



WP/09/133

IMF Working Paper

The Transmission of Financial Stress from Advanced to Emerging Economies

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IMF Working Paper

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Authorized for distribution by Jörg Decressin

June 2009

Abstract

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This paper studies how financial stress, defined as periods of impaired financial intermediation, is transmitted from advanced to emerging economies using a new financial stress index for emerging economies. Previous financial crises in advanced economies passed through strongly and rapidly to emerging economies. The unprecedented spike in financial stress in advanced economies elevated stress across emerging economies above levels seen during the Asian crisis, but with significant cross-country variation. The extent of pass-through of financial stress is related to the depth of financial linkages between advanced and emerging economies. Higher current account and fiscal balances do little to insulate emerging economies from the transmission of financial stress in advanced economies, although they may help dampen the impact on the real economy. Case study evidence of past banking sector financial stress in advanced economies implies that the decline capital flows may be large and drawn-out.

JEL Classification Numbers: F30; G10

Keywords: financial crises, financial stress index, emerging economies

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I. INTRODUCTION*

After an initial period of resilience, the financial turmoil in advanced economies hit emerging markets hard. In late 2008 stock markets tumbled in all emerging regions, while at the same time spreads on sovereign debt widened and exchange markets came under pressure. The developments in financial markets were accompanied by a slowdown in private capital inflows. Emerging economy equity and debt funds saw significant withdrawals, and lending by advanced economies' banks dropped precipitously reflecting both a weakened outlook and the need for banks to de-leverage.

Given the scale of the crisis, a rich debate about similarities with past global crises and its implications for emerging economies has ensued (e.g. Eichengreen and O'Rourke, 2009, Calvo and Loo-Kung 2008). During similar large-scale financial crises in emerging economies—notably the 1982 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 1). Although the main trigger for these two crises was not widespread financial stress in advanced economies—as explored below—both these crises overlapped with severe strains in the U.S. and Japanese banking sectors.

Given the potentially significant implication for emerging economies, this paper attempts to provide a first empirical assessment of the intensity of financial stress and its spreading to emerging economies. Episodes of financial stress are defined as periods when the financial system is under strain and its ability to intermediate is impaired. The paper poses three main questions: (i) How severe is the current level of financial stress in advanced and emerging economies compared with past episodes? (ii) How strongly and rapidly is financial stress transmitted, and do global factors, country characteristics, or policies influence the transmission? Finally, (iii) what are the longer-term implications for capital flows to emerging economies? Given that the global crisis occurred only recently and to keep the analysis tractable, the paper does not address the implications of financial stress for the real economy.

To answer these questions, the paper employs a new financial stress index for emerging economies, building on an index created for advanced economies by Cardarelli, Elekdag, and Lall (2009). The index captures financial market developments in a variety of financial markets and provides a snapshot of credit conditions and is available for download along with this study. The index relies primarily on market data and hence is available at a high frequency and with a short time lag. The continuous nature of the index also goes beyond binary variables—crisis, no-crisis—used in the literature (e.g., Laeven and Valencia, 2008)

* We are indebted to Menzie Chinn, Charles Collyns, Jörg Decressin, and numerous seminar participants at universities, central banks, and ministries of finance around the world for invaluable comments. Stephanie Denis and Murad Omoev provided excellent research assistance. An earlier version of this paper was published as chapter 4 of the IMF's April 2009 World Economic Outlook. All remaining errors and omissions are the responsibility of the authors.

and allows to more systematically explore the comovement of stress across advanced and emerging economies.

Understanding the transmission of financial stress is the subject of a rich literature. The main two channels of transmission identified in the literature are trade and financial channels. For example, Eichengreen and Rose (1999), Glick and Rose (1999), and Forbes (2001) highlight 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. Chui, Hall, and Taylor (2004) provides an overview of the main findings. Transmission through these channels can be *common* and affect multiple countries at the same time (e.g. through blanket withdrawals by common lenders) or it can be *country specific*. The latter is often thought to depend on country-specific financial and trade linkages, structural characteristics, and vulnerabilities or policies, such as current account and budget imbalances.

The empirical analysis of this paper is implemented via a set of econometric approaches and a complementary case study analysis. We first establish that financial stress in emerging economies has a common component and that advanced economies' stress appears to be an important driver. The main empirical analysis then assesses the intensity and determinants of stress comovement between advanced and emerging economies building on a two-stage estimation approach based on Forbes and Chinn (2004). This approach exploits the monthly nature of the data and begins by estimating the degree of stress transmission (stage one). In stage two, the differences in stress comovement and their determinants are studied. This analysis is, however, constrained by the high frequency of the underlying stress data, especially in relation to structural and policy variables that are typically available at an annual frequency. In consequence, an annual panel data model that includes structural and policy variables is also employed. Finally, two case studies assess the impact of advanced economy banking crises on capital flows to emerging economies (US banks in early 1980s; Japanese banks in mid 1990s).

The study finds that in late 2008 financial stress in emerging economies was exceptionally high and surpassed the peaks seen during the 1997–98 Asian crisis. The comparable measure of stress for advanced economies shows even more pronounced financial market dislocations, and finds that stress reached a multiple of peak levels seen since 1980. Moreover, the current crisis affected all segments of the financial system and spread to all major regions in advanced and emerging economies.

The stress indices for emerging and advanced economies comove strongly, with crises tending to occur at the same time in both. On average, close to 70 percent of stress in advanced economies is transmitted to emerging economies, although individual country responses can vary significantly. Moreover, transmission is fast: it takes only one to two months for financial stress to reach emerging economies. The large common impact of the current crisis, across all emerging regions, is therefore in line with past patterns.

Differences among emerging economies in the degree of stress transmission are associated with the strength of financial linkages, generally measured by the stock of foreign liabilities, to advanced economies. While it is somewhat difficult to disentangle the relative importance

of particular linkages, such as bank lending, portfolio flows, and direct investment, bank lending ties appear to have been especially significant in the current crisis. This is reflected in the fact that the most virulent responses to the crisis were initially experienced in emerging Europe, which has strong bank lending linkages to western European banks. As these banks were hit exceptionally hard, credit conditions in their main borrower region were hit comparably stronger.

Low external vulnerabilities and a strong policy record reduce financial stress transmission, but cannot ring-fence a country's financial sector against a major shock. Emerging economies obtain some protection against financial stress from lower current account and fiscal deficits and higher foreign reserves during periods of financial calm 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.

The implications of the case study analysis for capital flows are sobering. Past banking sector stress in advanced economies led to large and protracted reductions in capital flows to emerging economies as banks were rebuilding their balance sheets. The current level of advanced economies' stress and the fact that it is rooted in systemic banking crises suggest that a similar process of adjustment may be underway. Emerging economies may therefore suffer large and drawn-out declines in access to foreign capital, especially for banking-related flows.

The rest of this chapter is structured as follows. The next section discusses the construction of the financial stress index and describes recent trends. The section that follows presents some stylized facts on the comovement between the index for emerging and the one for advanced economies. It then discusses potential explanations for stress transmission and some data underpinning their empirical relevance. The following section 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 of previous systemic banking crises in advanced economies on emerging economies. The last section offers concluding remarks and reflects on the role of policies and the outlook for capital flows to emerging economies.

II. MEASURING FINANCIAL STRESS

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).¹ However, financial stress attributed primarily to securities

¹To identify currency crises, event narratives have been 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, 2008a). 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).

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 measure the stress propagation process for two reasons. First, past 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.² 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 a financial stress index for advanced economies (*AE-FSI*) proposed by Cardarelli, Elekdag, and Lall (2009). The two indices are available for download in conjunction with this study.

A. Definition of Financial Stress and its Measurement

In the context of this paper, an episode of financial stress is defined as a period when the financial system is under strain and its ability to intermediate is impaired. Financial stress tends to be associated with at least four fundamental characteristics: large shifts in asset prices, an abrupt increase in risk and/or uncertainty, liquidity droughts, and concerns about the health of the banking system. The events affecting financial market conditions can be varied and have external or domestic origins, such as risk-reassessments of investors, changes in preferences, unexpected financial or corporate losses, or certain policies.³ In general, such events shape the supply or demand of funds in financial markets—and therefore asset prices—and may thereby afflict multiple segments of the financial system.

In constructing the stress index the paper is agnostic about the types of events that cause financial stress. The main purpose is rather to obtain a comprehensive measure capturing a broad part of a country’s financial system. Reflecting this objective, the index assesses market responses in securities and exchange markets, as well as the banking sector. One important refinement for the EM-FSI relative to the index proposed by Cardarelli, Elekdag

² 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.

³ Examples are the introduction of capital controls or sharp changes in monetary policy such as the aggressive tightening of US monetary policy in the early 1980s which also affected financial markets in emerging economies.

and Lall (2009) is the inclusion of a measure of exchange market pressure, which is a more common source of stress in emerging economies than in advanced economies.

The index primarily relies on price movements relative to past levels or trends to proxy for the presence of strains in financial markets and on intermediation. Price data are readily available at a high frequency and hence can capture sharp market responses, which last sometimes only short periods. However, some countries target price levels in exchange markets thereby reducing their ability to signal stress, and hence we also include a measure of foreign reserve depletion into the index in addition to exchange rate movements. Calvo and Reinhart (2002) show that many emerging economies with officially flexible exchange rate regimes often allow only minimal exchange rate movement. Finally, for equity markets we complement a price measure (stock market returns), with a volatility measure to allow an additional market signal for impaired credit conditions (see details below).

Construction of index

The EM-FSI comprises five variables, which are aggregated into an overall index to capture credit conditions in three financial market segments (banking, securities markets, and exchange markets). The five components of the EM-FSI are the “banking-sector beta,” denoted as β , stock market returns, time-varying stock market return volatility, sovereign debt spreads, and an exchange market pressure index (*EMPI*). As mentioned above, these five components all help associate the degree of financial stress with large swings in asset prices, abrupt changes regarding uncertainty and the appetite for risk, (international) liquidity conditions, credit availability and/or financial intermediation. The choice of sub-indices was limited by data considerations and a preference for parsimony.⁴

To yield the aggregate financial stress index for an individual country the five components are standardized and summed up:

$$EM-FSI = \beta + \text{Stock market returns} + \text{Stock market volatility} + \\ + \text{Sovereign debt spreads} + EMPI$$

Further details on the definition of the five components (before standardization) and the aggregation method are given below:

- The “*banking-sector beta*” is the standard capital asset pricing model (CAPM) beta, and is defined as follows:

$$\beta_{i,t} = \frac{COV(r_{i,t}^M, r_{i,t}^B)}{\sigma_{i,M}^2},$$

⁴ Corporate bond markets were not included for two reasons. Although this market segment has developed rapidly over the past few years, the market is still small in most emerging economies. Importantly, comparable data were not available for a sufficiently large pool of emerging economies.

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. The series takes on only positive values exceeding a threshold of one, and zero values otherwise. To better capture banking-related financial stress, the banking beta was recorded only when banking returns were lower than overall market returns.

- *Stock market returns* are computed as the year-on-year change in the stock index multiplied by minus one, so that a decline in equity prices corresponds to increased securities-market-related stress.
- *Stock market volatility* is a time-varying measure of market volatility obtained from a GARCH(1,1) specification, using month-over-month real returns and modeled as an autoregressive process with 12 lags.
- *Sovereign debt spreads* is defined as the bond yield minus the 10-year United States Treasury yield using JPMorgan EMBI Global spreads. When EMBI data were not available, five-year credit default swap spreads were used.
- The *EMPI* captures exchange rate depreciations and declines in international reserves, and is defined for country i in month t as:

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

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 taken 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. The index accommodates episodes of hyperinflation, defined as annual inflation rates exceeding 150 percent, by adjusting means and standard deviations for periods with and without the prevalence of hyperinflation.⁵

The aggregation of these subindices into the EM-FSI is based on a variance-equal weighting. Under this method each component is computed as a deviation from its mean and weighted by the inverse of its variance (similar to Kaminsky and Reinhart, 1999). This approach adjusts the stress subindex for differences in volatility, allows a simple decomposition of stress components, and is also the most common weighting method in the literature.

⁵One caveat in interpreting the exchange market pressure component is that the impact of stress in this 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.

Ideally, the aggregate index should be constructed using economic weights, such as the size of each financial market sector surveyed, but such weights were not available on a comparable basis across countries. Previous research shows however, that variance-equal weighting performs as well in signaling stress episodes as weighting based on economic fundamentals (Illing and Liu, 2006). Moreover, robustness tests indicate that equal-variance weights are very similar to weights identified by a principal components analysis of the stress subindices.

All components are available in monthly frequency. The EM-FSI is constructed for 26 countries roughly spanning the period from January 1997 to latest available and are published in conjunction with this paper.

Index performance compared to literature

The index captures the most important episodes of financial stress experienced by emerging economies when contrasted to previous academic studies. 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 (2008a, 2008b). 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 (typically used to identify currency crises).

We find that the subcomponents of the EM-FSI accurately indicate the type of crisis they are intended to signal. Specifically, we find that 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.⁶ Recalling that the EM-FSI starts in early 1997, in line with expectations, the sovereign spread component of the index signals correctly all debt-related crises (Argentina 2002, 2005; Korea 1998; Russia 1998). Lastly, 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.

B. Patterns of Financial Stress in Emerging and Advanced Economies

Figure 2 depicts regional averages of the EM-FSI including all countries in our sample. Broadly speaking, four systemic financial stress episodes can be identified using this new index.⁷ 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

⁶ While this may seem tautological, the EMPI definitions used in some cases to identify currency crises differ, as well as other variable definitions, sample periods, and countries used across studies.

⁷To facilitate comparisons, each regional EM-FSI was standardized.

the financial turmoil owing to the default on 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.

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. By the final quarter of 2008, all regions showed exceptionally high levels of stress, at exactly the same time that advanced economies experienced stress. In the first quarter of 2009, stress appears to have subsided somewhat, notably in emerging Asia and Latin America, but it has generally remained high. The lower panels of Figure 2—using monthly data—show a regional decomposition of stress by components. 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). Since then the index has come down from its peak but has not declined to neutral levels.

For advanced economies, Cardarelli, Elekdag, and Lall (2009) developed a monthly, market-based Financial Stress Index (AE-FSI) for 17 economies covering about 80 percent of advanced economy GDP since 1981.⁸ The index comprises seven subindices related to banking sectors, securities markets, and foreign exchange volatility. An update of the index to March 2009 illustrates the unprecedented breadth and intensity of the current crisis. Since the first quarter of 2008, nearly all the advanced economies have experienced exceptionally high, stress (Figure 3, top panel).⁹

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 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). More recent stress episodes in advanced economies have tended to be more related to securities markets (for example, equity market crises in 1998, 2000, and 2002). 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 3 compare selected indicators before, during, and after the peak of various stress episodes. In 2008, banking stress—measured by the deviation from trend of

⁸ 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.

⁹The 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.

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 European ERM crisis.

III. COMOVEMENT OF FINANCIAL STRESS: THEORY AND EVIDENCE

The top panel of Figure 4 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 and the AE-FSI were higher in late 2008 than at any previous time. 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.¹⁰ 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).

To investigate further how the current crisis differs from previous ones, the lower two panels of Figure 4 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 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.

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.

A. Rationale for Stress Comovement

The presence of *common* factors in the transmission of financial stress is apparent from the comovement of the indices for emerging and advanced economies, which was noted

¹⁰Some 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.

previously. At the same time individual country experiences were far from uniform suggesting that *country-specific* factors also influenced the transmission pattern. Figure 5 provides a schematic presentation of how these factors may interact based on arguments in the literature as outlined below.

Common factors

Common factors can be global shocks (for example, global shifts in market sentiment or risk aversion) and may manifest themselves through herd behavior in markets, cross-country contagion, and common-lender effects via blanket withdrawal of funds by highly exposed financial institutions (Broner, Gelos, and Reinhart 2006; Calvo 2005; and Pons-Novell 2003). 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 6).¹¹ 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.¹² 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

The literature has grouped country-specific factors into two broad categories: financial and economic linkages between emerging and advanced economies; and domestic vulnerabilities, deriving from policies or from structural characteristics.

Country-specific linkages facilitate the transmission of financial stress through trade and financial exposures, with the relative importance of the two channels a subject of debate in the literature. In particular, 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. In a recent study, Forbes and Chinn (2004) attribute the main role

¹¹Foreign 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, Prasad, Rogoff, and Wei 2006; and IMF, 2007).

¹²The declines in external positions often were the result of debt relief.

in the transmission of financial shocks to trade, with bank lending of lesser but increasing importance.

The basic rationale in the case of stress transmission from advanced to emerging economies is as follows. Financial stress can rise in response to actual or incipient *capital outflows* initiated by investors in advanced economies following a financial shock. As financial institutions re-balance portfolios or de-leverage, economies with larger liabilities are likely to be affected more. 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 commodity exporters which have saved windfalls. Similarly, 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.¹³

Figure 7 compares the size and composition of financial linkages across emerging economies.¹⁴ These linkages are measured as liabilities to advanced economies (and assets, when available) relative to domestic GDP. The top panel shows how over the past 10 years, 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 (lower panel).¹⁵ As a result, emerging Europe may now be more vulnerable to external 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 in emerging and developing economies (Figure 8). 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.

The importance of trade linkages 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

¹³ The role of trade competition in common markets, often emphasized in the literature on crisis contagion among emerging economies, seems less relevant when financial stress originates in advanced economies. Indeed, advanced economies themselves constitute key common markets and, moreover, competitiveness gains related to exchange rate movements tend to be less apparent in the case of stress transmission from advanced to emerging economies.

¹⁴ 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.

¹⁵ 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.

20 percent of emerging economies' GDP. Almost half of these exports now come from emerging Asia, especially China.

It is important to note that 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.¹⁶

Country-specific sources of vulnerabilities to external shocks include solvency and liquidity problems, weaknesses in domestic balance sheets, and factors related to openness (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). 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.

Figure 9 compares standard indicators of vulnerability across different emerging regions. The top two panels show the current account and fiscal balances.¹⁷ 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 position, 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.

IV. TRANSMISSION OF STRESS: A COMPREHENSIVE ANALYSIS

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

¹⁶ 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).

¹⁷ 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.

economies. The section is divided into three complementary exercises: (i) an estimation of a common time-varying component in the EM-FSI and its relationship to the AE-FSI and other global factors, (ii) a two stage econometric analysis of monthly financial stress comovement using a country-by-country approach; and (iii) an annual panel data analysis of determinants of financial stress. Finally, complementing the econometric analysis is a case study analysis of previous systemic banking crises in advanced economies and their effects on emerging economies since there have been no systemic banking crises during the past decade (when the EM-FSI is available).

The purpose of the first econometric exercise is to assess how strongly emerging and advanced economy stress are associated with each other. In particular, we estimate a common emerging economy financial stress component and then relate it to advanced economy stress and other global factors. The second and third exercise try to uncover differences and determinants of stress comovement. The first one makes full use of the available monthly data applying a two-stage method by identifying differences in comovement parameters (stage 1) and then relating them to country characteristics (stage 2). This method has the advantage of exploiting the high frequency nature of the index, but is constrained by the limited availability of country-specific control variables at this frequency. Hence the other, third, approach converts the stress index into an annual series and estimates a panel model with structural and policy variables, which are only available at an annual frequency.

A. Common Time-Varying Component in EM-FSI

The first exercise explores in a more rigorous way the degree of common comovement of financial stress across emerging economies displayed in Figure 4. In a first step, the monthly stress index is regressed on country and time-fixed effects, where $Month_t$ denotes a dummy variable for month t in the data set and α_i a country-specific fixed effect.

$$(1.1) \quad EMFSI_{it} = \alpha_i + \sum_t \rho^t Month_t + \varepsilon_{it}$$

The obtained coefficient time-series $\{\rho^t\}$ measures the common time-varying element in the emerging economy stress index. This component explains about 50 percent of the overall variation in EM-FSI implying that stress in emerging economies has indeed a sizeable common component. 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 between the two series (Figure 10).

In a second step, this relationship is explored in more depth by relating the common time component, ρ^t , to the stress index in advanced economies and to global factors:

$$(1.2) \quad \rho^t = \alpha + \beta AEFSI_t + \sum_g \gamma^g GF_t^g + \varepsilon_t$$

The latter include year-on-year changes in world industrial production, aggregate commodity prices, and the three-month London interbank offered rate (LIBOR).

Table 2 summarizes the results. The most important explanatory variable of the common time-varying component, ρ^l , is stress in advanced economies (explaining 41 percent of the variation in ρ^l). Global factors also matter, but they have a comparatively smaller explanatory power. In sum, the model has a good statistical fit, with an R^2 of 0.54, suggesting that stress in advanced economies plays an important role in determining stress in emerging economies.

B. Stress Transmission Analysis: 2-Stage Procedure (Forbes-Chinn)

The relationship between the two stress indices – for advanced and for emerging economies – was explored in more depth using a method developed by Forbes and Chinn (2004). This econometric approach addresses two questions: what is the intensity of stress comovement (stage 1) and what explains cross-country variations in the extent of comovement (stage 2). Our approach builds on the original study and allows more dynamics in the 1st stage, as well as a more complete set of explanatory factors in the 2nd stage.

Stage 1: Estimating transmission coefficients

To implement stage 1, the financial stress index ($EMFSI$) for each emerging economy i is modeled as a function of financial stress in advanced economies ($AEFSI$), financial stress in other emerging economies (\overline{EMFSI})—to control for horizontal contagion—and a number of global factors (GF), allowing for a dynamic structure. The parameter of primary interest in this model is the coefficient on $AEFSI$, which describes the intensity of comovement between financial stress in emerging and advanced economies. In what follows, this parameter is referred to as the comovement or transmission parameter, or simply as “beta”.

The empirical specification allows comovement parameters (β) to vary by advanced economy regions (c) and across time periods (τ), with the dynamics of stress transmission captured using lags (l) in both the dependent and independent variables:

$$(1.3) \quad EMFSI_{it} = \alpha_i + \sum_c \sum_{l=0,1} (\beta_i^{cl} AEFSI_{t-l}^c + \sum_{\tau=1,2} \beta_{\tau i}^{cl} D_{\tau} AEFSI_{t-l}^c) + \sum_g \sum_{l=0,1} \gamma_i^{gl} GF_{t-l}^g + \sum_{l=0,1} \delta_i^l \overline{EMFSI}_{it-l} + \lambda_i EMFSI_{it-1} + \varepsilon_{it}$$

Depending on the specification, $AEFSI$ is either an aggregate of 17 major advanced economies or three separate aggregates, indexed by c , for the United States and Canada, western Europe, and Japan and Australia, using purchasing-power-parity GDP weights in both cases. There are two episodes of financial stress in advanced economies, indexed by τ , 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.¹⁸ To account for different period effects, interaction terms of the stress index with dummy variables (D_t) are introduced.

The global factors, GF , include the same variables as in the previous subsection, namely the 3-month LIBOR, year-on-year changes in global industrial production, and commodity prices. In order to control for possible financial contagion from other emerging economies, which might occur concurrently with stress transmission from advanced economies, a measure of financial stress in other emerging economies, \overline{EMFSI} , is introduced. This measure is constructed by, first, aggregating stress indices $EMFSI$ across all emerging economies except country i (using purchasing-power-parity GDP weights) and, second, stripping this aggregate of any contributions from $AEFSI$ or GF . Since $EMFSI$ is modeled as a function of $AEFSI$ and GF , it stands to reason that \overline{EMFSI} should capture only the pure contagion between emerging economies that is not driven by financial stress in advanced economies or by global factors. Accordingly, for every country i , \overline{EMFSI} is constructed as the residual from a model very much like that in equation (1.4) with the aggregated $EMFSI$ excluding country i as the dependent variable.

One important assumption in the analysis is that financial stress in advanced economies is exogenous to financial stress in emerging economies. Indeed, the narrative analysis of widespread financial stress episodes in advanced economies did not identify any stress triggers in emerging economies (Table 1). Moreover, formal empirical tests on the direction of causality supported the assumption of independence of advanced economy stress for the majority of emerging economies. 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. We maintain therefore for the remainder of the analysis the assumption that financial stress in advanced economies is exogenous to emerging economy financial stress.

Turning to the dynamic structure, standard lag-length criteria recommend one or two lags for the model, indicating rapid transmission. Following the Schwartz information criterion, the model is estimated with one lag. In order to account for this lag structure, the parameter of primary interest – the coefficient of stress comovement between advanced and emerging economies – is computed as a *direct* effect (concurrent and lagged) plus an *indirect* effect via lagged emerging economy stress (i.e. via λ_i). Accordingly, for the full sample period, the combined transmission effect after one lag can be computed as $\beta_i^c = \beta_i^{c0} + \beta_i^{c1} + \beta_i^{c0} \lambda_i$; for each

¹⁸ 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. 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 from January 1997 to June 1998 is included in the model.

of the two stress sub-periods, it can be computed as $\beta_{ti}^c = (\beta_i^{c0} + \beta_{ti}^{c0}) + (\beta_i^{c1} + \beta_{ti}^{c1}) + (\beta_i^{c0} + \beta_{ti}^{c0})\lambda_i$. The effects of the contagion variable and the global factors can be obtained in a similar way.

Table 3 provides a summary description of the results from the first stage regressions, using *AEFSI* aggregated across 17 major advanced economies. The results for the disaggregated version with three advanced regions – the United States and Canada, western Europe, and Japan and Australia – are not shown in the interest of space. In either case, equation (1.5) is estimated separately for each of the 18 countries for which *EMFSI* is available. The length of the sample varies somewhat by country, with the longest sample running from January 1997 through January 2009. The model fits the data well for all countries, with R^2 about 0.7, on average. The transmission of financial stress from advanced economies is both statistically and economically significant in most countries, with $\beta=0.7$ on average for the full sample, although comovement parameters vary considerably across emerging economies and time periods. By means of comparison, financial contagion from other emerging economies is also a key determinant of financial stress, with the effect exceeding one, on average.

The estimated comovement parameters, or betas, are highlighted in Figure 11. As noted above, the average country-specific comovement parameter (across all periods and regions) is large, implying that stress in advanced economies as an important common component of stress in emerging economies. On average, close to 70 percent of stress in advanced economies is transmitted to emerging economies (Figure 11, top panel).¹⁹ Moreover, transmission is fast: it takes only one to two months to reach emerging economies. The comovement parameters, however, vary substantially across countries, ranging from close to zero for Pakistan, Hungary, and China, to more than one 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) (middle panel). It appears that while some countries (such as Brazil and Colombia) experienced stronger financial spillovers in the past, other countries (such as China and Hungary) are seeing more intense transmission during the current crisis. 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 are somewhat stronger (bottom panels).

Stage 2: Analysis of comovement in financial stress

In the second stage, we explore factors that may explain country differences in comovement parameters, separately for the past and current global financial crises periods. We model country-specific regional comovement parameters as a function of trade (*TL*) and financial

¹⁹Because both the AE-FSI and the EM-FSI are subject to measurement error, estimates of betas are potentially biased downward.

(*FL*) linkages between emerging economies and advanced regions, other relevant factors (*X*), and country-specific fixed effects:

$$(1.6) \quad \beta_{\tau i}^c = \alpha_i + \sum_k \alpha_k FL_{ik}^{\tau c} + \alpha_l TL_i^{\tau c} + \sum_m \alpha_m X_{im}^{\tau c} + \varepsilon_{\tau i}^c$$

with k denoting types of financial linkages and m the number of country controls.

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).²⁰ Financial linkages, *FL*, include bank lending, portfolio investment, and direct investment.²¹ 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 definitions of advanced regions vary somewhat for each of these three linkages due to differences in the data available for the period of interest.^{22,23}

The trade linkages variable, *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. 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. In addition, some specifications include dummy variables for the United States and Canada and for western Europe.

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).²⁴ An analysis of the variation in the transmission coefficients, or betas, suggests important differences in the transmission of stress across the two episodes (Table 4):

²⁰ Because estimations of the comovement parameters for Pakistan and Egypt during the first stress episode were problematic given short data samples, these two countries are excluded from the second-stage estimations.

²¹ This is a more complete set of financial linkages relative to the original paper by Forbes and Chinn (2004) that did not include portfolio investment.

²² 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 in 2001). Direct investment linkages exclude Belgium and Spain. In addition, the composition of advanced regions varies somewhat due to differences in reporting by specific countries. It should also be noted that missing values in measured linkages were 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.

²³ 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.

²⁴ All the explanatory variables are time-averaged over each of these two stress periods.

- 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. That said, all three financial linkages taken together were jointly significant as determinants of stress transmission. 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.
- Bank linkages emerge as a more important 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 more than 1. Notably, this result is not driven by the overall financial openness of emerging economies, which does not seem to play a significant role in stress transmission (last column). Comovement with western Europe is a lot 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 (column 6) 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.

Interestingly, and contrary to the original study by Forbes and Chinn (2004), we find that financial linkages appear more important than trade linkages as determinants of stress transmission in our sample. In addition, while linkages appear to play an important role, further testing showed that country-specific vulnerabilities (such as current account or fiscal deficits) are not an essential part of the stress transmission mechanism (that is, they are not associated with betas).²⁵ A further analysis of the role of country-specific vulnerabilities as determinants of financial stress is undertaken in the following section.

C. Stress Transmission and Other Country Characteristics: Annual Panel

The third exercise aggregates the financial stress index into annual data and relates it to 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. Second, the quarter with the largest stress level is selected for the

²⁵One 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.

annual index. An alternative specification using 12-month averages yielded similar results in terms of significance but implied a lower average transmission coefficient (β).

As above, the *EMFSI* is modeled as a function of the financial stress index for advanced economies (*AEFSI*), financial stress in other emerging economies (\overline{EMFSI}), and global factors (*GF*), as well as lagged country-specific variables (*X*). In addition, the model tests for the presence of interaction effects between stress in advanced economies and country-specific characteristics ($AEFSI \times X$). 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:

$$(1.7) \quad EMFSI_{it} = \alpha_i + \beta AEFSI_t + \sum_j \xi^j X_{it-1}^j + \sum_j \theta^j AEFSI_t \times X_{it-1}^j + \overline{\delta EMFSI}_{it} + \sum_g \gamma^g GF_t^g + \varepsilon_{it}$$

The global factors include a similar set of variables as in the monthly model, namely the year-over-year changes in world real output, change in commodity terms of trade, and the three-month LIBOR.²⁶ In contrast to the monthly model, 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. All country specific characteristics (*X*) were introduced with a one-year lag to reduce endogeneity concerns arising from the impact of financial stress on these variables (e.g., fiscal or current account balance). The coefficients of interest are the average comovement parameters (β); the direct effect of country-specific variables on stress (ξ); and the coefficient measuring indirect effects of these variables on the transmission of stress (\square).

Table 5 summarizes the findings from the annual panel regressions. The average comovement parameter β is highly significant and about 0.45 in value (see column 6), smaller but close to the estimates of β uncovered by the monthly exercise. Similar to the results from the monthly model, the coefficient on \overline{EMFSI} —measuring horizontal contagion among emerging economies—is positive and larger than one. 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 consistent with results reported in the literature (Martin and Rey, 2006; Imbs, 2006; and Kose, Prasad, and Terrones, 2005).

Important specific risk factors for financial stress in emerging economies are the presence of low current account and fiscal balances, and low levels of foreign reserves. 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 5 columns 3 and 4). A 1 percentage point of GDP higher deficit is associated with an average stress index

²⁶ 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).

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 5), but their effect becomes borderline significant (p -value of 12 percent) when all control variables are included in the model (column 5). In general, these results are robust to the inclusion of other control variables including exchange rate regime, level of public governance, democratic institutions, and per capita income levels.

In Table 6 we explore whether transmission is influenced by the global nature of a crisis in advanced economies. To address this question we interact the stress index for advanced economies with specific time-periods. Specifically, we test in models 2 and 3 whether the transmission coefficient differs between calm and stress periods. Confirming earlier results, we find that stress transmission is higher during stress periods (1998, 2000, 2002, 2008), but the transmission is not significantly stronger during the current one. The final four models (columns 4-7) test whether current account and fiscal imbalances or reserve levels have different effects on financial stress during global stress periods. In none of the specifications is the interaction statistically significant.

Finally, we test whether the transmission itself is influenced by country specific vulnerabilities and policies. In other words, we ask whether higher external or fiscal balances or foreign reserve levels offer protection against the transmission of stress. Table 7 shows the results from including interaction effects between the above variables and the stress index in advanced economies. There is little evidence that high current account, fiscal balances and reserves substantially lower the transmission of stress. Partly this result may be explained by the “overpowering” effect that large financial stress episodes have (next paragraph).

To gauge the relative size of the common effect and of vulnerabilities on stress in emerging economies we computed the model’s estimated contributions to changes in financial stress in emerging economies, distinguishing between periods of calm in advanced economies and periods of widespread financial stress (1998, 2000, 2002, 2008). The contributions are computed by multiplying average annual changes of each explanatory variables with the respective estimated coefficient from the econometric using the model in column 6 of Table 5. We find that during high-stress periods, the largest single factor driving stress increases in emerging economies is the financial stress impulse in advanced economies. It explains 70 percent of the increase in financial stress. Contagion from other emerging economies has a very limited effect, and global factors (falling interest rates and commodity prices) have a small mitigating effect. The contribution from higher current account and fiscal balances prior to such high-stress events in advanced economies is less than 10 percent.²⁷ In contrast, during calm times in advanced economies, improvements in current account and fiscal balances and reserve accumulation have a greater effect on reducing stress. Together, they

²⁷Gonzalez-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 actors matter during more calm periods.

explain about 30 percent of the decline in average emerging economy stress during this period. In sum, the identified country vulnerabilities matter, but their relative impact is small when advanced economies are in stress.

D. Case Study Analysis: Banking Crisis and Capital Flows

The current crisis has involved systemic banking crises in many of the advanced economies. Yet 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.²⁸ 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). 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.

Nonetheless, given their exposure to Latin America,²⁹ 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 12, top and middle panel).³⁰

²⁸ 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.

²⁹ 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.

³⁰ Consolidated banking data (Figure 4.14, top panel) that combine liabilities by 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 inter-office lending but excludes claims of foreign affiliates) shows a more pronounced withdrawal by U.S. banks, right after the Latin American debt crisis erupted.

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.

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 13). 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.³¹ 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).³²

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 pullout 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 spread shot up) and they came under pressure to improve their capital 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

³¹The results are reported in terms of destination country GDP, but they largely hold also in dollar terms and if normalized by Japan's GDP.

³²In 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.

increase capital ratios led to a reversal of this strategy.³³ 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.³⁴ 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.

V. CONCLUSIONS

This paper introduces a new financial stress index for emerging economies and analyzes how financial stress was transmitted in the past and during the current global crisis. The analysis finds that financial stress tends to spread rapidly to emerging economies 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 economies and raised the financial stress index above levels seen during the Asian crisis. Since then, stress has come down from its peaks.

Financial links appear to be a key 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 a main source of stress.

Emerging economies are 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, the calming effects are too small to prevent stress transmission. That does not mean that such policy buffers are ineffective. Rather they influence the transmission to the *real* economy (for example, by using reserves to buffer the effects from a drop in capital inflows) and the duration of the crisis,³⁵ links that were however not studied in this paper.

³³Laeven and Valencia (2008) argue that the Japanese crisis became systemic only in November 1997.

³⁴For 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.

³⁵Mecagni and others (2007) show that improvements in pre-crisis conditions can reduce the duration of capital account crises.

Although the current crisis is still ongoing, some conclusions can be drawn. Banking flows to emerging economies are likely to take a severe hit, as evidenced for instance 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, the effects of the current crisis on capital flows may be long-lasting and a quick return to past international investment patterns should not be expected.

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Data Appendix

Sample

The EM-FSI is constructed for 26 countries spanning the period from January 1997 to latest available. The econometric study uses data up to March 2009, the attached data set includes more recent data. 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 are used in the econometric analysis. The countries are Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, South Africa, Thailand, and Turkey.

The complete set of advanced economies used in this chapter includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom, and United States.

Bank linkages are measured excluding Australia, Denmark, and Norway. Portfolio linkages exclude Finland, and also 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 in 2001). Direct investment linkages exclude Belgium and Spain.

The two indices, AE-FSI and EM-FSI, are available for download along with this study.

Table 1. Episodes of Widespread Financial Stress in Advanced Economies¹

1982	<i>U.S. Banking Sector Stress</i>		
	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 over double 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. Among emerging economies Mexico declared a debt service moratorium. With the exceptions of Chile, Colombia, and Costa Rica, all Latin American countries defaulted. Around the same time, though largely unrelated to the Latin debt crisis, the U.S. Savings and Loans crisis began.
	Belgium	France	
	Germany	Italy	
	Netherlands		
1987	<i>Stock Market Crash</i>		
	Canada	United States	The October 1987 U.S. stock market crash was the largest one-day decline in stock market values. The Dow Jones fell by 23 percent. Repercussions were felt in virtually all advanced countries equity markets. In emerging economies Brazil declared a debt service moratorium. Around the same time the Louve Accord was signed, prior to which the U.S. dollars hit record lows (e.g., 50 percent decline from the 1985 peak).
	Belgium	Germany	
	Netherlands	Norway	
	Spain	Sweden	
	Germany	Netherlands	
	Switzerland	UK	
	Australia	Japan	
1990	<i>Nikkei crash and Scandinavian banking crises</i>		
	Canada	United States	The junk bond market collapsed in the United States and the Nikkei crashed, with the Tokyo stock market falling by 50 percent. Other sources of financial stress were a continuation of the bailout program for the U.S. Savings and Loans institutions which reached \$150 billion. Relatedly, Drexel Burnham Lambert—which was the fifth-largest investment bank in the United States at the time—filed for bankruptcy. In emerging economies systemic banking crises affected Argentina, Brazil, Hungary, and Romania.
	Austria	Belgium	
	Finland	Germany	
	Netherlands	Norway	
	Sweden	Switzerland	
	UK		
	Australia	Japan	
1992	<i>ERM crisis</i>		
	Canada		The European exchange rate mechanisms collapsed and the Japanese asset price bubble burst. Moreover, equity and commodity markets were rattled by the start of first Gulf war. Around the same time the Scandinavian banking crises affected Finland, Norway and Sweden. Emerging economies stress included 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	
	UK	Spain	
	Japan		
1998	<i>LTCM collapse</i>		
	Canada		The collapse of the U.S. based hedge fund Long Term Capital Management (LTCM) rattled stock markets. It was preceded by the Russian default, but LTCM already experienced financial woes prior to that event: in May and June of 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 markets. Among emerging economies financial stress increased strongly in Mexico and Brazil, which suffered a currency crisis culminating in the 70 percent depreciation of the real starting in January 1999.
	Austria	Denmark	
	France	Germany	
	Netherlands	Norway	
	Spain	Switzerland	
	UK		
	Japan		
2000	<i>NASDAQ crash</i>		
	Canada	United States	Large declines in the U.S. S&P stock market index began in August 2000 and were led by the technology sector. The main financial stress episodes in emerging economies included debt restructuring in Ecuador and Russia, as well as a systemic banking crisis in Turkey.
	Finland	Netherlands	
	UK		
2002	<i>WorldCom, Enron, and Arthur Anderson defaults</i>		
	Canada	United States	Scandals wreaked havoc across global financial markets. The turmoil started with the demise of Arthur Andersen (one of the “Big Five” large international accounting firms), which was convicted of obstruction of justice in conjunction with the Enron scandal on June 15, 2002. Furthermore, 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 1 standard deviation above its trend.

Table 2. Emerging Economy Stress: Determinants of Common Time Trend¹

Financial Stress (adv. econ.)	0.48*** (0.05)	0.47*** (0.06)
Industrial production growth (adv econ.)		0.03 (0.08)
Commodity price growth		-0.04*** (0.01)
Libor (3-month)		0.04 (0.08)
Constant	-0.08 (0.13)	0.01 (0.27)
Observations	133	133
R ²	0.411	0.543

Source: Authors' calculations.

¹Robust standard errors in parentheses; ***, **, * denote significance at the 1 percent, 5 percent, 10 percent level, respectively. Common time trend obtained from time-fixed coefficients of a monthly panel model of emerging economy stress 1997–2008.

Table 3. Comovement in Financial Stress Between Emerging and Advanced Economies ^{1/}

Dependent variable: EM-FSI	full sample	R2	AE-FSI full sample	AE-FSI 1998H2 - 2003H1	AE-FSI 2007H2 onward	EM-FSI aggregate 2/
Pakistan	06/01 - 01/09	0.771	-0.032 <i>-0.135</i>	- -	- -	-0.405 <i>-0.849</i>
Hungary	01/99 - 01/09	0.761	-0.028 <i>-0.111</i>	0.043 <i>0.169</i>	1.207 <i>7.560</i>	0.933 <i>3.281</i>
China	01/97 - 04/08	0.662	0.045 <i>0.136</i>	0.220 <i>0.805</i>	1.008 <i>3.672</i>	1.294 <i>2.524</i>
Argentina	01/97 - 01/09	0.665	0.440 <i>1.741</i>	0.138 <i>0.636</i>	0.188 <i>1.298</i>	0.658 <i>2.711</i>
Thailand	05/97 - 01/09	0.748	0.463 <i>1.721</i>	0.567 <i>2.340</i>	0.048 <i>0.360</i>	1.828 <i>4.858</i>
Egypt	07/01 - 12/08	0.703	0.524 <i>1.775</i>	- -	- -	1.313 <i>2.733</i>
Poland	01/97 - 12/08	0.492	0.566 <i>2.534</i>	0.329 <i>1.619</i>	0.014 <i>0.092</i>	0.923 <i>3.458</i>
Morocco	01/97 - 12/08	0.431	0.641 <i>2.448</i>	0.594 <i>3.208</i>	0.089 <i>0.671</i>	0.596 <i>1.768</i>
Malaysia	01/97 - 01/09	0.749	0.683 <i>3.000</i>	0.195 <i>0.869</i>	0.167 <i>1.312</i>	1.124 <i>2.867</i>
Philippines	12/97 - 12/08	0.748	0.704 <i>2.706</i>	0.654 <i>2.648</i>	0.280 <i>1.995</i>	1.790 <i>6.441</i>
Mexico	01/97 - 01/09	0.830	0.836 <i>4.299</i>	0.693 <i>4.876</i>	0.542 <i>4.544</i>	1.033 <i>4.330</i>
South Africa	01/97 - 12/08	0.803	0.840 <i>3.264</i>	0.487 <i>2.298</i>	0.762 <i>4.808</i>	1.449 <i>5.682</i>
Peru	03/97 - 01/09	0.819	0.855 <i>4.199</i>	0.719 <i>4.074</i>	0.541 <i>2.798</i>	1.866 <i>6.981</i>
Brazil	01/97 - 01/09	0.649	0.873 <i>2.627</i>	1.133 <i>4.544</i>	0.460 <i>2.935</i>	1.236 <i>3.688</i>
Colombia	02/97 - 01/09	0.691	0.993 <i>3.578</i>	0.948 <i>4.094</i>	0.399 <i>2.533</i>	1.304 <i>3.599</i>
Korea	12/97 - 01/09	0.706	0.996 <i>3.974</i>	0.556 <i>2.399</i>	0.455 <i>2.159</i>	1.789 <i>5.194</i>
Chile	05/99 - 01/09	0.677	1.373 <i>4.773</i>	0.643 <i>2.227</i>	0.624 <i>3.347</i>	1.351 <i>3.912</i>
Turkey	01/97 - 12/08	0.641	1.397 <i>4.952</i>	0.555 <i>2.414</i>	0.040 <i>0.241</i>	1.165 <i>3.211</i>

Source: Authors' calculations. Robust t-statistics in italics

1/ All regressions include 3-month labor and year-on-year changes in global industrial production and commodity prices.

2/ The EM-FSI aggregate excludes the country under study and is net of effects from AE-FSI and global controls.

Table 4. The Role of Linkages as Determinants of Comovement

Past stress in advanced economies (July 1998 - June 2003)							
Dependent variable: comovement parameters of financial stress							
Bank linkages	0.013**				0.003	-0.015	0.005
	[0.006]				[0.008]	[0.009]	[0.007]
Portfolio linkages		0.054***			0.035	-0.015	0.027
		[0.015]			[0.027]	[0.032]	[0.021]
Direct investment linkages			0.040***		0.011	0.028	0.005
			[0.007]		[0.022]	[0.022]	[0.020]
Trade linkages				0.022***	0.002	0.009	0.007
				[0.007]	[0.014]	[0.012]	[0.011]
US and Canada dummy						0.379***	
						[0.130]	
Western Europe dummy						0.504***	
						[0.158]	
Trade openness							-0.002
							[0.001]
Financial openness							-0.003
							[0.002]
Test of joint significance of financial linkages (via banks, portfolio and direct investment)					3.14**	1.32	2.06
					(0.04)	(0.29)	(0.12)
Country effects	yes	yes	yes	yes	yes	yes	no
Observations	48	48	48	48	48	48	48
R-squared	0.19	0.33	0.32	0.25	0.36	0.52	0.27
Latest stress in advanced economies (July 2007 onwards)							
Dependent variable: comovement parameters of financial stress							
Bank linkages	0.036*				0.038**	-0.020	0.034**
	[0.018]				[0.018]	[0.022]	[0.015]
Portfolio linkages		0.034*			0.008	-0.002	0.009
		[0.018]			[0.018]	[0.017]	[0.012]
Direct investment linkages			0.081***		0.081	0.061	0.045
			[0.027]		[0.061]	[0.039]	[0.047]
Trade linkages				0.046*	-0.079	-0.019	-0.044
				[0.026]	[0.049]	[0.042]	[0.037]
US and Canada dummy						0.556	
						[0.329]	
Western Europe dummy						1.925***	
						[0.610]	
Trade openness							0.002
							[0.004]
Financial openness							-0.005
							[0.003]
Test of joint significance of financial linkages (via banks, portfolio and direct investment)					4.22**	1.69	3.63**
					(0.01)	(0.19)	(0.02)
Country effects	yes	yes	yes	yes	yes	yes	no
Observations	48	48	48	48	48	48	48
R-squared	0.24	0.10	0.20	0.10	0.31	0.60	0.25

Source: Authors' calculations. Robust standard errors in parenthesis; ***, **, * denote significance at the 1 percent, 5 percent, 10 percent level, respectively.

Table 5. Emerging Economy Stress: Country-specific Effects

	Financial Stress Index (EM-FSI)					
	(1)	(2)	(3)	(4)	(5)	(6)
Financial stress (adv econ)	0.40*** (0.06)	0.34*** (0.06)	0.33*** (0.06)	0.40*** (0.07)	0.38*** (0.06)	0.44*** (0.05)
Financial stress (other em econ) ¹		1.76*** (0.47)	1.76*** (0.47)	1.52*** (0.44)	1.51*** (0.48)	1.26*** (0.41)
Libor (3 month)	0.26** (0.09)	0.22** (0.09)	0.20** (0.09)	0.21** (0.09)	0.17* (0.09)	0.16 (0.10)
Global growth	-1.12*** (0.19)	-1.04*** (0.16)	-0.97*** (0.14)	-0.95*** (0.18)	-0.88*** (0.16)	-0.75*** (0.13)
Commodity terms of trade (growth)	-0.04 (0.03)	-0.03 (0.03)	-0.02 (0.03)	-0.03 (0.03)	-0.04 (0.03)	-0.03 (0.02)
Financial openness ² (t-1)	0.02** (0.01)	0.02** (0.01)	0.03*** (0.01)	0.02* (0.01)	0.02*** (0.01)	0.02** (0.01)
Trade Openness ³ (t-1)	-0.07** (0.03)	-0.06* (0.03)	-0.06* (0.03)	-0.05 (0.03)	-0.04 (0.03)	-0.04 (0.03)
Current account (t-1) ⁴			-0.14* (0.07)			-0.13** (0.05)
Fiscal balance (t-1) ⁴				-0.16 (0.11)		-0.19* (0.09)
Foreign reserves (t-1) ⁴					-0.08* (0.05)	-0.06 (0.05)
Constant	6.41*** (1.42)	4.63*** (1.49)	3.87** (1.59)	3.96** (1.63)	4.75** (1.65)	3.18* (1.63)
Observations	190	190	190	190	190	190
Countries	18	18	18	18	18	18
R ² overall	0.15	0.24	0.22	0.29	0.25	0.27
R ² within	0.51	0.53	0.55	0.55	0.55	0.58

Source: Authors' calculations.

Robust standard errors in parentheses; ***, **, * denote significance at the 1 percent, 5 percent, 10 percent level, respectively. All regression include country fixed effects.

¹ Financial stress in other emerging economies after controlling for advanced economy stress and global factors (see Table 3).

² Foreign assets plus liabilities over GDP.

³ Exports plus imports over GDP.

⁴ In percent of GDP.

Table 6. Emerging Economy Stress: Interactions with Stress Periods in Advanced Economies

	Financial Stress Index (EM-FSI)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Financial stress (adv econ)	0.44*** (0.05)	-0.20 (0.12)	-0.21 (0.15)	-0.20 (0.12)	-0.18 (0.13)	-0.18 (0.12)	-0.14 (0.14)
Financial stress (adv econ) x stress periods		0.66*** (0.13)		0.66*** (0.13)	0.65*** (0.13)	0.66*** (0.13)	0.66*** (0.13)
Financial stress (adv econ) x stress periods (98-02)			0.63*** (0.11)				
Financial stress (adv econ) x stress period (08)			0.68*** (0.17)				
Financial stress (other em econ) ¹	1.26*** (0.41)	1.06** (0.40)	1.04** (0.41)	1.06** (0.40)	1.06** (0.40)	1.06** (0.41)	1.08** (0.39)
Libor (3 month)	0.16 (0.10)	0.36*** (0.12)	0.37** (0.15)	0.36*** (0.12)	0.37*** (0.12)	0.36*** (0.12)	0.37*** (0.12)
Global growth	-0.75*** (0.13)	-1.01*** (0.14)	-1.02*** (0.15)	-1.01*** (0.14)	-1.03*** (0.15)	-1.02*** (0.15)	-1.04*** (0.15)
Commodity terms of trade (growth)	-0.03 (0.02)	-0.05 (0.03)	-0.05 (0.03)	-0.05 (0.03)	-0.05 (0.03)	-0.05 (0.03)	-0.04 (0.03)
Financial openness (t-1) ²	0.02** (0.01)	0.02** (0.01)	0.02** (0.01)	0.02** (0.01)	0.02** (0.01)	0.02** (0.01)	0.02** (0.01)
Trade Openness (t-1) ³	-0.04 (0.03)	-0.03 (0.03)	-0.03 (0.03)	-0.03 (0.03)	-0.03 (0.03)	-0.03 (0.03)	-0.03 (0.03)
Current account (t-1) ⁴	-0.13** (0.05)	-0.11** (0.05)	-0.11** (0.05)	-0.11* (0.06)	-0.12** (0.05)	-0.11** (0.05)	-0.12* (0.06)
Fiscal balance (t-1) ⁴	-0.19* (0.09)	-0.17* (0.09)	-0.18* (0.09)	-0.17* (0.09)	-0.20** (0.09)	-0.17* (0.09)	-0.19* (0.09)
Foreign reserves (t-1) ⁴	-0.06 (0.05)	-0.06 (0.04)	-0.06 (0.04)	-0.06 (0.04)	-0.06 (0.04)	-0.06 (0.04)	-0.05 (0.04)
Current account (t-1) x stress periods				-0.00 (0.01)			0.00 (0.01)
Fiscal balance (t-1) x Stress periods					0.01 (0.01)		0.01 (0.01)
Foreign reserves (t-1) x stress periods						-0.00 (0.00)	-0.00 (0.00)
Constant	3.18* (1.63)	2.86* (1.52)	2.94* (1.58)	2.88* (1.63)	2.77* (1.54)	2.84* (1.49)	2.68 (1.61)
Observations	190	190	190	190	190	190	190
Countries	18	18	18	18	18	18	18
R ² overall	0.27	0.38	0.37	0.38	0.37	0.38	0.37
R ² within	0.58	0.63	0.63	0.63	0.63	0.63	0.63

Source: Authors' calculations.

Robust standard errors in parentheses; ***, **, * denote significance at the 1 percent, 5 percent, 10 percent level, respectively. Stress periods are 1998, 2000, 2002, and 2008. All regression include country fixed effects.

¹ Financial stress in other emerging economies after controlling for advanced economy stress and global factors (see Table 3).

² Foreign assets plus liabilities over GDP.

³ Exports plus imports over GDP.

⁴ In percent of GDP.

Table 7. Emerging Economy Stress: Interactions with Stress Level with Advanced Economies

	(1)	Financial Stress Index (EM-FSI)		(4)
		(2)	(3)	
Financial stress (adv econ)	-0.18 (0.12)	-0.21 (0.13)	-0.22 (0.14)	-0.19 (0.14)
Financial stress (adv econ) x stress periods	0.65*** (0.13)	0.68*** (0.15)	0.71*** (0.18)	0.66*** (0.18)
Financial stress (other em econ) ¹	1.07** (0.40)	1.03** (0.41)	1.02** (0.40)	1.03** (0.42)
Libor (3 month)	0.35** (0.12)	0.37** (0.13)	0.37** (0.13)	0.36** (0.14)
Global growth	-1.00*** (0.14)	-1.02*** (0.15)	-1.04*** (0.16)	-1.04*** (0.15)
Commodity terms of trade (growth)	-0.05 (0.03)	-0.05 (0.03)	-0.05 (0.03)	-0.05 (0.03)
Financial openness (t-1) ²	0.02** (0.01)	0.02** (0.01)	0.02** (0.01)	0.02** (0.01)
Trade Openness (t-1) ³	-0.03 (0.03)	-0.03 (0.03)	-0.03 (0.03)	-0.03 (0.03)
Current account (t-1) ⁴	-0.08 (0.05)	-0.11** (0.05)	-0.11** (0.05)	-0.08 (0.05)
Fiscal balance (t-1) ⁴	-0.18* (0.09)	-0.19* (0.10)	-0.18* (0.09)	-0.20* (0.10)
Foreign reserves (t-1) ⁴	-0.06 (0.04)	-0.06 (0.04)	-0.06 (0.04)	-0.06 (0.04)
Current account (t-1) x Stress index (adv econ)	-0.06 (0.04)			-0.07 (0.05)
Fiscal balance (t-1) x Stress index (adv econ)		0.03 (0.07)		0.04 (0.09)
Foreign reserves (t-1) x Stress index (adv econ)			-0.01 (0.02)	0.00 (0.03)
Constant	2.92* (1.49)	2.91* (1.49)	3.04* (1.62)	2.97* (1.52)
Observations	190	190	190	190
Number of countries	0.629	0.626	0.627	0.630
R ² overall	0.38	0.37	0.36	0.37
R ² within	0.63	0.63	0.63	0.63

Source: Authors' calculations.

Robust standard errors in parentheses; ***, **, * denote significance at the 1 percent, 5 percent, 10 percent level, respectively. All regression include country fixed effects.

¹ Financial stress in other emerging economies after controlling for advanced economy stress and global factors (see Table 3).

² Foreign assets plus liabilities over GDP.

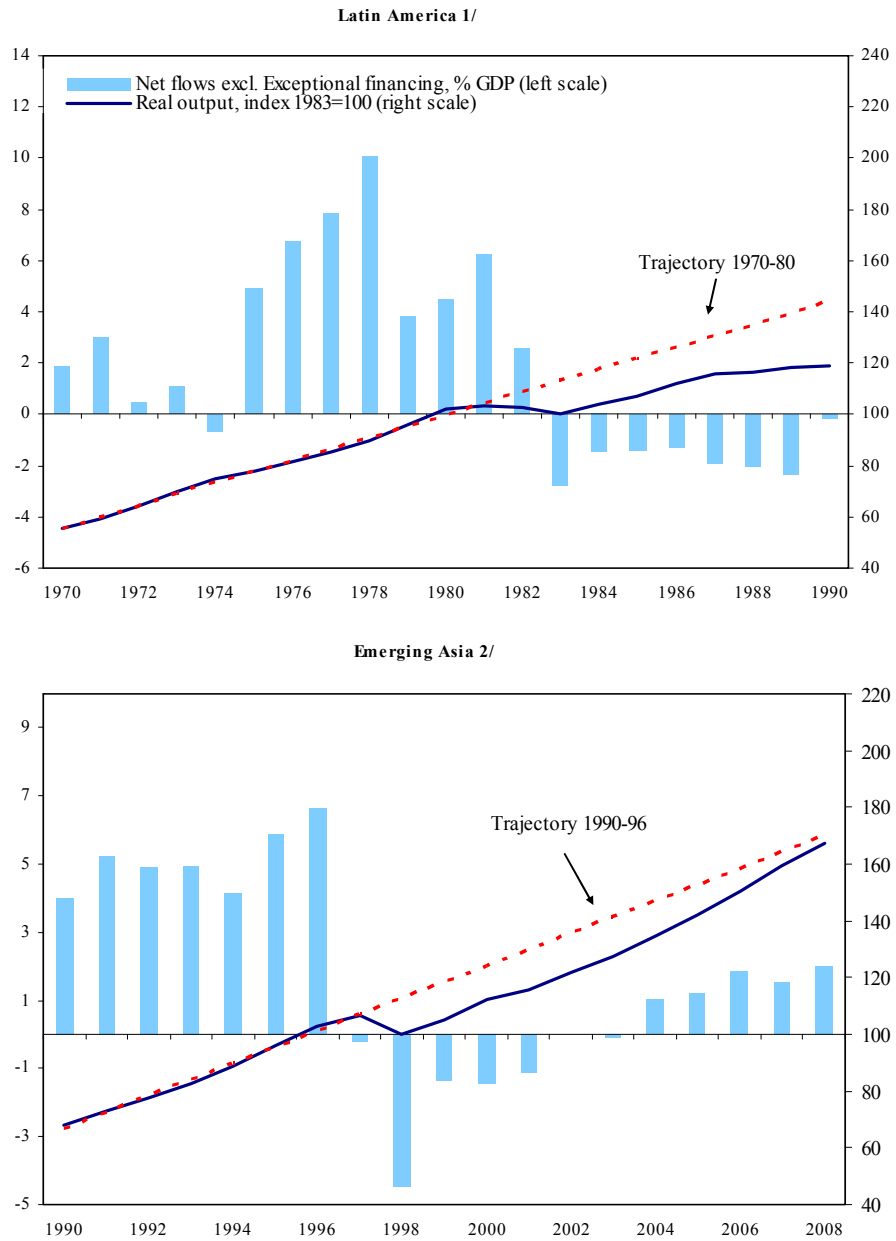
³ Exports plus imports over GDP.

⁴ In percent of GDP.

Table 8. List of Variables

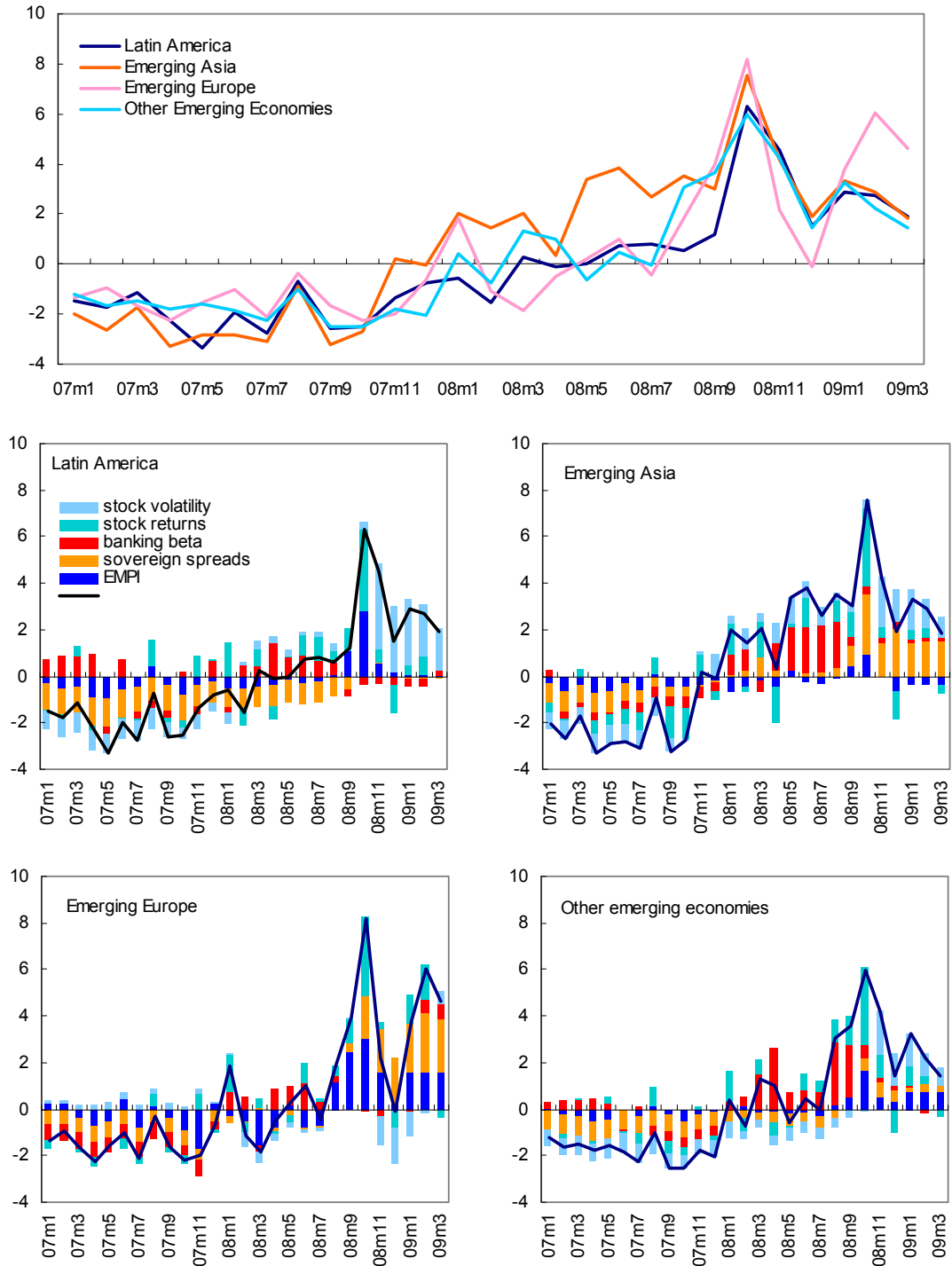
Descriptor		Definition	Source
<i>EM-FSI</i>	Financial stress (emerging economies)	Index (see text)	IMF staff calculations
<i>AE-FSI</i>	Financial stress (advanced economies)	Index (see text, and Cardarelli, Elekdag, Lall 2009)	IMF staff calculations
<i>EMFSI</i>	Financial stress (aggregate of other emerging economies)	Aggregate index excluding country under study and net of effects from AE-FSI and global controls (see text)	IMF staff calculations
Global controls			
	LIBOR (three-month)	Interest rate (average monthly)	GDS
	Global growth	Annual growth rate	WEO
	Commodity terms of trade (growth)	Annual growth rate	WEO
	Industrial production (growth)	Annual growth rate	GDS
	Commodity prices (growth)	Annual growth rate	GDS
Country characteristics			
	Financial openness	Foreign assets plus liabilities divided by GDP	Lane and Milesi-Ferreti (2006)
	Trade openness	Exports plus imports divided by GDP	WEO
	Current account balance	Percent of GDP	BOPS
	Fiscal balance	Percent of GDP	WEO
	Gross foreign reserves	Percent of GDP	BOPS
Financial and trade linkages			
	Bank linkages	Gross liabilities to advanced regions in percent of emerging economy GDP.	BIS, Locational and Consolidated Banking Statistics
	Portfolio linkages	Gross liabilities and assets vis-à-vis advanced regions in percent of emerging economy GDP.	IMF, Coordinated Portfolio Investment Survey
	Direct investment linkages	Gross liabilities to advanced regions in percent of emerging economy GDP.	OECD, International Direct Investment Statistics
	Trade linkages	Total exports to advanced regions (as reported by advanced economies) in percent of emerging economy GDP.	IMF, Direction of Trade Statistics

Figure 1. Sudden Stops of Capital Flows and Effects on the Real Economy



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

Figure 2. Financial Stress in Emerging Regions and by Components
(Purchasing-power parity weighted average)



Source: Authors' calculations.

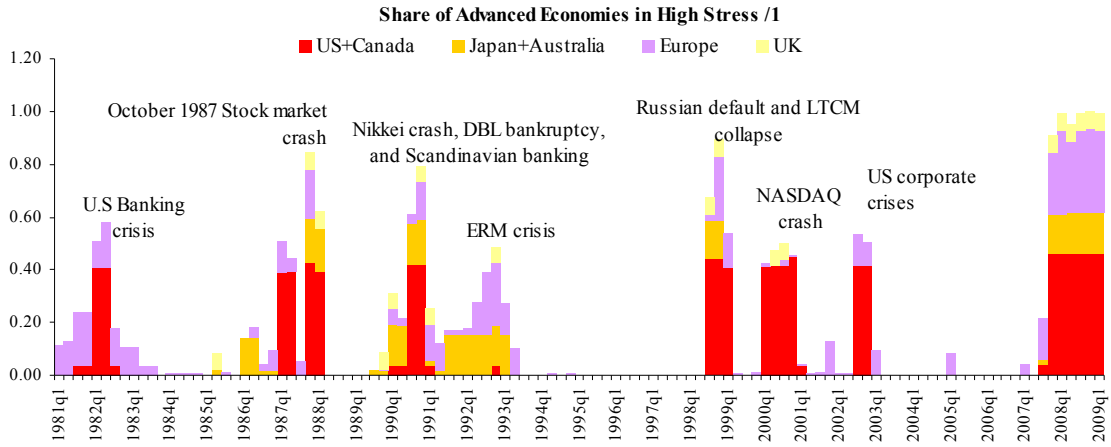
Emerging Asia: China, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Sri Lanka, and Thailand.

Emerging Europe: Czech Republic, Hungary, Poland, Romania, Slovak Republic, and Slovenia.

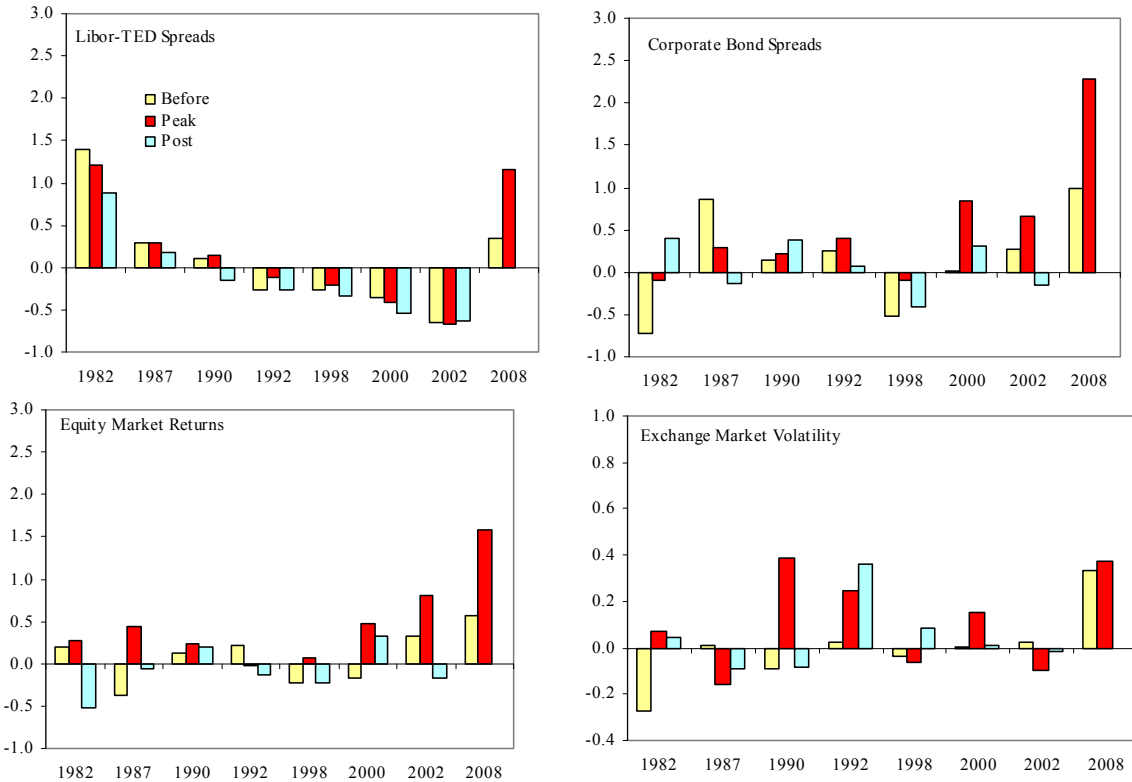
Latin America: Argentina, Brazil, Chile, Colombia, Mexico, and Peru.

Other emerging economies: Egypt, Israel, Morocco, Russia, South Africa, and Turkey.

Figure 3. Financial Stress in Advanced Economies



Intensity of Stress during Episodes of Widespread Financial Stress /2



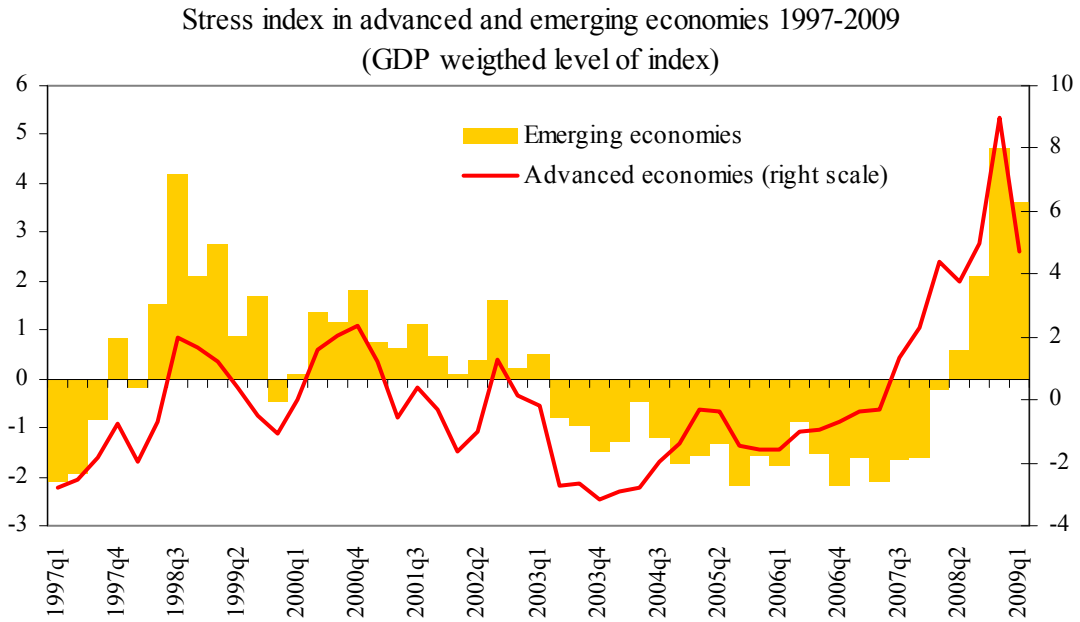
Source: Authors' calculations.

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

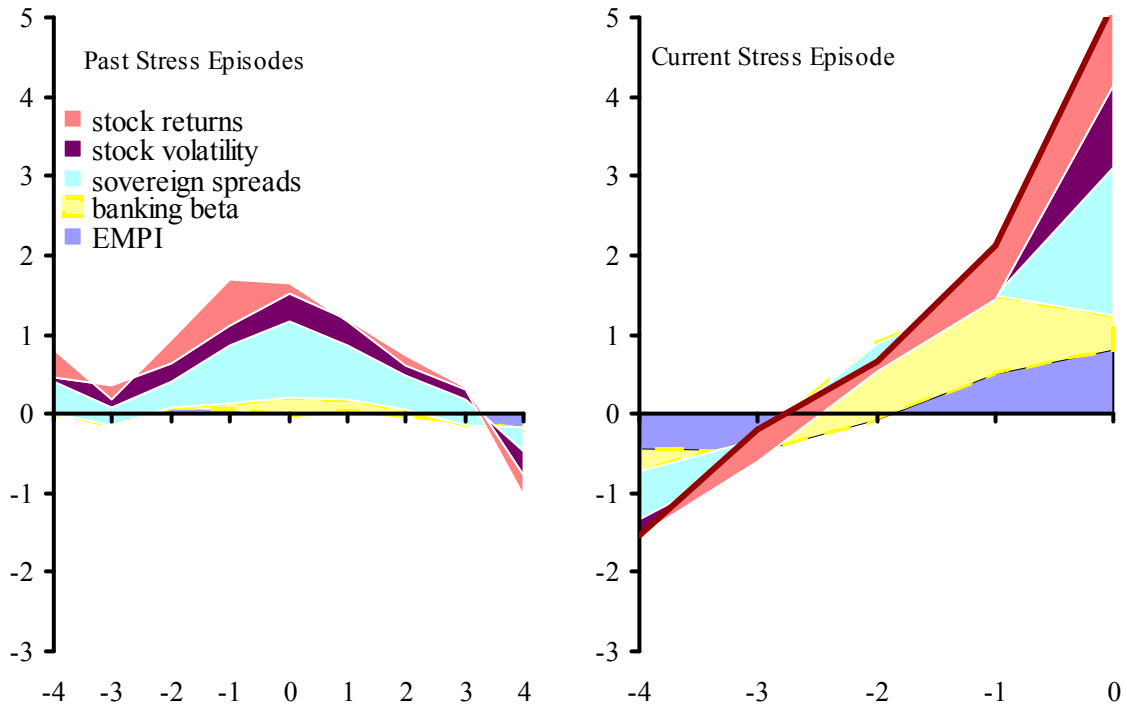
1/ High stress defined as a stress index level of one standard deviation above its trend. Widespread stress is defined as periods during which 50 percent of advanced economies' GDP was in high stress. A total of seven episodes were identified with peak stress dates in 1982, 1987, 1990, 1992, 1998, 2000, 2002, and 2008.

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

Figure 4. Financial Stress in Emerging and Advanced Economies



Stress in Emerging Economies during Periods of Widespread Stress in Advanced Economies / 1



Source: Authors' calculations.

1/ Peaks in 1998:Q4, 2000:Q4, and 2002:Q3. Peak assumed in 2008:Q4.

Figure 5. The Transmission of Stress: Schematic Depiction of Effects

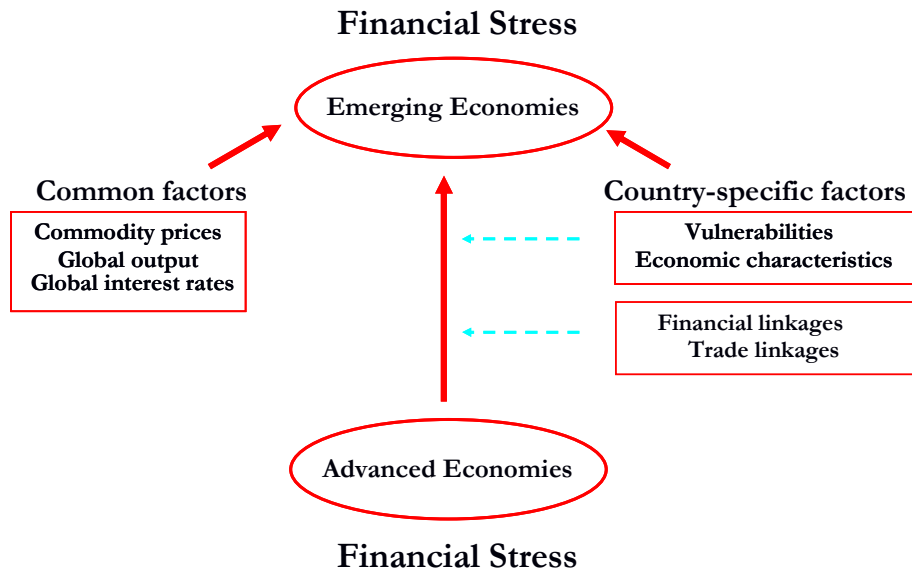
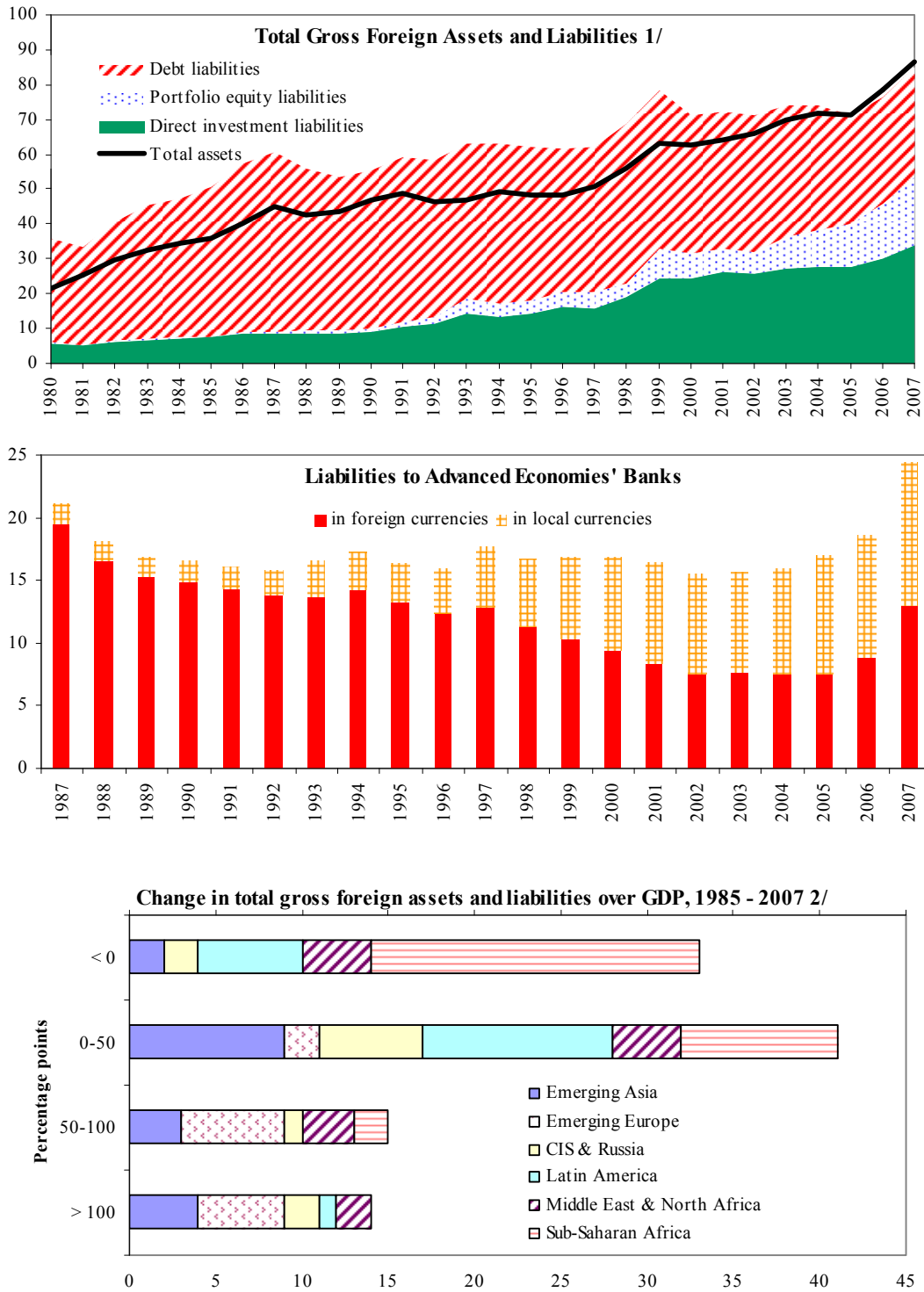


Figure 6. Financial Integration of Emerging and Developing Economies

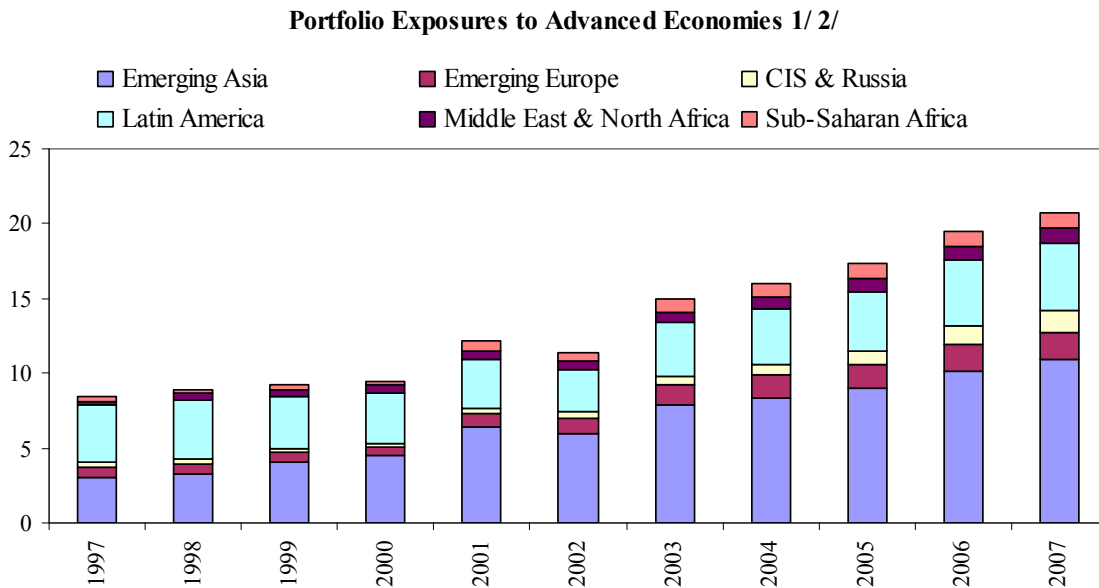
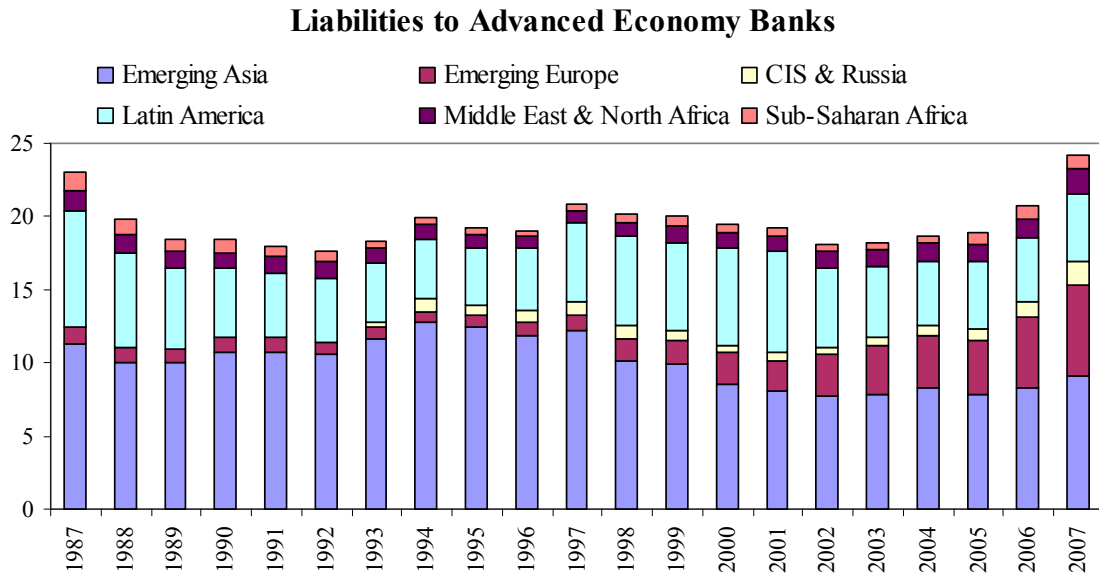


Sources: Bank for International Settlements; Lane and Milesi-Ferretti (2006); and authors' calculations.

1/ Total assets include foreign exchange reserves.

2/ 1995–2007 in the case of emerging Europe and Commonwealth of Independent States and Russia. Total foreign assets exclude foreign exchange reserves.

Figure 7. Financial Exposures of Emerging to Advanced Economies
(Percent of emerging economies' GDP)

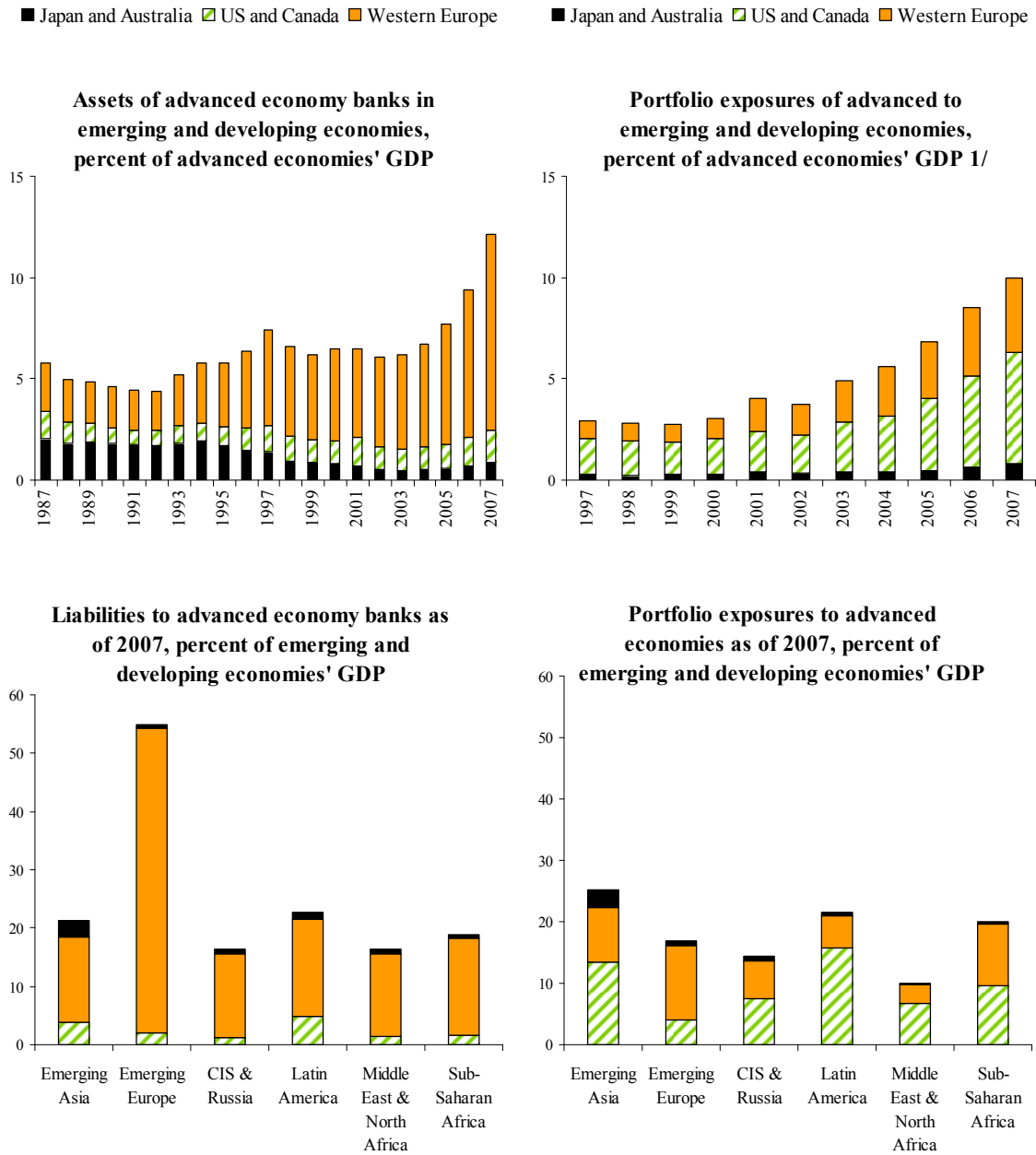


Sources: Bank for International Settlements; IMF, Coordinated Portfolio Investment Survey; and authors' calculations.

1/ Including liabilities and nonreserve assets.

2/ The data for 1998, 1999, and 2000 are based on interpolations.

Figure 8. Financial Linkages Between Advanced and Emerging Economies

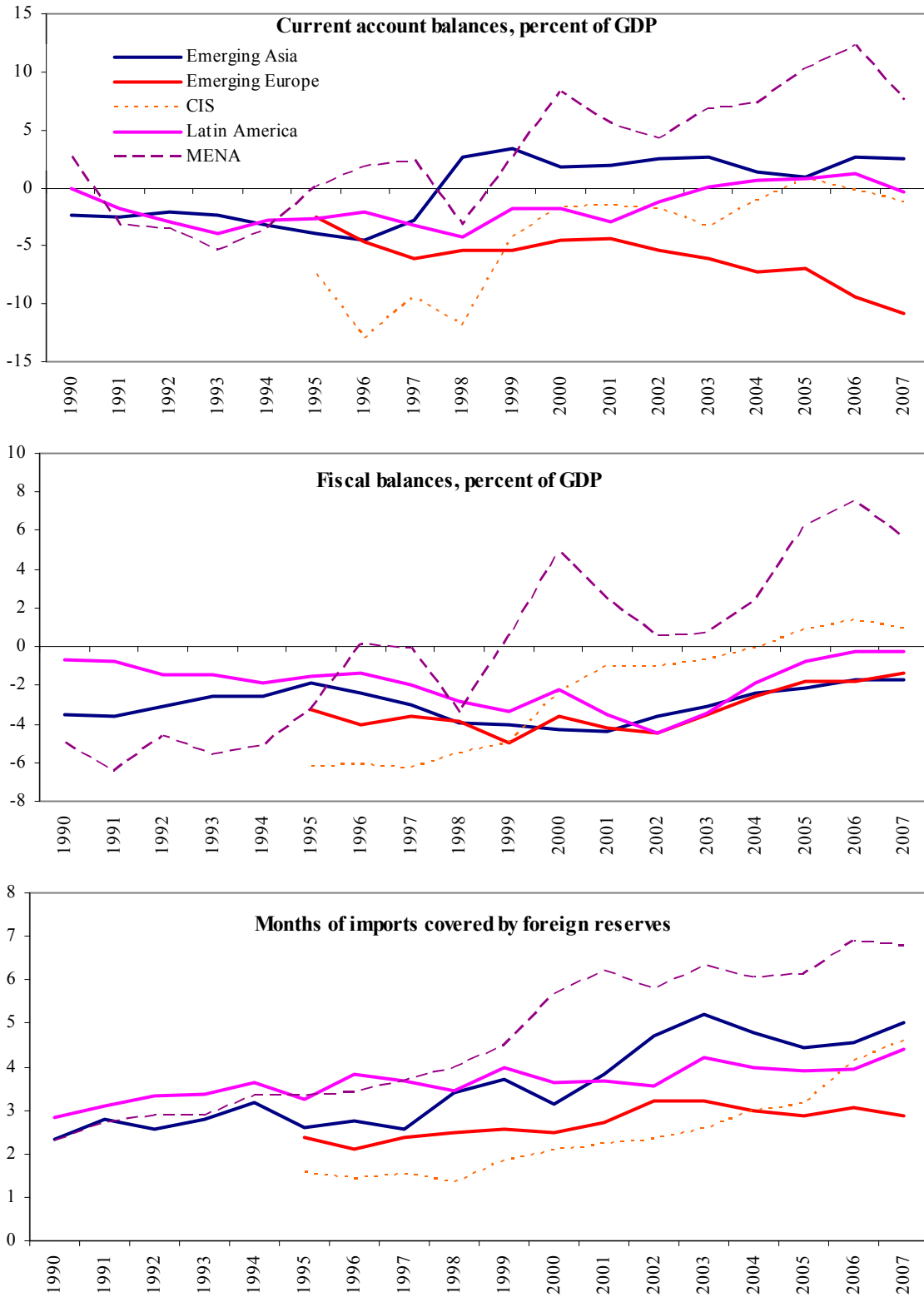


Sources: Bank for International Settlements; IMF, Coordinated Portfolio Investment Survey; and authors' calculations.

Notes: CIS = Commonwealth of Independent States. Bank linkages are measured excluding Australia, Denmark, and Norway. Portfolio linkages exclude Finland, and also Germany and Switzerland prior to 2001.

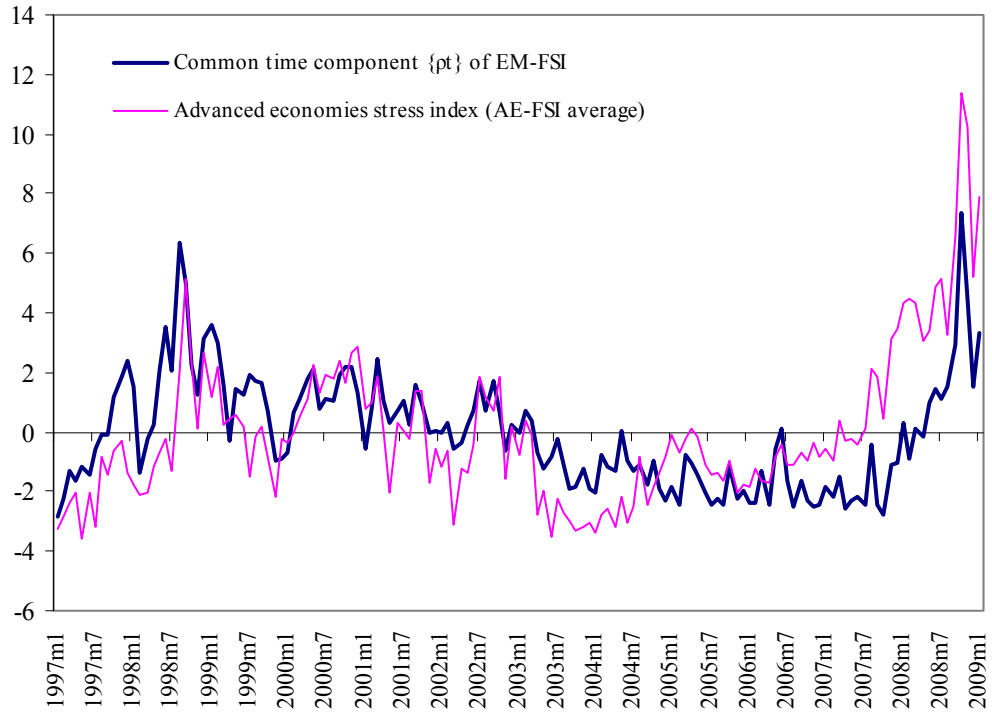
1/ Including liabilities and non-reserve assets. The data for 1998, 1999, and 2000 are based on interpolations.

Figure 9. Vulnerability Indicators by Region, 1990–2007



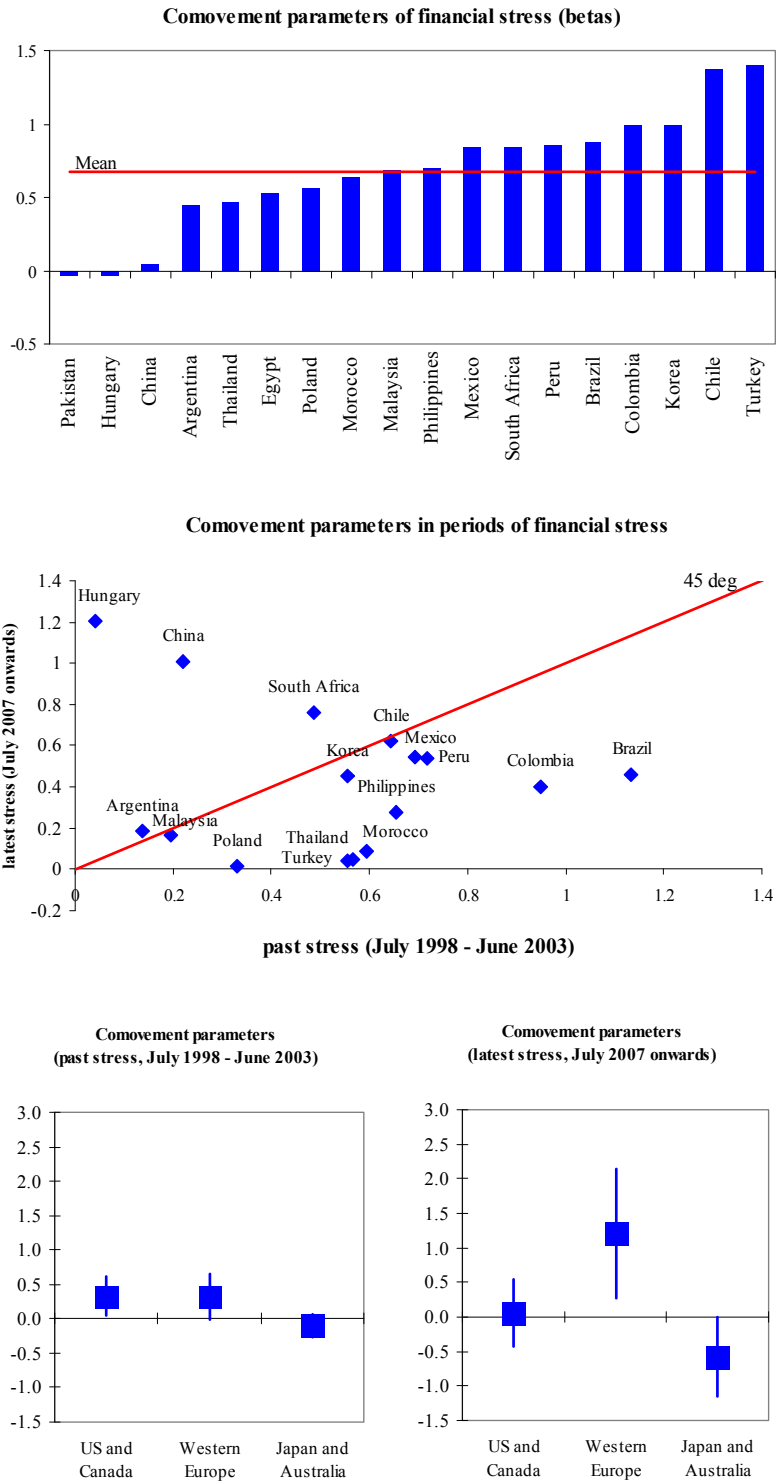
Sources: IMF, Balance of Payments Statistics; and authors' calculations.

Figure 10. Emerging Economy Stress: Common Time Component and Stress in Advanced Economies (*Level of index*)



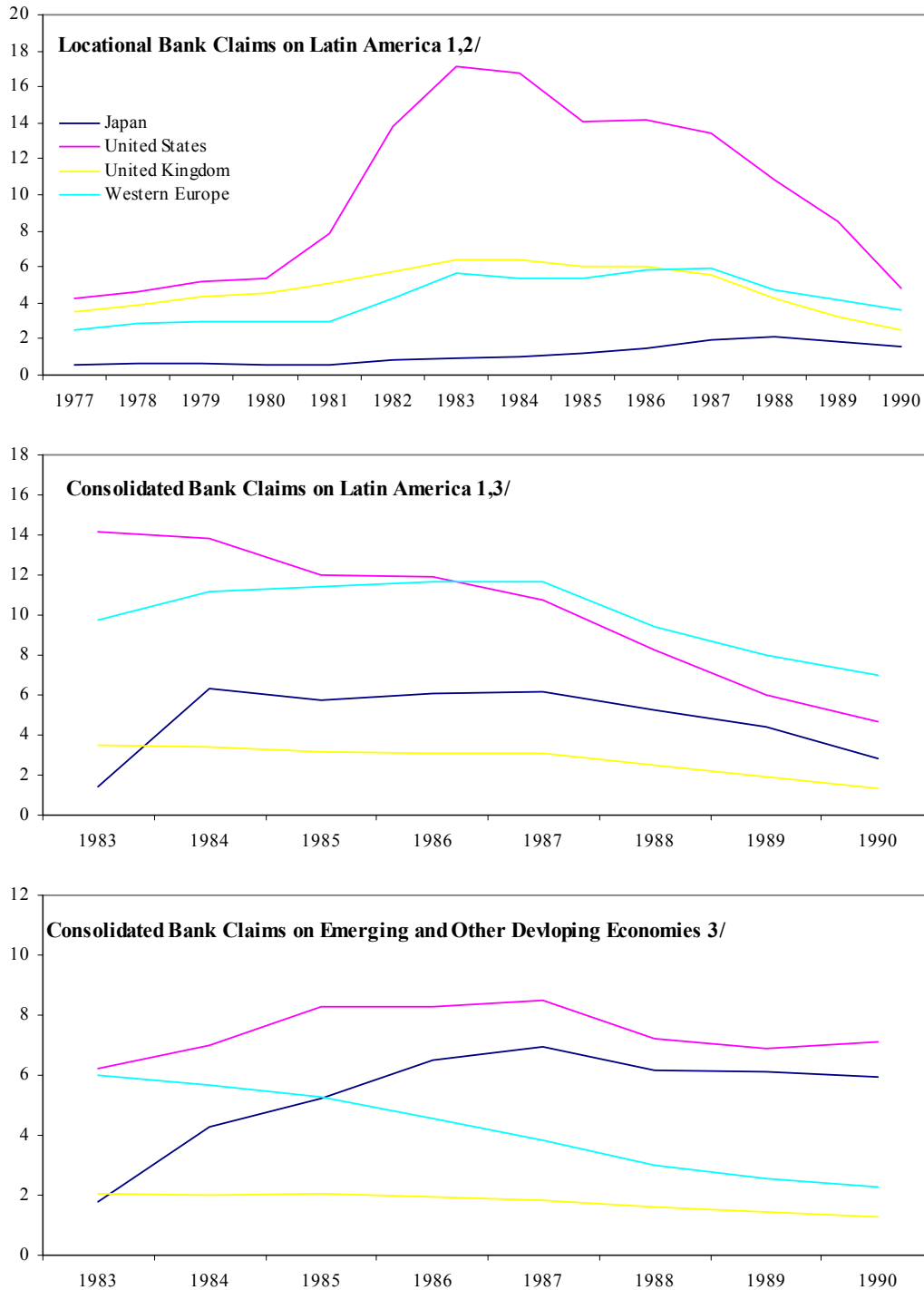
Source: Authors' calculations.

Figure 11. Comovement in Financial Stress Between Emerging and Advanced Economies



Source: Author's calculations.

Figure 12. Impact of the Latin American Debt Crisis on Banking Liabilities



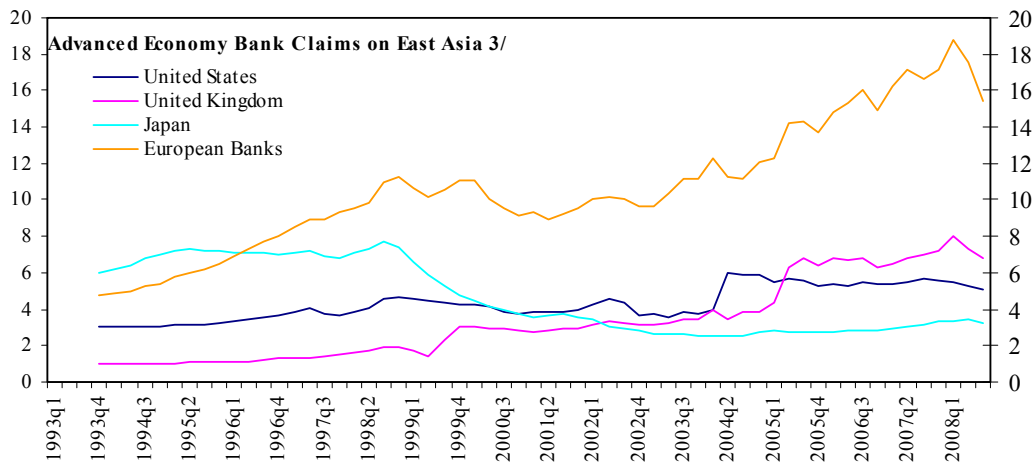
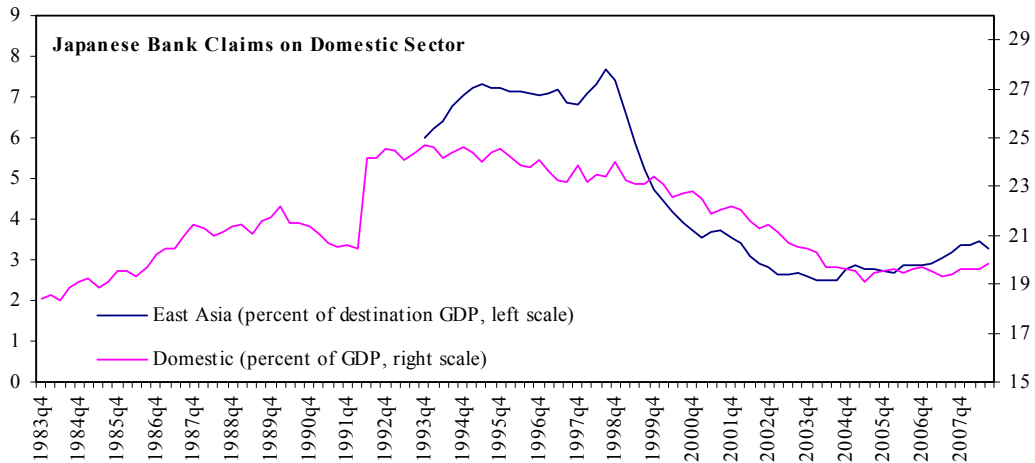
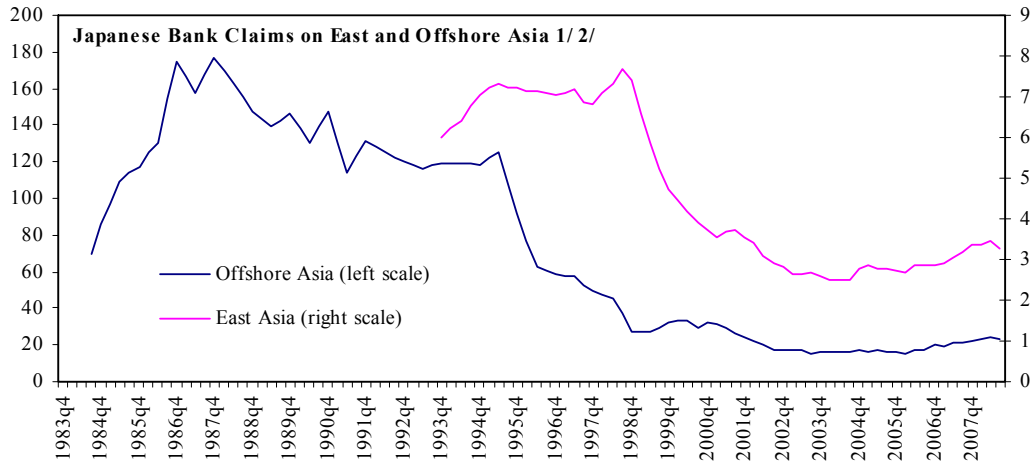
Sources: Bank for International Settlements (BIS); and authors' calculations.

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.

Figure 13. Impact of the Japanese Banking Crisis on Bank Lending



Sources: Bank for International Settlements (BIS); and authors' 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.