the emerging market sell-off in June 2006. Although the macroeconomic implications were minor, it did raise asset price volatility in countries with large current account deficits.

[9]A depletion of reserves may indicate exchange market pressures, although the exchange rate appears stable. Calvo and Reinhart (2002) show that many emerging economies with officially flexible exchange rate regimes often allow only minimal exchange rate movement—the "fear of floating" hypothesis.

[10]One caveat in interpreting the exchange market pressure component is that the impact of stress in this

Construction of the stress index for emerging economies

Financial stress events have two elements in common: they occur suddenly, and they usually involve multiple sectors of a country's financial system. The overall level of stress experienced in a country depends on the economic importance of the stressed financial sector. This has two implications for the construction of a stress index: first, the indicator should cover developments in a broad set of financial markets and, second, the aggregation of the subindices should reflect the relative importance of the various financial sectors.

Based on these principles, the EM-FSI for each country comprises the following five indicators:

- an exchange market pressure index (EMPI), which increases as the exchange rate depreciates or as international reserves decline;[11]
- emerging economy sovereign spreads, whereby rising spreads indicate increased default risk;
- the "banking-sector beta," based on the standard capital asset pricing model (CAPM) computed over a 12-month rolling window. A beta greater than 1—indicating that banking stocks are moving more than proportionately with the overall stock market—suggests that the banking sector is relatively risky and is associated with a higher likelihood of a banking crisis;
- stock price returns, calibrated such that falling equity prices correspond to increased market stress; and
- time-varying stock return volatility, wherein higher volatility captures heightened uncertainty.

One difference between the EM-FSI and the stress index for advanced economies is the absence of a subindex capturing corporate bond spreads. Although this segment of emerging economies' capital markets has developed rapidly over the past few years, it is still small in most emerging economies. Most important, comparable data were not available for a sufficiently large pool of emerging economies.[12]

The aggregation of the subindices into the EM-FSI is based on variance-equal weighting. Under this method each component is computed as a deviation from its mean and weighted by the inverse of its variance. This approach gives equal weight to each stress subindex, allows a simple decomposition of stress components, and is also the most common weighting method in the literature.[13]

Using the components described above, the EM-FSI is constructed for 18 emerging economies from 1997 to 2008 using monthly data.[14] In addition to capturing the most important episodes of financial stress experienced by emerging economies, the EM-FSI performs well when contrasted to previous academic studies.[15] A narrative analysis later in this chapter examines well-known financial stress episodes before 1997.

component depends on the degree of dollarization and currency mismatches in domestic public and private balance sheets. In particular, countries with relatively high foreign currency liabilities on balance sheets may experience a greater impact on the real economy through balance sheet effects from a given exchange rate depreciation.

[11]For similar measures, see Ramakrishnan and Zalduendo (2006) and Batini and Laxton (2005).

[12]The index does not cover interest rate changes, since these could be the result of policy measures unrelated to financial stress.

[13]Although economic weights, such as the size of each financial market sector, would have been preferable, such weights were not available on a comparable basis across countries. However, variance-equal weighting has been shown to perform as well in signaling stress episodes as weighting based on economic fundamentals (Illing and Liu, 2006). Moreover, robustness tests indicated that equal-variance weights are very similar to weights identified by a principal components analysis of the stress subindices.

[14]The EM-FSI was constructed for countries for which data were available for all subcomponents. See Appendix 4.1 for a list of countries.

[15]Subcomponents of the EM-FSI capture crises identified in the literature. Following the literature, an episode of high financial stress was identified when the index for a country exceeds 1.5 standard deviations above its mean. See Appendix 4.1 for details.

Patterns of financial stress in emerging economies

Broadly speaking, four systemic financial stress episodes can be identified using this new index (Figure 4.5, top panel).[16] The first spike in the EM-FSI signals the intensification of the Asian crisis during the last quarter of 1997, a severe, but primarily regional episode. The second occurs toward the end of 1998 and was felt more intensely across emerging economies. This episode reflected the financial turmoil owing to the default of Russian external obligations and the collapse of Long-Term Capital Management (LTCM), and culminated in the Brazilian currency crisis. The third rise in the EM-FSI peaked around the dot-com crash of 2000. The fourth increase in the EM-FSI is more differentiated across regions, with the largest rise occurring in Latin America during the Argentine default in 2002.[17]

The new index also captures well the recent eruption of stress. Signs of crisis first appeared in Asia and multiplied quickly across all other regions. In the final quarter of 2008, all regions showed exceptionally high levels of stress, at exactly the same time that advanced economies experienced stress. The lower panels of Figure 4.5—using monthly data—show a regional decomposition of stress. The synchronized increase in stress in 2008 is marked and shows peaks in all regions in October, although experiences within regions varied (for example, some central European economies, such as Poland and the Czech Republic, experienced less stress). The composition of the jump in stress is explored in more depth below.

Links between Advanced and Emerging Economies

The strong comovement of stress across emerging economies suggests that common factors play a role. One of these factors could be financial

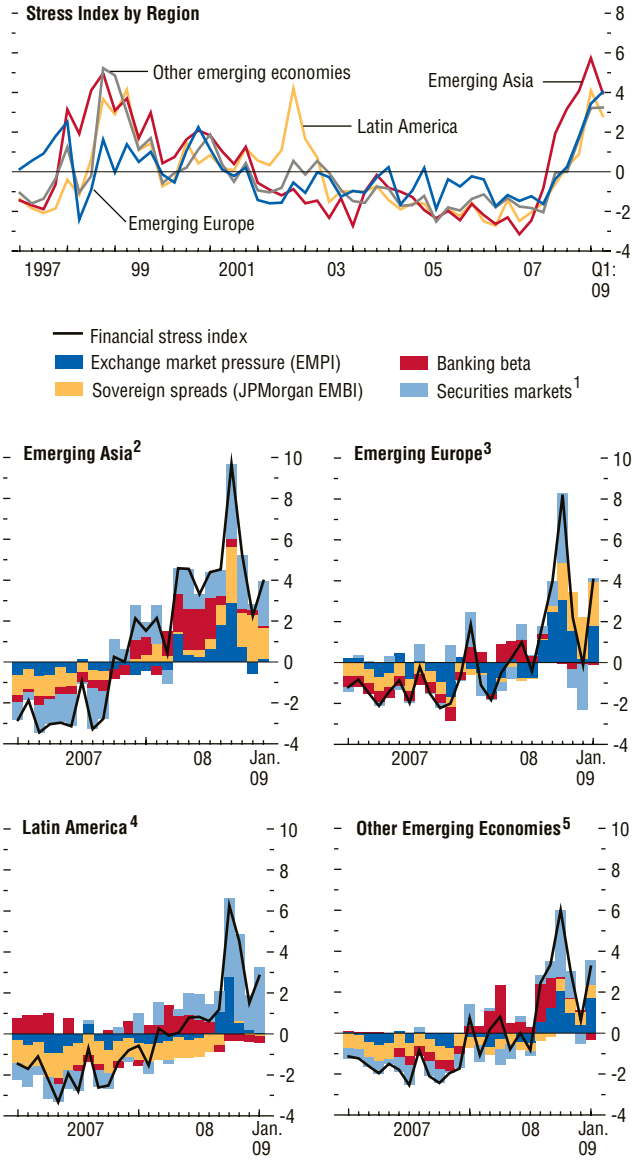
[16]To facilitate comparisons, each regional EM-FSI was standardized.

[17]Similarly, Latin America seems to have been sensitive to the sell-off in emerging assets around June 2006.

Figure 4.5. Financial Stress Indices in Emerging Economies

(Purchasing-power-parity-weighted average)

Current levels of financial stress are at historical highs. Stress increased in all regions in the third quarter of 2008 and showed strain in all parts of the financial sector.

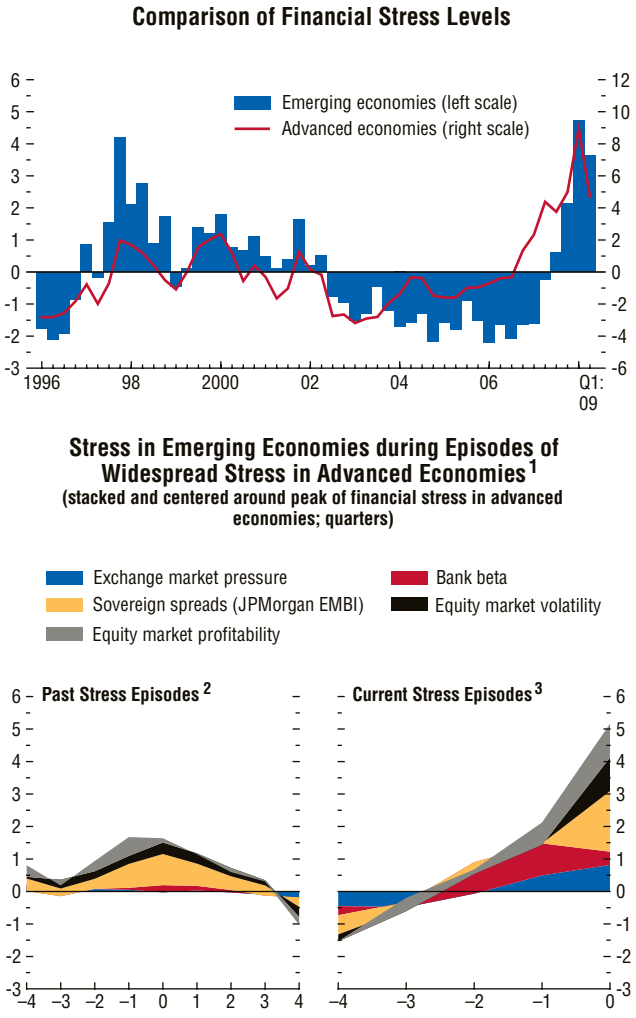


Source: IMF staff calculations.
[1]Includes stock returns and volatility.
[2]Emerging Asia: China, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Sri Lanka, and Thailand.
[3]Emerging Europe: Czech Republic, Hungary, Poland, Romania, Slovak Republic, and Slovenia.
[4]Latin America: Argentina, Brazil, Chile, Colombia, Mexico, and Peru.
[5]Other emerging economies: Egypt, Israel, Morocco, Russia, South Africa, and Turkey.

Figure 4.6. Financial Stress in Emerging and Advanced Economies

(Level of index, GDP weighted)

There is a strong visual link between stress in advanced and emerging economies, with peaks and troughs roughly coinciding. The increase in emerging economy stress is larger this time when compared with past episodes and involves all segments of the financial sector.



Source: IMF staff calculations.
[1]See Figure 4.5. Refer to Appendix 4.1 for definitions of stress components.
[2]Peak in 1998:Q4, 2000:Q4, and 2002:Q3. See Table 4.1.
[3]Peak assumed in 2008:Q4.

stress in advanced economies. We first briefly present empirical evidence indicating that *stress in advanced and emerging economies is closely linked* and then discuss the *reasons they may be linked.*

Does Stress Comove?

The top panel of Figure 4.6 compares aggregate financial stress indices for advanced economies (AE-FSI) and emerging economies (EM-FSI). There is a strong visual link, with local peaks in the two indices broadly coincident. Particularly notable is that the EM-FSI is currently higher than at any previous time, as is the AE-FSI. Moreover, the second-highest peak in the EM-FSI occurs in the same quarter as the collapse of LTCM, an event that led to significant financial stress in advanced economies.[18] The strong links are also apparent from looking at calm periods in emerging economies (when the EM-FSI is below zero), as they tend to overlap with calm periods in advanced economies (when the AE-FSI is below zero).

During the current crisis, there is an evident "decoupling" and subsequent "recoupling." The AE-FSI turned positive in the second quarter of 2007 and then rose rapidly. In contrast, the EM-FSI stayed significantly negative until the first quarter of 2008. It turned positive only in the second quarter of 2008 and then blew up in the third quarter and particularly in the fourth. Thus, in this episode, there was a limited early response in emerging economies but then a sharp catch-up.

To investigate further how the current crisis differs from previous ones, the lower two panels of Figure 4.6 decompose the EM-FSI into its components. The bottom left panel shows the average of each component centered around three previous crises since 1997; the bottom

[18]Some commentators have argued that the Russian default in 1998 led to the demise of LTCM. However, LTCM had already reported losses prior to the Russian default, weakening the argument that the stress event was purely emerging economy driven. The sharp widening of risk premiums following the August default was the final blow.

right panel shows the current crisis. There are clear differences. First, financial stress in emerging economies is much stronger in the current episode, in line with the larger impulse from advanced economies. Second, the composition differs. In previous crises, the main driver was wider risk premiums (the EMBI sovereign bond index), compounded by stock market volatility. Perhaps surprisingly, the index of exchange market pressure was barely visible in the three previous crises.[19]

In the current crisis, stress first became visible in the second quarter of 2008 in the banking sector. Subsequently, exchange market pressures increased, and by the last quarter of 2008 the turmoil also included widened sovereign spreads (EMBI) and heightened stock market volatility. In sum, the current crisis differs from previous episodes in that it involves all components—banking, foreign exchange, debt, and equity. Banking stress (as picked up by the banking beta) seems to be an especially important catalyst in the present turmoil.

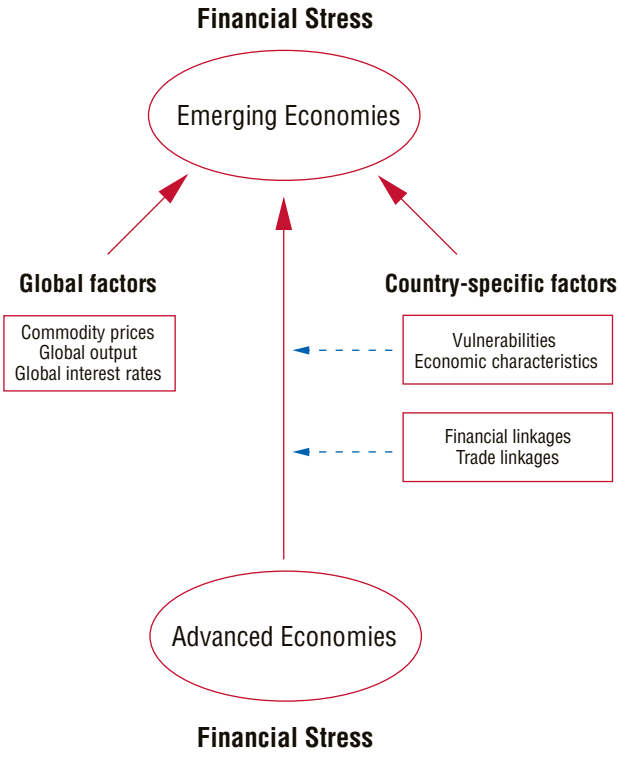
How Does Stress Get Transmitted?

What factors drive the relationship between financial stress in advanced economies and emerging economies? In broad terms, there are *common* factors that produce similar effects across all emerging economies and *country-specific* factors that underlie differences between individual emerging economies. Figure 4.7 provides a schematic presentation of these effects.

Common factors

The presence of common factors is apparent from the comovement of stress across emerging regions and between emerging and advanced economies, which was noted previously. Common factors can be global shocks (for example,

Figure 4.7. The Transmission of Stress: Schematic Depiction of Effects



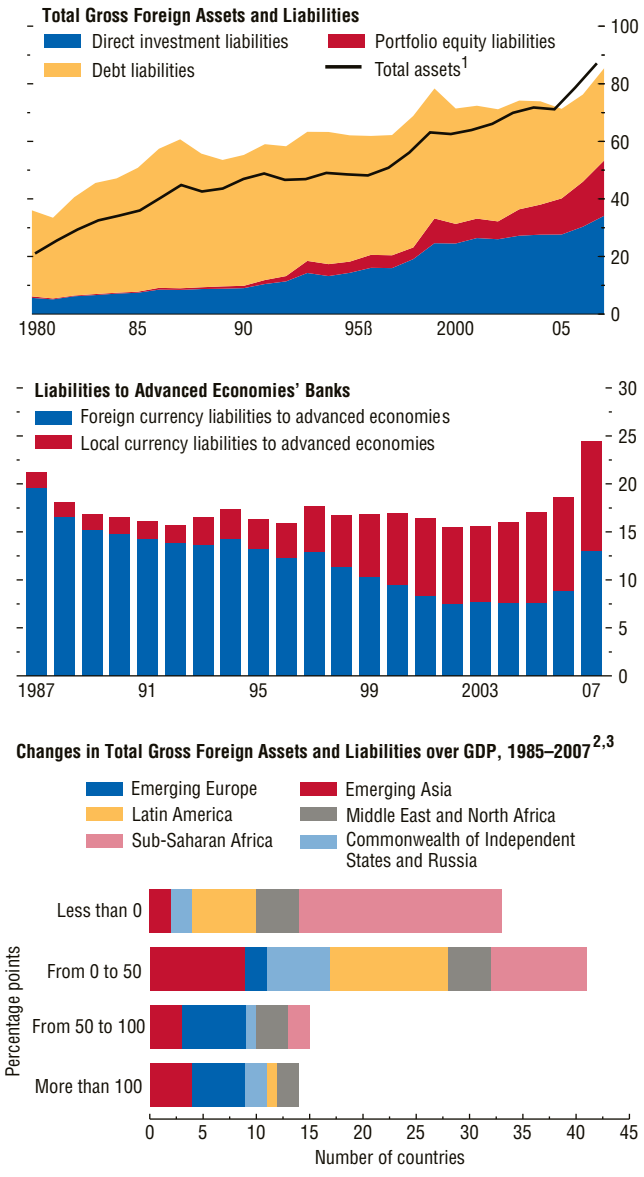
Source: IMF staff.

[19]The reason for the relatively moderate response around the Asian crisis is that there were offsetting effects between countries afflicted by the crisis and other countries that experienced a reduction in stress, such as India and China.

Figure 4.8. Financial Integration of Emerging and Developing Economies

(Percent of emerging and developing economies' GDP)

Foreign liabilities of emerging economies have grown rapidly over the past 30 years, driven by direct and portfolio investment. Bank lending has remained a major source of financing, with the composition shifting from foreign to domestic currency lending. Gross external investment positions have increased especially strongly in emerging Europe.



Sources: Bank for International Settlements; Lane and Milesi-Ferretti (2006); and IMF staff calculations.

[1]Includes foreign exchange reserves.

[2]Total foreign assets excludes foreign exchange reserves.

[3]1995–2007 in the case of emerging Europe and Commonwealth of Independent States and Russia.

global shifts in market sentiment or risk aversion) and may manifest themselves through herd behavior in markets, cross-country contagion, and common-lender effects (that is, the blanket withdrawal of funds by highly exposed financial institutions).[20] The role of such common factors is likely related to the increasing financial integration of the majority of emerging economies in the past decades—in other words, financial globalization.

Indeed, total foreign liabilities of emerging economies have been growing swiftly over the past 30 years (Figure 4.8).[21] The increase is largely related to rising portfolio equity and direct investment. Although debt liabilities have declined somewhat over time, debt to advanced economy *banks* on a consolidated basis (with accounts of foreign affiliates consolidated along with those of the headquarters) has risen in recent years relative to GDP, and the composition has shifted from foreign to domestic currency debt (middle panel). Part of this process is attributed to the rapid increase in foreign bank ownership, especially in emerging Europe (Claessens and others, 2008; and Goldberg, 2008).

Financial integration has, however, increased unevenly across regions (bottom panel). Over the past couple decades, approximately 70 percent of countries have increased their gross external positions, but others have seen declines, particularly in Africa.[22] Some countries have seen large increases, notably those in emerging Europe, where most countries' gross external positions rose by more than 50 percent of annual GDP in just over a decade.

Country-specific factors can be grouped into two broad categories: financial and economic linkages between emerging and advanced econ-

[20]See Broner, Gelos, and Reinhart (2006); Calvo (2005); and Pons-Novell (2003).

[21]Foreign assets, notably official reserves, also rose. Gross positions, however, are more appropriate than net positions for gauging integration. Indeed, a measure commonly used in the literature is the *sum* of foreign assets and liabilities (see, for example, Kose and others, 2006; and IMF, 2007).

[22]The declines in external positions often were the result of debt relief.

omies; and domestic vulnerabilities, deriving from policies or from structural characteristics.

Country-specific linkages

How do linkages to advanced economies facilitate the transmission of financial stress? The two channels of transmission emphasized in the literature are trade and financial channels.[23]

Financial stress can rise in response to actual or incipient *capital outflows* initiated by investors in advanced economies following a financial shock. The importance of this channel of stress transmission can be measured by foreign liabilities to advanced economies divided by domestic GDP. In addition, financial stress can increase as a result of losses incurred on emerging economy assets invested in advanced economies experiencing a crisis. This channel of transmission could be significant in some countries, notably in the Middle East, and can be captured by the ratio of assets held in advanced economies to domestic GDP. Overall, financial linkages can be quantified as a sum of gross foreign assets and liabilities vis-à-vis advanced economies relative to GDP.[24]

Financial stress can also occur through trade linkages in response to actual or incipient *declines in exports* to advanced economies in crisis, reflecting current or expected slowdowns in demand. The importance of this linkage can be measured by exports to advanced economies divided by domestic GDP. By this measure, trade linkages have become increasingly important over the past 20 years, with exports to advanced economies up from less than 10 percent to nearly 20 percent of emerging economies' GDP. Almost half of these exports now come from emerging Asia, especially China.[25] In addition, crisis transmission via both trade and financial linkages can be compounded by second-round effects. These work through spillovers from affected emerging economies back to advanced economies and also through spillovers within the group of emerging economies.[26]

Figure 4.9 compares the size and composition of financial linkages across emerging economies.[27] The top panel shows how over the past 10 years or so, liabilities to advanced economy banks have grown rapidly in emerging Europe, while declining somewhat in emerging Asia following the 1997–98 crisis. In parallel, portfolio liabilities (and assets) in emerging Asia have increased markedly.[28] As a result, emerging Europe may now be more vulnerable to exter-

[23]Eichengreen and Rose (1999), Glick and Rose (1999), and Forbes (2001) stress trade linkages. Kaminsky and Reinhart (2003); Caramazza, Ricci, and Salgado (2000); Fratzscher (2000); and Van Rijckeghem and Weder (2001) emphasize financial channels as well as trade. A survey of this literature is in Chui, Hall, and Taylor (2004). In a recent study, Forbes and Chinn (2004) attribute the main role in the transmission of financial shocks to trade, with bank lending of lesser but increasing importance.

[24]Because of data limitations, foreign assets could not be included in all measures of financial linkages. Specifically, although data on nonreserve foreign portfolio assets of emerging economies are available, data on foreign bank assets of these economies are generally lacking. For more information about these data, see Appendix 4.2.

[25]The trade and financial channels of crisis transmission may also interact, because the availability of trade credit is linked to trade volume. Indeed, recent declines in international trade are at least in part a result of collapsing trade credit.

[26]Losses on foreign investments can further increase the strain on advanced economies' financial systems and cause further pullout from emerging economies (along the lines of the common-lender effect emphasized in the contagion literature). In the same vein, falling external demand could intensify the real stress experienced by advanced economies and further depress their own demand and, as a result, the exports of emerging economies (a broadly similar multiplier effect is analyzed by Abeysinghe and Forbes, 2005). For countries that are not directly linked to advanced economies—because trade linkages among themselves have become more significant over time—falling demand and depreciating currencies could spread the stress.

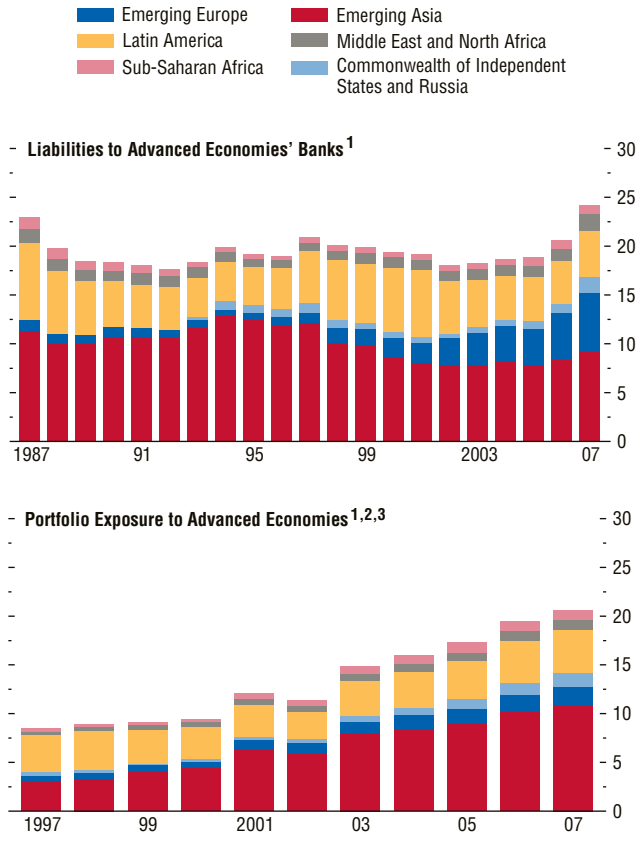
[27]Because trade and direct investment linkages have been discussed extensively elsewhere, the focus here is on bank lending and security holdings. See recent issues of the World Trade Organization's *World Trade Report* and the United Nations' Conference on Trade and Development's *World Investment Report,* as well as past issues of the *World Economic Outlook,* including Chapter 5 of the April 2008 issue and Chapter 4 of the October 2007 issue.

[28]Although nonreserve portfolio assets are sizable in emerging Asia relative to the other regions, they are significantly smaller than portfolio liabilities. The dynamics of overall portfolio exposures in emerging Asia, as well as in other regions, are driven mainly by portfolio liabilities to advanced economies.

Figure 4.9. Financial Exposures of Emerging to Advanced Economies

(Percent of emerging economies' GDP)

Exposures to advanced economies have risen in emerging Europe via bank lending and in emerging Asia via portfolio holdings.



Sources: Bank for International Settlements; IMF, Coordinated Portfolio Investment Survey; and IMF staff calculations.
[1]See Appendix 4.2 for the list of advanced economies.
[2]Including liabilities and nonreserve assets.
[3]The data for 1998, 1999, and 2000 are based on interpolations.

nal bank crises, whereas emerging Asia may be more susceptible to external securities- market disturbances.

Over the same period, western European banks have increasingly dominated banking flows, whereas North America has been the main source for portfolio investments (Figure 4.10). This implies that western Europe has become the most likely source of common-lender effects, and the United States and Canada have become more important sources of securities market disturbances.

Recent data underline the different regional patterns in financial integration. Data from the end of 2007 (bottom panels) show that emerging Europe has bank liabilities to advanced economies exceeding 50 percent of GDP, which is about three times that of the other regions. Emerging Europe is also most dependent on western Europe and therefore particularly liable to common-lender effects. In comparison, emerging Asia and Latin America appear somewhat less at risk, with broadly similar exposures via bank lending and portfolio holdings to, respectively, western Europe and the United States and Canada.[29]

Country-specific vulnerabilities

Country-specific sources of vulnerability to external shocks include solvency and liquidity problems, weaknesses in domestic balance sheets, and factors related to openness.[30] These factors heighten susceptibility to capital account crises and currency crises and potentially increase the rate of transmission of stress originating in investor economies. By signaling higher risks—for example, through sovereign default—they may cause investors to pull out more forcefully and thereby create self-fulfilling investor expectations.

[29]For an extensive discussion on the role of financial linkages in Latin America, see Mühleisen (2008).
[30]See Kaminsky and Reinhart (1999); Calvo (2005); Edwards (2005); Ghosh (2006); Calvo, Izquierdo, and Mejia (2004); Ramakrishnan and Zalduendo (2006); and Eichengreen, Gupta, and Mody (2006).

Figure 4.11 compares standard indicators of vulnerability across different emerging regions. The top two panels show the current account and fiscal balances.[31] Over the past few years, current account balances have become more divergent. Emerging Europe has seen large and sustained deficits, while many countries in Asia, the Middle East, and the Commonwealth of Independent States (CIS) have shifted to surpluses—partly because of the commodity price boom. Fiscal balances show a more homogenous picture, having in general improved across all regions. Looking at the two indicators in combination shows twin deficits—on the current account and the budget—mainly in emerging Europe.

A second (inverse) measure of vulnerability is the level of foreign exchange reserves (bottom panel). Following the Asian crisis, many countries strengthened their reserve positions, as judged by months of import coverage. Commodity exporters and economies in emerging Asia—especially China—achieved large increases; other countries in Latin America and emerging Europe saw moderate increases. Overall, although reserve buffers have risen strongly in dollar terms, the increase in terms of import coverage has been less impressive as trade volumes have grown markedly.

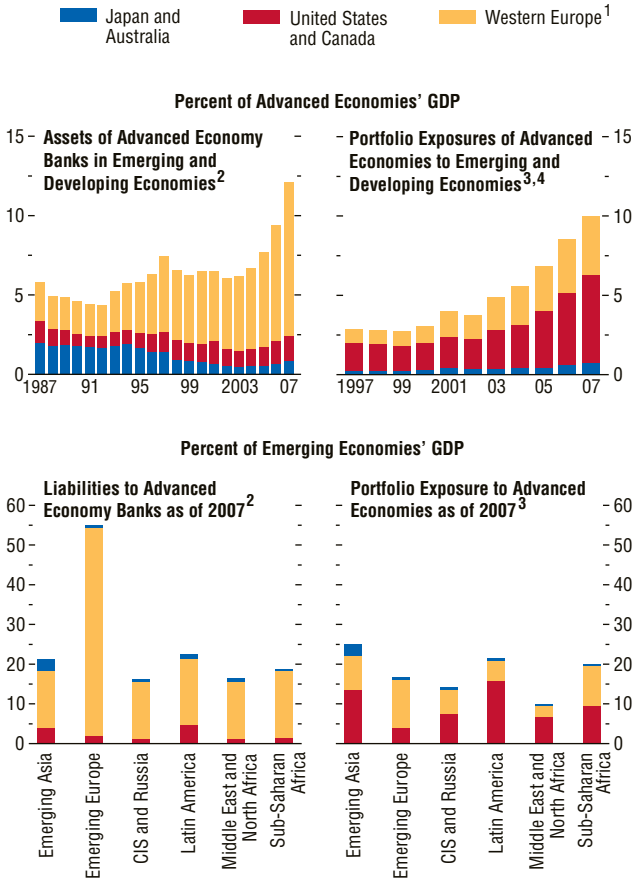
The Transmission of Financial Stress: An Overall Analysis

Periods of widespread financial stress in advanced economies appear to have significant effects on emerging economies. Data constraints limit, however, the ability to systematically explore these interactions over a long time horizon, which is why this section takes a two-pronged approach. The first part presents results from an econometric exercise using the financial stress indices, covering the period

[31]Although sustainability refers to a stock concept, empirical studies find that current account and fiscal balances—the corresponding flow variables—are important determinants of crisis events.

Figure 4.10. Financial Linkages between Advanced and Emerging Economies

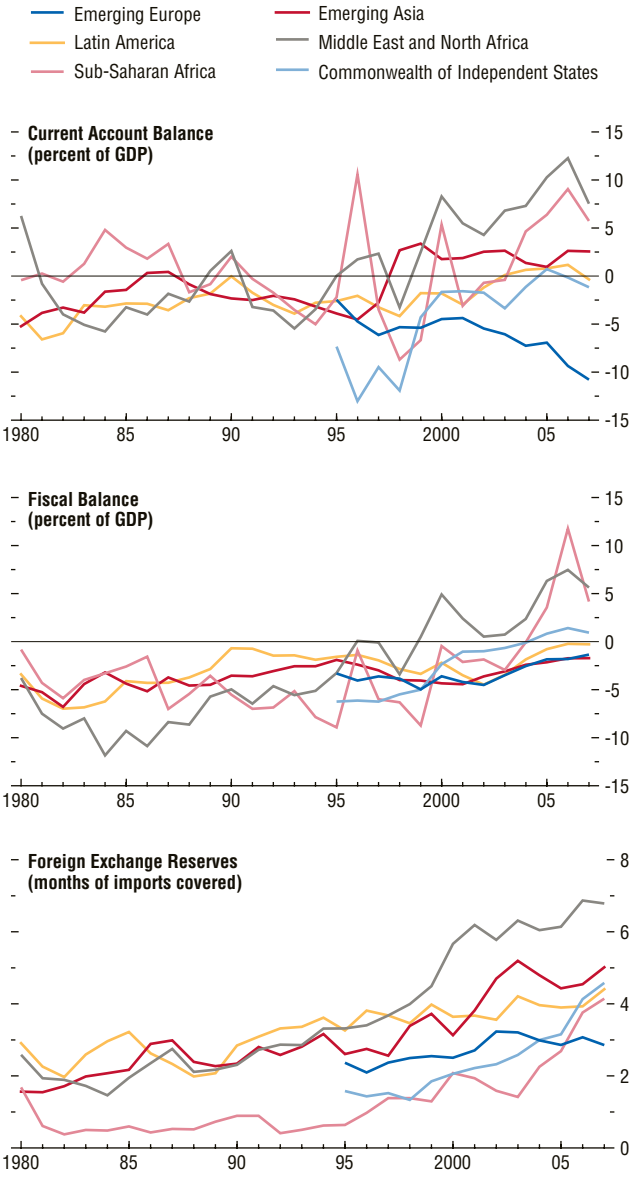
Western Europe dominates bank lending; portfolio investments come mainly from North America. The largest respective recipients of these two investing regions (relative to recipients' GDP) are emerging Europe and Latin America.



Sources: Bank for International Settlements; IMF, Coordinated Portfolio Investment Survey; and IMF staff calculations.
Note: CIS = Commonwealth of Independent States.
[1]See Appendix 4.2 for the list of economies.
[2]Excluding Australia for lack of data.
[3]Including liabilities and non-reserve assets.
[4]The data for 1998, 1999, and 2000 are based on interpolations.

Figure 4.11. Vulnerability Indicators by Region, 1990–2007

Current account balances have become more dispersed across emerging economies, while fiscal balances have generally moved in tandem and improved. Reserve coverage of imports has increased in all regions during the past decade.



Sources: IMF, *Balance of Payments Statistics;* and IMF staff calculations.

1997–2008. However, apart from the current crisis, there have been no systemic banking crises during the past decade, for which the EM-FSI is available. In light of this, the second part presents a case study analyzing the effects on emerging economies of previous systemic banking crises in advanced economies.

Econometric Analysis Using Stress Indices

The econometric analysis assesses more formally the respective roles of common and country-specific factors in the transmission of financial stress from advanced to emerging economies. Based on the above discussion, financial stress in emerging economies (EM-FSI) is related to three sets of variables: (1) stress in advanced economies (AE-FSI), (2) country-specific characteristics and vulnerabilities (X), and (3) general global factors (GF). One important assumption in the analysis is that financial stress in advanced economies is exogenous to financial stress in emerging economies.[32] Indeed, the narrative analysis of widespread financial stress episodes in advanced economies did not indicate stress triggers in emerging economies. Moreover, formal empirical tests on the direction of causality support the assumption of independence of advanced economy stress for the majority of emerging economies.[33]

The equation below provides a compact description of how these variables may be related (i and t denote countries and time, respectively; ε_{it} is an error term). This equation is meant to convey the thrust of the analysis, with more details provided in Appendix 4.2. In particular, some of the estimated specifications include lags of dependent and/or independent

[32]See Table 4.1 for a discussion of the triggers for financial stress episodes in advanced economies since the 1980s.

[33]Granger causality tests for the 18 available emerging economies showed that financial stress in advanced economies "Granger-caused" stress in emerging economies in 11 cases; tests were inconclusive in five cases. In one case, causality went in both directions, and only in two cases did it go from emerging to advanced economies.

variables, which are suppressed in equation (1) for ease of exposition.[34]

$$EMFSI_{it} = \alpha_i + \beta_i AEFSI_t + \delta X_{it} + \gamma_i GF_t + \varepsilon_{it}. \quad (1)$$

The relative roles of common and country-specific factors can be disentangled in a fairly straightforward manner:

- A key variable of interest is the size of the comovement parameters β_i, which measure how financial stress in emerging economy i responds to stress in advanced economies. A value of zero implies no comovement, whereas a value of 1 represents one-to-one transmission. The common effect of stress in advanced economies on emerging economies is measured by the average of the comovement parameters: $\beta = 1/n\Sigma_i\beta_i$ (n is the number of emerging economies).
- The country-specific component driving stress in emerging economies has two parts, a direct effect and an indirect effect. The indirect effect captures the impact of country-specific factors on the comovement parameters ($\beta_i=f(X_{it})$). For example, economies with high foreign liabilities to advanced economies may be expected to have a high comovement parameter. The direct effect captures the independent effect that country-specific factors have on emerging markets (δ). For example, countries that have more open capital accounts may be more prone to experience stress regardless of what is happening in advanced economies.
- Finally, stress may be driven by other global developments (such as commodity prices, interest rates, real activity), captured by GF_t and the coefficient γ.

Estimates of the parameters of interest are obtained through two related exercises. First, using *monthly* time series, equation (1) is estimated on a country-by-country basis identifying individual country comovement parameters β_i. The parameters β_i are allowed to vary across subperiods and by lending region (Japan and Australia, United States and Canada, and western Europe). The β_i s that are obtained are then related to measures of financial and trade linkages and other country-specific variables, building on Forbes and Chinn (2004), to examine what drives differences in comovements.

Second, to assess the importance of other country-specific factors—which are mostly available at an annual frequency—the above equation is also estimated using *annual* panel data. This approach allows more systematic testing of the role of country-specific variables (vulnerabilities) in generating stress. Both exercises were carried out on a sample of 18 emerging economies for which the EM-FSI was available.

Uncovering the Common Element and Differences in Comovements

Before estimating the financial stress equation, one way of gauging the importance of the common element in emerging economy stress is to relate its common time trend to the financial stress index in advanced economies. An empirical measure of the common time trend can be obtained by estimating fixed-time effects in emerging economy stress (Appendix 4.2). About 40 percent of this time trend, which represents shared emerging economy stress, is explained by the overall AE-FSI. Other global factors (interest rates, industrial production, commodity prices) explain another 18 percent.

The country-specific comovement parameter estimates confirm the importance of the common component in stress transmission. On average, close to 70 percent of stress in advanced economies is transmitted to emerging economies (average β=0.7: Figure 4.12, top panel).[35] Moreover, transmission is fast: it takes only one to two months to reach emerging economies.[36]

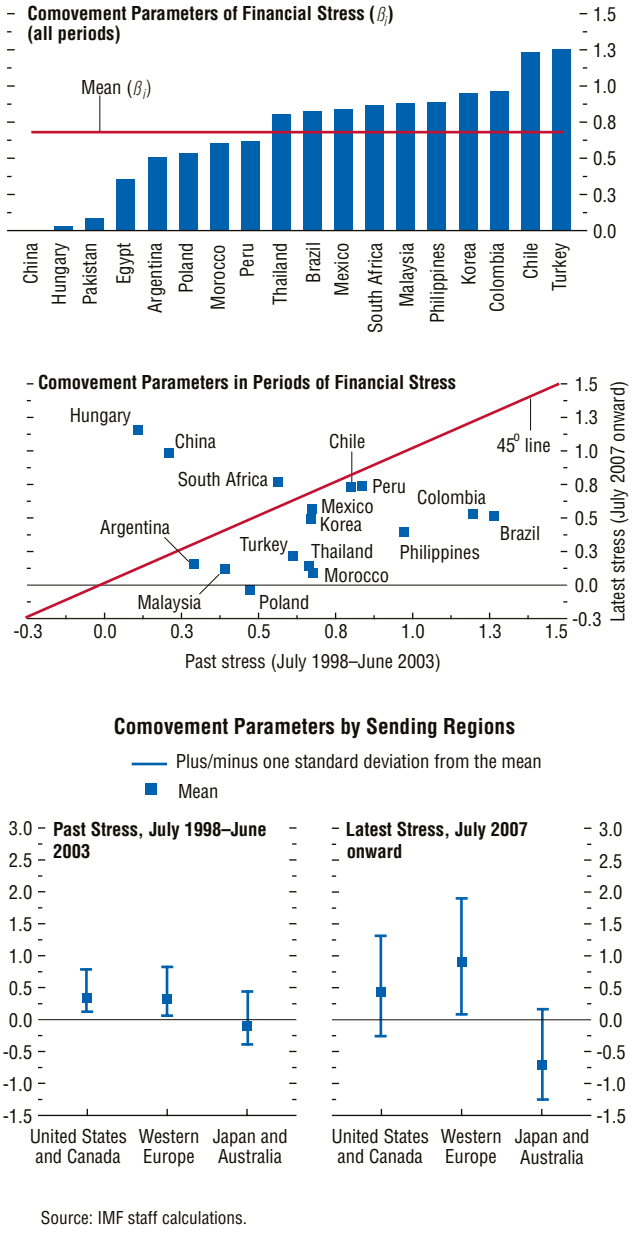
[34]Although nonlinear specifications are conceivable, the goodness of statistical fit of the linear model suggests that if offers useful insights.

[35]Because both the AE-FSI and the EM-FSI are subject to measurement error, estimates of β_i are potentially biased downward.

[36]To capture possible lags in stress transmission, the comovement parameters were estimated using a dynamic model. Standard lag length criteria recommended one or

Figure 4.12. Comovement in Financial Stress between Emerging and Advanced Economies

The common, or systemic, element of stress transmission (mean β_i) is large, but variation across countries is significant. In the current crisis, transmission has been lower than in the past for most sample countries, possibly reflecting the weak initial response. Transmission of stress from western Europe appears strongest during the current crisis.



Source: IMF staff calculations.

The comovement parameters, β_i, however, vary substantially across countries, ranging from close to zero for China, to more than 1 for Chile and Turkey.

The strength of comovement varies also over time and, more specifically, between the current crisis (from mid-2007 onward) and previous ones in advanced economies (from mid-1998 to mid-2003, Figure 4.12, middle panel).[37] It appears that different countries (such as Brazil, Colombia, Philippines) experienced stronger financial spillovers in the past, relative to those seeing more intense transmission during the current crisis (such as China, Hungary, and South Africa). It should be noted, however, that the results for the current crisis should be interpreted with some caution, since it is still unfolding. The strength of comovement also depends on which advanced economies are involved. In particular, financial spillovers from the United States and Canada and from western Europe were similar, on average, during previous stress episodes. In the current crisis, spillovers from western Europe appear somewhat stronger (bottom panels).

These findings point to the importance of *country-specific* factors in determining the impact of financial turbulence on individual emerging economies. As discussed, the comovement parameters, β_i, could be shaped by financial and trade linkages between emerging and advanced

two lags for the model, indicating rapid transmission. The reported results are based on the specification with one lag, following the Schwartz information criterion.

[37]These episodes of stress were identified as periods during which at least some advanced economies were almost always in high stress, in contrast to the calm period, when almost no advanced economies experienced high stress. Thus, from mid-1998 to mid-2003, and from mid-2007 onward, the AE-FSI indicated high stress for at least one country in all but a few months. This compares with a period of relative calm between mid-2003 and mid-2007. Accordingly, the model included period-specific comovement parameters: from July 2007 onward for the current crisis and from July 1998 to June 2003 for the previous period of stress across advanced economies (the latter includes, in particular, the LTCM collapse, the dot-com crash, and the defaults of WorldCom, Enron, and Arthur Andersen).

economies and by domestic vulnerabilities in emerging economies. To investigate these channels of transmission, three comovement parameters were estimated for each country, reflecting comovements with different regions (Japan and Australia, western Europe, and the United States and Canada). These were regressed on measures of trade linkages and financial linkages, including bank lending, portfolio holdings, and direct investment.[38] Because western Europe dominates bank linkages, whereas the United States and Canada dominate portfolio linkages (with the exception of emerging Europe), a specification including dummy variables for the United States and Canada and western Europe was also explored. The estimations were run separately for the previous episode of financial stress in advanced economies (from mid-1998 through mid-2003) and for the latest episode (from mid-2007 onward).

An analysis of the variation in the transmission coefficients, β_i, suggests important differences in the transmission of stress across the two episodes (Table 4.2):

- Although all the linkages were individually significant determinants of stress transmission in *previous crises*, it was hard to pinpoint the most important linkage, in part because of positive correlations among the different types of linkages. Although the coefficient on portfolio linkages was largest, it was not statistically significant at usual threshold levels after controlling for other linkages. The strength of comovement was similar with the United States and Canada, on the one hand, and with western Europe on the other, consistent with broadly similar roles of portfolio and bank linkages. In contrast, bank linkages emerge as the primary transmission channel during *the current crisis*. For instance, an increase in bank liabilities to western Europe from 15 percent to 50 percent of GDP (approximately the difference between emerging Europe and the other emerging regions) raises the comovement parameter by about 1. Comovement with western Europe is somewhat stronger than with the United States and Canada, consistent with the dominant role of bank linkages in the current crisis.
- Including dummy variables for advanced regions improves the statistical fit but makes coefficients on the linkages insignificant. More specifically, including the dummy for the United States and Canada weakens the coefficient on portfolio linkages, whereas including the dummy for western Europe, whose banks were actively lending to all emerging regions, weakens the coefficient on bank linkages. These findings suggest that the regional dummies pick up the regional patterns in bank lending and portfolio holdings.[39]

Further testing of the monthly model shows that country-specific vulnerabilities (such as current account or fiscal deficits) do not seem to influence the transmission of stress (that is, they are not significantly associated with the β_is). However, country-specific vulnerabilities could have direct effects on financial stress, and since these variables are not available at a monthly frequency, an additional empirical exercise is carried out to investigate their role in financial stress.

Do Country-Specific Vulnerabilities Matter?

To explore this hypothesis, equation (1) is estimated on annual data to include a broader set of country-specific variables.[40] In addition to vulner-

[38]Trade linkages were measured as total exports to advanced regions (as reported by advanced economies) relative to the domestic GDP of each emerging economy. Financial linkages were measured using total liabilities to advanced regions (and total assets in these regions in the case of portfolio holdings). These measures were averaged over the periods corresponding to the current and previous financial stress episodes.

[39]It should be noted that the results are not driven by the overall trade and financial openness of emerging economies, which, in fact, do not seem to play any significant role in the transmission of financial stress (see the far-right column of Table 4.2).

[40]The annual aggregation of the monthly stress data is performed in two steps. First, average quarterly stress levels are calculated. In the second step, the *quarter with*

Table 4.2. The Role of Linkages as Determinants of Comovement[1]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Past stress in advanced economies (July 1998–June 2003) *Dependent variable: comovement parameters of financial stress*							
Bank linkages	0.014**				0.005	–0.016	0.006
	(0.006)				(0.009)	(0.010)	(0.008)
Portfolio linkages		0.060***			0.045	–0.018	0.034
		(0.017)			(0.031)	(0.036)	(0.023)
Direct investment linkages			0.044***		0.009	0.030	0.003
			(0.009)		(0.026)	(0.027)	(0.024)
Trade linkages				0.023**	0.000	0.008	0.005
				(0.009)	(0.017)	(0.015)	(0.013)
United States and Canada dummy						0.469***	
						(0.141)	
Western Europe dummy						0.584***	
						(0.165)	
Trade openness[2]							–0.001
							(0.001)
Financial openness[3]							–0.003
							(0.002)
Country effects	yes	yes	yes	yes	yes	yes	no
Observations	48	48	48	48	48	48	48
R^2	0.17	0.31	0.29	0.21	0.34	0.53	0.25
Latest stress in advanced economies (July 2007 onward) *Dependent variable: comovement parameters of financial stress*							
Bank linkages	0.029*				0.033**	–0.005	0.025*
	(0.017)				(0.014)	(0.027)	(0.013)
Portfolio linkages		0.055***			0.033	0.006	0.027
		(0.020)			(0.026)	(0.019)	(0.016)
Direct investment linkages			0.144***		0.105	0.053	0.069
			(0.044)		(0.083)	(0.064)	(0.077)
Trade linkages				0.047	–0.063	–0.021	–0.031
				(0.030)	(0.047)	(0.047)	(0.041)
United States and Canada dummy						1.201**	
						(0.537)	
Western Europe dummy						1.819***	
						(0.630)	
Trade openness[2]							0.001
							(0.003)
Financial openness[3]							–0.005
							(0.003)
Country effects	yes	yes	yes	yes	yes	yes	no
Observations	48	48	48	48	48	48	48
R^2	0.14	0.19	0.16	0.09	0.26	0.52	0.20

Source: IMF staff calculations.
[1]Robust standard errors in parentheses; ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent level, respectively.
[2]Exports plus imports divided by GDP.
[3]Foreign assets plus liabilities divided by GDP.

ability indicators, measures of trade and capital account openness are included to account for their potential role in increasing volatility. The estimation results are reported in Table 4.3. In general, estimates of the average stress comovement coefficient, β, are close to levels found in the monthly model. Also consistent with the monthly model, the size of comovement of stress between emerging and advanced economies was

the highest stress level is selected for the annual index. An alternative specification using 12-month averages yielded similar results in terms of significance but implies lower transmission levels (betas). It appears that the process of averaging hides relevant information in the data.

Table 4.3. Emerging Economy Stress: Country-Specific Effects[1]
(Annual panel, 1997–2008)

	Financial Stress Index in Emerging Economies					
	(1)	(3)	(4)	(5)	(6)	(7)
Financial stress (advanced economies)	0.49***	0.52***	0.53***	0.56***	0.58***	0.62***
	(0.07)	(0.07)	(0.06)	(0.08)	(0.06)	(0.06)
Financial openness (t-1)[2]		0.02**	0.03***	0.02*	0.02***	0.02**
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Trade openness (t-1)[3]		–0.11***	–0.10**	–0.10***	–0.08**	–0.07*
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Current account (t-1)[4]			–0.14***			–0.13***
			(0.04)			(0.04)
Fiscal balance (t-1)[4]				–0.11		–0.18*
				(0.10)		(0.09)
Foreign reserves (t-1)[5]					–0.12*	–0.09
					(0.06)	(0.06)
R^2	0.55	0.60	0.62	0.60	0.62	0.63
R^2 (between)	0.26	0.18	0.18	0.19	0.18	0.20
R^2 (within)	0.39	0.47	0.49	0.47	0.50	0.52
Observations	210	210	210	210	210	210
Countries	18	18	18	18	18	18

Source: IMF staff calculations.
[1]Robust standard errors in parentheses; ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent level, respectively. All regressions include country-fixed effects and control for global factors. Global controls comprise the concurrent three-month London interbank offered rate (LIBOR), global real output growth, and the change in commodity terms of trade.
[2]Foreign assets plus liabilities divided by GDP.
[3]Exports plus imports divided by GDP.
[4]In percent of GDP.

not affected by the country-specific variables (interactions with AE-FSI).[41]

The annual model uncovers important *direct* effects that country-specific characteristics have on stress in emerging economies. Among country-specific variables, the two openness variables have opposite effects on financial stress. Higher de facto capital account openness—measured by foreign assets plus liabilities divided by GDP—is associated with higher stress levels. Trade openness has the opposite effect and reduces the level of financial stress. This finding is broadly consistent with the notion that one cost of capital account openness is higher volatility. This trade-off is attenuated by the degree of international economic integration as measured by trade openness (Imbs, 2006; and Kose, Prasad, and Terrones, 2005).

By far the most important specific risk factors for financial stress in emerging economies are the presence of sizable current account or fiscal deficits. Countries with higher current account or fiscal balances tend to experience less stress, with about the same marginal impact from the two variables on financial stress (Table 4.3, columns 4 and 5). A 1 percentage point of GDP higher deficit is associated with an average stress index increase of about 0.15 percentage point in the subsequent year. For comparison, during past stress events, the index for emerging economies increased between 1 and 2 percentage points in a year and by significantly more in the most recent episode.

High levels of foreign reserves also dampen stress experienced in emerging economies (column 6), but their effect becomes borderline (p-value of 12 percent) when all control variables

[41]A dynamic specification of the model using a dynamic generalized method of moments estimator generated very similar results. For a discussion of the panel model results, see Appendix 4.2.

are included in the model (column 7).[42] One reason for the small effect is that reserve buffers moderate stress in some segments (sovereign spreads) but not in others (equity markets). In general, these results are robust to the inclusion of other control variables.[43]

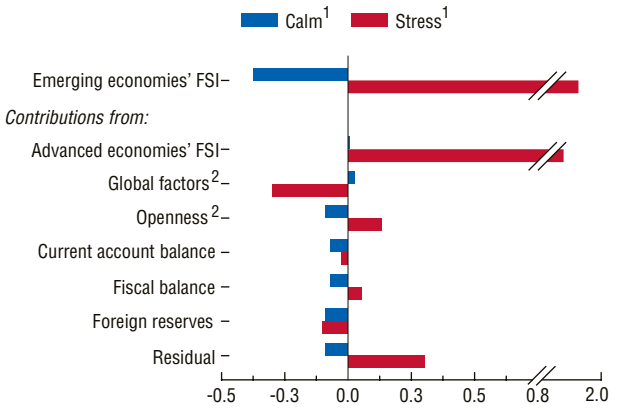
Figure 4.13 gauges the relative size of the common effect and of vulnerabilities on stress in emerging economies. It depicts the estimated contributions, distinguishing between periods of calm in advanced economies and periods of widespread financial stress (1998, 2000, 2002, 2008).[44] During high-stress periods, the largest single factor driving stress increases in emerging economies is the financial stress impulse in advanced economies. Global factors have a mitigating effect—mainly through offsetting commodity price changes—but their impact is relatively modest. The effect of improving current account and fiscal balances prior to such high-stress events in advanced economies is comparatively small.[45]

In contrast, during calm times in advanced economies, improvements in current account and fiscal balances and reserve accumulation all lower stress levels. Together, they explain a substantial share (about 60 percent) of the decline in average emerging economy stress during the calm periods. In sum, the identified country vulnerability indicators matter, but their impact is small when advanced economies are in stress.

Figure 4.13. Explaining Financial Stress in Emerging Economies

The combined contributions from improvements in current account and fiscal balances and from higher reserves explain a large share of the decline in financial stress during calm periods in advanced economies. In contrast, during periods of high stress in advanced economies such efforts cannot offset stress transmission.

Actual and Predicted Change in Emerging Economies' Stress, 1997–2008
(change in stress index, sample average)



Sources: Bank for International Settlements; IMF, *Balance of Payments Statistics;* and IMF staff calculations.
Note: FSI = Financial Stress Index.
[1]Stress years are 1998, 2000, 2002, and 2008; calm periods are all others. See Table 4.1.
[2]Based on Table 4.3, last column; global factors include three-month London interbank offered rate, global output growth, and change in commodities terms of trade. "Openness" combines financial and trade factors.

[42]The effects of these variables do not differ for the last period and do not affect the size of the transmission rate.
[43]Other variables were included but had no significant effect, including exchange rate regime, country governance, democratic institutions, and per capita income levels.
[44]The estimated contributions of explanatory variables to emerging economy financial stress are computed by multiplying annual changes of each explanatory variable by the estimated coefficient from the econometric model, based on column 7 in Table 4.3.
[45]Gonzalez-Hermosillo (2008) finds similarly that, during periods of stress, bond spreads in advanced and developing economies are driven by global market risk factors, whereas idiosyncratic factors matter during more calm periods.

Lessons from Previous Advanced Economy Banking Crises

The current crisis has involved systemic banking crises in many of the advanced economies. Yet, as noted at the beginning of this section, the sample period for the econometric analysis (1997–2008) provides limited coverage of systemic banking crises in advanced economies. Consequently, to complement the econometric analysis, this subsection studies the impact of two well-known banking crises in advanced economies.

With increasing banking globalization (in terms of cross-border flows and penetration of foreign bank subsidiaries and affiliates), a banking crisis in advanced economies could lead to significant common-lender effects and a marked reduction in capital flows. Yet few crises in the past decade have involved advanced economies that are also big lenders to emerging economies. For instance, the Scandinavian banking crisis of the early 1990s is considered to be systemic, but Scandinavian banks were not big players in emerging economies. This section presents case studies of two crises in which stressed banks in advanced economies were heavily involved in lending to emerging economies: the Latin American debt crisis of the 1980s and the Japanese banking crisis of the 1990s.

Latin American Debt Crisis

Many commentators associate the Latin American debt crisis with severe banking stress in the United States. It is true that many of the largest U.S. and European banks were heavily exposed to Latin America via syndicated loans to sovereign borrowers. By the end of 1978, such loans accounted for more than twice the capital and reserves of the major U.S. banks. However, the initial trigger of defaults in emerging economies was not a large-scale withdrawal by U.S. banks, but rather a combination of sharply rising U.S. interest rates and collapsing oil prices (Kaminsky, Reinhart, and Végh, 2004).[46]

Nonetheless, given their exposure to Latin America, the debt crisis hit large U.S. banks hard and led them to reduce lending to the region. Even after concerted rescheduling of debt, loans outstanding to the region decreased by more than 20 percent from 1983 to 1989. Lending to the region from other advanced economy banks also fell (Figure 4.14, top and middle panels).[47] Perhaps unsurprisingly, in relative terms, U.S. banks significantly retrenched from all emerging economies during the second half of the 1980s (bottom panel).

Although the protracted decline in bank lending is linked to stress in U.S. banks, it is not clear how applicable this episode is to the current crisis. In particular, in the Latin American debt crisis the trigger was default by the emerging economy borrowers, whereas the trigger for the current crisis is advanced economy lenders' losses, which have caused these lenders to deleverage and withdraw credit from emerging economies. Moreover, a systemic banking crisis was avoided in the United States in the 1980s—as opposed to currently—in part as a result of regulatory forbearance granted to the largest banks.

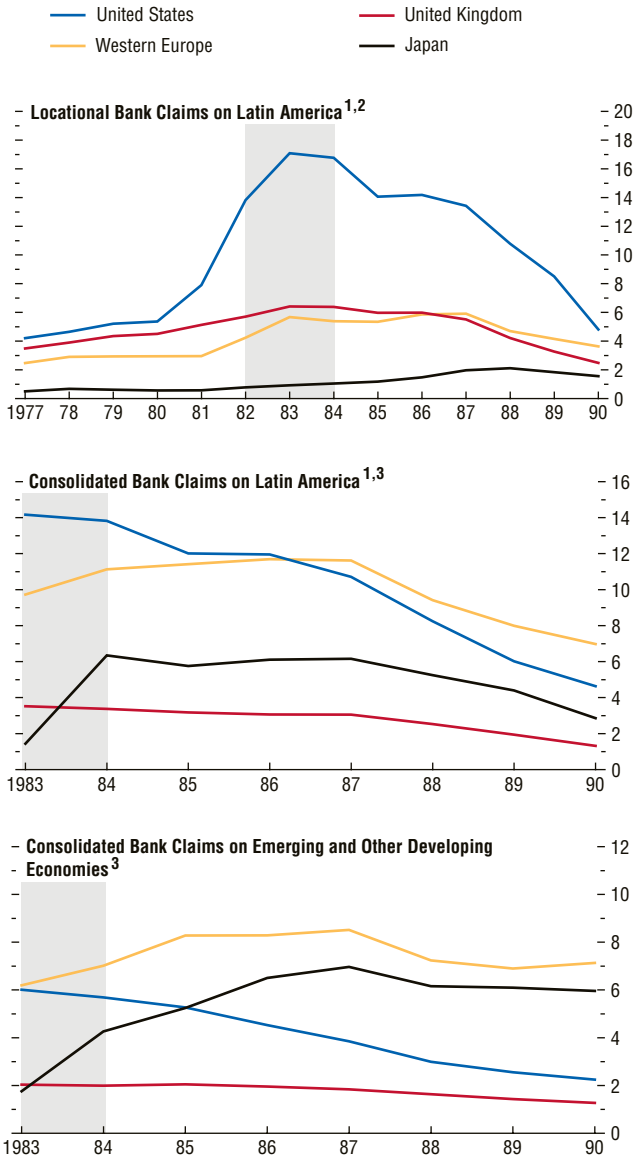
[46]In the 1970s, the largest U.S. banks expanded into Latin America in a search for yield, as structural changes (such as the expansion of the commercial paper market) reduced margins on domestic operations. Mexico was the first to default, in August 1982, and over the next few years 16 other Latin American countries rescheduled their debts to U.S. banks. The U.S. savings and loan crisis happened at about the same time, but it was not directly related to the Latin American debt crisis.

[47]Consolidated banking data (Figure 4.14, top panel) that combine liabilities of foreign affiliates with those of the headquarters (netting out interoffice lending) go back only to 1983 and show that lending from the United States to emerging economies in Latin America declined during the 1980s in line with bank lending to other countries. The longer series of bank liabilities using locational data (which includes interoffice lending but excludes claims of foreign affiliates) shows a more pronounced withdrawal by U.S. banks, right after the Latin American debt crisis erupted.

Figure 4.14. Impact of the Latin American Debt Crisis on Banking Liabilities[1]

(Percent of destination region's GDP)

The Latin American debt crisis of the early 1980s had a major impact on the largest U.S. banks, which withdrew from Latin America and emerging economies more generally.



Sources: Bank for International Settlements (BIS); and IMF staff calculations.
[1]Includes Argentina, Brazil, Chile, Mexico, and Venezuela.
[2]BIS-reported locational claims comprising cross-border claims of resident banks.
[3]BIS-reported consolidated bank claims include claims of all branches and subsidiaries in foreign countries.

Japanese Banking Crisis

Japan undoubtedly suffered a systemic banking crisis during the 1990s, resulting from collapses in stock and commercial real estate markets and rising corporate stress. At the time, Japanese banks were big players in emerging economies, especially in Asia.

Banking claims on offshore Asia (Hong Kong SAR and Singapore) started declining in the early 1990s, and the decline accelerated after 1994 (Figure 4.15). However, for east Asia, where Japanese banks were particularly exposed to Thailand and Indonesia, claims continued to rise until 1997, when the Asian crisis erupted. During the next two years, as a deteriorating Japanese economy exerted more pressure on its banking system, Japanese banks cut back on their exposure to east Asia, and even today claims remain significantly below the peak of a decade ago.[48] Reflecting the weakness of the Japanese banking sector, nominal claims to east Asia fell about the same time domestic lending in Japan started to decline, although the former fell by more relative to the peaks (claims on east Asia fell by about two-thirds and domestic claims fell by about one-quarter).[49]

The degree of retrenchment is even more striking when the claims of Japanese banks are compared with those from other advanced economy banks. This clearly shows that the Japanese withdrawal was not part of a general pull-out from east Asia, given that all other regions continued to maintain claims significantly above those levels at the time of the Asian crisis.

Interpreting these trends, Japanese banks at first pulled out of low-margin wholesale markets in the United States and offshore Asia, when their cost of funding spiked (the London interbank offered rate, LIBOR, spread shot up) and they came under pressure to improve their capi-

[48]Although these results are in terms of destination country GDP, they also largely hold in dollar terms and if normalized by Japan's GDP.

[49]In fact, Peek and Rosengren (1997 and 2000) show that Japanese banks transmitted the shocks that hit their own capital bases even to the U.S. real estate market through their U.S. branches.

tal ratios. At this time, Japanese banks switched to higher-margin markets in Asia, where lending relationships were more important and the presence of Japanese firms was pervasive. However, the Asian crisis, a weakening domestic economy, and heightened pressure to increase capital ratios led to a reversal of this strategy.[50] What followed was a massive and protracted decline in lending to east Asia, which only began to reverse partially following the economic recovery in Japan in 2002.

The drawn-out impact of the Japanese banking crisis underlines the importance of *common-lender* effects, which have grown even larger in recent years. For example, for emerging Europe, Aydin (2008) demonstrates that interbank market conditions in western Europe have had an impact on bank lending in central and eastern Europe. Similarly, for U.S. banks, Cetorelli and Goldberg (2008) find that foreign offices of U.S. banks have less access to their parent banks' balance sheets in times of tighter liquidity conditions in the United States.[51] Clearly, foreign bank ownership can increase financial fragility, but it can also be a stabilizing force when emerging economies experience stress—provided conditions in the parent banks' home countries are calm (Box 4.1).

Implications for the Current Crisis

What Have We Learned?

In the past, advanced economy crises have been transmitted to emerging economies rapidly and with a high pass-through. In line with this pattern, the unprecedented spike in financial stress in advanced economies in the third quarter of 2008 had a major effect on emerging

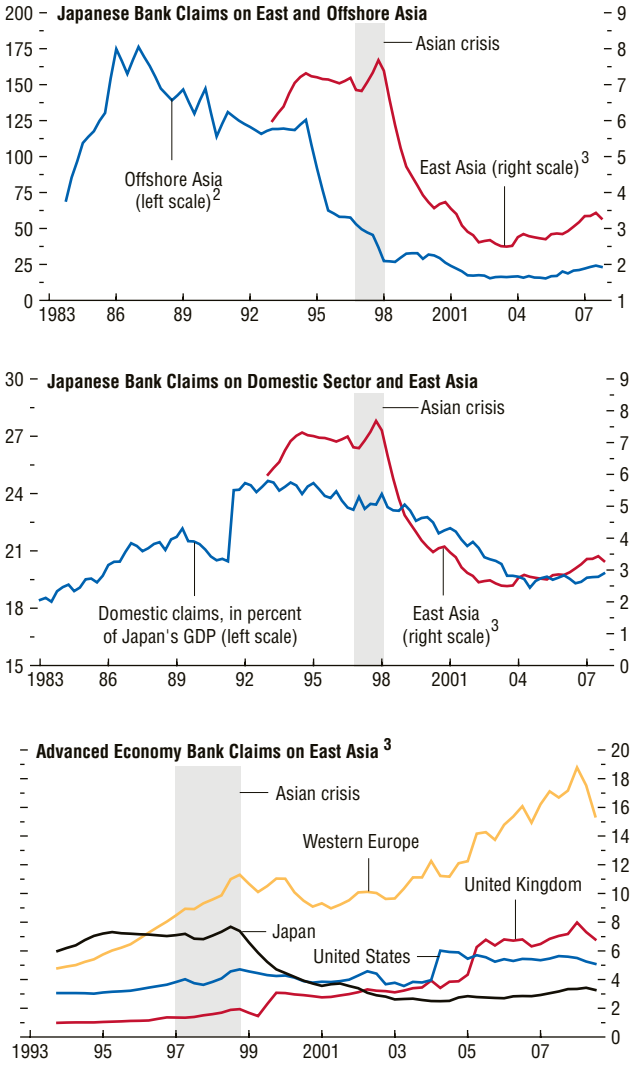
[50]Laeven and Valencia (2008) argue that the Japanese crisis became systemic only in November 1997.

[51]For example, their calculations show that internal borrowing by U.S. banks from foreign offices doubled from the average before the current crisis (that is, before summer 2007) and financed more than 20 percent of domestic asset growth of U.S. banks during the second half of 2007.

Figure 4.15. Impact of the Japanese Banking Crisis on Bank Lending[1]

(Percent of destination region's GDP, unless otherwise indicated)

There was a large and protracted retrenchment from east Asia by Japanese banks in the 1990s. However, this took place only after the Asian crisis and when banking woes became so severe that Japan entered a systemic banking crisis.



Sources: Bank for International Settlements (BIS); and IMF staff calculations.

[1]BIS-reported consolidated bank claims include claims of all branches and subsidiaries in foreign countries.

[2]Offshore Asia includes Hong Kong SAR and Singapore.

[3]East Asia includes Indonesia, Korea, Malaysia, Philippines, Taiwan POC, and Thailand.

Box 4.1. Impact of Foreign Bank Ownership during Home-Grown Crises

Banking globalization has increased in recent years, in terms of both cross-border flows and penetration of foreign bank subsidiaries and affiliates. Indeed, foreign entry has generally been pervasive across all regions, particularly in emerging Europe, where more than 70 percent of banks are now foreign owned. This could have a marked effect on capital flows from advanced to emerging economies.

On the negative side, foreign banks have sometimes pulled out and been associated with financial fragility, as evidenced during the Argentine crisis. At that time, Citibank sold its subsidiary (Bansud), and Credit Agricole chose not to bring in new capital, allowing the government to take over its subsidiaries Bersa, Bisel, and Suquia. Similarly, stress in parent banks' financial systems can also impair the stabilizing effects of foreign bank ownership, as shown by the recent example of Hungary's OTP in its Ukrainian subsidiaries.

However, there is also some evidence that foreign entry can help stabilize emerging economies' financial systems during home-grown crises. For example, Demirgüç-Kunt, Levine, and Min (1998) use cross-country regressions to demonstrate that foreign bank entry reduces the probability of crises in emerging markets. However, the estimates do not appear to fully control for endogeneity—in particular, the decision not to enter a foreign market can be influenced by anticipation of crisis, not only by its realization. Detragiache and Gupta (2004) show that in Malaysia during the Asian crisis, non-Asian foreign banks performed better in terms of profitability and loan quality than domestic banks or foreign banks operating mainly in Asia.

Why might foreign banks perform better in periods of generalized distress in emerging economies? First, they might be more profitable, efficient, and well capitalized, and thus better able to deal with a major shock. Second, subsidiaries of large global groups might find it easier to raise capital or liquid funds on international financial markets, by virtue of informational advantages or reputation. Third, even if external financing dries up because of increasing risk aversion, foreign bank subsidiaries might still have access to financial support from their parent bank, particularly if the latter is well diversified and only marginally affected by the difficulties in the host country.

The main author of this box is Ravi Balakrishnan.

economies. In the fourth quarter, financial stress was elevated in all emerging regions and, on average, exceeded levels seen during the Asian crisis.

Financial links appear to be a main conduit of transmission: emerging economies with higher foreign liabilities to advanced economies have been more affected by financial stress in advanced economies than emerging economies that are less linked. In the most recent period, bank lending ties have been a major channel of transmission, with western European banks the main source of stress.

In the past, emerging economies were able to obtain some protection against financial stress from lower current account and fiscal deficits during calm periods in advanced economies. However, during periods of widespread financial stress in advanced economies, these conditions did not prevent its transmission. Lower deficits may, however, limit the *real* implications of financial stress (for example, by using reserves to buffer the effects from a drop in capital inflows) and the duration of the crisis,[52] links that were not studied in this chapter. Moreover, lower current account and fiscal deficits also matter once financial stress in advanced economies recedes, because they help reestablish financial stability and foreign capital inflows.

[52]Mecagni and others (2007) show that improvements in precrisis conditions can reduce the duration of capital account crises.

What Are the Implications for the Current Crisis?

The current crisis in advanced economies is unique in its depth, breadth, and impact on all segments of advanced economy financial systems. Compared with stress episodes in the past decade, banking stress is a prominent feature and has spread from the United States to western Europe and from there to other financial centers and emerging economies. Although the crisis is still unfolding, some conclusions can be drawn:

- Emerging economies that have large bank lending exposures are most likely to experience stress. Moreover, the degree of current account and fiscal deficits will likely determine how quickly economies can reestablish financial stability, once stress in advanced economies recedes. Figure 4.16 maps where emerging economies lie along these two dimensions. The area in the lower right depicts countries (emerging Europe is prominent) with both high bank lending exposure and high twin deficits.
- Banking flows to emerging economies are likely to take a severe hit, as evidenced by the experience of south Asian economies during the Japanese banking crisis in the 1990s. Since then, banking globalization has continued, and risks associated with the common-lender effect have risen. Thus, systemic banking crises in advanced economies and their lengthy resolution are likely to presage a protracted decline in banking flows to emerging economies—especially in emerging Europe.

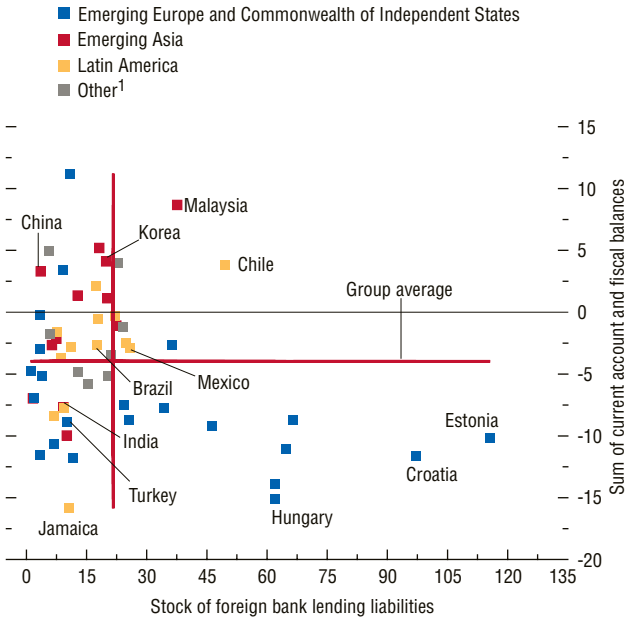
Which Policies Can Help?

Because it is too late to prevent the transmission of this crisis, policies should focus on limiting the risk of further escalation of financial stress through second-round effects. The rapid deleveraging of financial institutions in advanced economies and the rapidly deteriorating global economic outlook have imposed tight liquidity constraints in emerging economies. Some of these economies have benefited in dealing with these shocks from their recent strong

Figure 4.16. Exposure to Bank Lending Liabilities and Twin Deficits in Emerging Economies, 2002–06

(Percent of GDP)

Emerging Europe appears currently most at risk of experiencing stress, since these countries have high bank liabilities. These countries also have large fiscal and current account deficits, which limit their ability to soften the implications of financial stress on the real economy.



Sources: Bank for International Settlements; IMF, *Balance of Payments Statistics;* and IMF staff calculations.
[1]Includes Middle East and Africa.

growth performance and relatively large policy buffers. But many economies have suffered severe strain, as discussed in Chapters 1 and 2.

As the crises in advanced economies continue to deepen, and trade and capital flows decline further, exchange rates and financial systems in emerging economies could come under more severe pressure. In turn, a broad-based economic and financial collapse in emerging economies would have a significant negative impact on the portfolios of advanced economies. This could further exacerbate financial deleveraging in mature markets (especially in economies with large exposures, such as Austria and Belgium) and lead to further stress transmission, capital outflows, and economic slumps.

In light of such cross-country spillovers, there is a strong case for a coordinated approach to a range of policies, which is discussed in more detail in Chapter 1. Advanced economies should recognize the adverse feedback that will come from second-round effects caused by the decline of capital flows to emerging economies. By stabilizing domestic financial systems, advanced economies can help reduce stress in emerging economies. Support for advanced economy banks, notably those with a large presence in emerging economies, should help, provided it does not come with conditions that discourage foreign lending. More generally, enhanced coordination and collaboration between home- and host-country financial supervisors will be crucial for avoiding adverse cross-border spillovers from domestic actions.

Moreover, as the financial crisis plays out, there is a need to strengthen official support for emerging economies' access to external funding in order to limit adverse feedback loops caused by second-round effects. Examples include the swap lines opened with various emerging economies by the U.S. Federal Reserve and the European Central Bank, the extension of the Chiang Mai initiative, and the increase in available resources of the IMF and other multilateral institutions.

Consistent with these efforts, emerging economies need to protect their financial systems and follow prudent macroeconomic policies that provide countercyclical support to the extent possible, but they must also uphold confidence in the sustainability of their policies. For many affected countries in emerging Europe, membership in the European Union and the anchoring role of planned euro adoption have offered some stability. But, as discussed in Chapter 2, such policies need to be complemented by plans for mutual assistance to enhance a fast and targeted response to any new emerging crises.

More broadly, growing financial integration is an essential part of a prospering world economy. However, as international financial linkages increase, they also raise the likelihood of the transmission of financial stress. It is therefore desirable to offer enhanced multilateral insurance against external crises to well-governed countries that are opening their economies to the rest of the world (see IMF, 2009).

Appendix 4.1. A Financial Stress Index for Emerging Economies

The main author of this appendix is Selim Elekdag.

This appendix describes the components and the methodology used to construct the financial stress index for emerging economies (EM-FSI). The EM-FSI is composed of four market-based price indicators and an exchange market pressure index (EMPI). Each component is demeaned, scaled by the inverse of its standard deviation, and then added together to yield the index. This equal-variance-weighted combination has the advantage that large fluctuations in one component do not dominate the overall index. The additive feature also allows for a straightforward decomposition into contributions by subindex. Dates of peaks and troughs of the index are robust to other weighting schemes, including, for example, those based on principal components analysis.

The five components of the EM-FSI are the EMPI, sovereign spreads, the "banking sector beta," denoted with β, stock returns, and time-varying stock return volatility, which can be combined as follows:

$$EMFSI = EMPI + Sovereign\ Spreads + \beta + stock\ returns + stock\ volatility.$$

Further details on the five components are listed below:

The EMPI for country i for month t is calculated as follows:

$$EMPI_{i,t} = \frac{(\Delta e_{i,t} - \mu_{\Delta e})}{\sigma_{\Delta e}} - \frac{(\Delta RES_{i,t} - \mu_{\Delta RES})}{\sigma_{\Delta RES}},$$

where Δe and ΔRES denote the month-over-month percent changes in the exchange rate and total reserves minus gold, respectively. The exchange rate is vis-à-vis an anchor country, as discussed in Levy-Yeyati and Sturzenegger (2005). The symbols μ and σ denote the mean and the standard deviation, respectively, of the relevant series; in other words, each component of the EMPI is standardized. A further refinement allows the index to accommodate episodes of hyperinflation, defined as annual inflation exceeding 150 percent. In such cases, the mean and standard deviations were computed for episodes with and without the prevalence of hyperinflation.

Sovereign spreads are calculated using JPMorgan EMBI Global spreads and defined as the bond yield minus the 10-year U.S. Treasury yield. When EMBI data were not available, five-year credit default swap spreads were used.

The banking sector beta is the standard capital asset pricing model (CAPM) beta, and is denoted with β, defined as follows:

$$\beta_t = \frac{COV(r_t^M, r_t^B)}{\sigma_M^2},$$

where r represents the year-over-year banking or market returns, computed over a 12-month rolling window. In line with CAPM, a beta greater than 1—indicating that banking stocks move more than proportionately with the overall stock market—suggests that the banking sector is relatively risky, and would be associated with a higher likelihood of a banking crisis. A further refinement of this measure was to record a value only when banking returns were lower than overall market returns, in an effort to better capture banking-related financial stress.

Stock returns are the month-over-month change in the stock index multiplied by –1, so that a decline in equity prices corresponds to increased securities-market-related stress.

The final component is the time-varying stock return volatility derived from a GARCH(1,1) specification, using month-over-month real returns modeled as an autoregressive process with 12 lags. Increased volatility captures heightened uncertainty and thus increased financial stress.

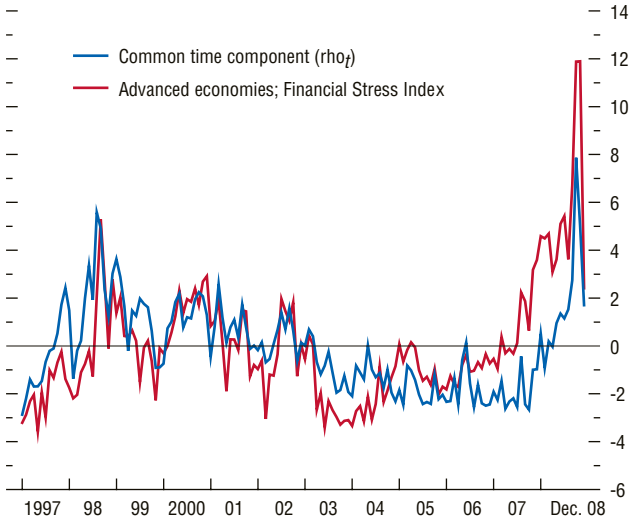
The EM-FSI is constructed for 26 countries spanning the January 1997 to December 2008 period; these countries are Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Russia, Slovak Republic, Slovenia, South Africa, Sri Lanka, Thailand, and Turkey. However, because the series is too short for some, only 18 countries (listed in the text) are used in the econometric analysis.

In addition to capturing the most important episodes of financial stress experienced by emerging economies, the EM-FSI also performs well when contrasted to previous academic studies. Specifically, the subcomponents of the EM-FSI accurately indicate the type of crisis they were intended to signal.[53] For example, the EMPI component (which is available from 1980 onward and is available for many more countries) captures more than 80 percent of the currency crises noted in the literature. Recalling that the EM-FSI starts in end-1996, in line with

[53]Following the literature, an episode of financial stress is identified as a period when the index for a country exceeds 1.5 standard deviations above its mean. The main papers surveyed are Chamon, Manasse, and Prati (2007); Calvo, Izquierdo, and Mejía (2008); Rothenberg and Warnock (2006); Kaminsky and Reinhart (1999); Edison (2003); Reinhart and Reinhart (2008); Eichengreen and Bordo (2002); Demirgüç-Kunt, Detragiache, and Gupta (2006); Laeven and Valencia (2008); Honohan and Laeven (2005); and Reinhart and Rogoff (2008, 2009).

expectations, the sovereign spread component of the index signals correctly all debt-related crises (Argentina 2002, 2005; Korea 1998; Mexico 1995; Russia 1998). Last, the securities-market-related component (based on the banking sector beta, stock returns, and volatility) flags eight of the nine post-1996 banking-related crises determined by the studies surveyed.

Figure 4.17. Emerging Economy Stress: Common Time Component and Stress in Advanced Economies
(Level of index)



Source: IMF staff calculations.

Appendix 4.2. Financial Stress in Emerging Economies: Econometric Analysis

The main authors of this appendix are Stephan Danninger and Irina Tytell.

The econometric findings discussed in the chapter are based on three complementary exercises:

- an estimation of a common time-varying component in the EM-FSI and its relationship to the AE-FSI and other global factors;
- an analysis of comovement in financial stress between emerging and advanced economies in a panel data set based on monthly data; and
- an analysis of determinants of financial stress in emerging economies in a panel data set based on annual data.

Analysis of the Common Time-Varying Component in EM-FSI

The first exercise explores in a more rigorous way the degree of comovement of financial stress across emerging economies displayed in Figure 4.5. In the first step of this exercise, the monthly panel is regressed on country and time-fixed effects, where $Month_t$ denotes a dummy variable for month t in the data set.

$$EMFSI_{it} = \alpha_i + \sum_t \rho^t Month_t + \varepsilon_{it}.$$

The obtained coefficient time series $\{\rho^t\}$ measures the common time-varying element in emerging economy stress. This component has significant explanatory power and explains 50 percent of the overall variation in EM-FSI.

A visual comparison of the $\{\rho^t\}$ time series and the aggregate stress index for advanced economies (AE-FSI) shows a strong degree of comovement (Figure 4.17). In a second step, this relationship is explored in more depth by estimating the following model:

$$\rho^t = \alpha + \beta AEFSI_t + \sum_g \gamma^g GF_t^g + \varepsilon_t .$$

The model relates the common time component, ρ^t, to the stress index in advanced economies and to global factors. The latter include year-over-year changes in world industrial production and aggregate commodity prices and the three-month London interbank offered rate (LIBOR). Table 4.4 summarizes the results. The most important explanatory variable of the common time-varying component, ρ^t, is stress in advanced economies (explaining 42 percent of the variation in ρ^t). Global factors also matter, but they have comparatively less explanatory power. In sum, the model has a good statistical fit, with a total R^2 of 0.57, suggesting that stress in advanced economies plays an important role in predicting stress in emerging economies.

Analysis of Comovement in Financial Stress

The second exercise builds on the two-step approach laid out by Forbes and Chinn (2004). In the first step, the financial stress index for each emerging economy i (EM-FSI) is modeled as a function of the financial stress index for advanced economies (AE-FSI), a number of global factors (GF), and a country-specific constant:

$$EMFSI_{it} = \alpha_i + \sum_c \beta_i^c AEFSI_t^c + \sum_g \gamma_i^g GF_t^g + \varepsilon_{it} .$$

The global factors include the same variables as outlined above. Depending on the specification, AE-FSI is either (1) an aggregate of 17 major advanced economies or (2) three separate aggregates for the United States and Canada, western Europe, and Japan and Australia, and uses purchasing-power-parity GDP weights in both cases. The coefficient of interest in this model is β_i—parameters of comovement in financial stress between emerging and advanced economies.

Table 4.4. Emerging Economy Stress: Determinants of Common Time Trend[1]

Financial stress (advanced economies)	0.49***	0.47***
	(0.04)	(0.05)
Industrial production growth (advanced economies)		–0.05
		(0.08)
Commodity price growth		–0.03***
		(0.01)
LIBOR (three-month)		0.06
		(0.08)
Constant	–0.11	0.18
	(0.11)	(0.28)
Observations	156	131
R^2	0.45	0.57

Source: IMF staff calculations.
[1]Robust standard errors in parentheses; ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent level, respectively. Common time trend is obtained from time-fixed coefficients of a monthly panel model of emerging economy stress during 1997–2008.

Because comovement parameters vary over time, especially between periods of financial stress and periods of financial tranquility, β_i is allowed to differ across periods. There are two episodes of financial stress in advanced economies that fall within the estimation sample, identified as periods during which at least some advanced economies were almost always in high stress. The first episode runs from July 1998 to June 2003 and includes the Long-Term Capital Management collapse, the dot-com crash, and the collapses of WorldCom, Enron, and Arthur Andersen. The second episode runs from July 2007 onward and spans the current financial turmoil.[54] To allow β_i to vary between these two episodes, the model is modified as follows:

$$EMFSI_{it} = \alpha_i + \sum_c (\beta_i^c AEFSI_t^c + \beta_{1i}^c D_1 AEFSI_t^c + \beta_{2i}^c D_2 AEFSI_t^c) + \sum_g \gamma_i^g GF_t^g + \varepsilon_{it} .$$

[54]The Asian crisis of 1997–98 also falls within the sample. However, because it was not associated with financial stress in advanced economies, comovement parameters specific to this episode are not of particular interest for this analysis. Instead, to allow higher levels of financial stress in emerging economies during this period, a dummy variable for the period January 1997 to June 1998 is included in the model.

Here, D_1 and D_2 denote dummy variables for the two stress episodes. Accordingly, comovement parameters for these episodes can be computed as $\beta_i^c + \beta_{1i}^c$ and $\beta_i^c + \beta_{2i}^c$, respectively.

Transmission of financial stress may not be instantaneous, and so lags of all the variables are included in the model in addition to contemporaneous values. Standard lag-length criteria recommend one or two lags for the model, indicating rapid transmission. Following the Schwartz information criterion, the model is augmented with one lag, as follows:

$$EMFSI_{it} = \alpha_i + \sum_c \sum_{l=0,1} (\beta_i^{cl} AEFSI_{t-1}^c + \beta_{1i}^{cl} D_1 AEFSI_{t-1}^c + \beta_{2i}^{cl} D_2 AEFSI_{t-1}^c) + \sum_g \sum_{l=0,1} \gamma_i^{gl} GF_{t-1}^g + \lambda_i EMFSI_{it-1} + \varepsilon_{it} .$$

The overall comovement effect on emerging economy stress after one month is the parameter of primary interest. Its computation must account for the lag structure of the model. In particular, the overall transmission of advanced economy stress is the sum of a *direct* effect (concurrent and lagged) plus an *indirect* effect via lagged emerging economy stress (via λ_i). For the full sample period, this combined transmission effect after one lag can be computed as $\beta_i^c = \beta_i^{c0} + \beta_i^{c1} + \beta_i^{c0}\lambda_i$. It is $\beta_{1i}^c = (\beta_i^{c0} + \beta_{1i}^{c0}) + (\beta_i^{c1} + \beta_{1i}^{c1}) + (\beta_i^{c0} + \beta_{1i}^{c0})\lambda_i$ for the first stress episode and $\beta_{1i}^c = (\beta_i^{c0} + \beta_{2i}^{c0}) + (\beta_i^{c1} + \beta_{2i}^{c1}) + (\beta_i^{c0} + \beta_{1i}^{c0})\lambda_i$ for the second stress episode.

This dynamic specification of the model is estimated separately for each of the 18 countries for which EM-FSI is available from January 1997 through November 2008, using monthly data. The countries are Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, the Philippines, Poland, South Africa, Thailand, and Turkey. For some countries, the EM-FSI series is shorter, including China (ending in April 2008), Colombia (starting in March 1997), Peru (starting in April 1997), Thailand (starting in June 1997), Korea and the Philippines (starting in December 1997), Hungary (starting in January 1999), Chile (starting in May 1999), Pakistan (starting in July 2001), and Egypt (starting in August 2001).[55] The model fits the data well for all countries, with R^2 between 0.5 and 0.8. The estimated comovement parameters are highlighted in Figure 4.11.

In the second step, comovement parameters are modeled as a function of trade (TL) and financial (FL) linkages between emerging economies and advanced regions, other relevant factors (X), and country-specific fixed effects:

$$\beta_i^c = \alpha_i + \sum_k \alpha_k FL_{ik}^c + \sum_l \alpha_l TL_{il}^c + \sum_m \alpha_m X_{im}^c + \varepsilon_{ic} .$$

This model is estimated on a two-dimensional data set of 16 emerging economies and three advanced regions (United States and Canada, western Europe, and Japan and Australia).[56]

FLs include bank lending, portfolio investment, and direct investment. For each emerging economy, they are measured as total liabilities to each of the advanced regions (and total assets in these regions in the case of portfolio holdings) relative to GDP. The data sources are Consolidated Banking Statistics of the Bank for International Settlements, Coordinated Portfolio Investment Survey of the IMF, and International Direct Investment Statistics of the Organization for Economic Cooperation and Development. The definitions of advanced regions vary for each of these three linkages owing to differences in the data available for the period of interest. The advanced economies used in this chapter comprise Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom, and United States. Bank linkages exclude Australia, Denmark, and Norway. Portfolio linkages exclude Finland and also exclude Germany and Switzerland prior to 2001 (these countries did not participate in the survey of 1997, although they reported for the annual surveys that began

[55]For Pakistan and Egypt, the comovement parameters during the first stress episode could not be estimated.

[56]Because the comovement parameters during the first stress episode could not be estimated for Pakistan and Egypt, these two countries are excluded from the second-stage estimations.

in 2001). Direct investment linkages exclude Belgium, Spain, and Sweden.[57,58]

The TL is measured as total exports to each of the advanced regions (as reported by advanced economies) relative to the GDP of each emerging economy. The data source for this linkage is the IMF's *Direction of Trade Statistics*. Other relevant factors (X) include trade and financial openness, respectively measured as exports plus imports divided by GDP and foreign assets plus foreign liabilities divided by GDP. These data are obtained from the IMF's World Economic Outlook database and External Wealth of Nations Database (see Lane and Milesi-Ferretti, 2006). In addition, some specifications include dummy variables for the United States and Canada and for western Europe.

The model is estimated separately for the two episodes of financial stress in advanced economies, using averages of the right-hand-side variables over the relevant periods. The main results are shown in Table 4.2.

While linkages appear to play an important role in crisis transmission, further testing showed that country-specific vulnerabilities (such as current account or fiscal deficits) are not an essential part of the transmission mechanism (that is, they are not associated with the β_is).[59]

Analysis of Other Country-Specific Effects Using Annual Data

The third exercise aggregates the financial stress index into annual data and merges it with country-specific variables, which are available only at an annual frequency. The annual aggregation of the monthly stress data is performed in two steps. First, average quarterly stress levels are calculated. Then, the quarter with the largest stress level is selected for the annual index. An alternative specification using 12-month averages yielded similar results in terms of significance but implied a lower transmission (β).

As above, the EM-FSI is modeled as a function of the financial stress index for advanced economies (AE-FSI$_t$), global factors (GF$_t$), and country-specific variables (X$_{it}$). In addition, the model tests for the presence of interaction effects between stress in advanced economies and country-specific characteristics (AE-FSI$_t \times$ X$_{it}$). This latter term is included to assess whether the finding from the monthly model that country-specific vulnerabilities do not influence the transmission process is also borne out in the annual panel:

$$EMFSI_{it} = \alpha_i + \beta AEFSI_t + \delta X_{it} + \lambda AEFSI_t \times X_{it} + \gamma GF_t + \varepsilon_{it} .$$

The global factors include a similar set of variables as in the monthly panel model, namely the year-over-year changes in world real output, changes in the commodity terms of trade, and the three-month LIBOR.[60] In contrast to the monthly series, the transmission coefficients are fixed across countries and time periods, because annual data limit the precision for differentiating coefficients by individual countries, time periods, or investor regions. The coefficients of interest are β, the average comovement param-

[57]In addition, the composition of advanced regions varies somewhat, owing to differences in reporting by specific countries. It should also be noted that missing values in measured linkages are interpolated (notably in the case of portfolio linkages between the surveys of 1997 and 2001). More information about these data sets can be found at www.bis.org/statistics/consstats.htm, www.imf.org/external/np/sta/pi/datarsl.htm, and www.oecd.org/document/19/0,3343,en_2649_33763_37296339_1_1_1_1,00.html.

[58]Portfolio investment data were adjusted for the offshore center bias using an adjustment method based on the portfolio allocation of source countries (see Lane and Milesi-Ferretti, 2008). This adjustment is based on the assumption that the funds invested in an offshore center by a source country are invested by the offshore center in the same way as the funds invested abroad directly by the source country.

[59]One explanation is that large financial linkages, for example through bank lending, go hand in hand with heightened vulnerabilities such as chronic current account deficits. Empirically, the size of financial linkages and current account deficits are positively correlated. Therefore, the observation that financial stress has spread first to more vulnerable economies is consistent with the finding that linkages drive the transmission of stress.

[60]The commodity terms of trade is the ratio of trade-weighted commodity export prices to trade-weighted commodity import prices (see Spatafora and Tytell, forthcoming).

Table 4.5. Emerging Economy Stress: Country-Specific Effects and Interactions with Stress in Advanced Economies[1]

	Financial Stress Index in Emerging Economies			
	(1)	(2)	(3)	(4)
Financial stress (advanced economies)	0.62***	0.63***	0.64***	0.65***
	(0.06)	(0.06)	(0.06)	(0.10)
LIBOR (three-month)	0.12	0.12	0.13	0.12
	(0.10)	(0.10)	(0.10)	(0.10)
Global growth	–0.55**	–0.55**	–0.56**	–0.55**
	(0.19)	(0.20)	(0.20)	(0.21)
Commodity terms of trade (growth)	–0.03	–0.03	–0.03	–0.03
	(0.02)	(0.02)	(0.02)	(0.02)
Financial openness $(t–1)^2$	0.02**	0.02**	0.02**	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)
Trade openness $(t–1)^3$	–0.07*	–0.08**	–0.07**	–0.07*
	(0.04)	(0.04)	(0.03)	(0.04)
Current account $(t–1)^4$	–0.13***	–0.12**	–0.14***	–0.13***
	(0.04)	(0.05)	(0.04)	(0.04)
Fiscal balance $(t–1)^4$	–0.18*	–0.18*	–0.20**	–0.18*
	(0.09)	(0.09)	(0.09)	(0.09)
Foreign reserves $(t–1)^5$	–0.09	–0.09	–0.09	–0.09
	(0.06)	(0.06)	(0.06)	(0.07)
Current account $(t–1)^4$ × financial stress (advanced economies)		–0.01		
		(0.01)		
Fiscal balance $(t–1)^4$ × financial stress (advanced economies)			0.01	
			(0.02)	
Foreign reserves $(t–1)^5$ × financial stress (advanced economies)				–0.00
				(0.00)
Constant	5.37***	5.54***	5.28**	5.38***
	(1.79)	(1.86)	(1.85)	(1.79)
Observations	210	210	210	210
R^2 (overall)	0.63	0.62	0.62	0.62
R^2 (between)	0.20	0.20	0.20	0.20
R^2 (within)	0.52	0.52	0.52	0.52
Countries	18	18	18	18

Source: IMF staff calculations.

[1]Robust standard errors in parentheses; ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent level, respectively. All regressions include country-fixed effects.
[2]Foreign assets plus liabilities divided by GDP.
[3]Exports plus imports divided by GDP.
[4]In percent of GDP.
[5]Gross foreign reserves in percent of GDP.

eter; δ, the direct effect of country-specific variables on stress; and λ, the coefficient measuring indirect effects of these variables on the transmission of stress.

Table 4.5 summarizes the findings from the annual panel regressions. The average comovement parameter β is highly significant and ranges between 0.60 and 0.65, in line with the estimates of β uncovered by the monthly exercise. The final three models test whether transmission is influenced by country-specific vulnerabilities (current account, fiscal balance, and reserve coverage) by including interaction effects. None of the interaction terms are significant, consistent with the result from the monthly exercise, which found that only linkages mattered for the transmission.

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