Crisis spillovers in emerging market economies: interlinkages, vulnerabilities and investor behaviour

Michael Chui[†]

*Simon Hall**

and

*Ashley Taylor**

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[†] Currently Hong Kong Monetary Authority. Research completed while at Bank of England.
* Bank of England.

E-mail: simon.hall@bankofengland.co.uk

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Abstract

Many emerging market economy (EME) financial crises in the 1990s quickly spread to other countries. By contrast, spillovers from the Argentina crisis in 2001-02 appear to have been much more limited. Why do some crises spread widely and others do not? This paper stresses the joint importance of intra-EME linkages, related country-specific vulnerabilities and investor behaviour. This framework provides insights into some potential reasons behind the differing extent of spillovers in two case studies—Asia 1997-98 and Argentina 2001-02. It also highlights the need for further analysis of the less easily measurable elements of the framework, in particular changes in investor behaviour.

Summary

Many emerging market economy (EME) financial crises in the 1990s quickly spread to other countries. By contrast, immediate spillovers from the Argentina crisis in 2001-2002 were much more limited. Why do some crises spread quickly and widely, while others are constrained to only a few countries? How is financial distress transmitted across countries? Do crises spread purely to countries with existing vulnerabilities? And can individual EMEs or the international community do anything to limit the potential for shocks to have harmful effects elsewhere? To address these questions, we need to enhance our understanding of how crises can be propagated.

Drawing on elements of both the contagion and early-warning system literature we propose a simple methodology for assessing potential spillovers to EMEs from crises elsewhere which stresses the joint importance of intra-EME linkages, related country-specific vulnerabilities and investor behaviour. The first element is an assessment of the potential for shocks to pass from a crisis economy to other EMEs through real and financial interlinkages, both directly and indirectly through third economies. Obviously, an examination of these *ex-ante* linkages can only offer a first pass at assessing potential for shock transmission: in some crises new (or strengthened) linkages will open up, for example, when investors reassess the fundamental vulnerabilities of EMEs following a crisis elsewhere; in other cases pre-existing linkages may turn out to be less important in crisis dynamics than expected. The second component is an examination of specific vulnerabilities of EMEs to shocks potentially transmitted from a crisis EME. Other important factors, which are more difficult to quantify *ex ante,* include the potential responses of policy-makers and investors to the initial shock and crisis transmission.

This framework provides insights into the reasons for different spillovers in two case studies—Asia 1997-98 and Argentina 2001-02. These studies suggest that the framework might be a useful starting point for assessing the likelihood of a crisis spreading from one EME to another. However, our case studies also highlight what we do not know about the spread of crises. Actual crisis dynamics are affected by a much wider range of factors. Some crises spread through mechanisms we have not been able to measure. For example, we have limited information on non-bank financial channels. And even for bank channels, theory offers us little guidance on how creditors will adjust their lending in the event of losses on part of their portfolio due to an EME crisis. Further work in these areas might shed light on the evolution of recent crises, help provide forward-looking tools for spotting incipient future crises, and potentially help policy-makers to identify measures that might prevent them.

1 Introduction

Emerging market economy (EME) financial crises in recent years have sometimes quickly spread to other countries. For example, in the Mexican crisis of 1994-95, the East Asian crisis of 1997-98, and the Russian crisis in 1998, seemingly isolated problems in a core of countries—whether manifested as a stock market crash, a banking panic, a balance-of-payments crisis, or a mixture of all these—spilled over elsewhere. By contrast, spillovers to other EMEs from recent crises in Turkey and Argentina were much more limited.

Why do some crises spread quickly and widely, while others are constrained to a narrow group of countries? How is financial distress transmitted across countries? Do crises spread mainly to countries with existing vulnerabilities? And can individual countries or the international community do anything to limit the potential for shocks to have harmful effects elsewhere? To address these questions, we need to enhance our understanding of how crises can be propagated.

A huge volume of theoretical and empirical research has been published in recent years both on contagion and crisis indicators.(1) The empirical literature on contagion has mainly focused on the broad questions of whether it actually exists and, if so, how it operates. Results from these studies on the incidence of contagion and alternative propagation channels have varied widely, in part reflecting different views of how to define contagion and how to model the transmission of shocks. The crisis indicators literature has identified a range of macroeconomic and balance sheet vulnerabilities which have potential to forewarn of crises, although the forecasting performance of the so-called 'early-warning systems' is at best mixed. This paper does not attempt to define or measure contagion, nor does it offer a new measure of country vulnerability. Instead it aims to draw on elements of both these literatures to propose a systematic surveillance framework for assessing the potential vulnerability of EMEs to spillovers from crises elsewhere. While traditional early-warning studies can help to spot countries most vulnerable to crisis, our work attempts to pick out those countries that might be 'second-round casualties' of a crisis elsewhere, given their own vulnerabilities and linkages to the 'ground zero' crisis economy.

The paper sets out to assess why spillovers from EME crises might have varied through time. In particular, it proposes a simple surveillance framework for assessing those EMEs most at risk from crises elsewhere. Section 2 sets out our organising framework for analysing contagious crises, based around a simple shock, transmission channel, vulnerability and impact framework

(1) On the former, see for example, IMF *WEO* (1999) and Claessens and Forbes (2001); on the latter, see Chui (2002) and the IMF *Global Financial Stability Report* (2002).

which we illustrate with a simple model. It also summarises potential theoretical underpinnings for the various elements of this framework. Section 3 reviews empirical work assessing the relative importance of alternative transmission channels in past crises. Section 4 outlines how previous studies have measured the potential for spillovers and calculates a range of easily measurable trade and bank lending linkages across EMEs. Section 5 then considers whether the strength of these linkages, together with country vulnerability indicators, help us *ex post* to rationalise crisis spillovers (or their absence) in the Asia and Argentine EME crises. We use this to assess the potential value of the framework as a surveillance tool. This section also considers how changes in investor behaviour can add to, or reduce, the extent of crisis spillovers. Section 6 draws out some potential policy implications and conclusions.

2 A framework for assessing external vulnerability

This section sets out a very simple analytical framework which views crisis spillovers as emanating from an initial external shock which is transmitted to other countries through real or financial channels. The impact of this shock will depend upon the vulnerability of recipient EMEs to the specific shock as well as any responses by policy-makers and investors.(2)

Shocks

Shocks may vary in type. First, they may be common to several EMEs or may be country-specific. Examples of common shocks might include a macroeconomic shock in a major economy—such as a change in US interest rates or a depreciation of the yen—which has potential widespread implications for EMEs. Masson (1998) describes such shocks as 'monsoonal'. Country-specific external shocks might involve currency adjustment or a financial collapse in a strong trade or financial partner. Second, shocks may be fundamentals-based or may result from seemingly exogenous shifts in investor behaviour, including changes in 'risk appetite'. Within the latter category, the potential for so-called 'sunspot crises'—where agent behaviour leads an economy to shift from a good to a bad equilibrium—has been highlighted in second-generation currency crises models (see Obstfeld (1986, 1994)).

To illustrate the transmission of such external shocks, consider the following simple stylised representation of disturbances to output in an EME:

$$y = \bar{y} + \chi t + \alpha r^{k} + \delta y^{*} + \beta g \qquad \textbf{(1)}$$

(2) Our approach is similar to that of De Bandt and Hartmann (2000) who characterise systemic crises as shock-propagation-crisis.

where actual output (y) equals potential output ($\bar{y}$) plus the effects of a combination of disturbances.

Specifically, disturbances may arise from shocks to the relative price of tradables (t), to the cost of finance (r^k), to foreign income (y^*) and to exogenous domestic expenditures (g). For simplicity we consider a linear model, although clearly these shocks may interact. The coefficients χ, α, δ, and β represent the responsiveness of domestic output to the respective shocks. With the obvious exception of exogenous domestic expenditures, these output disturbances may reflect the impact upon the EME of external shocks. The two main propagation mechanisms of such shocks are trade and financial channels.

Propagation mechanisms

The output of an EME may be affected by an adverse shock in a major external trade partner or by a crisis in another economy with which it has trade linkages. These trade effects may occur with a lag. But the expectation of their effects may have an immediate impact upon local asset markets as growth prospects are revised downwards.

There are a number of potential trade channels. A 'competitiveness effect' may arise if the initial crisis economy devalues its currency. The resulting relative price change reduces the competitiveness (both bilaterally and in common export markets) of tradables produced by other economies. This effect is captured for the economy in our stylised model through movements in the relative price of tradables t (equation **(2)**).

$$t = w\, s' \qquad \textbf{(2)}$$

with $w=(w_1,w_2,\ldots,w_n)$ and $s=(s_1,s_2,\ldots,s_n)$.

The vector t reflects changes to bilateral common currency relative unit costs of tradable goods (s). These changes are weighted by w_j to capture both direct and indirect trade interlinkages to the economy in crisis (ie through bilateral and common external markets). The quasi-elasticity χ (in equation **(1)**) indicates the sensitivity of total domestic income to shifts in the relative price of tradables (ie vulnerability to terms of trade shocks). As discussed below, pre-existing external vulnerabilities—such as substantial current account deficits—might increase the response of output to trade shocks (a shift in χ)—for example, if it raises concern about the sustainability of the trade position.

Trade shocks can also be transmitted through reductions in income in a crisis economy which may reduce its demand for imports from all other economies. This effect can be captured in our

model through a disturbance to foreign income, y^* (equation **(3)**). Changes in foreign incomes might also affect finance supply to the EME. The latter could also operate through the foreign interest rate terms in the vector r^k in equation **(4)** below, depending on whether finance is rationed by quantity or by price. The impact of disturbances to individual foreign incomes will depend on their importance in trade or finance supply (with subscripts T and F respectively) to the EME, as represented by the components of the vector δ:

$$\delta = \left(\delta_{T1} + \delta_{F2}, \quad \delta_{T2} + \delta_{F2}, \quad \cdots, \quad \delta_{Tn} + \delta_{Fn}\right), \text{ and } y^* = \begin{pmatrix} y_1^* \\ y_2^* \\ \vdots \\ y_n^* \end{pmatrix} \qquad \textbf{(3)}$$

Several theoretical models draw on the currency crisis literature to show how trade spillovers might lead to secondary balance of payments crises. For example, Gerlach and Smets (1995) have extended a traditional 'first-generation' balance of payments crisis model to a three-country setting to show how a speculative attack and depreciation of one currency can spill over to trade partners. In their model, a forced depreciation of one currency affects the competitiveness of the other economies whose currencies are fixed, and this can increase speculative pressure and potentially lead to the collapse of their currencies. They show that spillover effects are more potent the stronger are trade linkages and the lower the degree of real and nominal wage flexibility. The former factor relates to propagation mechanism for shocks; the latter reflects the vulnerability of economies to transmitted shocks.(3)

Transmission of shocks through financial channels has received increasing attention in recent years. Theoretical models typically explore how crises can be propagated by the responses of creditors/investors with multi-country exposures ('common creditors') to shocks to part of their portfolio. In terms of equation **(1)**, financial shocks may occur via r^k (a generic disturbance term for cost of finance influences on output). In addition, as discussed above, it may also happen through y^*, if foreign income shocks affect the supply of foreign finance.

Disturbances to total financing costs might arise from shocks to the cost of either domestic or overseas finance—represented by a vector r (see equation **(4)**). For overseas shocks, a distinction may again be made between direct and indirect shocks. For example, a rise in US interest rates might represent a common and direct external shock. Alternatively the finance shock may be indirect, for example, if a crisis in one EME resulted in international creditors

(3) Corsetti, Pesenti, Roubini and Tille (2000) also stress that competitiveness effects can either operate bilaterally or through competition in third markets.

changing their required return on exposures to other EMEs. The likelihood and extent of such readjustments may depend on the balance sheet vulnerability of the common creditor.

$$r^k = \psi\, r \qquad \textbf{(4)}$$

where $\psi = (\psi_d, \psi_{f1}, \ldots, \psi_{fn})$, $r = \begin{pmatrix} r_d \\ r_{f1} \\ \vdots \\ r_{fn} \end{pmatrix}$

and the domestic interest rate (r_d) is included as an alternative source to foreign financing.

The impact of shocks to the costs of different finance sources will depend on an EME's sensitivity to each. In our stylised economy this can be represented by a vector ψ—which represents the share of each finance source in total finance. The impact on output of shocks to finance costs depends on α, the responsiveness of interest-sensitive expenditures. This quasi-elasticity parameter in turn may depend on structural features of the corporate sector. For example, if corporate balance sheets are already heavily indebted, a shock to the cost of finance may have a greater impact on investment and output.(4)

Various theoretical models have been proposed to explain crisis propagation via financial channels. One set of models has examined the role of liquidity shortages in crisis spillovers. For example, Garber and Grilli (1989) and Valdés (1997) have extended the Diamond-Dybvig (1983) bank-run model to an international setting. In these models, a bank run in one country can lead to fire sales of long-term assets in a second country to replenish investor liquidity. This can lead to capital outflows in the second country and ultimately a secondary crisis. Similarly, Allen and Gale (2000) have considered overlapping claims of different regions within the international banking system. When one region suffers a banking crisis, the other regions suffer a loss because their claims on the troubled region fall in value. In extreme cases, a crisis can pass from region to region. Empirical models of crisis spillovers, discussed below, often consider the potential for crisis transmission via this sort of behaviour by common international creditors to EMEs, although typically the precise underlying theoretical mechanism is not specified.

(4) Financial accelerator models suggest that balance sheet vulnerabilities can affect the impact of changes in finance costs on investment (see, for example, Bernanke *et al* (1999)).

Other models have focused on co-ordination failure among creditors particularly in an environment of incomplete and/or asymmetric information.(5) For example, Calvo and Mendoza (2000) have analysed crisis spillovers in global capital markets using a model of financial herding by Banerjee (1992). They assume that investors face a fixed country-specific information cost and a variable performance benefit (cost) of obtaining a mean portfolio return higher (lower) than the mean return on the market portfolio. They show that investors' incentives to follow the herd rather than gather country-specific information grow stronger as the world capital market expands. Small rumours can trigger herd behaviour among investors, and shift an economy from a good equilibrium to a bad one, with large capital outflows unrelated to economic fundamentals. For example, a sudden crisis in one country may lead investors to reevaluate the potential for crisis elsewhere—this 'wake-up call' may lead uninformed investors to withdraw funds independent of developments in fundamentals. Our shock, linkages and vulnerabilities framework may be less helpful in identifying countries at risk when this 'pure contagion' behaviour plays an important role in crisis dynamics.(6)

Vulnerabilities

Strong linkages may predispose a country to external shocks but are not a sufficient condition for crisis: the responses of investors and policy-makers and country-specific vulnerabilities are likely to be the arbiters of whether a shock in one EME leads to a crisis in another.

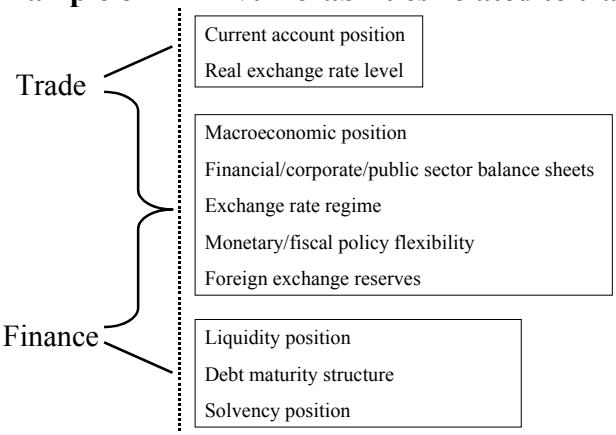
The financial position of creditors may play a key role in their response to shocks to their EME portfolio and the cross-country propagation of shocks. For example, sound initial investor balance sheets may act as a buffer, helping prevent shocks in one EME being passed on elsewhere. Conversely, investors with weak and/or highly leveraged balance sheets may react more to shocks, and potential propagate crisis. Similarly, the reaction of policy-makers to any incipient crisis will be critical: sound initial fiscal and monetary positions and credible policy frameworks provide policy-makers with greater flexibility to respond to shocks.

The susceptibility of EMEs to external shocks will also depend on domestic vulnerabilities. In our stylised economy, the likelihood of shocks leading to output disturbances depend on the

(5) Schinasi and Smith (2000) demonstrate using a textbook portfolio allocation model how leveraged investors will reduce their investments in many risky assets when hit by an adverse shock. Calvo and Mendoza (2000) emphasise, however, that contagion only occurs under a combination of information asymmetry and particular institutional or regulatory features of financial markets. For example, the gain of paying for costly country-specific information declines as the market grows only if investors face binding short-selling constraints.
(6) Masson (1998) defines pure contagion as shifts in agents' expectations unrelated to changes in a country's macroeconomic fundamentals.

structural characteristics represented by the vector of parameters in equations **(1)** to **(4)**.[7] Open EMEs will be sensitive to terms of trade shocks while an EME that sources most of its finance externally will be more exposed to international credit supply shocks. Country vulnerabilities related to the type of shock transmitted may determine whether a secondary crisis develops. For example, for trade shocks initial external accounts and domestic growth positions are likely to determine potential for spillovers (see Diagram 1). Similarly, for financial shocks initial liquidity positions and the maturity structure of debt obligations will be important.[8] Other fragilities not explicitly identified in the stylised economy above are also likely to be relevant. For investor 'herding' channels of crisis transmission, discussed above, financial and/or macroeconomic similarities between an EME and a crisis EME may be a further fragility in a world of incomplete information.

Diagram 1
Example of EME vulnerabilities related to trade or financial spillover channels



Crisis early-warning models typically include a range of these (and other) indicators of vulnerability to crisis.[9] However, most EWS models tend not to relate an EME's potential exposure to shocks (eg its linkages to crisis economies) to their vulnerability to such shocks; those that do, typically restrict themselves to inclusion of regional dummies and/or 'crisis' indicator variables.[10] The discussion above on trade and financial linkages indicates that the

(7) The impact of shocks on output volatility will also depend on variances and covariances between different shocks.
(8) Sachs *et al* (1995) stress the role of short-term debt in crises.
(9) Chui (2002) highlights the most commonly used indicators in these studies, together with the economic rationale for their inclusion. In summary, these models often include external vulnerabilities such as real effective exchange rate over/undervaluation, the current account position, trade openness, foreign exchange reserve cover, the external debt burden and its maturity, and the extent of capital controls. Domestic vulnerabilities include growth and employment trends, fiscal positions and monetary conditions. And following the banking and currency crises in Asia, indicators of financial system fragility have also been used.
(10) There are some exceptions. Caramazza *et al* (2000) include an interaction term between the current account and a trade linkage variable which they find to be significant. Others, such as Kaminsky and Reinhart (2000), have controlled for fundamentals first, and then examined linkage variables.

forecasting performance of these models might potentially be enhanced by efforts to more explicitly model which vulnerabilities matter for which country given their varying susceptibility to different types of external shock. Our framework potentially complements EWS models by offering a more structural assessment of whether linkages and vulnerabilities together make a country vulnerable to crises elsewhere.

3 Empirical evidence on spillover channels

What empirical evidence is there on the relative importance of different shocks, transmission mechanisms and vulnerabilities? Results are mixed, varying with the time period considered in studies, the way propagation channels are quantified and the measure of spillover adopted.(11) As noted above, most studies have not jointly tested the importance of specific linkages and relevant vulnerabilities. Taken together, this all complicates interpretation of results on the relative importance of alternative channels.(12)

Despite these caveats, some general conclusions can be drawn (Table A summarises some key findings). Eichengreen *et al* (1996), Glick and Rose (1999) and Hernandez and Valdes (2001) find a role for trade linkages in a wide cross-section of countries over the past three decades, but less evidence for a role for financial linkages. However, the former two results may reflect the inclusion in these studies of developed market crises where trade interlinkages have historically been stronger than in emerging economies. It may also reflect lower relative levels of financial integration in previous decades.

Studies focusing explicitly on EMEs and covering more recent time periods have found a greater role for financial interlinkages. In the absence of comprehensive data on overall financial interlinkages across economies, many studies of financial channels have focused on cross-border bank lending linkages, particularly those operating via major common lenders. For example, Caramazza *et al* (2000) found that common bank creditor indicators had a significant impact on the probability of crises while the trade channel was weak.(13) Van Rijckeghem and Weder (2001) found evidence of common lender effects during the Thai, Mexican and Russian

(11) For a more comprehensive discussion see Pericoli and Sbracia (2001).
(12) The results are also complicated by data characteristics and econometric problems with the various techniques that have been used. See, Rigobon (2001) for a comprehensive review.
(13) Using the industrial economy sub-sample they are unable to replicate some of the results of Eichengreen *et al* (1996), which they report may suggest a significant difference in the nature of crises between developing and emerging economies.

crises.[14] Moreover, they find that trade linkages are in general significant when tested in the absence of common creditor linkages but not always after controlling for common creditor channels. Kaminsky and Reinhart (2000) argue that financial linkages help explain spillovers to Argentina and Brazil in the 1994 Mexican crisis and to Indonesia after the 1997 Thai devaluation as trade links were relatively weak in both cases. However, they note that it is difficult empirically to differentiate between the impact of financial and trade linkages as most countries that are linked in trade are also linked in finance.

Table A
Selected empirical evidence on crisis spillovers

Study	Data	Methodology	Results
Caramazza *et al* (2000)	20 industrialised economies and 41 EMEs. Data from 1990-98.	Pooled probit with exchange market pressure (EMP) indicator.	Common creditor indicators and financial weakness (particularly reserve adequacy) have significant impact on the probability of a crisis having controlled for fundamentals and trade linkages.
Eichengreen *et al* (1996)	20 industrialised economies. Data from 1959-93.	Pooled probit with EMP crisis indicator.	Contagious currency crises spread mainly as a function of trade links rather than through macro similarities.
Forbes (2001)	58 economies (around half developed, half EME). Data from July 1994 to June 1999.	Pooled regression of average weekly abnormal stock returns in crisis periods (which are defined by an EMP indicator).	Three trade linkage measures are tested (see Box A for definitions)—the 'competitiveness' effect is always negative and highly significant; the income effect negative and significant; and the cheap import effect is positive but usually insignificant. The EME policy response to a crisis is a key determinant of the significance of these effects.
Fratzscher (2000)	24 EMEs (Asia, Latin America and Europe). Data from 1986-98.	VAR of continuous EMP on fundamentals and other EMEs' lagged EMP weighted by interlinkage indicators. Univariate and random effects panel used. Linear and non-linear Markov switching models are tested.	Univariate case: Coefficients for financial interlinkages and (sometimes) trade linkages are large and significant. Panel approach: Financial interlinkages (especially equity market interlinkages) and trade linkages are significant after controlling for fundamentals. Financial channels appear particularly strong within Asia but less significant for Latin America.
Glick and Rose (1999)	161 countries (developed and EME). Data covering crisis episodes 1971 to 1997-98.	Pooled probit with EMP crisis indicator and OLS regression on continuous EMP indicator.	Trade channel appears consistently important in explaining the incidence of crisis and also, from the regression on a continuous EMP indicator, the intensity of crisis.
Hernandez and Valdes (2001)	17 EMEs for equity indices and 8-14 countries for EMBI data. Three months of weekly data around each of the Thai, Russian and Brazilian crises.	Pooled regression of financial market variables on corresponding variables in other economies weighted by a transmission channel indicator.	Bond spreads and local equity prices are used as dependent variables. Using bond spreads: With competing channels, trade competition coefficient is not significant from zero. Common creditor effects are a more important channel. The absolute competition for funds measure (see Box B for definitions) is most relevant for the Thai crisis; the relative measure is more relevant for crises in Russia and Brazil. Using equities: Financial competition effects are significant in all crises. Trade and regional effects important in the Thai and Brazilian crises.
Kaminsky and Reinhart (2000)	20 countries—Asian and Latin American EME and 5 industrialised economies. Data from 1970-98.	Probabilistic (score-based) approach.	When there is a high proportion (over 50%) of contemporaneous crises, conditioning on financial interlinkages provides the greatest increase in probability of crises (with the common creditor greatest then market correlation measures). The improvement from conditioning on bilateral trade linkages is less. Third-party trade linkages provide a relatively small improvement on the probability conditional on crises elsewhere.
Rigobon (2001)	Bond spread data: 7 Latin American EMEs from April 1995 to July 1998. Equity data: 13 Latin American and Asian EMEs from July 1994 to end-1998.	Based on change in covariance matrices.	Trade linkage is a positive and marginally significant factor. The contribution of common shocks to the variance rises in high volatility periods. Using equity data, it is impossible to reject the hypothesis that all the coefficients on common shocks are equal to zero. With bond spread data, it is impossible to reject that the coefficient on common shocks is equal to that on the US interest rate. Also the US interest rate explains much idiosyncratic variation.
Van Rijckeghem and Weder (2001)	42-85 EMEs (varying sample size) with data covering Mexican, Thai and Russian crises.	Pooled probit using EMP crisis indicator.	Probit: Common creditor indicators are significantly associated with a higher contagion probability. Trade links are less significant (not significant at all in the Asian crisis once common creditor channels have been controlled for).

(14) Their results depend on the precise specification of their common creditor links indicator. For example, they find that an absolute funds competition index is the most highly significant indicator in the Mexican and Russian crisis, while a relative index is most significant for the Thai crisis (Box B below defines these indicators).

In recent years, there have been an increasing number of studies of non-bank financial links. For example, Froot *et al* (2001) examined State Street Bank and Trust data on daily portfolio flows into developed and emerging markets which they found to have a strong correlation across regions (which increased during the Asian crisis although not during the Mexican crisis).[(15)] They also found that flows were related to past returns in the recipient economy. Kaminsky *et al* (2000 and 2001) found similar evidence in EME mutual fund flows with spillovers to some Latin American EMEs during the Mexican crisis and broader spillovers following the Thai devaluation.

A key lesson from empirical work seems to be that results are highly sensitive to how propagation mechanisms are specified and how crisis contagion is measured.[(16)] On the latter, Hernandez and Valdes (2001) find that trade linkages are insignificant when bond spreads are indicators of crisis but significant (during some crises) when equity market variables are used. Taken together, these findings may be indicative of substantial measurement issues in calibrating interlinkages or they may simply reflect the operation of distinct channels within a generic class of linkages (for example, the relative importance of third-party versus bilateral trade linkages). Alternatively, they may reflect the varying importance of certain asset markets across EME regions—for example, greater development of bond markets in Latin America than in Asia.

In conclusion, the broad range of potential theoretical mechanisms for crisis spillovers and the mixed empirical evidence on the importance of these channels suggest that EME surveillance on potential for crisis spillovers needs to be wide-ranging. The next section uses readily available data to calculate some of the estimates of cross-EME interlinkages used in empirical studies.

(15) Forbes and Rigobon (1999) suggest that correlations are biased upwards when volatility increases and must be adjusted to obtain a true measure of spillovers.
(16) On comparisons of different trade measures, Glick and Rose (1999) find that their results are not substantially altered by different trade measures. Interestingly Van Rijckeghem and Weder (2001) find that, when testing trade channels alone, direct trade linkages are significant for the Mexico and Russian crises but it is third-market trade linkages which are significant in the Asian crisis.

4 Calibrating external linkages

This section presents a range of measures of *ex-ante* real and financial linkages, as used in past empirical work. Section 5 below combines these measures with estimates of country vulnerabilities in some simple case studies of recent emerging market crises.

Measuring trade linkages

The empirical studies of crisis propagation mechanisms through trade channels discussed in Section 3 have employed a range of measures of trade linkages, varying in their degree of sophistication, from simple estimates of a country's openness, to bilateral trade linkages with a crisis economy, through to a detailed calibration of common third-market linkages. A few studies have considered linkages using disaggregated data at industry or product level. Box A gives some examples of such measures.

Measuring financial linkages

As noted earlier, most empirical tests of financial linkages have focused on banking sector interlinkages, particularly via major international creditors. This probably reflects a desire to use consistent and readily available data across EMEs and time periods which is not always possible for non-bank financial positions. Studies have typically used the consolidated international banking statistics compiled by the Bank for International Settlements (BIS) for developed economies. These data offer a consistent source for creditor country exposures to different EMEs. But they have some drawbacks. For instance, they report exposures of BIS country banks but do not record intra-EME financial exposures. This may not matter for EMEs where a large share of EME funding comes from developed markets, but will do in cases where intra-EME lending is significant (as the recent financial spillovers from Argentina to Uruguay highlights). In terms of BIS country lending, they do not cover off-balance sheet positions, indirect exposures or offsetting guarantees.

Empirical estimates of common creditor effects can be split into two main types. 'Type I' effects measure direct lending between BIS countries and EMEs, which might provide insights on potential spillovers from banking instability in EMEs to developed economies and *vice versa*. 'Type II' common creditor effects, measuring indirect linkages between EMEs through a shared lender, are of more direct interest to our focus on EME spillovers. We follow empirical studies in interpreting this linkage as a measure of the potential for withdrawal of funds by a common creditor from other EMEs following a crisis in one part of its portfolio, although we

Box A: Indices of trade channel interlinkages

X_{ij}^{z} is exports from country *i* to country *j* in industry z. X_{i}^{z} and X_{-i}^{z} are exports and imports of country *i* in industry *z*. Country 0 is the initial crisis economy. Formulations are adaptations of originals.

Openness

The simplest measure of trade channels is openness, the ratio of total trade to GDP:

$$Openness_i \equiv \frac{X_i}{GDP_i}$$

Bilateral trade indices

Some measures of bilateral linkages simply capture the absolute size of direct trade linkages. For example, Van Rijckeghem and Weder (2001) use the share of total exports to the crisis economy:

$$Direct_i \equiv \frac{X_{i0}}{X_i}$$

Forbes (2001) use exports as a share of country *i*'s GDP:

$$Income_i \equiv \frac{X_{i0}}{GDP_i}$$

Fratzscher (2000) measures bilateral exports between an EME and a crisis economy relative to total exports:

$$Bilateraltrade_i \equiv \frac{X_{i0} + X_{0i}}{X_i + X_0}$$

Others focus on similarities in levels of trade. For example, Glick and Rose (1999) calculate a simple bilateral index which increases as bilateral exports between the two economies become closer:

$$Directtrade_i \equiv 1 - \frac{|X_{i0} - X_{0i}|}{X_{i0} + X_{0i}}$$

Third-market trade effects

Kaminsky and Reinhart (2000) use simple trade cluster dummies for third-market trade effects. Countries are classified in an Asia or a Latin American cluster on the basis of common trade patterns (for example, the relative importance of Japan and the United States as third markets respectively). A more sophisticated approach by Glick and Rose (1999) measures third-market competition between country *i* and crisis economy 0 as a weighted average of the absolute importance of third markets *k* to countries 0 and *i*. The first term is a weighting of the importance of third market *k* in total trade of countries 0 and *i*. The second term proxies for export overlap (in a manner similar to the Grubel and Lloyd (1975) measure of intra-industry trade) between countries 0 and *i* in third market *k*.

$$Trade_i \equiv \sum_k \left[\left(\frac{X_{0k} + X_{ik}}{X_0 + X_i} \right) \left(1 - \frac{|X_{ik} - X_{0k}|}{X_{ik} + X_{0k}} \right) \right], k \neq i$$

They also present a measure which captures similarities in relative trade shares:

$$Tradeshare_i \equiv \sum_k \left[\left(\frac{X_{0k} + X_{ik}}{X_0 + X_i} \right) \left(1 - \frac{\left| \left(\frac{X_{0k}}{X_0} \right) - \left(\frac{X_{ik}}{X_i} \right) \right|}{\left(\left(\frac{X_{0k}}{X_0} \right) + \left(\frac{X_{ik}}{X_i} \right) \right)} \right) \right]$$

Finally, Eichengreen *et al* (1996) use the weights in IMF real effective exchange rate indices. These weights reflect direct trade from country *i* to *j* plus the relative importance to country *j* of exports to a third country *k* (with which *i* is a major trade partner). These trade measures are weighted by relative unit labour costs.

Industry-level linkages

Several studies have attempted to capture industry-level trade effects. For example, Forbes (2001) calculates an index where the first term in the brackets captures the potential impact of crisis in one economy on industries globally. The index also has a role for vulnerability: the second term captures the exposure of economy *i* to each industry. The index is scaled relative to the maximum value in the sample:

$$Compete_i \equiv \frac{100}{MAX_{compete}} \sum_z \left[\frac{X_0^z}{\sum_i X_i^z} \times \frac{X_i^z}{GDP_i} \right]$$

Finally, Fratzscher (2000) also takes explicit account of trade at product levels. He develops an index:

- $$REAL_{ij} \equiv \sum_z \sum_k \left(\frac{X_{jk}^z}{X_k^z} \times \frac{X_{ik}^z}{X_i} \right) + \sum_z \left(\frac{X_{ik}^z + X_{ji}^z}{X_i^z + X_j^z} \right)$$

where the first term measures third market competition (*j* is a stronger competitor with *i* the larger its export market share by industry in the third market and the larger the dependence of that industry in country *i* on exports to the third market). The second term indicates the degree of bilateral trade between economy *i* and *j*.

acknowledge that theory is unclear about the behavioural response of creditors to portfolio shocks. For example, a crisis in one EME might lead the creditor to withdraw lending from large EME debtors, perhaps to replenish liquidity; it might scale back lending to all EME creditors proportionately; lending might only fall for EMEs which appear similar in risk characteristics; or there might be no response at all. It is even possible that lending to other economies might rise as the creditor withdraws from the crisis country and redeploys surplus funds elsewhere. The nature of the response is likely to depend on the balance sheet position of lenders, in particular whether the losses are sufficient to lead them to replenish capital or liquidity. Box B summarises some popular measures.

For financial propagation across non-bank channels (for example, through portfolio flows) some studies have used pre-crisis equity market correlations as a proxy for potential interlinkages between markets. For example, Kaminsky and Reinhart (2000) have identified clusters of markets with relatively high pre-crisis equity market correlations as having strong financial interlinkages. As recognised in these studies, such measures are far from perfect. For example they are based on correlations in a predefined period (and hence may not pick up increased or new financial propagation mechanisms during a crisis), they do not take into account market liquidity and they may simply reflect strong real interlinkages.

Evidence on trade linkages

How strong are trade linkages between EMEs? What is the relative importance of bilateral and third-market linkages? These questions can potentially be addressed by the IMF Direction of Trade Statistics which offers a comprehensive database on merchandise trade flows across both developed and emerging market economies.

As noted above, trade openness is perhaps the simplest measure of EME exposure to external shocks. Openness has increased substantially over time for all the major EME regions and is particularly high in economies in non-Japan Asia (with the exception of China and India) and emerging Europe; and relatively lower in Latin America.

Intra-country trade linkages may be bilateral or operate via common export markets. Chart 1 illustrates with a heatmap one measure of bilateral trade between EMEs. Intra-EME trade is generally quite low, although there are some notable intra-regional links in Asia (which mainly reflect trade in intermediate goods, particularly high-technology products, ultimately destined to developed economy markets) and bilateral trade links between Argentina and Brazil.

Box B: Indices of common creditor linkages

Measures of common creditor channels between a crisis economy and another EME are usually based on some index of a creditor's pre-crisis exposures to a crisis economy and the pre-crisis dependence of the second EME on this common creditor. The measures divide into those which focus on interlinkages between an initial crisis economy and other EMEs via a single common lender (defined as the creditor with the largest absolute claims on the ground-zero crisis economy) and those which attempt to combine exposures to different common creditors. In the indices below, country *0* can be thought of as the original crisis EME, country *i* another EME and country *k* is the common creditor. Formulations are adaptations of originals.

Single common creditors

Caramazza *et al* (2000) present a simple index of EME linkages via the single (largest) creditor *k* to crisis country *j*.

$$\text{BISAB}_i = \left(\frac{B_{ik}}{B_i}\right)\left(\frac{B_{ik}}{\sum_{j\in all} B_{jk}}\right)$$

where the first term indicates the dependence of country *i* on lending from the common creditor *k* as a proportion of total borrowing by *i*. The second term indicates the exposure of the common creditor *k* to country *i* as a proportion of its total lending to all countries, $\sum_{j\in all} B_{jk}$.

Sbracia and Zaghini (2001) outline several alternative measures which capture dependence on finance relative to GDP for the borrower and measures of exposure relative to total funds advanced by the common lender. Again, as with the corresponding trade measures, a number of their measures blur the distinction between propagation mechanisms and vulnerability in the transmission of systemic events. For example, in I_i^1 the first term measures the exposure, relative to GDP, of country *i*'s dependency on the common creditor. The second term measures the exposure of the common creditor on the crisis economy relative to the common creditor's total capital (and hence might provide some information on the likelihood of margin calls). This formulation is proposed to address some perceived flaws in BISAB_i in considering exposures as a proportion of total lending rather than relative to GDP (for the borrower) or capital (for the lender) and in disregarding the exposures of the lenders to the crisis economy.

$$I_i^1 \equiv \left(\frac{B_{ik}}{GDP_i}\right)\left(\frac{B_{0k}}{C_k}\right).$$

The second term in I_i^2 tries to capture the rebalancing of credit to country *i* by the common creditor following a crisis. For any country *i* this increases with the magnitude of the common creditor's claims on the crisis economy relative to total claims and with the level of funds the common creditor provides to country *i*. However, they offer no theoretical rationale for why rebalancing should occur in this way.

$$I_i^2 \equiv I_i^1\left(\frac{B_{ik}}{\sum_{j\in DC} B_{jk} - B_{0k}}\right)$$ where *DC* indicates developing economies.

Multiple common creditors

Van Rijckeghem and Weder (2001) follow the approach of Glick and Rose (1999) to trade interlinkages, offering two measures of multi-creditor bank links between EMEs. They offer two measures of creditor interlinkages which distinguish between absolute or relative competition for funds available.

$$\text{Fundscomp}_i \text{ (absolute)} \equiv \sum_k \left(\frac{B_{0k}+B_{ik}}{B_0+B_i}\right)\bullet\left[1-\left(\frac{|B_{ik}-B_{0k}|}{B_{ik}+B_{0k}}\right)\right],$$

$$\text{Fundscomp}_i \text{ (relative)} \equiv \sum_k \left(\frac{B_{0k}+B_{ik}}{B_0+B_i}\right)\bullet\left[1-\left(\frac{\left|\frac{B_{0k}}{B_0}-\frac{B_{ik}}{B_i}\right|}{\frac{B_{0k}}{B_0}+\frac{B_{ik}}{B_i}}\right)\right]$$

Hernandez and Valdés (2001) note that these different measures reflect different propagation mechanisms: under the former, in which a larger borrower represents greater competition for funds, the propagation mechanism may be margin calls if fund supply is limited; under the latter, which indicates similarity in borrowing patterns (as a share of total borrowing), the propagation mechanism may be through informational spillovers.

Chart 1
Heat map of intra-EME bilateral trade, 2000[(a)]

		Asia									Europe and other				Latin America				
		China	Hong Kong	India	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand	Poland	Russia	South Africa	Turkey	Argentina	Brazil	Colombia	Mexico	Venezuela
Asia	**China**																		
	Hong Kong	26.6																	
	India	0.7	1.7																
	Indonesia	1.6	1.0	1.0															
	Korea	3.7	2.7	0.7	1.2														
	Malaysia	1.2	2.1	1.9	2.2	2.6													
	Philippines	0.6	1.7	0.3	0.9	2.3	2.3												
	Singapore	2.6	4.6	2.1	3.5	3.1	18.2	3.6											
	Thailand	1.2	2.1	1.0	1.8	1.4	3.7	2.0	5.9										
Europe and other	**Poland**	0.3	0.1	0.1	0.2	0.6	0.1	0.0	0.1	0.1									
	Russia	1.6	0.1	1.1	0.1	0.5	0.2	0.0	0.3	0.0	3.9								
	Turkey	0.3	0.2	0.5	0.2	0.5	0.2	0.0	0.2	0.2	0.4	2.6							
	South Africa	0.5	0.5	1.2	0.2	0.8	0.3	0.1	0.4	0.0	0.1	0.1	0.3						
Latin America	**Argentina**	0.3	0.2	0.9	0.2	0.4	0.2	0.1	0.1	0.3	0.1	0.1	0.7	0.2					
	Brazil	0.6	0.5	1.1	0.3	0.9	0.3	0.2	0.3	0.3	0.3	0.4	0.6	0.4	15.7				
	Colombia	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.5	1.4			
	Mexico	0.3	0.4	0.1	0.2	0.8	0.2	0.1	0.4	0.2	0.0	0.1	0.0	0.0	0.3	1.2	0.4		
	Venezuela	0.1	0.1	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.6	2.6	4.6	0.5	

Key: 0-1%; 1-5%; 5-10%; 10-20%; 20-30%

Sources: IMF Direction of Trade Statistics and authors' calculations.
(a) Defined as pairwise exports as percentage of sum of total exports of the two economies.

Table B
Trade dependencies on G3, 2000[(a)]

		EU	US	Japan
Asia	China	14.8	26.9	14.6
	Hong Kong	15.0	21.4	5.3
	India	24.0	22.8	5.3
	Indonesia	14.1	15.0	21.7
	Korea	13.3	22.5	11.4
	Malaysia	13.8	21.7	12.5
	Philippines	16.6	30.2	14.6
	Thailand	16.7	22.5	15.7
	Singapore	13.4	17.2	7.4
Europe	Poland	70.0	3.2	0.2
	Turkey	51.8	10.7	0.5
	Russia	35.8	7.7	2.7
	South Africa	29.4	10.5	7.0
Latin America	Argentina	17.8	11.4	1.5
	Brazil	26.5	22.6	4.6
	Colombia	15.1	49.7	1.9
	Mexico	3.2	84.1	1.4
	Venezuela	7.8	60.8	1.0

Note:
0% to 10%; 10% to 30%; 30% to 50%; 50% to 70%; Over 70%

Sources: IMF Direction of Trade Statistics and authors' calculations.
(a) Defined as direct exports from country *i* to region *j* as percentage of total exports by *i*.

Crisis spillovers through trade channels are perhaps more likely to occur through shifts in relative competitiveness in developed economy markets: in 2000 industrial economies were the destination for 60% of merchandise exports from developing economies. Historical associations and/or geographical proximity appear to matter in EME trade relationships with developed economies. For example, Table B suggests that the EU is the main destination for merchandise exports from emerging Europe, particularly Poland. Similarly, much of Latin America has strong linkages with the United States. For Asian EMEs, linkages with the EU and the United States are again substantial. Japan remains an important market but its relative importance for non-Japan Asia has declined steadily over time. Finally, there are obviously some strong EME trade linkages with developed economies at the product level, as was exemplified by marked falls in Asian EME growth in 2001 in the wake of the global slowdown in demand for high-technology products. We do not consider these links further here.(17)

Chart 2
Tradeshare index of third-market linkages[(a)(b)]

		Crisis country: Asia									Europe and other				Latin America			
		China	Hong Kong	India	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand	Poland	Russia	South Africa	Turkey	Argentina	Brazil	Colombia	Mexico
Asia	China																	
	Hong Kong	0.78																
	India	0.74	0.70															
	Indonesia	0.82	0.79	0.64														
	Korea	0.87	0.80	0.74	0.81													
	Malaysia	0.85	0.88	0.68	0.84	0.84												
	Philippines	0.90	0.77	0.70	0.80	0.80	0.82											
	Singapore	0.76	0.90	0.64	0.80	0.77	0.85	0.73										
	Thailand	0.90	0.81	0.73	0.85	0.87	0.86	0.88	0.77									
Europe and other	Poland	0.20	0.20	0.35	0.22	0.21	0.20	0.24	0.20	0.24								
	Russia	0.42	0.40	0.50	0.38	0.40	0.37	0.38	0.38	0.40	0.61							
	South Africa	0.55	0.49	0.61	0.50	0.53	0.50	0.49	0.50	0.53	0.38	0.54						
	Turkey	0.33	0.31	0.55	0.33	0.34	0.31	0.34	0.30	0.36	0.69	0.59	0.51					
Latin America	Argentina	0.50	0.48	0.55	0.46	0.52	0.45	0.45	0.45	0.49	0.28	0.44	0.49	0.42				
	Brazil	0.58	0.52	0.68	0.48	0.60	0.52	0.54	0.47	0.58	0.35	0.51	0.55	0.47	0.69			
	Colombia	0.42	0.36	0.43	0.31	0.38	0.35	0.48	0.30	0.40	0.25	0.30	0.31	0.31	0.59	0.66		
	Mexico	0.31	0.28	0.36	0.26	0.32	0.31	0.43	0.25	0.33	0.09	0.15	0.20	0.20	0.23	0.35	0.65	
	Venezuela	0.33	0.28	0.35	0.25	0.32	0.29	0.40	0.25	0.32	0.14	0.19	0.22	0.22	0.44	0.55	0.82	0.74

Key: 0-0.2; 0.2-0.4; 0.4-0.6; 0.6-0.8; 0.8-1.0

Sources: IMF Direction of Trade Statistics and authors' calculations.
(a) Data for 2000. Defined as relative version of the index.
(b) Calculated on basis of 8 common markets—EU, Japan, United States, developing Europe, developing Africa, developing Asia, developing Middle East and developing Western Hemisphere (as classified by IMF Direction of Trade Statistics).

(17) Work by Forbes (2001) and Fratzscher (2000) has explored the product composition of trade exposures in more detail. However, in these studies there are unresolved questions about the appropriate level of industry-level disaggregation.

To capture the potential for trade competition in third markets, we calculate a summary index of third-market linkages developed by Glick and Rose (1999). Their relative tradeshare index (described in Box A above) increases (to a maximum value of 1) as the export shares of a crisis economy and another EME in third markets become closer or rise in absolute terms. Chart 2 suggests that these trade linkages are probably strongest for Asian EMEs which have similar patterns of high developed market exposures. Several Latin American EMEs also record high values for this index, predominantly via overlap in the US market. Within developing Europe the highest trade overlaps would appear to be between Poland, Russia and Turkey. A striking feature across all EME areas is the regional clustering of these trade overlaps: intra-region values of the indices are almost always higher than extra-region values. India, Brazil and South Africa provide some exceptions to this rule, perhaps reflecting their historic strong trade links with European markets.

Evidence on financial channels

Data availability makes financial linkages substantially harder to measure than trade relationships. For example, there are few consistent sources of information on intra-EME financial exposures, although as noted above this is probably less problematic given that a substantial proportion of external funding to emerging markets comes from developed markets. Moreover, even data we do have on developed economy exposures tend to focus on banking exposures rather than other asset holdings. This has become more problematic as the composition of EME debt stocks has shifted since the late 1980s increasingly towards bond, portfolio investments and FDI.

BIS consolidated cross-border and local currency lending data record exposures of banks in BIS reporting countries to developing economies back as far as 1985. Using the foreign claims data (which includes both cross-border and local exposures), the United States is the largest creditor to developing economies, with a focus on Latin America (see Table C). Germany also has substantial exposures to most EME regions, but particularly to Eastern Europe. Japan remains a major creditor to emerging Asia despite running down its claims since the mid-1990s; the United Kingdom also has significant exposures in the region, most notably to Hong Kong. Elsewhere, Spain has increased its bank lending exposures in recent years, predominantly in Latin America.

Table C
Developed economy claims on EMEs[a]

		France	Germany	Japan	Spain	UK	US
Asia	China	9.1	12.1	18.2	0.8	11.7	10.8
	Hong Kong	4.1	3.6	13.1	0.1	47.8	8.4
	India	5.2	15.1	6.9	0.0	25.9	21.5
	Indonesia	6.1	22.6	22.7	0.2	10.0	9.4
	Korea	9.7	8.2	13.1	0.1	10.1	23.3
	Malaysia	4.2	6.4	11.5	0.0	26.8	14.7
	Philippines	5.6	16.2	14.0	0.7	11.4	22.4
	Singapore	3.8	11.4	15.0	0.0	22.3	12.9
	Thailand	4.5	9.4	25.6	0.0	10.4	10.3
Europe and other	Poland	3.8	27.8	0.7	0.4	1.0	9.5
	Russia	6.2	50.4	1.2	0.6	1.5	6.8
	South Africa	8.9	20.9	6.3	0.3	9.3	16.0
	Turkey	10.0	28.5	3.4	0.9	8.6	9.0
Latin America	Argentina	5.7	9.9	2.5	23.1	6.6	27.2
	Brazil	4.9	8.3	2.7	17.5	10.8	23.6
	Colombia	5.6	10.4	6.1	29.3	7.6	24.5
	Mexico	2.2	3.1	1.5	41.5	2.5	34.6
	Venezuela	7.9	9.4	2.6	37.3	7.8	15.7

Key: 0-10%, 10-20%, 20-30%, 30-40%, 40-50%, Over 50%

Sources: BIS and authors' calculations.
(a) Percentage of total foreign claims of each EME in 2002 Q1.

We calculate a summary index of common creditor linkages proposed by Van Rijckeghem and Weder (2001) which is analogous to the approach of Glick and Rose (1999) to third-market trade linkages (Chart 3). Their relative index measures similarities in finance dependencies of EMEs across common creditors (see Box B). As was the case for trade linkages, there appear to be strong intra-regional similarities but here inter-regional linkages are more marked.[18] For example, the index yields relatively high values for links between South Africa and Turkey and some Asian and Latin American EMEs.

(18) Van Rijckeghem and Weder also calculate an absolute index, which captures similarities in levels of finance from major creditors. This measure might capture crisis propagation via margin calls funded out of most liquid (largest) credits. Regional patterns are less dominant for this index. Major debtors become more prominent, such as Argentina, Brazil, Mexico, Korea and China.

Chart 3
Relative funds competition index 2002 Q1[(a)]

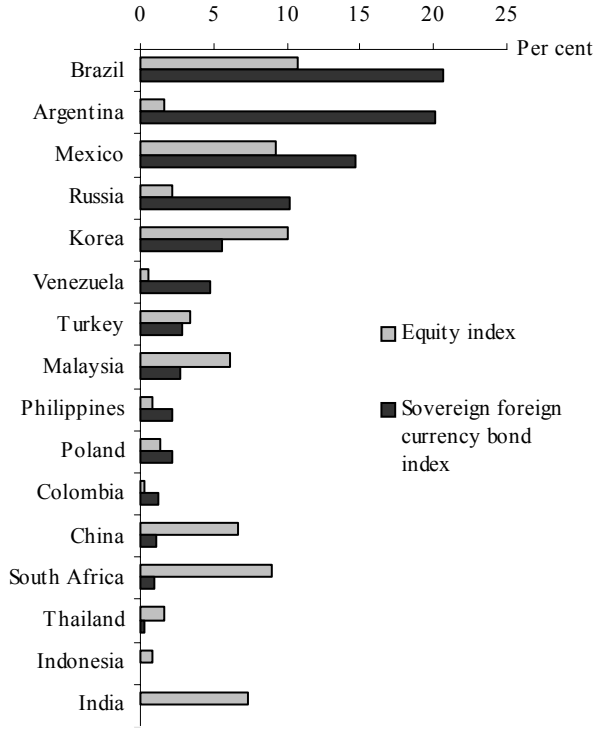
Crisis country		Asia									Europe and other				Latin America				
		China	Hong Kong	India	Indonesia	Korea	Malaysia	Philippines	Singapore	Thailand	Poland	Russia	South Africa	Turkey	Argentina	Brazil	Colombia	Mexico	Venezuela
Asia	China																		
	Hong Kong	0.56																	
	India	0.71	0.66																
	Indonesia	0.82	0.51	0.67															
	Korea	0.74	0.52	0.72	0.67														
	Malaysia	0.72	0.79	0.82	0.63	0.74													
	Philippines	0.81	0.53	0.79	0.78	0.83	0.75												
	Singapore	0.81	0.72	0.81	0.71	0.71	0.83	0.78											
	Thailand	0.80	0.51	0.65	0.83	0.69	0.67	0.75	0.73										
Europe and other	Poland	0.49	0.23	0.52	0.61	0.41	0.39	0.56	0.43	0.51									
	Russia	0.45	0.23	0.46	0.58	0.44	0.35	0.53	0.40	0.43	0.70								
	South Africa	0.72	0.45	0.76	0.78	0.79	0.63	0.79	0.66	0.66	0.63	0.62							
	Turkey	0.70	0.44	0.64	0.76	0.62	0.52	0.69	0.60	0.62	0.75	0.71	0.81						
Latin America	Argentina	0.54	0.34	0.61	0.48	0.64	0.54	0.64	0.53	0.50	0.44	0.38	0.56	0.51					
	Brazil	0.57	0.41	0.66	0.57	0.69	0.59	0.68	0.58	0.63	0.50	0.39	0.62	0.58	0.82				
	Colombia	0.60	0.40	0.69	0.56	0.73	0.61	0.69	0.61	0.57	0.43	0.39	0.62	0.55	0.90	0.84			
	Mexico	0.30	0.24	0.39	0.24	0.43	0.33	0.38	0.31	0.25	0.28	0.21	0.36	0.26	0.75	0.64	0.75		
	Venezuela	0.59	0.37	0.56	0.51	0.63	0.54	0.56	0.60	0.52	0.44	0.44	0.56	0.55	0.80	0.74	0.84	0.71	

Key: 0-0.2; 0.2-0.4; 0.4-0.6; 0.6-0.8; 0.8-1.0

Sources: BIS and authors' calculations.
(a) Consolidated foreign claims data used. Calculated using sample of 13 major published reported common creditors as composing the 'total claims' on economy (this has been used to overcome problems of breaks in the reporting sample when looking at time series). Common creditors are Belgium, Canada, Finland, France, Germany, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, UK and the US.

As discussed earlier, systematic data on non-bank financial holdings, broken down by creditor, are not readily available. However, country weights in widely tracked international equity and bond indices provide one illustration of the relative importance of different EMEs to global investors – and hence the potential for intra-EME linkages via international investors. Chart 4 shows that Latin American EMEs dominate foreign currency sovereign bond markets. Asian EMEs generally have higher relative equity market capitalisations, although these are also significant in Brazil and Mexico.

Chart 4
Weights in emerging market sovereign bond and equity indices[(a)]



Sources: MSCI and JP Morgan Chase & Co.
(a) Equity index weights are for MSCI Emerging Markets Free Index at 10 January 2001. Sovereign bond index weights are from EMBI Global at 31 January 2001 (prior to Argentina default). The value of Argentina's external sovereign bond weighting fell sharply with the move to default (to 1.8 % at 16 May 2002). Hong Kong and Singapore are not classed as emerging markets for the purposes of these indices.

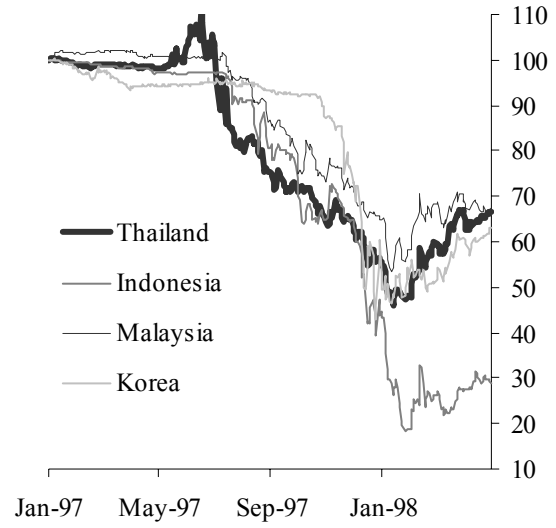
5 Linkages, vulnerabilities and spillovers in past EME crises

An actual or potential crisis in an EME permits a much more specific study of the potential for trade or financial spillovers. On the trade side we can identify the main bilateral trade partners of crisis countries and key competitors in third markets. On the financial side we can identify the major international creditors to crisis countries and other countries with dependencies on these lenders. In this section we calculate links from two recent crisis economies, namely Thailand in 1997 and Argentina in 2001. The Thai baht devaluation in mid-1997 was quickly followed by currency crises in Indonesia, Korea, Malaysia and to a lesser extent the Philippines. By contrast, spillovers from the crisis in Argentina in late 2001/early 2002 were much less widespread. We assess whether a surveillance strategy of identifying pre-crisis linkages of EMEs to these crises economies and assessing relevant vulnerabilities of these linked EMEs sheds light on the reasons for these differing crisis dynamics.

The Asian crisis[19]

Our framework requires us to identify an initial crisis economy from which trade and financial disturbances might spread. The Asia crisis included periods of turbulence in a number of economies. For the purposes of this case study, we focus on links from Thailand given that the baht depreciation pre-dated others in the region (see Chart 5). Thailand's large current account deficit, high short-term debt and financial fragility contributed to speculation against the baht from as early as June 1996. In early 1997 the authorities attempted to support the baht through intervention, particularly in the forward market. Intensified speculation led to rapid depletion of reserves and the brief imposition of capital controls before the baht was finally devalued on 2 July 1997.

Chart 5
Exchange rate against US dollar
(Index 1 Jan 1997=100)



Source: Thomson Financial Datastream.

EME links to Thailand

Thailand had strong intra-regional trade linkages in 1996 with around 37% of merchandise exports destined to non-Japan Asia. Export links with EMEs outside Asia were much lower. Other major export markets were the United States, EU and Japan (each accounting for around 16%-18% total exports). The Glick-Rose common market trade share index suggests that Asian EMEs were perhaps most at risk of third-market trade competitiveness spillovers from the baht devaluation. In terms of financial linkages, Japan had by far the largest financial exposure to Thailand with BIS foreign claims of US$39.5 billion in 1996 Q4 (about 25% of its claims on developing countries). The United States was the next largest creditor at US$8.4 billion (4.6%

(19) For comprehensive studies of the Asian crisis see, for example, Corsetti, Pesenti and Roubini (1999) and Goldstein (1998).

of total US claims on developing countries). Asian EMEs were the most dependent on Japan as a source of funds. Indonesia and Korea had the most similar financial exposures to Thailand across common creditors according to the Van Rijckeghem and Weder relative index. Taken together, these measures suggest that Asian EMEs were by far the most strongly linked to Thailand (see Table D).

Table D
Thailand: Ranking of interlinkages, 1996

	Bilateral trade	%	Common market (relative) trade index		Debtor dependence on Japan	%	Bank finance overlap (relative index)		By average ranking
1	Singapore	7.7	China	0.94	Indonesia	39.3	Indonesia	0.88	Indonesia (1=)
2	Malaysia	3.9	Malaysia	0.90	China	32.1	Korea	0.78	Malaysia (1=)
3	Hong Kong	2.1	Indonesia	0.90	Malaysia	30.8	China	0.75	China
4	Korea	2.0	Korea	0.89	Singapore	27.4	Malaysia	0.75	Korea (4=)
5	Philippines	1.8	Hong Kong	0.86	Hong Kong	27.1	Singapore	0.68	Singapore (4=)
6	Indonesia	1.6	Singapore	0.85	Korea	23.8	Hong Kong	0.65	Hong Kong
7	China	1.5	Philippines	0.83	India	16.8	India	0.61	India (7=)
8	India	0.8	India	0.75	Philippines	10.3	Turkey	0.53	Philippines (7=)
9	Brazil	0.5	Brazil	0.60	South Africa	10.2	South Africa	0.52	South Africa
10	Poland	0.4	South Africa	0.59	Turkey	8.8	Philippines	0.51	Brazil

Sources: IMF Direction of Trade Statistics, BIS foreign claims data and authors' calculations.

Vulnerabilities

Table E provides some summary vulnerability measures for the ten countries which appeared to have strongest links to Thailand. Most EMEs in our sample had strong GDP growth in the period leading up to regional crisis and relatively stable inflation (in the range of 5%-10%). And with stable nominal exchange rates against an appreciating US dollar, several Asian EMEs faced real exchange rate appreciation in the run up to the crisis. Several had substantial current account deficits, particularly some of the Asian EMEs (Singapore's strong surplus was a notable exception).[(20)] Indeed, with the benefit of hindsight many Asian EMEs appear to have had external balance sheet vulnerabilities. Along with Thailand, Indonesia and Korea had insufficient reserves to cover short-term external debt. And short-term liabilities typically accounted for over 50% of total debt.[(21)]

(20) Chinn (2000) argues, however, that one cannot generalise that overvaluation was prevalent through Asia.
(21) Singapore and Hong Kong's high level of short-term external debt reflected, in part, their roles as financial centres.

Table E
Vulnerabilities, 1996[a]

	Indonesia	Malaysia	China	Korea	Singapore	Hong Kong	India	Philippines	South Africa	Brazil	Memo: Thailand
Macroeconomic											
GDP growth (%)	8.0	10.0	9.6	6.8	7.7	4.5	7.3	5.7	4.2	2.7	5.9
CPI inflation (%)	7.9	3.5	8.3	4.9	1.4	6.3	9.0	8.4	7.3	15.8	5.9
Current account to GDP (%)	-3.4	-4.4	0.9	-4.4	15.2	-1.4	-1.5	-4.8	-1.3	-3.0	-8.1
REER (end-year change over previous 2 yr.)[b]	4.6	4.8	n.a.	1.5	6.0	10.1	-4.1	4.5	-11.9	-8.0	4.8
Exchange rate regime (IMF definition)	Managed	Managed	Managed	Managed	Managed	Currency board	Float	Float	Float	Managed	Peg
Fiscal											
Central government budget balance (% of GDP)[c]	1.2	1.1	-0.8	0.1	14.7	2.2	-4.9	0.3	-4.6	-2.6	0.9
External balance sheet											
Reserves to short-term BIS debt	0.5	2.4	4.0	0.5	0.4	0.4	2.9	1.3	0.1	1.4	0.8
Short-term BIS debt to total BIS debt	61.7	50.3	48.9	67.5	92.6	82.5	42.2	58.2	53.4	63.0	65.2
M2 to reserves ratio	6.3	3.4	8.5	6.2	1.0	0.3	8.3	4.5	59.0	3.5	3.8
Fiscal											
Average Moodys bank financial strength rating[d]	D	C/C+	D	D	B	C	D	D+	C	D+	D+
Growth in bank claims on private sector (%)	21.4	20.8	24.7	20.0	15.8	15.8	20.3	48.7	17.4	2.8	14.7
Annual M2 growth (%)	27.2	24.3	25.3	15.8	9.8	12.5	18.7	22.1	14.3	12.2	12.6
Gross private capital flows (% of GDP, 3-year average)	6.1	13.5	7.5	12.2	60.6	n.a.	3.7	14.8	8.6	10.0	14.6

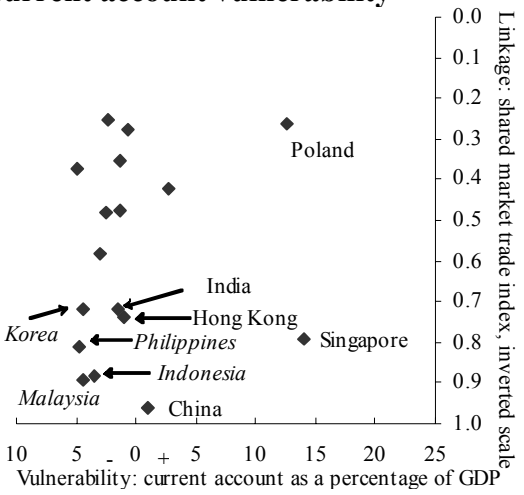
Sources: BIS, IMF website, IMF International Financial Statistics, JP Morgan Chase & Co, Moodys, World Bank Development Indicators.
(a) Stock data end-1996 except exchange rate regime at end-April 1997.
(b) Real effective exchange rate.
(c) Brazil data is PSBR. India budget balance is central government and on a fiscal-year basis whilst Malaysia's is federal balance.
(d) Financial strength ratings range for A for banks with superior intrinsic financial strength down to E for those with very modest intrinsic financial strength.

Many Asian EMEs also had internal vulnerabilities in this period. Fiscal positions in most Asian EMEs appeared relatively strong: with the exception of India, budget surpluses had been the norm for several years and debt levels were relatively low (not indicated in the table due to incomplete data availability)—although this ignores public sector contingent liabilities in financial sectors which subsequently crystallised during the crisis. But the financial strength ratings of many EMEs in our sample were relatively weak (and many were to fall further as the extent of financial system problems was revealed). Obvious exceptions included Hong Kong, Malaysia, Singapore and South Africa.

Assessment

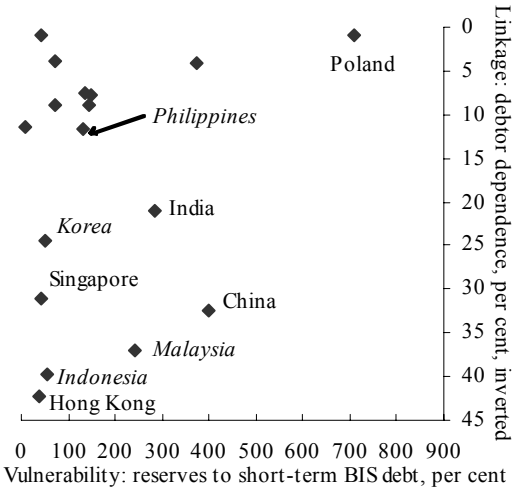
Does the evidence suggest that a coincidence of trade and financial ties and related vulnerabilities could have contributed to the initial spread of the Thai crisis? Charts 6 and 7 relate some selected measures of trade and financial links of major EMEs to Thailand in 1996 with relevant vulnerabilities in these countries. Chart 6 shows shared market trade linkages to Thailand and related current account vulnerabilities of major EMEs in 1996. Chart 7 shows EMEs' dependence on bank lending from Japan (the major common creditor in the crisis) against their related vulnerability of liquid foreign exchange reserves coverage of short-term foreign currency debt. Economies located closer to the bottom left-hand corner of each chart would perhaps be expected to face greater spillovers given the conjunction of a strong linkage and high relevant vulnerability.

Chart 6
Thailand crisis: indirect trade linkage and current account vulnerability[(a)]



Sources: IMF, IMF Direction of Trade Statistics and Bank calculations.
(a) Crisis economies in 1997-8 indicated in italics. Full sample: Argentina, Brazil, China, Colombia, Hong Kong, India, Indonesia, South Korea, Malaysia, Mexico, Philippines, Poland, Russia, Singapore, South Africa, Turkey and Venezuela.

Chart 7
Thailand crisis: common creditor dependence and reserve coverage of short-term external debt [(a) (b)]



Sources: IMF, BIS and Bank calculations.
(a) Reserves excluding gold.
(b) Crisis economies in 1997-8 indicated in italics. Full sample: Argentina, Brazil, China, Colombia, Hong Kong, India, Indonesia, South Korea, Malaysia, Mexico, Philippines, Poland, Russia, Singapore, South Africa, Turkey and Venezuela.

These charts suggest that trade and bank linkages, together with associated vulnerabilities, go some way towards identifying those Asian economies – namely, Indonesia, Korea, Malaysia and, to a lesser extent, the Philippines (perhaps reflecting its lower debtor dependence) – that experienced the most severe spillovers from the Thai crisis.[(22)] These countries had both relatively strong trade links with Thailand and the vulnerabilities of relatively large current account deficits. Many also had *de facto* currency pegs that may have constrained scope for adjustment to trade competitiveness shocks. Similarly these EMEs also tended to have strong banking sector dependencies on Japan (Thailand's main BIS-area bank creditor) which may have interacted with generally low reserve coverage of short-term debt.

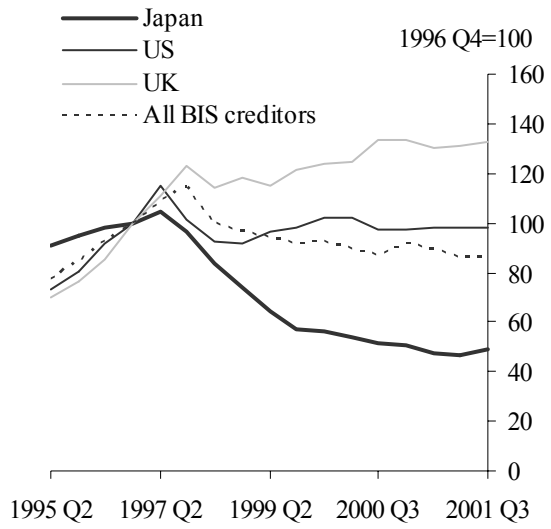
Some other economies were relatively strongly linked to Thailand but perhaps had lower vulnerability to spillovers. For example, China and India had relatively high reserves to short-term debt and were less vulnerable to exchange rate pressures given their capital controls.

(22) Clearly, different vulnerabilities and linkages may be combined. One alternative is reserve coverage of total short-term obligations (current account deficit and short-term debt). The picture is relatively similar with this option given the size of short-term debt obligations relative to current account balances (for example, Singapore's current account surplus of US$13 billion was small relative to short-term BIS debt of US$175 billion at end-1996).

Singapore, and particularly Hong Kong, which had relatively strong trade and bank creditor ties with Thailand, faced speculative pressure during the crisis but had liquid and well-capitalised financial systems which may have helped them to contain spillovers.

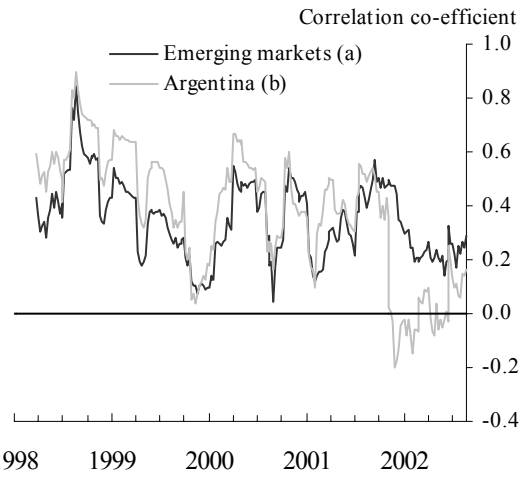
In terms of *ex-post* evidence on the role of trade or financial channels during the crisis, BIS data suggest a significant reduction in Japanese claims on Thailand (down 40% from 1997 Q2 to 1998 Q2). There were also sizable reductions in Japanese claims on the rest of developing Asia, with the exception of China and the Philippines. By contrast, overall claims by other BIS countries on the region remained relatively stable (Chart 8). In terms of export performance, exports from Brazil, Indonesia, Korea and South Africa weakened substantially following the crisis.

Chart 8
BIS foreign claims on developing Asia



Sources: BIS and authors' calculations.

Chart 9
Correlation between changes in emerging market bond spreads



Sources: JP Morgan Chase & Co and authors' calculations.
(a) 13-week rolling average of bilateral correlations between weekly spread changes across 21 EMEs.
(b) 13-week rolling average of bilateral correlations between weekly spread changes of 20 EMEs with Argentina.

The Argentine crisis[23]

The crisis in Argentina was the culmination of a protracted period of economic weakness and deepening fiscal difficulties with spreads rising markedly in October 2000 and May 2001.[24] Yield spreads on Argentine sovereign bonds rose sharply in July 2001 following a run on bank

(23) See www.nber.org/~confer/2002/argentina02/argentina_bg.html for further background papers on the Argentina crisis.
(24) Given the build up in pressures through 2001, we use 2000 data to consider pre-crisis vulnerabilities and linkages.

deposits. Spreads increased further in the following October and November following evidence of a weakening in the government's fiscal position. In December 2001, the authorities introduced capital controls before finally devaluing the peso on 1 January 2002. On 3 January the authorities missed an interest payment on a Lira-denominated bond, with Argentina in formal default 30-days afterwards once the conventional grace period expired. On 11 February the dual exchange rate regime was abandoned and the peso floated.

Despite the severe economic problems facing Argentina, spillovers to other major EMEs were relatively limited.(25) Indeed, having risen through early 2001, the correlation between Argentine and US dollar-denominated sovereign bond spreads of other major EMEs fell markedly as the crisis intensified in late 2001 (Chart 9). Does a similar examination of linkages from Argentina to other EMEs and their respective vulnerabilities shed light on why spillovers have been more limited than in the Asia crisis?

EME links to Argentina

Brazil had strong direct trade linkages with Argentina in 2000 and indeed saw a substantial fall in exports to Argentina in the wake of the crisis (down 55% in 2002). But Argentina's direct regional trade linkages were more limited than those from Thailand in 1997 (see Table F). On indirect trade links, the Glick-Rose index also ranks Brazil highly, reflecting important shared markets in developed Europe and the United States. But overall, Argentina in 2000 appears to have had less strong and widespread trade ties with other EMEs than did Thailand in 1996.

BIS foreign claims data suggest that the United States was the largest bank creditor to Argentina at US$25.3 billion in 2000 Q4 (about 12% of its BIS claims on developing countries).(26) Spanish banks' foreign claims were close behind at US$23.1 billion (also about 12% of its BIS claims on developing countries). US banks were creditors to a relatively geographically dispersed set of EMEs. Highest dependence was perhaps in Latin America although it was less marked than the reliance of Asian EMEs on Japanese lending at the time of the Asian crisis. Latin American EMEs were also highly dependent upon Spanish banks. Spain accounted for

(25) 18 countries are included in this part of the study (Argentina, Brazil, China, Colombia, Hong Kong, India, Indonesia, Korea, Malaysia, Mexico, Philippines, Poland, Russia, Singapore, South Africa, Thailand, Turkey and Venezuela). At end-April 2002 countries from this sample had combined weights of 85% and 78% in the JP Morgan Chase & Co EMBI Global and the Morgan Stanley Capital International Emerging Markets Free equity index respectively. Hong Kong and Singapore are not included in these EME indices, but are considered given their trade and financial links to EMEs. Uruguay experienced spillovers from the problems in Argentina but is not included given its very low weight or omission from these indices.

(26) Spain was the largest bank creditor in terms of BIS international claims which exclude local currency claims of overseas banks on local residents.

56% of Mexico's BIS foreign bank liabilities, around 40% in Venezuela and over 20% in Colombia and Brazil. These similarities in funding sources are seen in the Van Rijckeghem and Weder relative index. In terms of non-bank financial links, Argentina accounted for around 20% of the EMBI Global sovereign bond index prior to the crisis. *Ex ante* this might have suggested potential for spillovers to other major sovereign external bond debtors such as Brazil, Mexico and Russia.(27) Table F summaries linkages measures and suggests that Argentina was most clearly linked to EMEs within Latin America.

Table F
Argentina: Ranking of interlinkages, 2000

	Bilateral trade	%	Common market (relative) trade index		Debtor dependence on Japan	%	Bank finance overlap (relative index)		By average ranking
1	Brazil	15.8	Brazil	0.72	Colombia	23.0	Colombia	0.87	Brazil
2	South Africa	0.9	Colombia	0.61	Philippines	22.2	Brazil	0.85	Colombia
3	India	0.9	India	0.57	Korea	21.8	Venezuela	0.76	India
4	China	0.5	Venezuela	0.55	Brazil	21.8	Mexico	0.67	Korea
5	Colombia	0.5	Korea	0.55	India	18.6	Korea	0.63	Venezuela
6	Venezuela	0.4	China	0.54	South Africa	17.6	Philippines	0.57	South Africa
7	Korea	0.3	South Africa	0.53	Mexico	17.5	Turkey	0.54	Mexico
8	Thailand	0.3	Thailand	0.52	Venezuela	15.6	India	0.52	Philippines
9	Mexico	0.3	Hong Kong	0.51	Malaysia	14.2	South Africa	0.51	Malaysia
10	Malaysia	0.2	Indonesia	0.48	Poland	13.0	Malaysia	0.50	China

Sources: IMF Direction of Trade Statistics, BIS foreign claims data and authors' calculations.

Vulnerabilities

Table G summarises vulnerability measures for the ten countries with apparent strongest links to Argentina in 2000, the year preceding the crisis. Growth and fiscal positions were arguably little changed overall in 2000 from the time of the Asia crisis, although there had been some notable declines in inflation across EMEs. By contrast, external vulnerabilities, perhaps the most critical indicator for international spillovers, were generally lower. There was some evidence of an improvement in current account positions and a reduction in short-term external debt relative to foreign exchange reserves, particularly in Asian EMEs. But perhaps the clearest change is in terms of exchange rate flexibility, with a distinct shift over recent years from managed to flexible exchange rate systems (Chart 10). This might offer a valuable adjustment mechanism to shocks for countries in which there is insufficient domestic nominal flexibility.

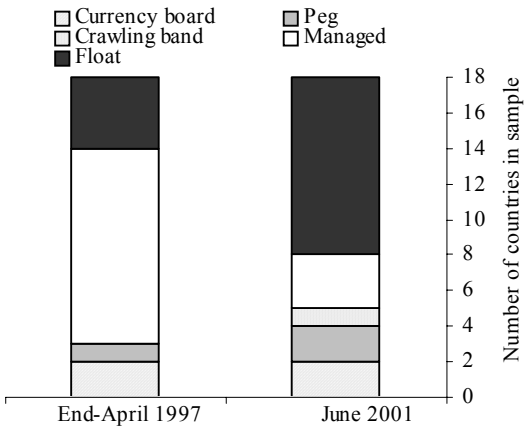
(27) The value of Argentina's sovereign bond weighting fell sharply with the move to default (to 1.8% at 16 May 2002).

Table G
Vulnerabilities, 2000[a]

	Brazil	Colombia	India	Korea	Venezuela	South Africa	Mexico	Philippines	Malaysia	China	Memo: Argentina
Macroeconomic											
GDP growth (%)	4.4	2.8	6.0	8.8	3.2	3.1	6.9	4.0	8.3	8.0	-0.5
CPI inflation (%)	7.0	9.2	4.0	2.3	16.2	5.4	9.5	4.3	1.5	0.4	-0.9
Current account to GDP (%)	-4.1	0.4	-0.9	2.5	10.9	-0.4	-3.2	12.2	9.4	1.9	-3.1
REER (end-year change over previous 2 yr.)[b]	-4.8	-7.2	11.4	6.0	18.3	2.3	30.9	-9.1	7.1	n.a.	9.7
Exchange rate regime (IMF definition)	Float	Float	Managed	Float	Band	Float	Float	Float	Peg	Peg	Currency board
Fiscal											
Central government budget balance (% of GDP)[b]	-3.2	-7.0	-5.4	2.5	-2.1	-1.9	-1.3	-4.1	-4.2	-2.8	-2.4
External balance sheet											
Reserves to short-term BIS debt	1.0	2.1	4.3	2.9	2.9	0.6	1.6	2.0	4.2	8.7	0.6
Short-term BIS debt to total BIS debt	55.9	53.1	49.8	70.0	24.4	64.5	45.4	48.8	47.0	47.6	56.5
M2 to reserves ratio	5.0	43.2	6.5	3.4	1.5	10.4	3.4	3.1	3.1	9.7	3.6
Fiscal											
Average Moodys bank financial strength rating[c]	D+	D	D	E+	D	D+/C	D	D	D	E+	D
Growth in bank claims on private sector (%)	25.4	4.1	20.0	19.1	25.5	15.2	-6.2	5.4	6.1	11.4	-3.8
Annual M2 growth (%)	4.3	9.3	15.2	25.4	23.1	7.2	-4.2	8.1	9.9	12.3	1.5
Gross private capital flows (% of GDP, 3-year average)	11.6	9.1	3.4	18.2	15.3	17.7	6.8	27.6	14.8	12.2	13.2

Sources: BIS, IMF website, IMF International Financial Statistics, JP Morgan Chase & Co, Moodys, World Bank Development Indicators.
(a) Stock data end-2000 except average Moodys Bank financial strength rating at October 2000.
(b) Real effective exchange rate.
(c) India budget balance is central government and on a fiscal-year basis whilst Malaysia's is federal balance.
(d) Financial strength ratings range for A for banks with superior intrinsic financial strength down to E for those with very modest intrinsic financial strength.

Chart 10
Exchange rate regimes [a]



Source: IMF International Financial Statistics.
(a) Peg: conventional fixed peg arrangements other than currency board. Band: pegged exchange rates within horizontal bands. Managed: managed floating with no preannounced path for the exchange rate. Float: independently floating.

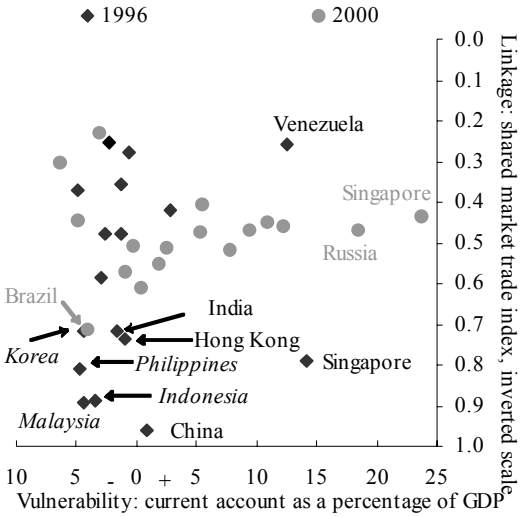
Assessment

Do these linkages and vulnerabilities shed light on the more limited spillovers from the Argentine crisis?

In Charts 11 and 12 the grey markers indicate that trade and bank linkages and vulnerabilities were not clearly lower in the lead up to the Argentine crisis relative to the period before the Thai devaluation. But what is evident is that there were relatively fewer coincidences of EMEs with

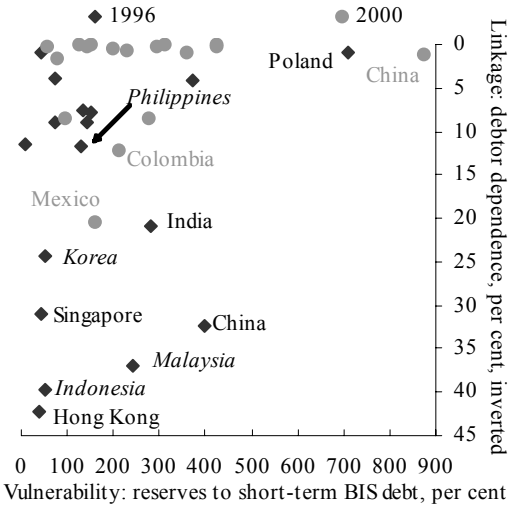
close trade or banking linkages to Argentina and related vulnerabilities – EMEs appear less frequently in the lower left portions of the charts. There were some important exceptions. In particular, Brazil had relatively strong trade ties and associated external vulnerabilities, and perhaps had other financial linkages to Argentina via shared bond market creditors.[28] However, Brazil had reduced some other vulnerabilities since the Asian crisis, perhaps most notably in its policy flexibility. For example, Brazil was among the EMEs to move towards a more flexible exchange rate regimes.

Chart 11
Argentina crisis: indirect trade linkage and current account vulnerability[a]



Sources: IMF, IMF Direction of Trade Statistics and authors' calculations.
(a) Crisis economies in 1996 indicated in italics. Full sample (including crisis economies): Argentina, Brazil, China, Colombia, Hong Kong, India, Indonesia, South Korea, Malaysia, Mexico, Philippines, Poland, Russia, Singapore, South Africa, Thailand, Turkey and Venezuela.

Chart 12
Argentina crisis: common creditor dependence and reserve coverage of short-term external debt [a] [b]



Sources: IMF, BIS and authors' calculations.
(a) Reserves excluding gold.
(b) Crisis economies in 1996 indicated in italics. Full sample (including crisis economies): Argentina, Brazil, China, Colombia, Hong Kong, India, Indonesia, South Korea, Malaysia, Mexico, Philippines, Poland, Russia, Singapore, South Africa, Thailand, Turkey and Venezuela.

Lessons for surveillance

In summary, analysis of interactions of linkages and vulnerabilities appears to be a useful starting point for assessing the potential for crisis spillovers. But it is only a starting point. It is subject to type I and type II errors. First, it can predict spillovers when none are realised and second, and perhaps more worryingly, not predict spillovers when they are realised.

(28) Again, it is worth emphasising that this is but one option for combining linkages and vulnerabilities. If one considers again the ratio of total short-term obligations to reserves, Brazil and Turkey, with current account deficits, appear more vulnerable than on coverage of short-term debt alone.

One reason for these errors may be that we have only examined the readily measurable subset of potential linkages between EMEs and associated vulnerabilities. The analysis would benefit from assessment of a richer set of vulnerabilities—including less readily measurable indicators of structural reform progress and balance sheet structures—in countries at risk on the basis of linkages. On real linkages, the potential for product level trade spillovers is not considered. For finance links, off-balance sheet bank exposures, perhaps via credit default swap markets, are omitted. Furthermore, evidence on non-bank spillovers, particularly on the counterparties of these financial flows, is only partial. And intra-EME financial linkages have not been calibrated. Although, as discussed in Section 4, some empirical studies have attempted to examine these linkages in more detail, further transparency and data availability would provide important insights into the process of EME crisis spillovers for both market participants and policy-makers. As these gaps are filled they will add further detail to the analysis of spillovers within this generic framework.

Investor behaviour

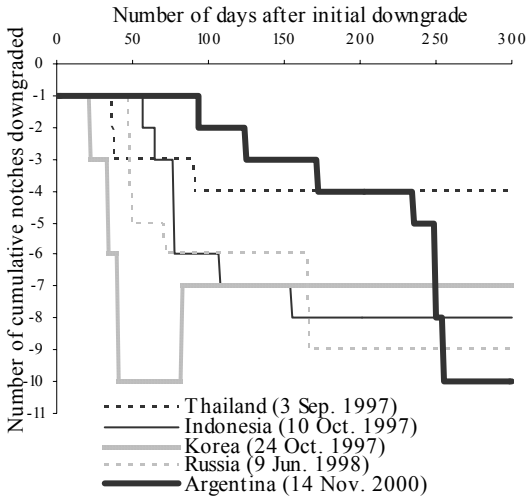
Another potentially telling reason why the linkage and vulnerability analysis above can only offer a partial explanation of past crisis dynamics is that it does not explicitly consider investor behaviour. For example, the financial linkages measures presented provide information on the scale of investor exposures to EMEs, but do not indicate their actual portfolio behaviour in a crisis. Considering potential changes in investor behaviour may provide important insights into the spillover process. Indeed, behavioural changes among investors, as well as the lower coincidence of high vulnerabilities and high linkages, may have contributed to the absence of spillovers from the Argentina crisis. The lower correlation of spreads on internationally traded EME bonds suggests that investors differentiated between Argentina and other EME debtors, particularly relative to earlier crisis periods.

What might explain this shift in behaviour? One argument might be that policy initiatives by EMEs and the IMF following previous crises have led to improvements in country surveillance. For example, increased EME data dissemination may mean that it is now less costly for investors to differentiate between EME credits.

Another reason might have been the widespread anticipation of the crisis. Sudden crises can lead to disorderly selling in thin markets, perhaps making spillovers more likely. By contrast, when the probability of crisis rises gradually over time, investors can make adjustments to their portfolios in an orderly manner given that there are also likely to be still buyers in the market.

Analysis of spreads and ratings behaviour in the period around EME crises suggests that the recent events in Argentina were much more widely anticipated than earlier crises, such as that in Russia in 1998 and Korea in 1997 (Chart 13). BIS lending data shows that foreign claims on Argentina fell from US$92.1 billion at end-2000 to US$73.9 billion at end-2001 (before subsequently falling to US$42 billion at June 2002). Furthermore this anticipation of the crisis enables off-balance sheet adjustments to exposures, for example through credit-default swaps and foreign exchange hedging which are not incorporated in the BIS data.

Chart 13
Ratings downgrades during crises[(a)]



Source: Standard & Poor's and authors' calculations.
(a) Indicates cumulative movement during period. Initial downgrade (date in brackets) is the first downgrade during the crisis year with previous rating change in all cases over 18 months earlier than this change. Thai baht devaluation was 2 July 1997 with Korean won and Indonesian rupiah depreciation following. Russia restructuring and exchange rate measures were announced on 17 August 1998. Argentina devaluation was on 11 February 2002.

The shift in investor behaviour may reflect changes in the EME investor base in recent years. In terms of bank creditors, Japan was the main international lender to Thailand and other Asian EMEs in 1996, whereas the United States and Spain were the principal creditors to Argentina. The relatively strong initial financial position of the Spanish and US banking systems in 2001 (rated between B and C+ by Moody's for average financial strength at October 2000) may have helped them absorb losses on Argentine exposures.[(29)] By contrast, Japanese banks' losses on exposures to Thailand weakened an already poor balance sheet position (rated D for average financial strength by Moody's in 1997). In global capital markets, IMF reports have highlighted a decline in involvement of leveraged creditors such as hedge funds, and increased prominence

(29) Rating B denotes strong intrinsic financial strength. Rating C denotes adequate intrinsic financial strength. Rating D denotes inadequate financial strength.

of 'buy-hold' institutional investors, such as insurance companies.(30) The former may be forced into liquidating positions with short-term sales in a crisis, for example in order to meet margin calls. By contrast, the latter class of investors may be less vulnerable to shocks to asset returns because they tend to be less leveraged and have longer horizons.

6 Lessons for policy-makers

The potential for problems in one EME to spread elsewhere is a concern for policy-makers in EMEs and in the wider international financial community. Economic theory suggests a range of potential crisis spillover mechanisms, both real and financial. A substantial empirical literature has developed in recent years attempting to disentangle which of these channels might have been the most important in past crises. These studies have offered mixed evidence, partly reflecting variations in the measurement of propagation channels, the definition of crisis spillover (or contagion) and the crisis period considered. Moreover, few studies explicitly include an assessment of how specific linkages and country vulnerabilities might jointly determine the wider impact of EME shocks.

This paper presents a more structural approach to analysing the potential for spillovers from crisis economies. The proposed surveillance framework seeks to identify shocks, quantify potential channels of transmission from a crisis country to other EMEs, and assess EME vulnerability to any observed shock. The paper also notes the importance of the reaction of investors and policy-makers to the initial crisis and its transmission. The starting balance sheet position of these agents is likely to have an important impact on their behaviour.

Our case studies of the Asian crisis and Argentine crisis may shed light on the differing conclusions reached by empirical studies on why crises spread. We find that the strength of trade and financial channels between crisis economies and other EMEs has varied across these crises. Importantly, malign coincidences of strong linkages and relevant country-specific vulnerabilities differed markedly across our case studies. For example, in the Asian crisis there were several countries with both strong trade and financial links to Thailand and relevant macroeconomic and financial vulnerabilities. This was not the case in the Argentine crisis.

What are the implications of these findings for policy-makers? Our case studies suggest that an analysis of potential interactions between *ex-ante* interlinkages and relevant vulnerabilities

(30) See, for example, IMF *Emerging Markets Financing* February 2001, page 18, and the IMF *Capital Markets Report*, September 2000, pages 63 and 185.

might be useful as a first-pass tool for assessing where to focus attention in monitoring spillovers from EME crises. In this respect this work complements the increased focus of the IMF on strengthening its surveillance of country vulnerabilities, particularly through development of early warning systems.

However, our case studies also highlight that there is much we do not know about the spread of crises. Actual crisis dynamics are affected by a much wider range of factors than considered in this paper. Crises can sometimes spill over through mechanisms that cannot be easily measured systematically. For example, we have limited information on non-bank financial channels. And even for bank financial channels, theory offers us little guidance on how creditors will adjust their EME lending in the event of losses on part of their portfolio arising from an EME crisis. Analysis of the Argentine crisis and experience of other EME crises, such as that in Russia in 1998, suggest that further research on the behaviour of international investors towards EMEs would help in assessing the likely future incidence of contagion.

Our findings also have implications for EMEs themselves. As suggested by King (2001) '*…limitations on official finance mean that countries should think carefully about the provision of self-insurance against a liquidity crisis*'. Our framework suggests that insurance against external shocks might be especially important in EMEs with strong interlinkages and vulnerabilities. This might take the form of measures to strengthen domestic balance sheets, such as increased reserves and/or lower short-term debt (as seen in Asian EMEs in recent years). It might also take the form of diversifying trade or finance sources as advocated by Chiang and Majnoni (2001). In addition, these EMEs might decide to arrange private contingent credit lines or initiate investor-relation programmes to minimise the risk of financial outflows in periods of EME turbulence.

To conclude, our framework potentially offers insights on how and why crises in individual EMEs might (or might not) spread to other EMEs. But it also reveals some substantial gaps in our understanding of crisis spillovers, particularly those operating through shifts in investor behaviour in non-bank financial markets. Further work on these areas might shed light on the evolution of recent crises, help to provide forward-looking tools for spotting incipient future crises, and potentially help policy-makers to identify measures that might prevent them.

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