*… with associated global exchange rate misalignments*

**Box 1**

## MEASURING INTERNATIONAL FINANCIAL SPILLOVERS

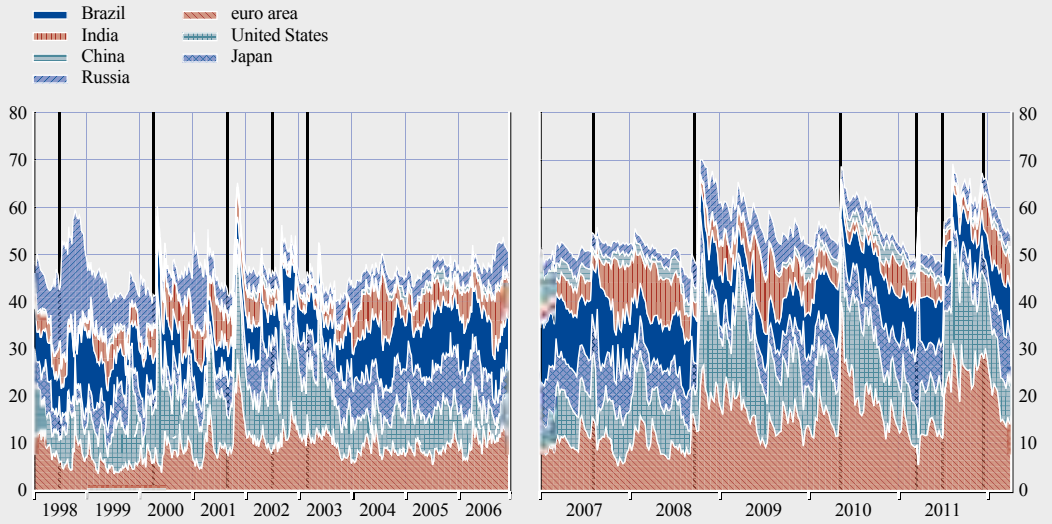
International real and financial linkages, while an integral part of an efficient and well-functioning economic and financial system, also embed an inherent fragility in the form of an international propagation of adverse (in addition to benign) country-specific developments. Given the complexity of financial markets, financial spillovers may take on many forms. Equity markets are an asset class in which financial linkages and prospects for spillovers are strong. Indeed, through highly mobile international capital in this asset class, equity prices are naturally endowed with a high degree of internationalisation. This box uses equity prices to construct a global spillover index for major markets, which is decomposed to show the contribution of each region to global financial market stress.

The computed global spillover index provides empirical evidence that part of the recent decline in financial market stress across the globe was driven by a decline in spillovers from the euro area to the rest of the world.[1] As shown in the chart, the global spillover index can reflect the magnitude, the persistence and the regional origins of a set of systemic risk events since 2007. Significant recent events in this regard include the collapse of Lehman Brothers in September 2008, as well

1 Spillovers are assessed by decomposing the time-varying variance/covariance matrix of the residuals from a cross-country VAR(2) of weekly returns of seven major stock market indices (euro area, United States, Japan, Brazil, Russia, India and China). The time-varying variance/covariance matrix corresponds to the DCC GARCH estimator proposed in R. Engle and K. Sheppard, "Theoretical and Empirical Properties of Dynamic Conditional Correlation Multivariate GARCH", *NBER Working Paper Series*, No 8554, 2001. At each point in time, the ten-week-ahead forecast error variance is decomposed applying the generalised identification method proposed in M.H. Pesaran and Y. Shin, "Generalised Impulse Response Analysis in Multivariate Models", *Economic Letters*, No 58(1), 1998. Bilateral spillovers are calculated following the methodology described in F.X. Diebold and K. Yilmaz, "Better to Give than to Receive: Predictive Directional Measurement of Volatility Spillovers", *International Journal of Forecasting*, 28(1), 2012.

**Contributions to global stock market spillovers**

(Jan. 1998 – Apr. 2012)




Sources: Thomson Reuters and ECB calculations.
Notes: Each region's contribution to the forecast error variance of the whole system of economies is shown. The vertical lines mark the following set of events: July 1998 – Russian crisis; April 2000 – dot-com bubble bursts; September 2001: 9/11 terrorist attacks; July 2002 – WorldCom bankruptcy; March 2003 – Iraq war begins; August 2007 – Bear Stearns liquidates two hedge funds; August 2008 – Lehman Brothers bankruptcy; May 2010 – EU and IMF agree on €110 billion support package for Greece; March 2011 – earthquake in Japan; August 2011 – euro area sovereign debt crisis intensifies; December 2011 – EU announces fiscal compact and ECB announces the plan to conduct two three-year LTROs.

as European sovereign strains in two distinct phases: first, the strains regarding the sustainability of Greek sovereign debt that erupted in May 2010 and, second, the intensification of the euro area sovereign debt crisis in the summer of 2011 amid expanding sovereign contagion fears. In contrast, the natural disasters that hit Japan in early 2011 made an only transitory contribution to global stock market spillovers.

The persistence of spillovers in the aftermath of the collapse of Lehman Brothers was perhaps the most striking over recent years, with the United States being identified as the main source of risk for global financial markets for several months after this event, as indicated by its sizeable contribution to the global spillover index over the period.

The euro area sovereign debt crisis, by contrast, appears to have had a short-lived spillover impact in early 2010. This contrasted, however, with a much sharper spillover in the second half of 2011. More generally, the results would suggest that over the two years leading up to the end of 2011, developments in the euro area played an ever-increasing role as a driver of global asset market volatility.

More recently, the role of the euro area as a source of shocks has become less important. This is consistent with the view that the policy measures taken by the Eurosystem (most importantly the launching of the three-year longer-term refinancing operations (LTROs)) and by the euro area Heads of State or Government (e.g. the announcement of the fiscal compact) since December 2011 have contributed to mitigating the fallout from the tensions among European sovereigns and banks, thereby dampening outward spillovers to the rest of the world.

Broadening the geographical analysis, the results suggest that the euro area and the United States are overall net "exporters" of financial spillovers, although the extent thereof has abated recently (see the table below). This is not surprising in view of the relatively large size of the US and EU equity markets in comparison with those in emerging markets. From a cross-country perspective, a directional decomposition of the spillover index shows that the euro area and the United States have persistently acted as exporters of financial spillovers since the beginning of the financial crisis in 2007. Conversely, emerging market economies, in particular China, have imported more financial spillovers than they have exported. Finally, the role of Japan in global asset markets is balanced with respect to inward and outward spillovers, with the shock related to the natural disasters of March 2011 the sole exception.

All in all, the results suggest that spillovers can be strong and multi-directional, depending on the nature of region-specific shocks. In recent years, results suggest that the euro area and the United States were predominant sources of spillovers. That said, from a broader financial stability perspective, the prospect of time-varying spillovers – not least given a likely continued increase in equity market capitalisation in emerging market economies – calls for a close monitoring of financial developments in all key economies.

**Net financial spillovers**

(annual averages)

| | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| Euro area | + | + | + | + | + |
| USA | + | + | + | + | |
| Japan | | - | | | |
| Brazil | | - | | | |
| India | | | - | - | |
| China | | | | - | - |
| Russia | - | | - | - | - |

Note: A plus (minus) sign represents net positive outward (inward) spillovers that account for more than 20% of total forecast error variance in the system.

***Signs of recovery in the United States, albeit with downside risks***