INTERNATIONAL MONETARY FUND

IMF Country Report No. 11/203

THE UNITED STATES

SPILLOVER REPORT - 2011 ARTICLE IV CONSULTATION

July

Under Article IV of the IMF's Articles of Agreement, the IMF holds bilateral discussions with members, usually every year. In the context of the 2011 Article IV consultation with United States, the following documents have been released and are included in this package:

- **Spillover Report** for the 2011 Article IV consultation, prepared by a staff team of the IMF, following discussions that ended on June 27, 2011, with the officials of United States on economic developments and policies. Based on information available at the time of these discussions, the spillover report was completed on July 7, 2011. The views expressed in the spillover report are those of the staff team and do not necessarily reflect the views of the Executive Board of the IMF.

- **Spillover Report - Selected Issues Paper**

The policy of publication of staff reports and other documents allows for the deletion of market-sensitive information.

Copies of this report are available to the public from

International Monetary Fund • Publication Services
700 19th Street, N.W. • Washington, D.C. 20431
Telephone: (202) 623-7430 • Telefax: (202) 623-7201
E-mail: publications@imf.org Internet: http://www.imf.org

Price: $18.00 a copy

INTERNATIONAL MONETARY FUND

UNITED STATES

SPILLOVER REPORT – 2011 ARTICLE IV CONSULTATION

July 22, 2011

KEY POINTS

Issues. Spillover reports explore the external effects of policies in systemic economies, focusing on concerns raised by key partners. Foreign officials appreciated the boost to world growth from U.S. stimulus but were concerned over unintended consequences. Loose U.S. monetary policies could fuel unsustainable capital flows and commodity prices; high U.S. government deficits create tail risks of a generalized bond shock; and laws and rule changes passed ahead of Basel III could foster financial sector arbitrage

Findings. The main messages flowing from staff analysis are:

- **Short-term U.S. spillovers on growth abroad are uniquely large, mainly reflecting the pivotal role of U.S. markets in global asset price discovery**. While U.S. trade is important, outside of close neighbors it is the global bellwether nature of U.S. bond and equity markets that generates the majority of spillovers.
- **U.S. macroeconomic stimulus likely supported foreign activity more in 2009 than in 2010.** Facing global turmoil, 2009 initiatives calmed markets. In the less fraught 2010 environment similar policies produced a less favorable response.
- **Looking forward:**
  - With QE2 having limited spillovers, its fully anticipated ending will have even less effects. The main monetary exit risk is that expectations of monetary tightening would reverse earlier capital flows to other countries.
  - Spillovers from credible and gradual fiscal consolidation are limited and ambiguously signed, while those from the tail risk of a potential loss of confidence in U.S. debt sustainability are universally large and negative.
  - Robust supervision of U.S.-based (not necessarily U.S.-owned) investment banks can reduce risks of negative global spillovers via dollar funding markets.
  - Overall, U.S. and foreign goals may be better aligned for fiscal and financial policies, given a common interest in limiting globally important tail risks, than for monetary policies, where low interest rates facilitate financial risk-taking.

Approved By
Tamim Bayoumi and Rodrigo Valdés

This report was prepared by a staff team comprising Tamim Bayoumi (head), Ashok Bhatia, Edouard Vidon, and Francis Vitek (all SPR), Martin Sommer (WHD), Alasdair Scott and Hui Tong (RES), and Andy Jobst (MCM). Additional inputs were provided by Trung Bui, Sean Cogliardi, and Manju Ismael (all SPR).

SPILLOVER REPORTS

Spillover reports examine the external effects of policies in five systemic economies (the "S5"): China, the Euro Area, Japan, the United Kingdom, and the United States. The mere existence of external effects does not imply that policy modification or collective action is needed—that depends on many factors, including the presence of economic externalities. The aim is to stimulate discussion, providing a global perspective for policy advice in Article IV discussions and input to the Fund's broader multilateral surveillance.

In each case, key partners are asked about outward spillovers from the economy in question, on the basis of which staff choose issues for analysis. To facilitate candor, spillover reports do not cite who raises a specific issue. For this report, those consulted were officials and analysts from the other S5 and from selected emerging markets—Brazil, Hong Kong SAR, India, Indonesia, Korea, Mexico, Poland, Russia, Singapore, and Thailand.

This report does not try to capture the totality of U.S. influence on the world economy. Rather, it focuses on a few forward-looking issues raised by partners, brings to bear relevant analysis, and describes the reactions of the U.S. authorities. Technical papers underlying the analysis can be found in a companion Selected Issues paper (www.imf.org). A separate report will summarize the cross-cutting themes emerging from discussions with the S5.

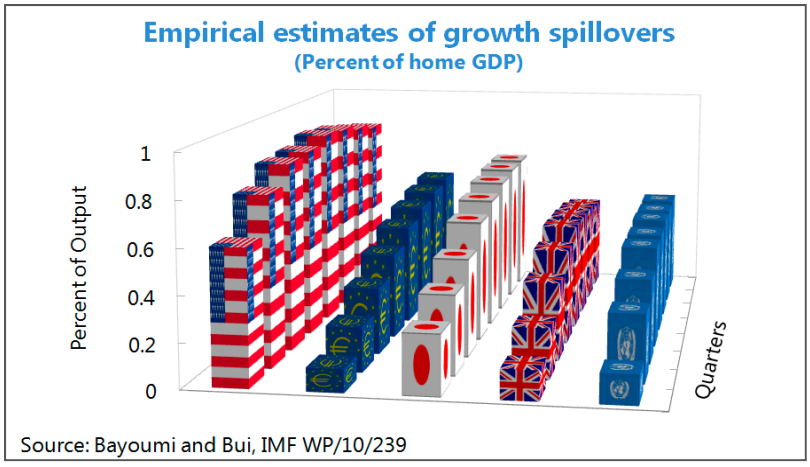
CONTENTS

COUNTRY FLAGS USED IN FIGURES

 Argentina	 Australia	 Brazil	 Canada	 China	 France
 Germany	 India	 Indonesia	 Italy	 Japan	 Korea, South
 Mexico	 Russia	 Saudi Arabia	 South Africa	 Spain	 Switzerland
 Turkey	 United Kingdom	 United States	 Euro Area	 Rest of World	
 Canada & Mexico	 Australia & Canada	 Euro Area, Korea, Switzerland,& United Kingdom	 Indonesia & Russia	 Brazil, Mexico, South Africa, & Turkey	

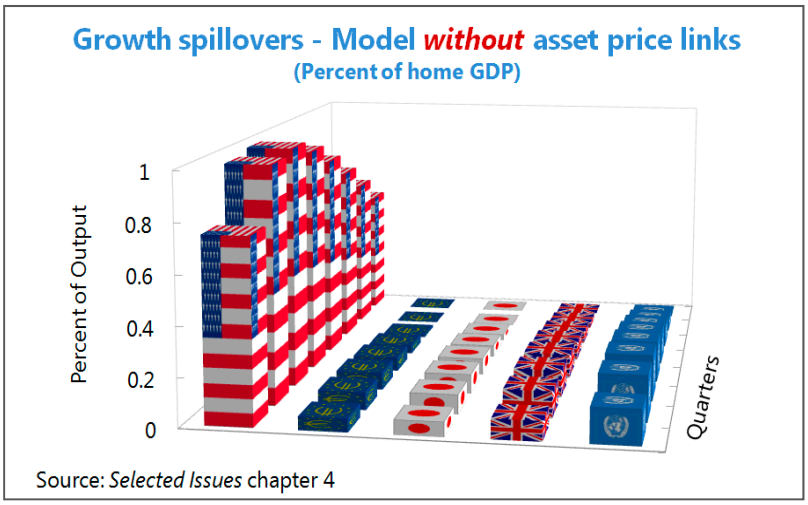
SETTING THE SCENE: THE SIZE AND SOURCES OF U.S. SPILLOVERS

1. The massive global recession set off by U.S. shocks confirmed the reality of major U.S. spillovers to the rest of the world. Financial weaknesses from badly underwritten subprime mortgages in a highly interconnected U.S. financial system during a period of excess borrowing in the U.S. and elsewhere rapidly metastasized into a global crisis. Typical trade and financial market spillovers were accentuated as market disruption rendered liquidity scarce for major global banks and quasi-banks dependent on dollar wholesale funding. With credit to households, firms, and importers suddenly curtailed, confidence collapsed alongside private spending. This led to the deepest and most synchronized world recession since the 1930s, consistent with research finding that U.S. growth spillovers are large and transmitted mainly via financial channels.



Source: Bayoumi and Bui, IMF WP/10/239

2. Simulations involving "standard" international links typically report small U.S. growth spillovers. Standard macroeconomic models focus mainly on links via exports and imports, which depend on activity and exchange rates (the latter driven by interest rate differentials), as well as wealth effects from international asset holdings. Estimated spillovers are generally limited as bilateral trade and portfolio links are fairly small, particularly across systemic countries whose size and diversity tends to make them relatively closed to external trade. U.S. trade is a major driver of activity only in Canada and Mexico,

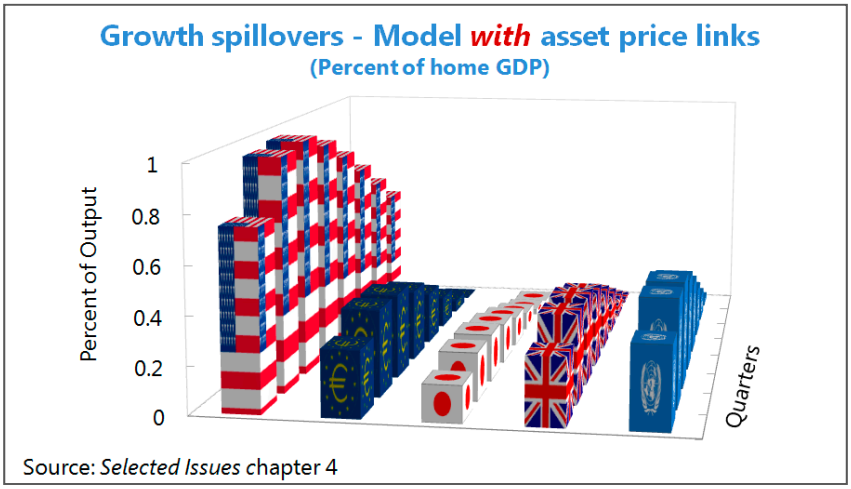


Source: *Selected Issues* chapter 4

immediate neighbors and signatories to the North American Free Trade Agreement (NAFTA), as well as the Caribbean and Central America.

3. U.S. markets are central to global asset pricing, an aspect not well captured in conventional policy simulations. The United States accounts for about one-third of both global stock and bond market capitalization. However, the true importance of U.S. markets is captured by turnover—they represent close to two-thirds of equity and government bond market turnover in the S5. Deep markets and the accompanying vast volume of market analysis mean that, despite the strong domestic orientation of U.S. markets, U.S. financial assets are bellwethers for global prices. Consistent with this central role in global price discovery, numerous studies have found that U.S. news is a major driver of foreign asset prices, while foreign events have only weak effects on U.S. asset prices.

4. These financial market ties are a major conduit spreading the impact of U.S. policies abroad. Analysis using different techniques consistently finds that a change in U.S. bond yields has a significant impact on yields in other countries and the ratio for equity price changes is larger still (Selected Issues, Chapters 1–3). While the ultimate source of these financial linkages—global market integration or more-difficult-to-analyze "animal spirits" associated with private sector confidence—remains uncertain, imposing observed correlations between U.S. and foreign asset prices on a standard macroeconomic model generates larger and more plausible international spillovers.

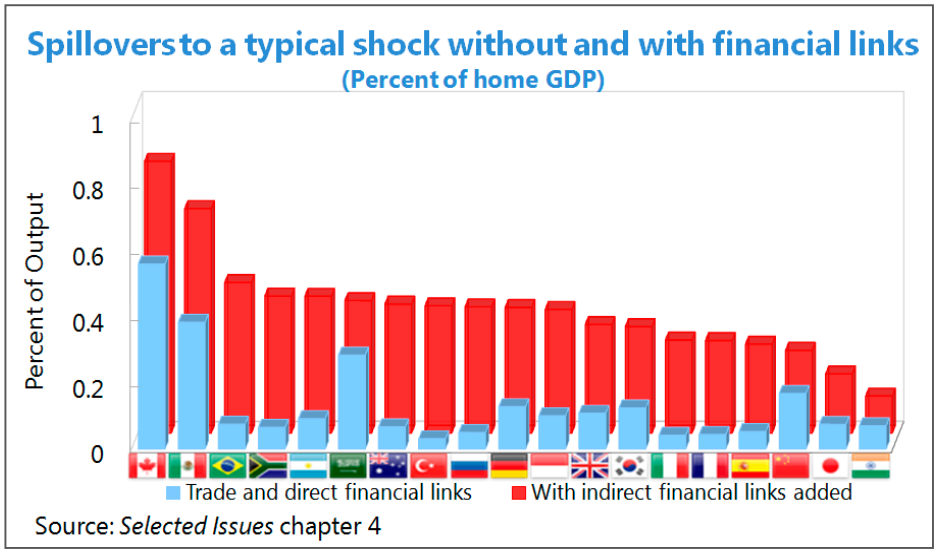


Source: *Selected Issues* chapter 4

5. Beyond close neighbors, spillovers via global asset prices are estimated to typically dominate trade channels. The relative importance of these two channels can be assessed by comparing outcomes from a standard macroeconomic model with those from the same model with typical international bond and equity price associations superimposed. Results across a mix of shocks indicate that spillovers via financial market channels typically dominate beyond close neighbors or countries with extensive capital controls (China and, in bond markets, India). For most

G20 countries, a one percentage point increase in U.S. growth is estimated to raise growth by around half a percentage point, with some three-quarters of the impact coming via asset prices. By contrast, overall Canadian and Mexican growth spillovers are estimated at more like four-fifths of a percent, with trade channels accounting for two-thirds of the total. During the crisis, the impact of disruptions in U.S. wholesale funding on global banking added a further layer to spillovers via financial channels, explaining the virulence of cross-border effects at the time.

6. The critical role of financial prices in spillovers underscores the importance of the macroeconomic and financial environment. Given the forward-looking nature of asset markets, spillovers will in part depend upon the factors prompting the policy change and the overall environment in which the policy change takes place. As elaborated below, estimated spillovers from similar policies can therefore vary significantly over time. In what follows, event studies—which have been applied by others to identify the domestic impacts of U.S. policies over the crisis—are used to assess international impacts (Selected Issues, Chapter 2). While such analysis by its nature measures only initial financial market responses, it provides a powerful tool for considering potential asset price linkages associated with specific policy decisions.



Source: *Selected Issues* chapter 4

7. Some senior U.S. officials were sympathetic to staff analysis, while others were less convinced on the size and sources of spillovers. Some senior officials agreed that spillovers appear to travel largely through financial market prices adding that uncertainty about the reasons for these asset price correlations implied equal uncertainty about the underlying channels of transmission. Other senior officials, pointing to factors such as global risk-aversion, were less convinced that financial market connections (which in any case could reflect real sector behavior) predominated in the transmission of shocks, and pointed to the lower estimates of U.S. spillovers in Chapter 4 of the Spring 2007 *World Economic Outlook*. Officials also noted that while U.S. policies inevitably created positive and negative spillovers, this did not imply that the U.S. should counteract such effects. Staff agreed, noting that one goal of spillover reports was to support analysis by other countries of changes to the global environment.

BACKGROUND: MAPPING THE LINKAGES

A. Direct Financial Ties

8. The pivotal role of dollar markets in the global economy is reflected in the composition of U.S. net international liabilities, the largest in the world. Reflecting the dollar's status as the main global reserve asset, the United States has massive net bond debt, worth almost 10 percent of global GDP and implying relatively large wealth spillovers. The net debt ratio has almost doubled since 2000, with foreign official holdings of U.S. Treasuries ballooning from half to three-quarters of the total. U.S. gross bond liabilities of 13 percent of global GDP comprise about equal quantities of government and private debt, plus a large amount of quasi-government "agency" bonds dominated by the mortgage giants Fannie Mae and Freddie Mac. By contrast, the United States has a positive net asset position in equities and foreign direct investment.

9. Bilateral portfolio links are strongest for major reserve holders and financial centers, focused on public and private bonds, respectively:

- *Net holdings of U.S. bonds are particularly large (over 5 percent of GDP) in some major reserve-holding emerging markets—most notably China*. Demand for reserves has helped lower U.S. yields (see the China *Spillover Report*).

- *Financial centers such as the United Kingdom hold large amounts of (mainly private) U.S. debt*. However, this is offset by large reciprocal U.S. holdings of foreign assets.

- *Foreign holdings of U.S. equities and U.S. holdings of foreign equities are both large*. This is particularly true in advanced economies (given deep markets that allow more scope for portfolio allocation) and the Americas (given proximity).

- *The stock of U.S. foreign direct investment is large in close neighbors (reflecting trade links) and other English-speaking advanced economies*. Foreign direct investment flows, however, are increasingly focused on emerging markets and low income countries.

B. Trade Relationships

10. The United States plays an important, but not predominant, role in global trade. U.S. trade is second to Euro area trade in value, and is only slightly larger than that of China, whose smaller economic size is offset by higher trade openness. The limited role played by the United States in global trade partly reflects its relatively low level of export compared to other systemic countries, reflected in the huge U.S. trade deficit and large trade surpluses of China and Japan. U.S.

imports, conversely, are around the same size as those of the Euro area and larger than those of the other systemic economies.

11. Bilateral spillovers from U.S. real activity and competitiveness are largest for neighboring countries:

- *U.S. activity and trade volumes*. For trade volumes in goods and services, the strongest spillovers are on NAFTA countries, Central America, and Asia. These estimates adjust for international supply chains (see Selected Issues. Chapters 5–6, and the China and Japan *Spillover Reports*).

- *U.S. activity and the terms of trade*. Spillovers are largest for the Middle East, Africa, and some oil producers. Higher U.S. activity mainly boosts global demand and prices of cyclically sensitive commodities such as fuels and metals.

- *Competitiveness*. The bilateral effects of dollar fluctuations tend to diminish with distance. Dollar appreciation increases output in NAFTA members and parts of Central America, as well as in Asia and parts of South America (Selected Issues, Chapter 5 discusses the impact on trade composition).

12. Low income countries' linkages with the United States vary across regions. Workers' remittances are important inflows to Central America (they also matter for Mexico), while tourism and financial services are crucial for many countries in the Caribbean. By contrast, links with low income African countries come mainly via commodity prices, while in the case of Asia demand for basic manufactured goods (such as textiles) matters most.

C. Asset Price Links

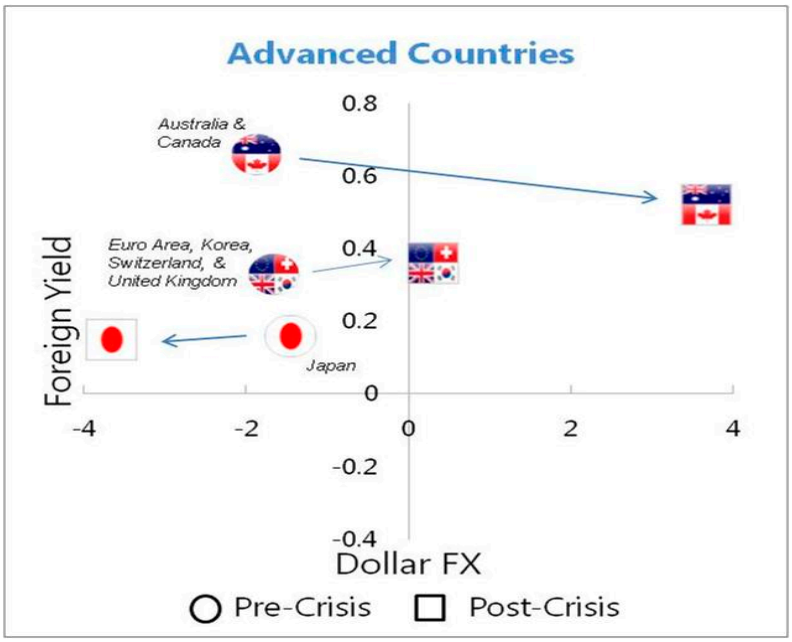
13. A percentage point rise in the 10-year U.S. Treasury bond yield is associated with significant global market effects that have changed dramatically over the crisis (Figure 1). Before the crisis typical relationships were:

- *Foreign bond yields*. Advanced economy bond yields typically rose by 0.4 percentage points, the effect being larger for Australia and Canada and lower for Japan. Most emerging market dollar bond yields showed a larger rise—more like 0.8 percentage points—except in China and India where capital controls prevented any significant impact.

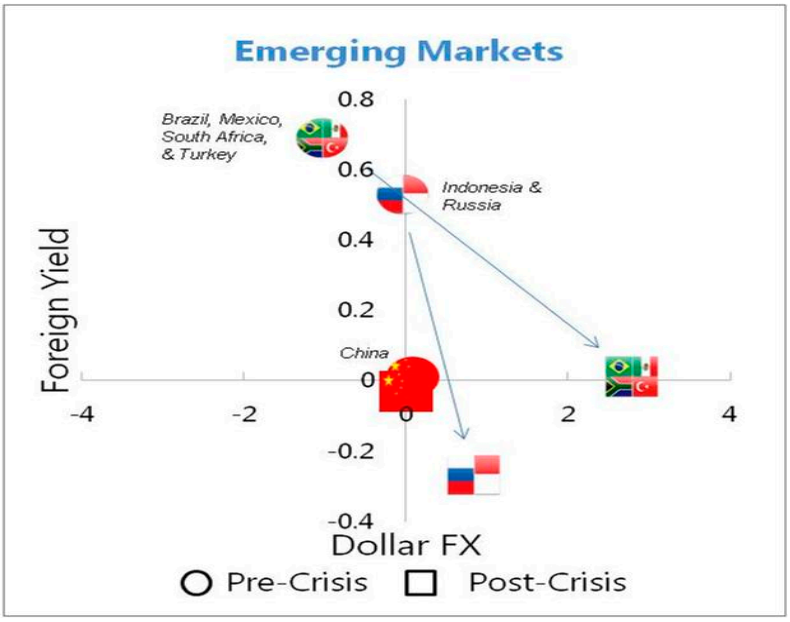
Figure 1. Estimated Bond Yield and Exchange Rates Spillovers

(Foreign responses to a percentage point increase in U.S. bond yields in percentage points)

Exchange rate responses in other advanced countries changed after the crisis.



Both bond yield and exchange rate responses in emerging markets changed after the crisis.



Source: Bloomberg, Haver, and IMF Staff calculations.

- *Exchange rates*. A nominal depreciation against the dollar of 1–2 percent in financially open economies, but little impact on emerging markets with managed exchange rates. This resulted in nominal effective appreciation in countries with managed rates, and depreciations elsewhere.

- *A fall in commodity prices and little effect on global risk appetite*. The commodity effect was particularly important for growth prospects in emerging markets that are commodity producers.

- *These associations were consistent with markets identifying increases in U.S. yields with higher U.S. growth prospects and expected monetary tightening*. The dollar typically appreciated as capital flowed from other countries to the United States.

14. Post-crisis, rising Treasury yields became associated with better global financial sentiment and capital outflows from the United States. With abundant liquidity providing incentives to invest spare cash and the zero federal funds rate allowing cheap dollar funding, safe haven considerations (or the converse) came to dominate market responses. In contrast to the pre-crisis norm, rising U.S. yields was associated with improvements in global risk appetite, increases in commodity prices, higher equity valuations, and depreciations of the dollar (except against other low-interest-rate currencies also used for cheap funding such as the yen). The pre-crisis positive link between Treasury and emerging market yields disappeared, possibly because capital inflows to emerging markets associated with better global prospects offset the usual upward pressure on local bond yields.

15. The timing of the return to more typical asset price relationships, and the nature of the "new normal," is a key uncertainty in assessing future policy spillovers. While there is no strong evidence of such a reversion at this point, rising U.S. Treasury yields should at some point again become more an indicator of future monetary policy tightening than of better global market sentiment. At that point, capital would likely flow back into the United States in response to higher Treasury yields, rather than away from it—although (as event studies suggest) correlations among bond yields may also be less tight post-crisis because of changing perceptions of relative fiscal risks between emerging and advanced economies.

D. Global Liquidity

16. Deep asset and money markets that channel liquidity globally largely explain the central U.S. role in financial intermediation and the virulence of crisis spillovers:

- *U.S. assets dominate collateralized credit markets*. The short-term nature of secured lending and repurchase agreements explains why many banks quickly found it difficult and increasingly costly to obtain term dollar funding as collateral and counterparty risks rose over the crisis.

- *The United States also has the largest global pension, mutual fund, and insurance industries given its wealth and limited social safety net relative to other advanced economies.* This "real money" investor base is central to the U.S. arm's-length, bond-based financing model.

- *Dollar wholesale funding is further boosted by the fact that large money market mutual funds are an intrinsically U.S. phenomenon*. Their systemic role was confirmed by the Treasury's guarantee program after a fund "broke the buck" during the crisis.

- *Strains in dollar funding over the crisis were partly relieved by swap arrangements between the Fed and other central banks.* The continuing importance of this channel is underlined by the latest extension of these swap arrangements through August 2012.

17. The importance of dollar wholesale funding explains the heavy foreign presence in the U.S. banking system despite the domestic focus of U.S. markets. Foreign banks have some $5.4 trillion of assets in the United States versus U.S. banks' $2.5 trillion of assets abroad, the largest difference in the world. Most other advanced-economy banks have major U.S. operations, while U.S. commercial banks tend to be more engaged in emerging markets (Selected Issues, Chapter 7).

18. Pension and mutual fund outflows from the United States are larger and more diversified than inflows, again reflecting the role of New York in wholesale funding. Large gross inflows and outflows from and to offshore centers such as the Cayman Islands reflect the complex financial engineering and book-entry practices prevalent in modern financial markets. However, the United States is also a significant net supplier of funds to countries as diverse as Brazil, Egypt, and India, underscoring the global reach of its role as a financial intermediary (see the U.K. Spillover Report for a related discussion of the role of London as an international financial center).

MOTIVATION: VIEWS OF OTHER AUTHORITIES ON U.S. POLICY SPILLOVERS

19. The support to global demand provided by U.S. policies was generally welcomed by foreign officials. While acknowledging the benefits of macroeconomic policies supporting U.S. growth, concern was often voiced that U.S. policies and those of other systemic economies were designed only to solve their own domestic difficulties, and could cause problems elsewhere. In

particular, U.S. policy slippages could lead to further capital inflows, spikes in inflation, and risked a hard landing for foreign growth.

20. Monetary policy was generally seen as the main area that gave rise to spillovers:

- *Several authorities were concerned that ample global liquidity had raised commodity prices and fed into inflation, which could become entrenched.* Several interlocutors ascribed these developments to quantitative easing, sometimes arguing that the 2010 easing ("QE2") was more important than Chinese demand in stoking commodity prices. By contrast, authorities in one country made a point of stating they did not believe U.S. monetary policy had an impact on commodity prices.

- *Currency strength and strong capital inflows in some countries were often seen as partly the result of QE2.* U.S. monetary policy was described as an important push factor for capital flows, while pull factors were also acknowledged to have had a role.

- *Views on the appropriate countervailing policies were mixed.* Some authorities saw exchange rate flexibility/appreciation as the best tool to address capital inflows, and resisting appreciation as only leading to higher flows. Authorities in several economies with restrictions on the capital account, however, mentioned that they did not receive massive capital inflows as a result of QE2. Others saw U.S. monetary policy as counteracting their own exchange rate strategy, and in some cases new capital restrictions were seen as having helped dampen flows.

- *Some were concerned that the unwinding of QE2 and/or U.S. policy rate hikes could trigger damaging capital flow reversals.* As returns on investment picked up in the United States and other advanced economies, funds would be diverted back to the source markets. Furthermore, monetary policy in some countries might have become more synchronized with that of the United States, exacerbating spillovers: when the U.S. tightens, others would also see the need to tighten further.

21. Fiscal policies in advanced countries with unsustainable current deficits, including the United States, were often described as having raised global tail risks. Concern was expressed over the possibility of a market reassessment of U.S. fiscal sustainability which could lead to a rapid deterioration in global financing conditions, capital flows, and possibly the value of the dollar:

- *Global bond yields could rise rapidly if markets demanded higher premiums against fiscal risks (as well as possible inflation concerns).* Other countries could face a sudden stop in capital inflows given increased U.S. financing needs.

- *Fiscal risks were also described as complicating the task of rebalancing the growth model of some countries.* Such rebalancing might have to be undertaken against the background of weak foreign demand and financial conditions, volatile currency and capital flows, and questions about the safety of dollar denominated foreign assets.

22. U.S. financial sector policies were also cited as a potential source of spillovers:

- *Authorities in some countries noted the importance of better supervisory cooperation.* They observed that if financial channels dominate in transmitting spillovers, then better regulatory and supervisory cooperation may be at least as important as macroeconomic policy coordination, the current focus of international efforts.

- *The Dodd–Frank Act in particular was seen as potentially having spillover effects via regulatory arbitrage, although the channels were uncertain*. Authorities in one country also expressed concern that a commitment to not bail out systemic financial institutions could be disruptive if carried out bluntly or time-inconsistently.

- *Limited supervision of money market funds, upon which many non-U.S. banks depend for wholesale funding, was seen as adding fragility to the global financial system*. Potential spillovers from deleveraging of U.S. financial institutions affected by, say, new losses on commercial property were also mentioned as a risk.

ANALYSIS: POLICY SPILLOVERS

23. Further fiscal stimulus and QE in 2010 have increased the likelihood of negative spillovers when macroeconomic policy support is reversed. With policy options diminishing and further delay of fiscal consolidation increasingly problematic, deficit reduction could occur more abruptly than earlier envisaged. This would improve U.S. saving, reduce global imbalances and real interest rates, and lower the risk that concerns about the long-term fiscal path will lead to a rapid increase in bond yields. However, it will also dampen U.S. growth and could delay monetary tightening. When it comes, such tightening is likely to reverse some capital flows to emerging markets with open capital accounts by reducing interest rate differentials, particularly if it occurs at a faster-than-anticipated pace. Meanwhile, implementation of the Dodd–Frank Act could put further pressure on bank credit, including cross-border lending.

A. Monetary Policy: Quantitative Easing and Future Rate Hikes

24. Concerns over monetary policy spillovers currently focus on the global impact of the end of quantitative easing and eventual Fed rate hikes at some point in the future. While fiscal policy operates on U.S. aggregate demand directly, with financial market effects as a by-product partly offsetting the impact on growth, monetary policy acts primarily through financial markets and hence international asset price linkages will normally amplify spillovers. This may be even more true currently, as very low interest rates may increase incentives to take financial risks. Spillovers from unexpected potential global asset price shifts reinforce the case for clear communication of future monetary policy intentions.

25. Estimated asset price spillovers of QE1 announcements are larger than pre-crisis monetary policy messages, while QE2 announcement spillovers appear generally smaller (Figure 2, top panel). Event studies were used to estimate the response of foreign asset prices per unit impact on U.S. 10-year bond yields and equity prices:

- *Both sets of easing announcements were associated with declines in foreign bond yields, but the response seems to have been notably larger for QE1*. A similar pattern emerges for appreciation in dollar exchange rates and higher U.S. inflation expectations.

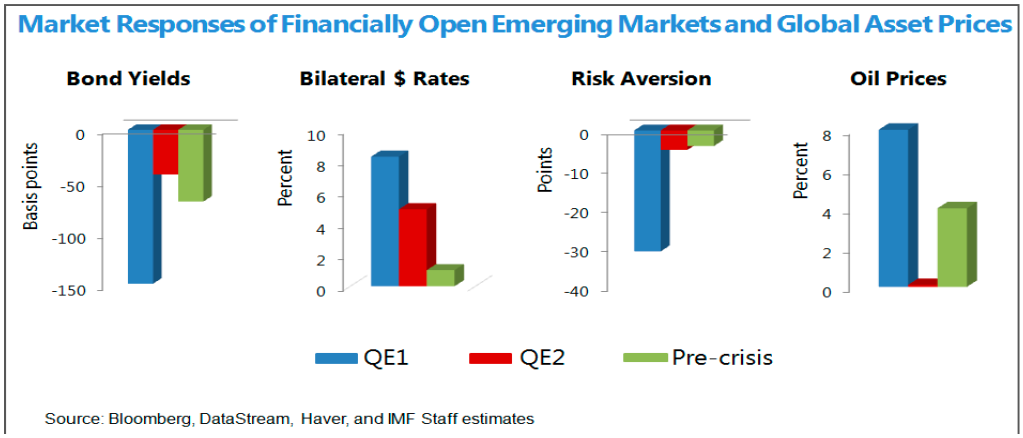
- *Unlike QE1 or pre-crisis policy announcements, QE2 announcements do not appear to be associated with a short-term improvement in global financial conditions*. This is true for the VIX (i.e., global risk appetite), oil and nonoil commodity prices, and global equity prices. This divergence appears to largely explain the more muted effects of QE2 on foreign bond yields/dollar exchange rates.

- *These asset price responses were generally similar to pre-crisis monetary policy announcements and significantly different from "typical" post-crisis ones.* Event studies of policy announcements involve a range of identifying assumptions. Yet the abnormal foreign asset price knock-ons uncovered suggests that this approach may provide a reasonable, albeit imprecise, estimate of global financial market effects.

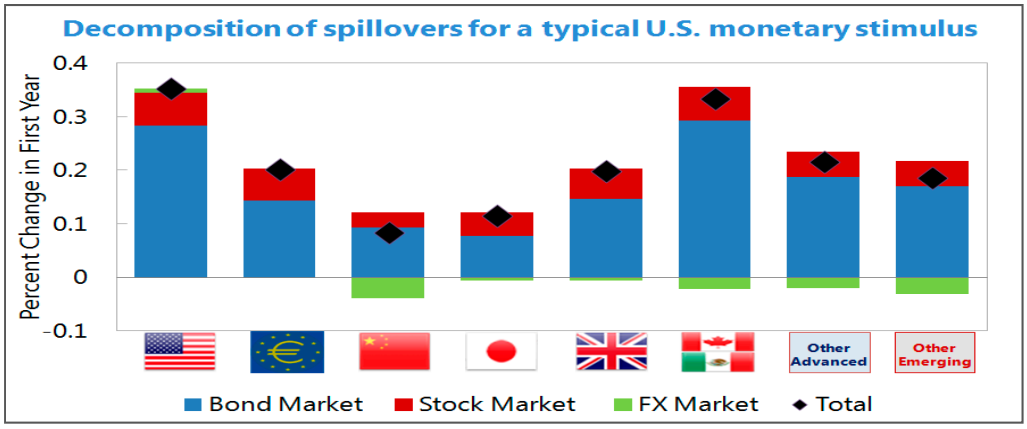
- *Vector autoregressions fitted to weekly data find that quantitative easing announcements were associated with higher capital inflows to emerging market bond and equity funds* (Selected Issues, Chapter 8). Actual Fed purchases of securities (i.e., implementation of the announcements) did not appear to affect such inflows.

Figure 2. Estimated U.S. Monetary Policy Spillovers
(percentage points unless otherwise indicated)

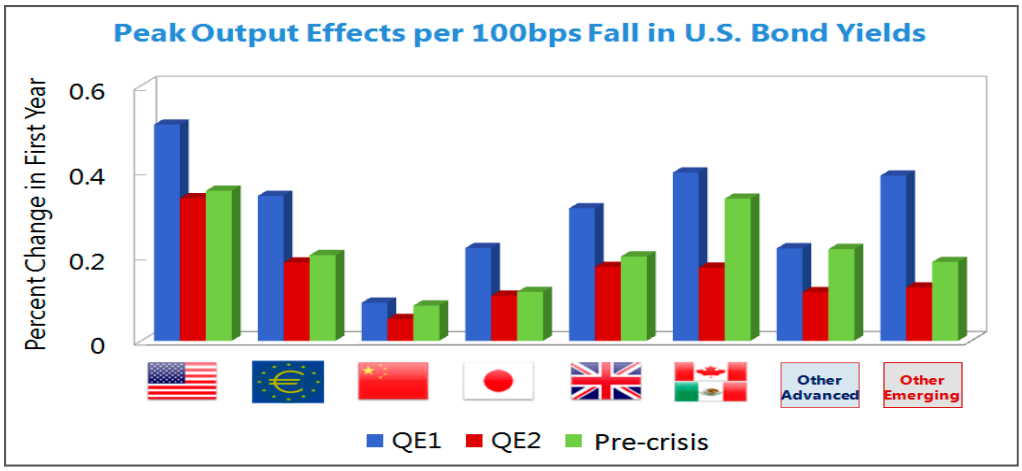
Global markets were more buoyed by QE1 than QE2.



Monetary spillovers appear to mainly come through bond price linkages.



Growth spillovers appear largest for QE1 because foreign bond yields fell more.



Source: Selected Issues, Chapters 2 and 9.

26. Growth spillovers from U.S. monetary policy were assessed by incorporating estimated asset price linkages from event studies into macro model simulations. Policy simulations were used to illustrate how estimated short-term impacts of policy announcements on asset prices (based on event studies) could percolate into activity. Pre-crisis spillovers were calculated by incorporating into a macroeconomic model estimated knock-ons between U.S. monetary policy (via U.S. asset prices) and foreign bond yields, equity prices, and exchange rates. The results suggest somewhat larger growth spillovers (per percentage point change in U.S bond yields) than those from the generic shock reported in Section I, with the main channel being via bond yields (Figure 2, middle panel and Selected Issues, Chapter 9).

27. Growth spillovers from QE1 announcements are also estimated to have been larger than pre-crisis monetary policy spillovers would suggest, and those from QE2 smaller (Figure 2, bottom panel). This ordering of the size of spillovers holds across a wide range of economies, reflecting the more positive international financial market knock-ons estimated for QE1 than for QE2. Analysis of the latter is complicated by the marked improvement in global financial conditions not long after Chairman Bernanke's August 2010 speech at Jackson Hole announcing QE2. Extensive analysis fails to establish a link between QE2 announcements and this development. However, if larger spillovers of the type estimated for QE1 are assumed, it is important that the full array of effects—on risk aversion, exchange rates, and commodity prices—be jointly considered, rather than focusing on some and not others.

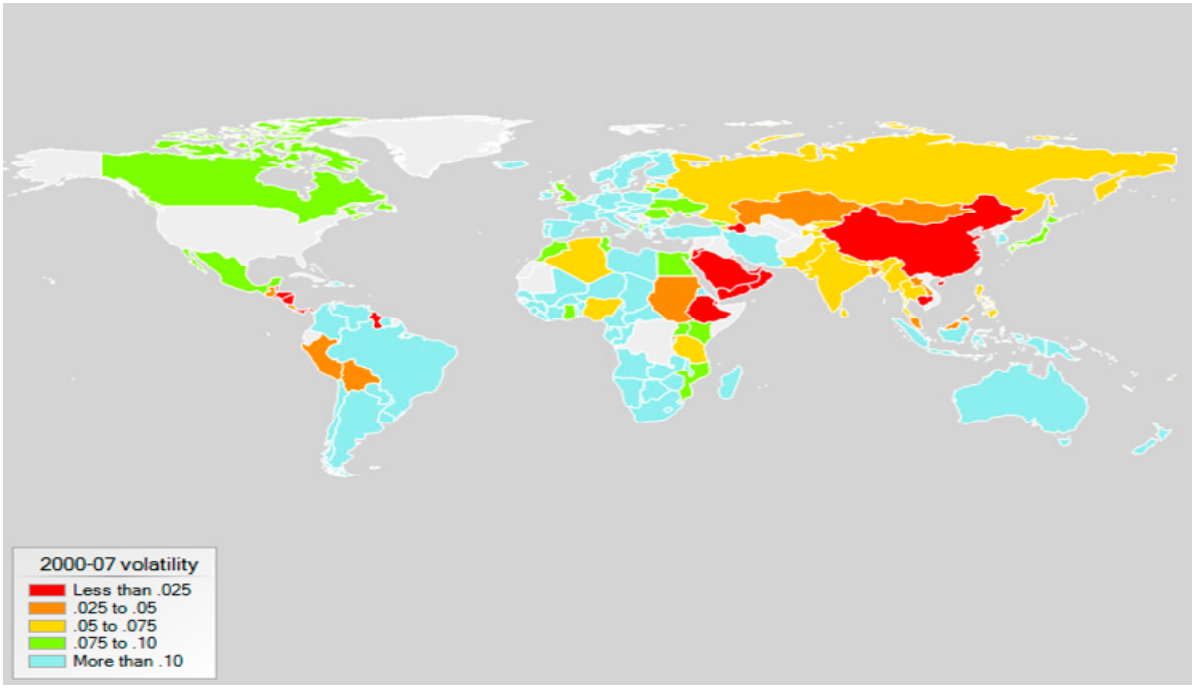
28. Looking forward, some reversal of inflows to emerging markets is likely when markets start expecting monetary tightening over the near future. With the end of QE2 having been fully anticipated, its impact has likely already been absorbed by markets. By contrast, when the Fed eventually starts to prepare to tighten policies, including by draining liquidity, it could cause a jump in Treasury yields and sharper capital outflows from emerging markets, particularly if the move was unexpected. This is because such a shift would be the precursor to future rate hikes (or swift balance sheet unwinding) thereby signaling smaller interest rate differentials and either greater confidence in the U.S. expansion or rising inflationary pressures (see also Chapter 3 of the Spring 2011 *World Economic Outlook)*.

29. The monetary policy dilemmas facing emerging markets are generally more acute than for advanced economies. Limited market depth makes emerging market financial conditions particularly susceptible to changing capital flows. Against a background of diverse monetary regimes, spillovers from U.S. monetary policy in any one country depend partly on exchange rate policies elsewhere, as the benefits (costs) to foreign activity of a dollar appreciation (depreciation) will be amplified if a close trading partner fixes to the dollar. This helps explain why exchange rate volatility versus the dollar tends to be regional, with much lower volatility in Asia and the Middle

East than in other regions, supported by active currency management and (in some cases) capital controls.

Pre-crisis historical volatility of dollar exchanges rates

(Standard deviation of log monthly returns, 2000 to 2007, annualized)



Source: IFS and IMF Staff calculations

30. Senior Fed officials were qualitatively comfortable with staff views on spillover channels from QE2 but less concerned about capital flow reversals. Regarding the impact of eventual monetary exit, emerging market capital flows were seen as mainly involving a structural component rather than a cyclical component that could be reversed, so that U.S. monetary tightening shouldn't constitute an untoward shock. In a market environment where the "winds had shifted", they felt that reactions of some authorities to QE2 may well have reflected strong cyclical positions that made the boost to global activity less attractive than was true at the time of QE1. Officials stressed that the FOMC was fully committed to be as transparent as possible, and agreed that good communication would make for a smoother exit from the zero bound.

B. Fiscal Policy: Stimulus and Consolidation

31. Concerns over fiscal spillovers are largely focused on the risks from a loss of market confidence in the U.S. fiscal policy trajectory. In principle, fiscal consolidation creates permanent positive growth spillovers via lower global real interest rates as well as short-term negative spillovers via losses in U.S. activity. In order to assess the net spillover effects from U.S. fiscal policy, a multi-

pronged approach was used, combining standard regression analysis; macroeconomic model simulations allowing for various degrees of credibility and financial linkages; and event studies focusing on the possible impact of key fiscal policy announcements on the relationship between U.S. Treasury yields and foreign asset prices.

32. The long-term impact of U.S. fiscal consolidation on foreign output is positive as lower U.S. government debt and higher saving reduce global real interest rates. Staff regression analysis finds that each percentage point reduction in the U.S. general government debt-to-GDP ratio lowers global real interest rates by 3–4 basis points over the long run, consistent with the prevailing literature (Selected Issues, Chapter 10). Macroeconomic model simulations then suggest that the long-term boost to foreign potential output from a 10 basis point permanent reduction in global real interest rates is a fairly uniform 0.1 percent (Figure 3, top panel). Importantly, this would also help rebalance global demand by reducing the U.S. current account deficit.

33. The short-term impact on foreign activity from a typical pre-crisis fiscal consolidation is estimated to be generally small and its sign uncertain (Figure 3 middle panel, and Selected Issues, Chapter 11). While results vary somewhat with assumptions about the size, speed, credibility, and composition of the package as well as the monetary policy response to it, for a generic fiscal stimulus the following general observations can be made:

- *For close trading partners such as Canada and Mexico short-term losses through trade generally dominate*. This also holds for countries with extensive capital controls, most notably China and (for bond markets) India.

- *Elsewhere, the net impact is generally small and ambiguous*. Using the foreign bond yield and exchange rate co-movements implied by a generic pre-crisis budget announcement, the net impact on output is found to be relatively limited.

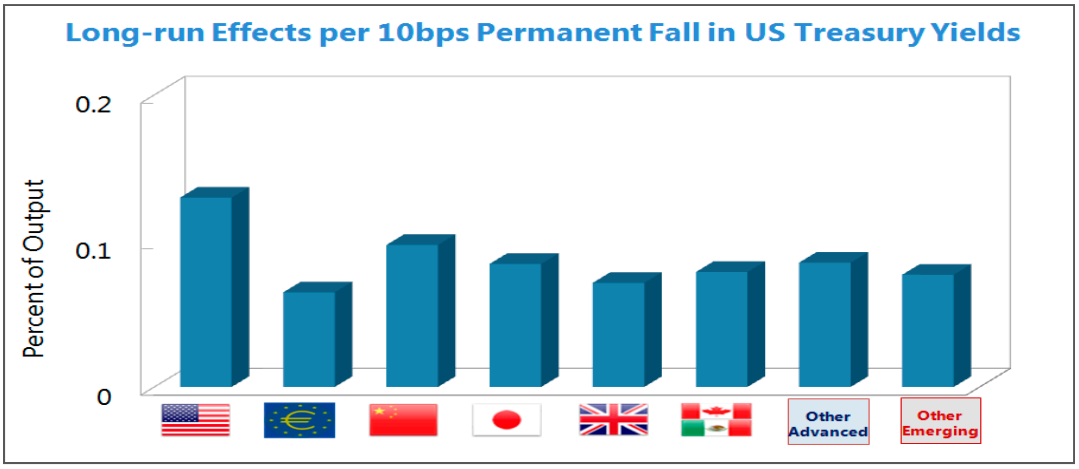
- *Nonetheless, there are significant implications for trade and the composition of demand*. Although the net effects on foreign output are small relative to the impact on U.S. output, this conceals a significant shift between external and domestic demand, at least for countries with flexible exchange rates.

34. The 2009 fiscal stimulus is estimated to have led to larger-than-expected support to foreign activity while, if anything, the 2010 package likely had the opposite effect. Event studies find that the estimated spillover from U.S. to foreign bond yields in response to stimulus announcements in 2009 was generally more limited than would have been expected given pre-crisis experiences. Illustrative policy simulations of a generic fiscal package generate correspondingly

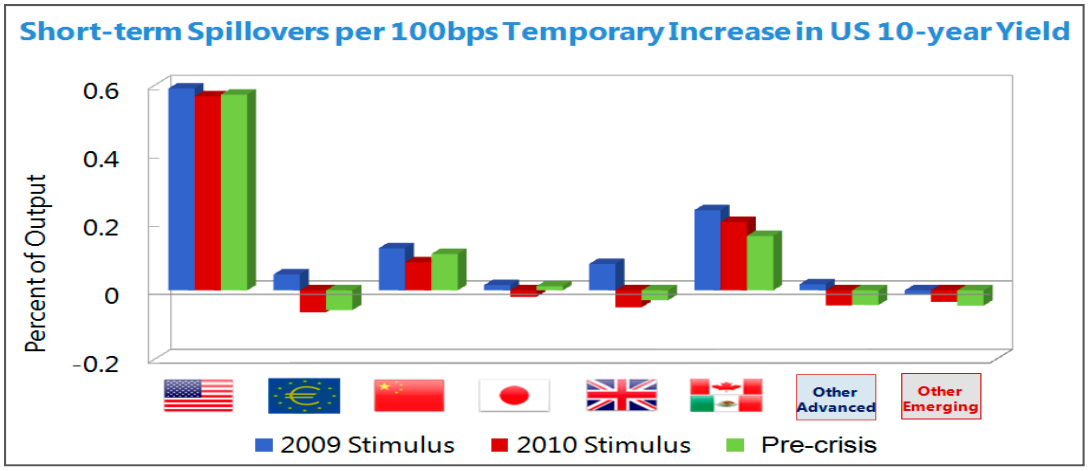
Figure 3. Estimated U.S. Fiscal Spillovers

(Percent of home GDP)

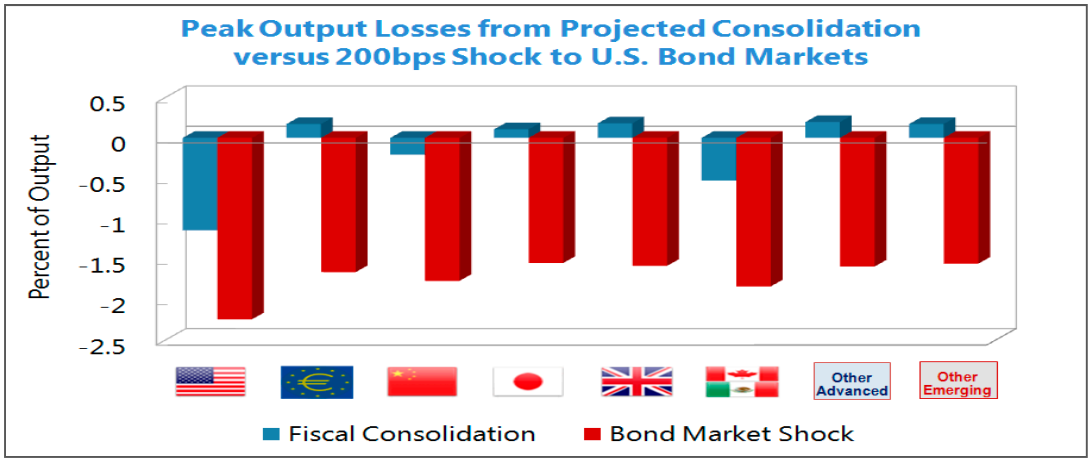
Consolidation has significant global long-term benefits.



Short-term spillovers are ambiguous, especially given high current levels of debt.



Spillovers from a U.S. bond market shock could be severe.



Source: Selected Issues, Chapter 11.

more-positive growth spillovers. Conversely, the relatively strong estimated bond market links after the 2010 stimulus announcement imply less benign spillovers. This underlines the importance of market sentiment in understanding global effects: in 2009, facing the risk of a Depression, U.S. fiscal expansion may well have led to a lowering of foreign bond risk premiums that largely offset the crowding out from higher U.S. government debt; by 2010, this effect appears to have reversed. It also emphasizes the importance of adopting a clear medium-term fiscal framework.

35. Looking ahead, a gradual, credible U.S. deficit reduction is unlikely to have major growth spillovers, particularly compared to those from a loss of fiscal credibility (Figure 3, bottom panel). Measured, well articulated, and credible fiscal consolidation that culminates in a major reduction in U.S. government debt as a ratio to GDP would likely provide positive net spillovers to the rest of the world in the short-run via lower bond yields than otherwise—notwithstanding their current low levels in the United States and some foreign economies—although a less credible adjustment could generate more generalized short-term output losses abroad. Gradual consolidation also reduces the tail risk of a global bond market event where investors would lose confidence in the ability of the United States to respond decisively to its looming fiscal challenges. Such a loss in confidence would generate major negative spillovers to the rest of the world given the role of U.S. government bond yields as global benchmarks.

36. Senior officials generally agreed on the importance of having a credible fiscal path to avoid crowding out and head-off tensions on U.S. and possibly global interest rates. They were less optimistic, however, on the short-run benefits of consolidation, as crowding out was not thought to be currently operative given low credit demand and bond yields. They cautioned that the negative short-run impact (including on foreign economies) from severe and frontloaded U.S. fiscal tightening could plausibly be large.

C. Financial Policy: Investment Banking and the Dodd-Frank Act

37. Disruptions in U.S. financial markets after the Lehman bust created major negative growth spillovers and exposed flaws in U.S. financial oversight. Regulators had made a sharp distinction between banks, subject to prudential supervision and special resolution procedures and with access to Fed liquidity, and nonbanks (notably investment banks, also known as broker-dealers) where supervision was focused on market conduct and official liquidity/resolution were not available. In response to the chaos in wholesale funding markets after the collapse of Lehman, access to Fed liquidity support was rapidly widened to include major investment banks, money market funds, and selected foreign central banks**.**

38. U.S. wholesale funds are generally channeled to the global banking system via major investment banks as well as money market mutual funds. In addition to U.S.-owned broker-

dealers (such as Goldman, Sachs & Co. and Citigroup Global Markets that have become or already were part of bank holding companies) several large northern European banks have U.S. operations deeply involved in investment banking. These include Barclays, Credit Suisse, Deutsche Bank, and UBS. In addition to the much simpler U.S. money market funds—which just on-lend short-term funds—investment banks are the arteries that connect the global banking system to U.S. securities and wholesale funding, often through the more internationalized U.K. markets (see the U.K. Spillover Report). Their systemic role was confirmed by the Fed's emergency lending actions during the crisis.

39. Wholesale funding uncertainties likely explain why co-movements of major U.S. and European bank equity returns have become much tighter since the crisis (Figure 4, top panel). Banking spillovers are measured using "beta" coefficients that estimate how excess equity returns of major foreign commercial and investment banks (i.e., bank stock returns relative to the overall market) react to U.S. bank excess returns. Before the crisis, only the major Swiss banks had a beta of over one-quarter. After the crisis, this was also true of major U.K., German, French, and Italian banks—especially investment banks. The dependence of European banks on U.S. wholesale funding provides a potential conduit for a European financial shock to affect the rest of the world (see the Euro area *Spillover Report*).

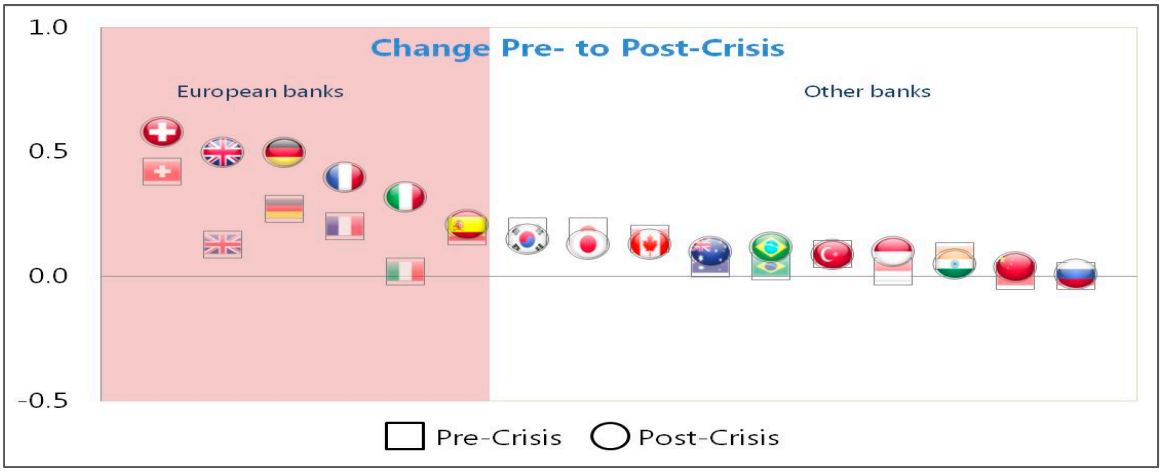
40. Dollar markets stretch well beyond U.S. borders, reinforcing spillovers while limiting the impact of U.S. regulatory choices. This reflects the global role of the dollar as a reserve currency and liquid store of value. Pre-crisis, U.S. regulations were often circumvented by investment banks moving trades to less-regulated markets; for example, looser U.K. rules on collateral "rehypothecation" drove some prime-brokerage business to London (see the U.K. Spillover Report). More generally, financial centers tend to have complementary strengths, e.g., New York's deep securities markets and London's derivatives focus and internationalism. Indeed, the nexus between the U.S. and U.K. dollar markets is symbolized by the fact that the world's most important private short-term dollar interest rate—the London inter-bank offered rate or LIBOR—is determined in London and only three of the 16 banks on the panel are U.S.-based.

Consistent with the crisis experience, significant spillovers are estimated to come from widespread U.S. wholesale funding disruption. Such disruption crystallized after Lehman's failure caused counterparty risks on other banks to jump on fears of a systemic crisis. This is illustrated by simulations using data on cross-border loans between U.S. and foreign-based banks to calibrate the knock-ons from disruptions in U.S. wholesale funding costs on foreign funding costs. The same model also provides estimates of the (potentially significant) growth spillovers of U.S. regulatory capital top-ups for systemic players mandated by the Dodd–Frank Act (Selected Issues, Chapter 12). In that case, however, costs must be viewed against the gains from greater financial stability.

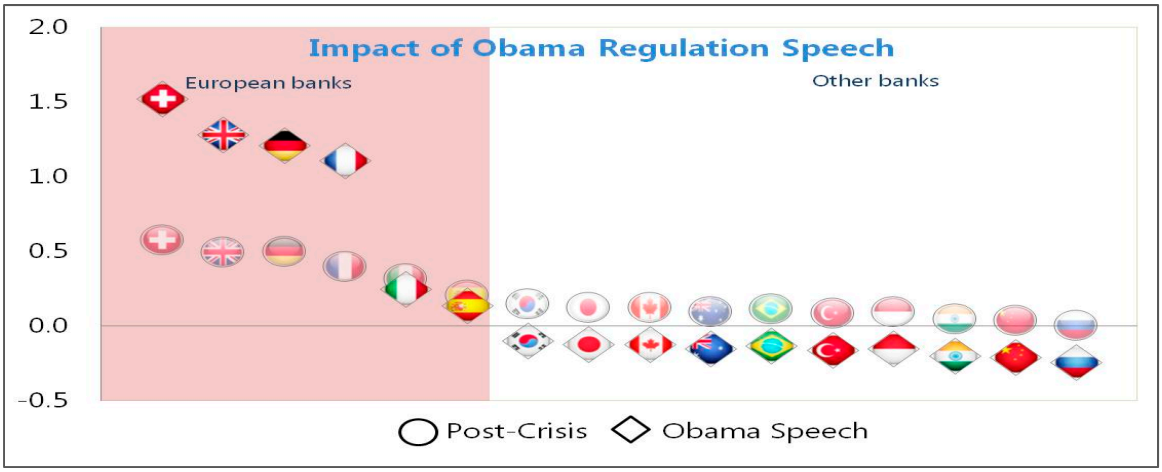
Figure 4. Estimated U.S. Financial Policy Spillovers

(Percent change in foreign bank equity excess returns per percent rise in U.S. bank equity excess returns)

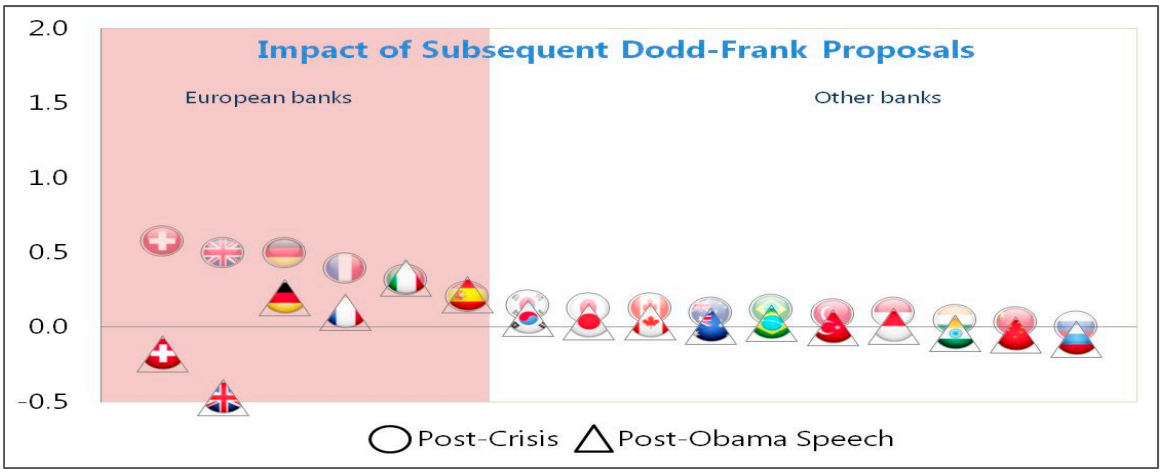
Disrupted wholesale funding increased U.S.-European bank links after the crisis.



The January 2010 Obama regulation speech signaled a new approach to global financial regulation.



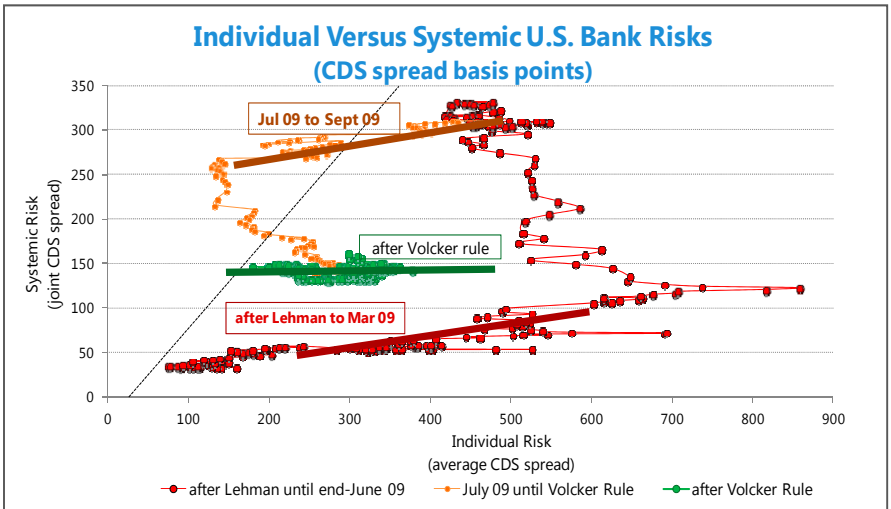
Subsequent Dodd-Frank announcements may have been more prone to regulatory arbitrage.



Source: Bayoumi and Bui (2011).

41. The U.S. structural response to these pressures was embodied in the July 2010 Dodd–Frank Act, the biggest reform of U.S. financial regulations since the 1930s. As elaborated in last year's U.S. Financial Assessment Program (FSAP), the Act strengthens the Fed's consolidated supervisory powers over bank holding companies (which now include all major U.S.-owned broker-dealers) but retains an element of "deference" to the securities and futures regulators. It establishes a Financial Stability Oversight Council (FSOC) that makes the regulatory perimeter dynamic by permitting any financial firm to be designated as systemic and brought under Fed oversight. The Fed may only lend to systemic nonbanks in extremis, however, with "Volcker rules" separating retail banking from more risky proprietary trading. The Act also creates a resolution mechanism for systemic holding companies.

42. The Dodd–Frank Act seems to have succeeded in its aim of reducing potential knock-on effects from major individual U.S. banks to the global financial system. As measures of the probability of default based on credit default swap spreads are contaminated by market assessments of whether a given bank's debt holders will be bailed out—the very behavior the legislation aims to curb—staff analysis gauges the risk of insolvency from prices of bank equity options (Selected Issues, Chapter 13). The positive relationship over the crisis between risks to individual banks and systemic risk seems to have flattened after the Act was passed, consistent with its core objective—thereby containing spillovers.



Source: *Selected Issues* chapter 13

43. A signal moment in the regulatory reform process appears to have been President Obama's speech on financial regulation in January 2010. The speech provoked a major market response, with negative excess returns on bank equity simultaneously in the United States and much of Europe (Figure 4, middle panel). More than the specifics, it would appear that the speech telegraphed U.S. seriousness on tightening financial regulations, with the market reaction confirming perceptions of U.S. leadership and expectations that similar regulatory stringency would follow in other jurisdictions. This interpretation is supported by the fact that the impact on banking systems

outside of Europe, that were more highly capitalized and less dependent on wholesale funding, was considerably more muted.

44. Market responses to subsequent Dodd–Frank announcements, however, may raise concerns about regulatory arbitrage between the United States and Europe. Announcements that led to increases (decreases) in excess returns on major U.S. banks are estimated to have led to oppositely signed excess returns on major U.K. and Swiss banks (Figure 4, bottom panel). Such opposing movements could indicate that markets may have seen these regulations as changing the relative competitive position of U.S. and European banks, rather than promulgating internationally consistent policy initiatives.

45. Going forward, decisions by the Oversight Council and proactive supervision by the Fed will matter deeply for international financial stability. Given the importance of U.S. wholesale funding for foreign banks and the role of U.S.-based investment banks as conduits, Council decisions on which institutions to designate as systemic will be key. Strong international links—which could rebound back onto U.S. financial stability—strengthen the case for designating all U.S.- and foreign-owned major investment banks as systemic and putting them under Fed umbrella supervision. Inside the perimeter, the equally difficult challenge will be to successfully prudentially supervise investment banks with highly malleable balance sheets. This may test the effectiveness of the FSOC, as the systemic overseer, to coordinate across specialized regulators.

46. Ideally, U.S. rules governing trading and funding activities will be closely synchronized with other major international financial centers—especially the United Kingdom. In practice, however, regulatory coordination seems strongest in the commercial banking context. New U.S. regulations risk pushing trading activities to less regulated sectors or jurisdictions. Already, major European investment banks have dissolved their U.S. bank holding companies to avoid higher capital requirements, while Volcker rules have led to the spin-off of trading activities to unregulated entities with strong but implicit links to regulated affiliates.

47. The authorities underlined that U.S. financial regulatory reform was geared toward achieving international consistency on big-picture issues. With capital standards being left to Basel, U.S. law is meant to augment the framework through systemic surcharges and responsibility fees, which were seen as examples of U.S. leadership. Some U.S.-specific measures, such as the Volcker rules, were not necessarily meant to be adopted by others. Large investment banks would be designated as systemic nonbanks and subjected to the same scrutiny as large bank holding companies. Nevertheless, regulatory arbitrage is recognized as a reality necessitating coordination through the Financial Stability Board.

CONCLUSIONS

48. The size of the U.S. economy and, in particular, the global dominance of its financial markets create uniquely large policy spillovers. Beyond close neighbors, these come largely through links associated with global financial asset prices, which directly affect financial conditions abroad and seep into domestic activity everywhere. These spillovers strengthen the case for clear communication of U.S. policies and for better-defined medium-term fiscal policy framework.

49. Concerns that the end of QE2 could lead to a rapid reversal of emerging market capital flows appear overblown. Markets reacted to quantitative easing announcements, with little or no additional impact from actual purchases of assets. The fully anticipated end to QE2 seems unlikely to provoke much market reaction. Emerging market capital flows are more likely to reverse as it becomes apparent that the Fed will hike rates in the foreseeable future, signaling smaller interest rate differentials and confidence in the U.S. expansion and/or fears about inflation.

50. A credible plan for a gradual U.S. fiscal consolidation would likely have limited short-term spillovers and substantial longer-term benefits. A gradual and credible consolidation would raise U.S. national saving, lowering global real interest rates and imbalances over the medium-term. Beyond close neighbors, negative spillovers from lower U.S. activity would likely be largely if not completely offset by improved global financial market sentiment given the high level of U.S. government deficits and debt.

51. The risk of major spillovers from a freeze in dollar wholesale funding reinforces the case for strong implementation of Dodd–Frank rules. Given the central role of U.S.-based (but not necessarily U.S.-owned) investment banks in funneling dollar liquidity to the rest of the world, stronger U.S. prudential supervision of these entities—preferably in concert with supervisors in other major financial centers given the geographic mobility of trading activity—would help contain renewed spillovers through this channel.

52. Overall, U.S. and foreign goals appear better aligned for U.S. fiscal and financial policies than for monetary policies. Fiscal consolidation and sounder financial regulation help avoid global tail risks. While there may be disagreements about the pace and details of implementation, all countries have a stake in a successful outcome. Monetary policy is more complex. While spillovers from QE2 appear limited, low short-term interest rates and abundant liquidity partly work by increasing incentives to take financial risks. This may be helpful for other countries in a similar cyclical position, but can be more problematic for those with open capital markets that have already shaken off the crisis and where investment opportunities are more plentiful. These other countries, however, also have macroeconomic tools to steer their economies.

INTERNATIONAL MONETARY FUND

UNITED STATES

2011 Spillover Report – Selected Issues

Approved by Tamim Bayoumi

July 22, 2011

Contents Page

Tables

Figures

I. U.S. Financial Spillovers: Typical Advanced Country Responses[1]

Endogenous estimates of spillovers from bond and equity price shocks across the United States onto other systemically important economies are reported. Changes in U.S. market prices are found to be the dominant source of global financial market spillovers, although UK bond markets and Euro area equity markets also generate mild non-U.S. spillovers.

The analysis relies on end-of-week data for nominal long-term sovereign bond yields and equity prices from 2000 through 2009 for the United States, the Euro area, Japan, and the United Kingdom. These economies were chosen because of their importance in the global economy and in financial markets. China—the remaining systemic country—was not included in the analysis as its markets are still forming and its extensive capital controls limit market spillovers. Euro area bond yields were proxied by German yields, while Euro area equity prices were measured by the FTSEurofirst 300 index. A weekly frequency was chosen as more relevant for macroeconomic analysis and avoiding the complications due to missing data and overlapping trading hours at the daily frequency.

The estimation procedure endogenously estimates asset price spillovers. Linkages across the four systemic bond yields and (separately) equity prices were identified using an adaptation of the methodology due to Rigobon (2003).[2] A structural vector auto regression (VAR) was estimated in which contemporaneous correlations of shocks across asset prices are identified by comparing the variance-covariance matrices in periods of high and low volatility. In essence, a period t is assigned to be highly volatile if the observed normalized error is x times of the overall sample standard deviation. To improve robustness, x is incrementally increasing from 0.65 to 2. The analysis focuses on the international linkages *within* each asset classes, thus bond yields and equity returns are considered separately.[3]

Outward spillovers from shocks to U.S. bond and stock markets are positive and large, pointing to the role of the U.S. as the driver of global financial asset pricing. Financial market spillovers are measured by *cumulative* changes in government long-term yields and stock market indices over the 4-week period after a shock. Spillovers from U.S. market shocks are larger than those of others systemic markets in both *absolute* and *relative* terms (Figure 1.1). In the bond markets, estimation results show that a typical one-standard-deviation shock to U.S. 10-year yields (about 12 bps) leads to an increase of between 4 and

---

[1] Prepared by Trung Bui (SPR). Further details on the identification scheme and results can be obtained from the author.

[2] Rigobon, Roberto (2003), "Identification through Heteroskedasticity," *The Reviews of Economics and Statistics*, vol. 85 (4), pp 777–792.

[3] Ehrmann, Fratzscher, and Rigobon (2005) find that the strongest financial spillovers between the U.S. and the Euro area take places *within* asset classes and indirect spillovers across domestic markets can magnify these spillovers. However, due to the number of countries considered in this analysis, a VAR that encompasses both *within*- and *cross*-markets linkages is less practical and its inference power is reduced substantially.

8 bps in foreign yields, implying spillover multipliers of 0.33 to 0.66: the smallest of these are in Japan, and the largest in the Euro area. By contrast, inward spillovers to U.S. bond yields are tiny (Figure 1.2). Similarly, outward spillovers from U.S. stock market shocks have multipliers ranging from 0.5 (in Japan) to 0.8 (in Euro Area and the U.K.); whereas shocks from other systemic equity markets have almost no impact on the S&P 500.

Figure 1.1: Spillovers from Shocks to Bond Yields

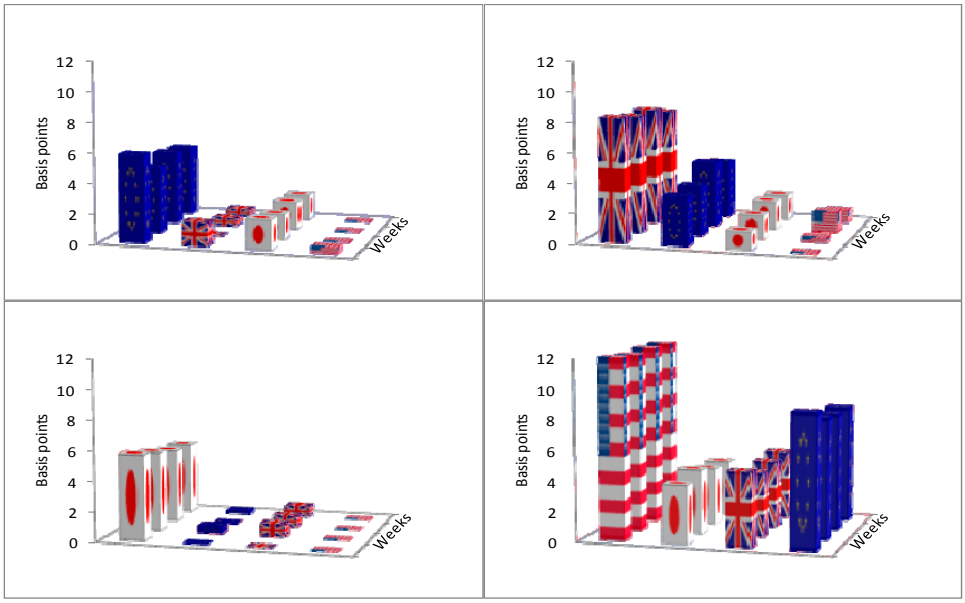
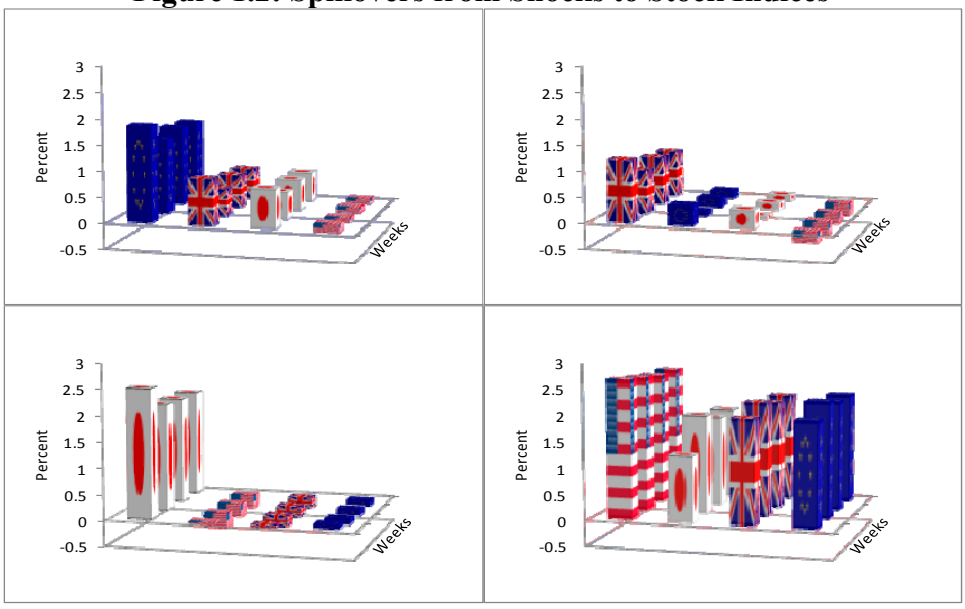


Figure 1.2: Spillovers from Shocks to Stock Indices



Note: The country origin of shock is identified by the background flag in each chart.

II. U.S. Financial Spillovers: Policy Announcements[4]

Event studies are used to estimate financial spillovers from U.S. policy announcements. The impact on foreign asset prices has varied. The announcement that the Administration supported tighter regulation of banks led to a generalized fall in European bank shares relative to local equity markets. For other aspects of the Dodd-Frank legislation, however, falls in U.S. bank equity prices were accompanied by increases in U.K. and Swiss major bank valuations. Turning to macro policies, 2008/9 fiscal and monetary stimulus packages generally supported foreign activity, while the impact of 2010 stimulus is less clear.

This chapter reports event studies that analyze the impact of U.S. financial, fiscal, and monetary policies on foreign asset prices across a range of G20 countries. The analysis looks first at "typical" responses of key foreign financial market prices to changes in U.S. asset prices. Given this baseline, the analysis then examines whether the responses to various types of U.S. policy announcements vary from this norm. A major complicating factor in this analysis is that financial market linkages appear to have shifted dramatically at the onset of the crisis. Hence, there are two "typical" relationships (pre- and post-crisis) to which policy responses since the crisis can be compared.

For U.S. financial policies the analysis involves comparing the response of foreign bank excess returns to its U.S. equivalent. Bank excess returns are defined as the difference between changes in major bank equity prices to the local equity market, and measure the market assessment of the change in the relative valuation of major banks compared to the market as a whole.

For fiscal and monetary policies the main analysis examines the response of foreign bond yields and exchange rates to changes in yields on the U.S. 10-year note. The response of the 10-year yield is known to be a useful measure of the impact of fiscal policies—which change the level of U.S. government borrowing and debt—and for U.S. monetary policies (pre-crisis, changes in the yield on the 10-year note were found to be a good measure of the unexpected element in U.S. monetary policy). Knock-on from these yields to foreign yields and dollar/nominal effective exchange rates are a major potential spillover to the rest of the world.

The specification for the event study regressions is based on a CAPM model with the United States assumed to be the "market". Hence, for example, foreign bond yields are regressed on Treasury yields (plus other variables), with the coefficient on Treasury yields being interpreted as the dependence of foreign yields on U.S. ones (the market "beta"). A post-crisis dummy is included in the regression as many of these underlying relationships appear to have shifted after early 2007 (results are robust to other plausible dates). Dummy

[4] Prepared by Tamim Bayoumi and Trung Bui. A more detailed description can be found in "Unforeseen Events Wait Lurking," forthcoming IMF working paper by the authors.

variables are also included on dates of policy announcements, with policies being regarded as having a significant impact on foreign asset prices if the market response on days of announcements is significantly different from the typical response indicated by the beta.

More specifically, the estimated equation was:

$$\Delta y_{it} = \alpha_i + (\beta_i + v_i\, postcrisis_{it} + \gamma' EVENTS_{it})\, \Delta US\ asset\ price_{it} + \varepsilon_{it},$$

where y_{it} is the foreign or global variable of interest (as discussed earlier, foreign excess bank returns, foreign bond yields, or dollar exchange rates), $postcrisis_{it}$ is a dummy variable for the period from the start of 2007 until the end of the sample, $EVENTS_{it}$ is a matrix of dummy variables singling out policy announcements, and $US\ asset\ price_{it}$ is the U.S. variable of interest (U.S. bank excess returns or 10-year Treasury yields).

Responses to events were measured using the (time-zone adjusted) market response on the day of the announcement. The short one-day window used in the baseline results (which has also become typical in event studies of U.S. monetary policy over the crisis) was used given the sheer number of shocks that were occurring over the crisis and post-crisis period: a longer window increases the risk of conflating identified events with other developments. Estimates using 2-, 5-, and 10-day windows produce similar results.

Results for announcements of the Dodd-Frank Act are summarized in Table 2.1. Links between U.S. and European bank excess returns were transformed by the crisis. Pre-crisis, only the Swiss beta exceeded 25 percent, implying that in all other cases a one percent U.S. bank excess return was associated with less than ¼ percent in excess returns abroad. By contrast, the post-crisis beta coefficient reported in the third column suggest that on a typical post-crisis day some 60 percent of excess returns across major U.S. banks spillover to Swiss banks, 50 percent to U.K. and German banks, and 40 30, and 20 percent to French, Italian, and Spanish banks, respectively. This involves a major increase from the pre-crisis betas, which is statistically significant except for Switzerland and Spain. By contrast, for non-European banking systems post-crisis changes in already small betas are insignificant.

Spillovers from U.S. financial regulation depends on the issue being addressed:

- *The January 21, 2010 Obama speech backing a tough banking regulation lowered U.S. and most European bank equity prices*. The negative excess returns of the Swiss, U.K., and German and French bank stocks were actually larger than those for U.S. banks. The abnormal response largely reflects anticipation of tougher future domestic bank regulation after the lead set by the United States.

- ***Other Dodd-Frank announcements of tighter- (softer-) than-expected U.S. bank regulation (hurt) bank excess returns in core European financial systems***. The impact is most concentrated in the Swiss and U.K. banks, suggesting that the announced regulations were seen as putting U.S. banks at a competitive disadvantage

compared to counterparts in major European financial markets. This suggests that markets may have perceived the potential for regulatory arbitrage.

Results for the impact of monetary and fiscal policies are summarized in Tables 2.2 and 2.3. Table 2.2 reports results of regressions linking changes in foreign bond yields to changes in U.S. 10-year note yields. Table 2.3 reports changes in dollar exchange rates associated with changes in U.S. 10-year Treasury yields. Results are reported for 6 country groupings: Japan (singled out for its different post-crisis exchange rate responses); advanced country commodity exporters (Australia and Canada); Korea and European advanced countries (Euro area, Switzerland, and the U.K.); China (whose dollar peg and extensive capital controls set it apart); financially open emerging markets (Brazil, Mexico, South Africa, and Turkey); and emerging markets which have less open financial systems (Indonesia and Russia). India is included with China for bond analysis (given its capital controls on these instruments) but with Russia and Indonesia for exchange rate and equity analysis.

Bilateral links between U.S. yields and those in emerging markets dissipated after the crisis to these countries. Before 2007, a rise in U.S. bond yields had a pass-through of some 70 percent for financially open emerging market economies, slightly less for India and Russia, and no link for China, the latter presumably reflecting capital controls. The results in Table 2.2 suggest that these emerging market links basically disappeared after the crisis. By contrast, links between U.S. yields and those of advanced economies with deeper financial markets remained relatively constant over the crisis. The pre-crisis relationship whereby a one-percentage point rise in U.S. yields led to a 40 basis point rise in European/Korean yields and a 15 basis point rise in Japanese yields appears unaffected by the crisis. The link between advanced commodity exporters yields and U.S. yields did fall modestly, from two-thirds to one-half.

Results for "normal" policy announcements suggest that pre-crisis spillovers from U.S. yields were largely driven by expectations about U.S. monetary policy. Budget announcements appear to have no significant differential impact on foreign bond yields, likely reflecting the fact that they were largely anticipated. Of considerably more interest is the fact that pre-crisis FOMC announcements also did not show significant differential impacts. This suggests that pre-crisis spillovers from U.S. bond yields largely reflected shifting expectations about U.S. monetary policy. When the Fed Funds rate hit the lower bound and the Fed vowed to keep it there for a considerable time, however, rises in bond yields seem to have become proxies for U.S. and global risk aversion/growth prospects, hence the lowering of the link with emerging market.

Shifts in the relationship with foreign exchange rates also suggest changes in the information contained in U.S. yields and resulting capital flows (Table 2.3). Before the crisis, rising U.S. 10-year yields were associated with significant depreciations against the dollar in advanced economies and financially open emerging markets, consistent with a generalized dollar appreciation from an expected tightening of U.S. monetary policies. By

contrast, there was no significant change for China, with its dollar peg, or Indonesia and Russia, with their more managed exchange rates. Post-crisis, however, increases in U.S. yields led to large appreciations in emerging markets, especially financially open ones, as well as advanced economy commodity exporters. By contrast, the yen depreciated by even more against the dollar when US yields rose, likely reflecting its status as a safe haven and a vehicle currency for "carry trades". U.S. yields had little impact on dollar exchange rates in advanced Europe and Korea. These shifts are consistent with the view that post-crisis higher U.S. yields led to capital flows into emerging markets and commodity producers and out of advanced economies with low interest rates—especially Japan.

Results for announcements of the fiscal stimulus packages (in Tables 2.2-2.3) suggest that the impact varies depending on the degree of financial turmoil. Fiscal stimulus typically increases Treasury yields, so that positive relationships imply higher foreign yields and negative foreign spillovers:

- The *2009 package* seems to have led to a delinking of European and Korean bond yields, suggesting negative financial market spillovers were tempered.

- The *2010 package* seems to have been accompanied by larger-than-normal increases in foreign yields and appreciation across a range of foreign currencies, suggesting larger-than-typical negative asset market spillovers.

These shifting relationships can plausibly be linked to changing perceptions of financial conditions. In 2009, when the world was engulfed in financial turmoil, fiscal stimulus led to little change in yields as the reduction in global lower risk premiums offset the rise in yields from anticipated higher U.S. debt. In 2010, when financial markets were in a more orderly state, concerns about rising U.S. debt may have led to tighter links across global yields.

QE1 seems to have had much more positive impacts on foreign financial conditions than QE2. In contrast to fiscal stimulus, QE works through *lowering* Treasury yields, and hence tight positive links to Treasury yields imply positive spillovers to the rest of the world:

- *Post-crisis FOMC meetings without QE announcements have negative coefficient on emerging market bond yields and larger-than-usual currency appreciations*. This is consistent with the view that greater optimism on U.S. growth, which drives up U.S. bond yields, led to capital outflows to emerging markets

- *QE1 announcements and related declines in US bond yields were also associated with large reductions in emerging market yields and currency appreciations* (Tables 2.2 and 2.3). These emerging market responses seem to have boosted foreign demand and capital outflows.

- *QE2 announcements had more muted effects on foreign markets than QE1 ones*.

Table 2.1: Bank Excess Return Regressions

	Baseline			Impact of Regulation	
Country	Full Period	Change Post-Crisis	Sum	Volcker Rule Speech	Other Dodd-Frank
Switzerland	***.42 (.09)***	.16 (.11)	0.58	***.94 (.07)***	***-.76 (.16)***
UK	**.13 (.05)***	***.37 (.08)***	0.50	***.78 (.08)***	***-.97 (.27)***
Germany	**.23 (.09)***	***.27 (.11)***	0.50	***.71 (.05)***	-.30 (.22)
France	***.20 (.06)***	***.20 (.07)***	0.40		
Italy	.02 (.08)	***.30 (.10)***	0.32	**-.07 (.03)***	.01 (.10)
Spain	***.18 (.07)***	.02 (.08)	0.21		
Japan	**.18 (.09)***	-.05 (.09)	0.13		
Korea	**.18 (.08)***	-.03 (.09)	0.15		
Canada	***.15 (.04)***	-.02 (.04)	0.13		
Australia	.05 (.03)	.05 (.04)	0.10		
Brazil	.04 (.08)	.08 (.08)	0.12	***-.25 (.01)***	***-.09 (.03)***
Turkey	.09 (.05)		0.09		
Indonesia	.02 (.08)	.09 (.08)	0.10		
India	.08 (.08)	-.03 (.09)	0.05		
China	.52 (.27)	-.49 (.27)	0.04		
Russia	-.16 (.17)	.16 (.18)	-0.01		

R^2	.06
DW	1.46

Note: Standard errors are in parenthesis. ** and * represent significant at the 1 and 5 percent significance level. Coefficients on some other macroeconomic events and bilateral dollar exchange rates are not reported

Table 2.2: Foreign Bond Yield Regressions

	Advanced Countries			Emerging Markets		
	Japan	Australia and Canada	Europe and Korea	China and India	Brazil, Mexico, South Africa, and Turkey	Indonesia and Russia
US 10 Year Yield	***.16 (.02)****	***.66 (.02)****	***.39 (.02)****	.01 (.02)	***.69 (.07)****	***.53 (.05)****
Change Post-Crisis	-.01 (.02)	***-.14 (.02)****	.03 (.03)	-.04 (.04)	***-.68 (.10)****	***-.80 (.12)****
Fiscal Event						
Budget	-.01 (.07)	.00 (.20)	.08 (.15)	.10 (.16)	-.18 (.34)	.33 (.69)
2008 Stimulus	***.22 (.08)****	-.15 (.12)	***-.24 (.05)****	.02 (.07)	***.88 (.08)****	.06 (.13)
2009 Stimulus	.29 (.25)	.61 (.55)	***-.46 (.20)****	.31 (.24)	-.02 (.73)	-2.39 (3.47)
2010 Stimulus	***.17 (.05)****	***.17 (.06)****	***.17 (.02)****	***.52 (.06)****	***.59 (.08)****	***.89 (.12)****
Monetary Events						
FOMC - Pre	-.18 (.09)	***.17 (.08)****	.02 (.08)	.19 (.11)	.39 (.21)	.35 (.28)
FOMC - Post	.01 (.06)	.11 (.06)	-.02 (.09)	***-.38 (.11)****	***-.45 (.21)****	-.51 (.41)
Chg Fed Funds	.01 (.02)	-.05 (.03)	-.01 (.02)	-.02 (.05)	.05 (.10)	.08 (.19)
QE 2008/09	-.03 (.06)	***-.11 (.06)****	-.07 (.11)	***.48 (.16)****	***1.48 (.31)****	***1.54 (.40)****
QE 2010	.02 (.04)	***-.23 (.05)****	.02 (.25)	***.59 (.27)****	***.43 (.15)****	***.70 (.23)****
R^2	.08					
DW	1.27					

Note: Standard error are reported in parenthesis. ** and * represents significance at the 1 and 5 percent levels, respectively. Some other financial policy event coefficients are not reported

Table 2.3: Dollar Exchange Rate Regressions

	Advanced Countries			Emerging Markets		
	Japan	Australia and Canada	Europe and Korea	China	Brazil, Mexico, South Africa, and Turkey	India, Indonesia, and Russia
US 10 Year Yield	***-1.45 (.37)****	***-1.88 (.33)****	***-1.66 (.29)****	.08 (.08)	***-1.03 (.34)****	-.05 (.13)
Change Post-Crisis	***-2.21 (.55)****	***5.55 (.63)****	***1.96 (.44)****	-.08 (.10)	***3.82 (.63)****	***.88 (.26)****
Fiscal Event						
Budget	-.43 (2.41)	4.33 (3.41)	2.28 (2.71)	.35 (.32)	4.58 (2.41)	1.01 (1.48)
2008 Stimulus	***10.22 (.61)****	***-2.54 (.96)****	-.33 (.59)	***.78 (.25)****	***-4.31 (.59)****	-.14 (.23)
2009 Stimulus	.06 (3.11)	6.22 (11.64)	-2.44 (11.44)	-.45 (.29)	2.94 (11.68)	**-6.19 (2.66)***
2010 Stimulus	***1.07 (.42)****	***-4.22 (1.67)****	***2.10 (.66)****	.19 (.12)	-.92 (.63)	***1.48 (.25)****
Monetary Events						
FOMC - Pre	.91 (1.52)	-.38 (2.21)	1.58 (1.22)	-.13 (.09)	**3.56 (1.60)***	.04 (.33)
FOMC - Post	-1.37 (1.27)	1.51 (1.66)	***3.32 (1.12)****	-.13 (.17)	***5.22 (1.80)****	.82 (.69)
Chg Fed Funds	.29 (.56)	-.78 (.78)	-.28 (.39)	-.01 (.02)	-.04 (.97)	**-.18 (.09)***
QE 2008/09	2.46 (1.45)	***-6.55 (1.96)****	***-4.15 (1.07)****	.00 (.15)	***-7.26 (1.84)****	***-2.12 (.69)****
QE 2010	***1.84 (.74)****	-2.74 (1.86)	-1.47 (2.12)	-.09 (.29)	***-3.89 (1.44)****	-1.03 (.93)
R^2	.04					
DW	2.02					

Note: See Table 2a. A positive value indicate an appreciation against dollar.

III. U.S. FINANCIAL SPILLOVERS: EMERGING MARKET BOND SPREADS[5]

To establish the potential effects of U.S. policy on foreign bond spreads, the relationship is examined between emerging market spreads and global "push" factors (i.e. U.S. interest rates and proxies for market pricing of risk) and country-specific "pull" factors (indicators of domestic creditworthiness). The results indicate a clear and significant relationship between spreads and the market price of risk. The link between U.S. policy interest rates and emerging market spreads is less clear. From both a statistical and an economic point of view, the better link is between spreads and long-term U.S. Treasury yields. In short, U.S. policies seem to affect emerging market spreads through their impact on financial risk and on U.S. long-term interest rates.

Panel regressions are run from 2000q1 to 2010q2 of emerging market spreads on nominal U.S. interest rates, indicators of market risk, S&P long-term country credit ratings and macroeconomic indicators of demand, solvency, and liquidity, such as GDP growth, inflation, money multipliers, credit to GDP, and trade balances. More specifically, fixed-effect panel regressions are run of (the logs or log differences of) JP Morgan EMBI stripped spreads on:[6]

- *Foreign rates:* U.S. Treasury yields (constant maturity), LIBOR, the Fed funds rate, and Fed funds futures (1 month and 3 month);
- *Market risk:* VIX or High Yield Spreads (difference between yields to maturity of AAA and Baa corporate bonds);
- *Credit risk:* Standard and Poors long-term credit outlook ratings (converted to linear and quadratic scales, with a binary dummy for junk vs non-junk ratings);
- *Determinants of domestic risk:* Macroeconomic indicators of the business cycle, liquidity and solvency.[7]

The results indicate that push factors play a significant role in emerging market bond spreads. U.S. interest rates and global risk measures explain over half of the variation in spreads.[8,9] EM spreads move one-for-one with the U.S. high yield spread (a proxy for

[5] Section prepared by Alasdair Scott (RES).

[6] The sample of countries includes Argentina, Brazil, Bulgaria, Chile, China, Columbia, Ecuador, Hungary, Lebanon, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, Turkey and Venezuela.

[7] Real GDP growth, annual and quarterly; CPI inflation rate, annual and quarterly; difference in M2/GDP; difference in credit:GDP ratio; difference in private investment/GDP ratio; difference in current account/GDP; difference in gross trade/GDP; difference in official reserves/GDP; and (where data available) difference in public deficits/GDP.

[8] This result is similar to those of studies of capital flows.

risk).[10] Depending on the specification used, a 100 basis point decrease in yields on 10-year Treasuries would be associated with a 60–115 basis point reduction in EM spreads.

The relationship between EM spreads and U.S. short rates (including Fed funds rate and futures) is only sometimes significant and most often negative (depending on other conditioning variables used). This negative coefficient on U.S. short-term interest rates and the consistently positive coefficients on U.S. long-term yields could indicate "carry-trade" type effects, but the restriction of including only the term premium is rejected. Results from rolling regressions of rates and spreads at daily frequency show that the coefficients on U.S. short-term interest rates are unstable (they fluctuate between negative and positive values). Our preferred model is therefore to think of U.S. monetary policy having effects on long-term U.S. Treasury yields, which are then associated with changes in spreads.

Such a result has an interesting implication. Whereas many other studies focus on the effect of U.S. monetary policy, the strong association with longer-term results suggests that other policies could have an effect on spreads and net funding rates. Most obviously, unconventional monetary policy measures designed to reduce longer-term rates will have implications for spreads. Fiscal policy decisions could affect term premiums, with consequent implications for spreads.[11]

---

[9] Of the macroeconomic indicators, only growth and inflation are consistently significant, but ratings are consistently significant.

[10] The high-yield spread fits the data slightly better, but is highly correlated with the VIX at daily and quarterly frequencies.

[11] There is also the possibility that U.S. policy actions, to the extent that they increase or reduce market uncertainty, could also have an effect on spreads via the market price of risk.

Table 3.1. Panel Regression Results for EM Spreads Model

(after testing down)

Dependent variable: EMBI stripped spreads

	log levels		log differences	
Constant	-2.483 (0.298)	-2.56 (0.20)	-0.036 (0.018)	-0.039 (0.023)
10-year Treasury yields *	1.152 (0.235)	0.850 (0.128)	0.290 (0.115)	0.277 (0.114)
3-month Treasury yields *	-0.115 (0.057)		-0.096 (0.033)	-0.086 (0.031)
High-yield spread *	1.005 (0.066)	1.021 (0.043)	0.935 (0.049)	0.934 (0.049)
Real GDP growth, quarterly	0.006 (0.004)			
Inflation rate, quarterly	0.048 (0.012)			
Official reserves to GDP ratio, difference	0.007 (0.003)	0.007 (0.003)		
M2 to GDP ratio, difference		-0.003 (0.002)		
Gross trade to GDP ratio, difference			0.003 (0.002)	0.003 (0.002)
S&P long-term credit rating, quadratic scale *		0.004 (0.001)		0.226 (0.126)
R^2	0.810	0.868	0.505	0.526

* Columns 1 and 2: logs. Columns 3 and 4: log differences

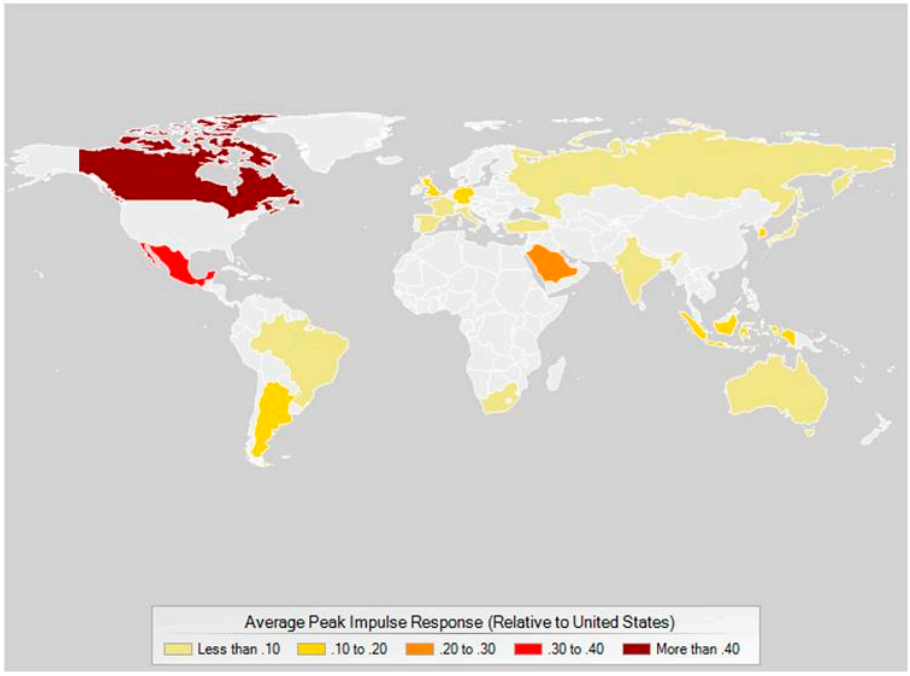
IV. U.S. Growth Spillovers: Typical Responses[12]

Business cycle spillovers from U.S. growth shocks via international trade and financial linkages are analyzed using a refined version of the structural G-20 macroeconometric model reported in Vitek (2010).[13] Financial links are found to be important for spillovers.

A. Spillovers from U.S. Shocks Abstracting from Asset Price Links

On average, the peak impulse responses of output in the rest of the world to real and financial shocks in the U.S. are increasing with geographical proximity (Figure 4.1). The highest dependence is exhibited by Canada and Mexico, reflecting their strong trade and financial linkages, followed by Saudi Arabia, reflecting its strong exchange rate and commodity price linkages.

Figure 4.1: Average Peak Impulse Responses of Output to Shocks in the U.S.



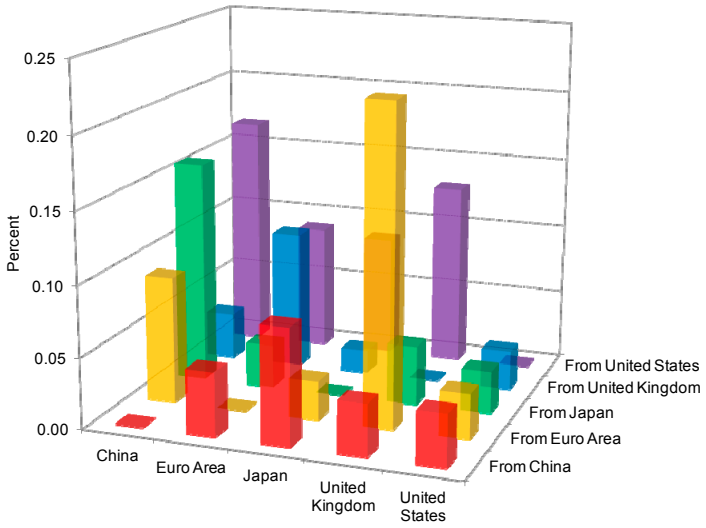
Spillovers from U.S. real and financial shocks in the U.S. to other systemic economies are somewhat stronger than the reverse impact (Figure 4.2). This reflects the relatively large economic size of the United States, together with its extensive international trade and widely-held financial assets.

---

[12] Prepared by Francis Vitek (SPR).

[13] Vitek, F. (2010), Monetary policy analysis and forecasting in the Group of Twenty: A panel unobserved components approach, *International Monetary Fund Working Paper*, 152.

Figure 4.2: International Business Cycle Transmission from Systemic Economies

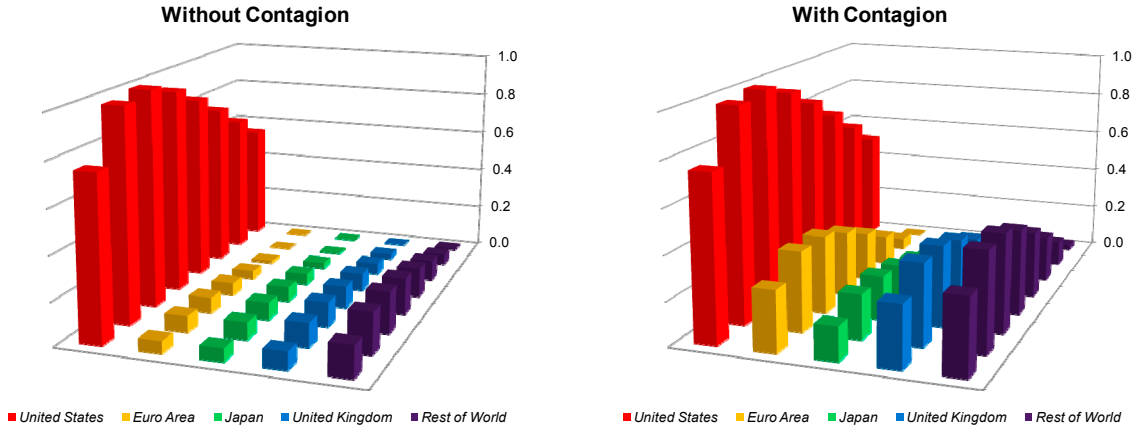


Note: Depicts the average peak impulse responses of output to supply, demand, monetary policy, term premium, and equity risk premium shocks in China ■, the Euro Area ■, Japan ■, the U.K. ■, and the U.S. ■ which raise output there by one percent.

B. Spillovers from U.S. Shocks Accounting for Asset Price Links

Asset price links in international bond and equity markets are accounted for by adding correlated term and equity risk premium shocks (Figure 4.3). Across bond markets, correlation coefficients with respect to the United States are assumed in the range from 0.16 to 0.66 for other advanced economies, and from 0.00 to 0.69 for emerging economies. Across stock markets, assumed correlation coefficients are 0.48 to 0.76 for other advanced economies, and 0.00 to 0.87 for emerging economies. These assumptions are based on an event study analysis of international financial market co-movements (reported in Chapter II).

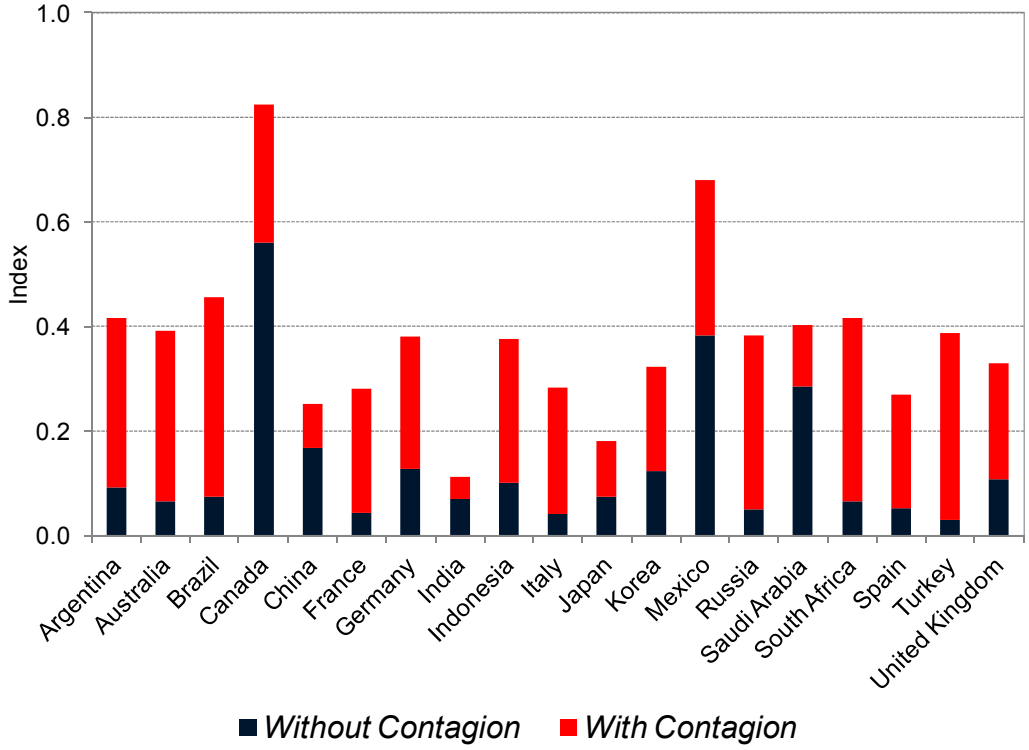
Figure 4.3: Average Impulse Responses of Output to Shocks in the United States



Note: Depicts the average impulse responses of output to supply, demand, term premium, and equity risk premium shocks in the U.S. which raise output there by one percent.

Accounting for asset price links amplifies spillovers substantially, while reducing their international variability (Figure 4.4). For economies with strong trade linkages with the United States, in particular Canada and Mexico, the contribution of international bond and stock market contagion is modest. In contrast, for economies with weak trade linkages the contribution of international bond and stock market contagion is dominant.

Figure 4.4: Average Peak Impulse Responses of Output to Shocks in the United States



V. U.S. TRADE SPILLOVERS: SUPPLY CHAIN EFFECTS[14]

Notwithstanding its important role in global trade, the United States is particularly highly integrated as a hub of the NAFTA supply chain, suggesting a significant role for outward spillovers through trade to NAFTA partners. China is also gaining importance as a major trading partner and contributor of foreign value added in U.S. gross exports, suggesting additional potential for outward spillovers through U.S. import demand.

The United States remains a major player in global and regional trade. Notwithstanding a shrinking share in global trade due to rising integration of rapidly growing emerging market economies such as China, the United States remains a major trade partner at the global level, accounting for about 11 percent of global trade (exports plus imports). The United States is also an important regional trading partner. Exports to NAFTA members (Canada and Mexico) account for the highest share of total U.S. exports (about 37 percent at their peak before the crisis). The United States is also the largest trading partner for Canada and Mexico, accounting for about two-thirds of overall trade in each country in 2010. Trade with China is also rising in importance, especially on the import side.

The United States is an upstream hub in the NAFTA supply chain. This is seen in the limited share of imported content in its exports and the higher share of indirect exports that are sent to third countries. Mexico, on the other hand, is downstream, reflecting specialized duty free assembly plants that use imported intermediates and re-export final goods back to the United States. Indeed, the NAFTA supply chain is distinct from the Asian supply chain along two key features: (i) NAFTA is highly concentrated on one regional powerhouse; unlike the Asian supply chain where inputs for the downstream country cross the borders of several countries (including the hub, Japan), almost all of the foreign value added in Mexico's exports is directly imported from the hub (the United States); and (ii) a significant amount of U.S. value added is shipped back home after further processing abroad, which is not the case for Japan; Mexico is therefore significantly more reliant on U.S. demand than a similarly downstream Asian country such as China would be on Japan's.

[14] Prepared by Nagwa Riad and Christian Saborowski with inputs from Mika Saito, based on the forthcoming Board paper on *Changing Patterns of Global Trade*.

5.1: Measures of Vertical Specialization across Borders: 2004

Country	(1) Imported contents embodied in gross exports	(2) Indirect exports sent to third countries /1	(3) Upstream or downstream position, (2)/(1)
Advanced economies			
United States	12.9	26.9	2.1
Japan	12.2	30.8	2.5
EU-15	11.4	20.9	1.8
Emerging market economies			
Mexico	48.0	10.0	0.2
China	35.7	12.5	0.4
EU accession countries	30.8	11.3	0.4

Source: Koopman and others (2010).

Hub's VA Contained in Gross Exports

	Total	In imports from the hub /2	In imports from the neighbors /3
Mexico	31.3	31.0	0.3
China	8.0	6.8	1.2
EU accession	17.5	17.3	0.2

Source: Fund staff estimates using Koopman and others (2010).

1/ Includes indirect exports that return to home country.

2/ For China, Mexico, and EU accession countries, hubs are Japan, the United States, and the EU respectively.

3/ For China, Australia, Hong Kong, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, Thailand, Vietnam, and the rest of E. Asia are included; for Mexico, Canada, Brazil, and Latin America are included; and for EU accession countries, EFTA, and Russia are included.

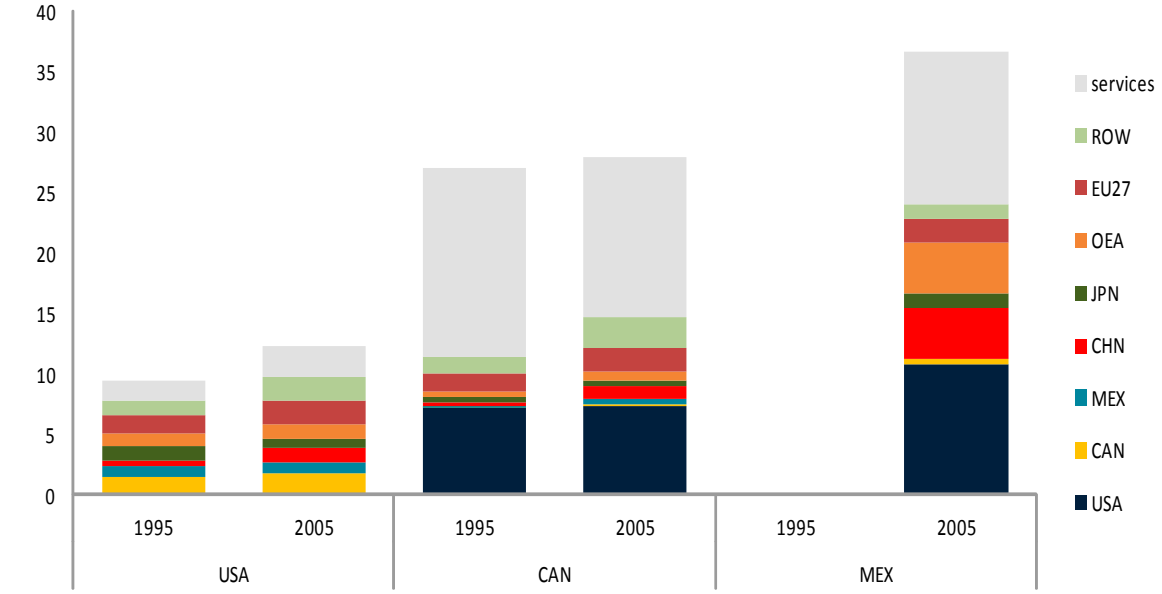
The United States is an important source of imported inputs in NAFTA countries' exports. Staff estimates based on OECD input-output tables for 1995 and 2005 suggest that the share of foreign content in U.S. gross exports has increased slightly—from 9.5 percent in 1995 to 12.3 percent in 2005 (Figure 5.1).[15] The United States is an important source of foreign value added (FVA) in the gross exports of Canada and Mexico (accounting for about a 20 percent and 30 percent of overall FVA, respectively), while the latter account for about a fifth of overall FVA in U.S. gross exports in 2005.

Notwithstanding strong regional integration through NAFTA, China's contribution to U.S. manufacturing exports exceeds Mexico's. U.S. exports are dominated by high and medium-high technology products, destined mostly to the region. Foreign content is highest in medium-low technology manufacturing exports, followed by medium-high and high technology manufacturing products (Figure 5.2). Importantly, whereas both Canada and Mexico broadly maintained their shares in total FVA in U.S. manufacturing exports (at about 17 percent and 10 percent, respectively), between 1995 and 2005, China more than doubled its share in FVA in U.S. manufacturing exports (to more than 11 percent in 2005). The increase in China's share in overall FVA of U.S. exports was mostly accounted for by growth in the high technology sector, where its share rose from 7 percent in 1995 to about 24 percent

[15] Staff's results using OECD input-output tables differ from those of Koopman and others (2010) reported in Table 1. Koopman relies on GTAP data which separately identifies exports from processing zones and are therefore accounted for differently.

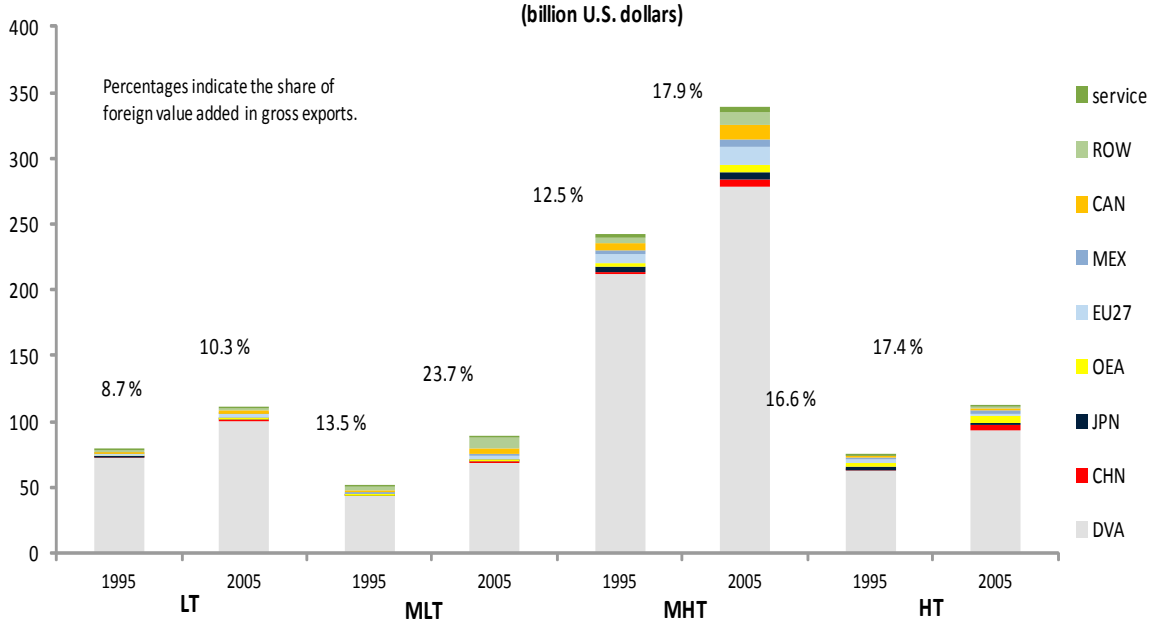
in 2005. This suggests that China may be rapidly catching up with NAFTA partners in terms of contribution to U.S. exports of high-technology goods, with broader spillover implications through U.S. demand.

Figure 5.1: NAFTA: Source of Foreign Value Added
(percent gross exports)



Source: IMF Staff estimates using OECD Input-Output Tables, COMTRADE and OECD STAN data.

Figure 5.2: Foreign Content in U.S. Manufacturing Exports
(billion U.S. dollars)



Source: IMF Staff estimates using OECD Input-Output Tables, COMTRADE and OECD Stan.

VI. U.S. TRADE SPILLOVERS: TYPICAL RESPONSE TO U.S. ACTIVITY[16]

The impact of a change in US imports on global activity is estimated taking account of supply chain effects. More specifically, in addition to the direct impact on bilateral trading partners, the knock-on effects through the global trade system are included by taking into account trade interconnectedness. Results show that the impact is largest for NAFTA and East Asia.

Methodology

Focusing on non-oil and non-commodity trade channels, a matrix of bilateral manufacturing and services exports as a share of each country GDP is constructed. Elements a(i,j) of this A matrix each measure the importance of bilateral manufacturing and services exports to j in terms of country i's GDP, and are obtained as:

$a(i,j) = \alpha^M(i)*\lambda^X(i)*\tau(i)*BXW(i,j)$ with $a(i,i) = -\alpha^M(i)*\lambda^M(i)*\tau(i)$

where BXW is the matrix of bilateral export weights, α^M the vector of country specific shares of manufactures and services in total non-oil trade, λ^X (λ^M) the vector of country specific shares of exports (imports) in manufacturing and services trade and τ the vector of country specific ratio of total non-oil trade (import plus exports) to GDP.

If other countries' imports remain unchanged, the non-diagonal elements of this A matrix measure the impact of a single country's increased imports on each partners' GDP. This only measures the direct (first round) impact of a trade shock: if only country j expands its imports by 1 percent, the impact on any country i (through manufacturing exports to j) will be a(i,j) percent of GDP. However, each country's position in the global supply chain requires it to increase its own imports in order to meet increasing demand for its own exports. Assuming that the elasticity of total imports to manufacturing exports is the same in all cases and equal to 1 for simplicity (keeping constant import to GDP ratios). As country i exports more, it will in turn increase its total imports from the rest of the world by a(i,i). Assessing the total impact thus requires adding to the direct impact the infinite sum of second round effects, etc. This geometric sum is given by $\sum_{n=1}^{\infty} A^n = (I - A)^{-1} - I = A(I - A)^{-1}$.

As an illustrative example suppose a 3 country world economy where the U.S. imports from each of the 2 other countries (EA and CN). Both EA and CN export more to the US than to each other. But EA and CN have different shares of manufacturing exports in total trade, and different degrees of trade openness. Denoting $w(i) = \alpha^M(i)*\lambda^{X\text{ or }M}(i)$ the share of manufacturing/services exports or imports in non-oil trade, let's assume:

[16] Section prepared by Edouard Vidon (SPR).

$$\begin{pmatrix} US \\ EA \\ CN \end{pmatrix} \text{BXW} = \begin{bmatrix} 0 & 2/3 & 1/3 \\ 2/3 & 0 & 1/3 \\ 2/3 & 1/3 & 0 \end{bmatrix}; \ \text{w} = \begin{bmatrix} 0.4 \\ 0.5 \\ 0.6 \end{bmatrix}; \ \tau = \begin{bmatrix} 0.25 \\ 0.60 \\ 0.67 \end{bmatrix}$$

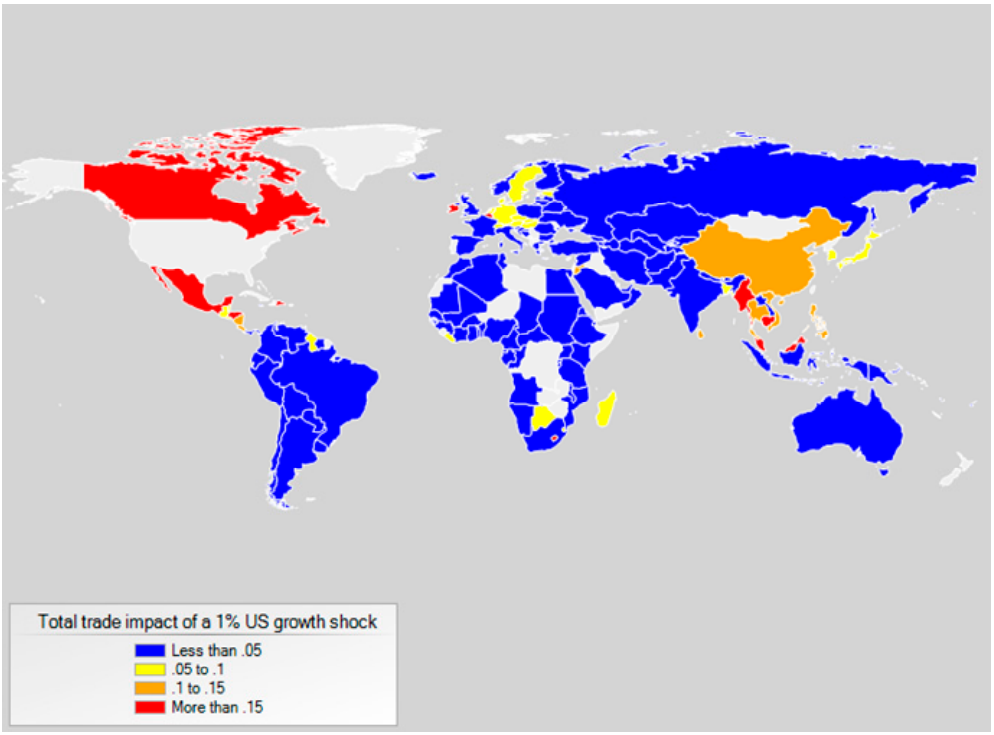
Suppose that the U.S. expands by 1 percent and its total imports increase by 1 percent. In the first round, EA and CN accrued manufacturing exports to the U.S. raise their own GDP according to the relative weight of these bilateral exports:

0.5*0.60*2/3 = 0.20 percent of EA's GDP and 0.6*0.67*2/3 ~ 0.27 percent of CN's GDP.

Recall that the change in EA and CN GDP translates with unit elasticity into a change in EA and CN total imports from their respective partners. As a consequence, in the second round: EA and CN increase imports from partners by 0.20*0.50*0.60 and 0.27*0.60*0.67 respectively; all countries exports to the EA and CN increase in line with the first round expansion of the EA and CN, multiplied by bilateral export weights, etc.

The following heat map, based on the latest REER weights dataset and average trade openness over the last 10 years, shows the total impact of a U.S. import shock on partners' non-commodity net exports, as a percentage of GDP (Figure 6.1). Results being sensitive to elasticity assumptions, the map should be read as showing growth impacts in relative terms. The impact is highest for NAFTA partners (Canada and Mexico) and for South-East Asia, especially (notably) China.

Figure 6.1: Impact of a Shock in U.S. Import Demand on Partners' Net Exports (as a percentage of GDP)



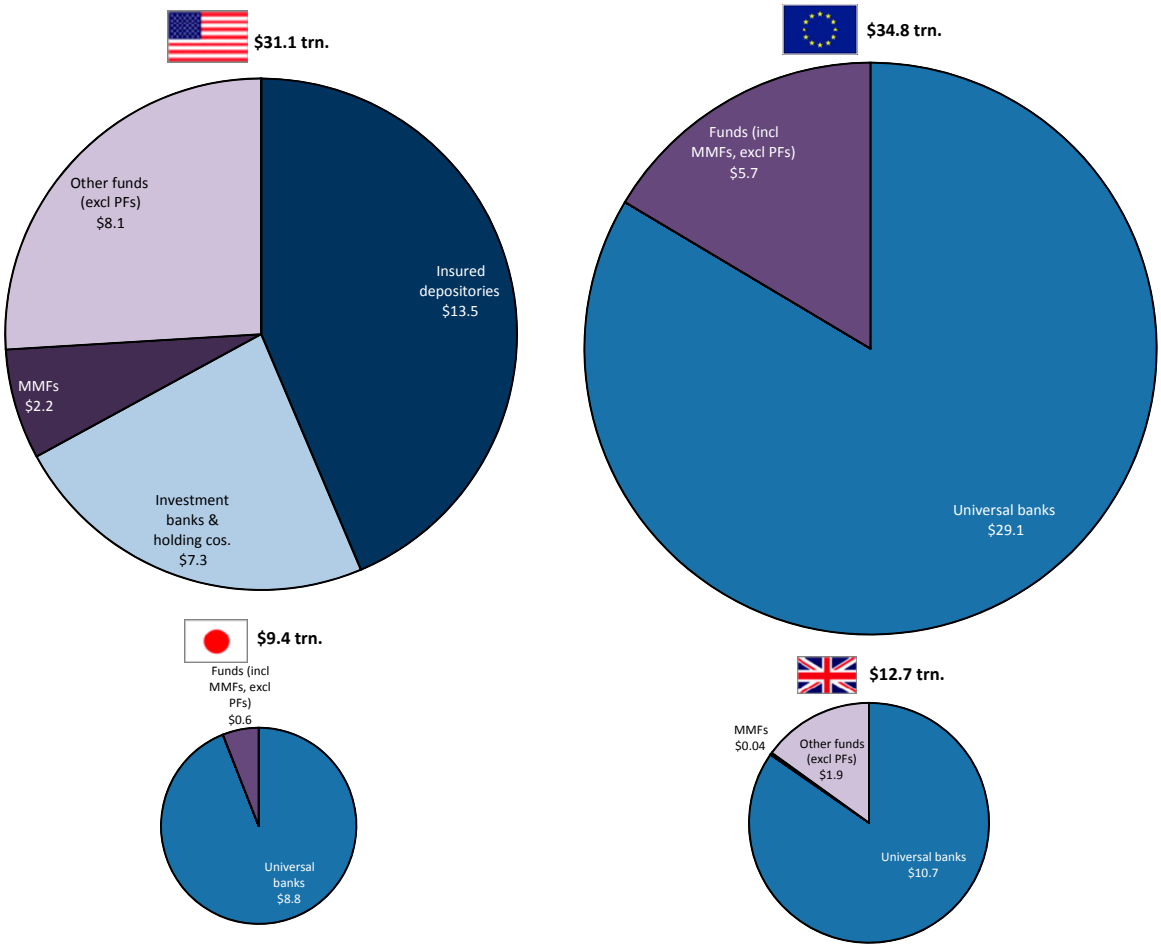
VII. U.S. FINANCIAL SPILLOVERS: CROSSBORDER LINKAGES[17]

Splicing macro and micro data from various sources, the key, globally systemic financial sectors are surveyed, focusing on: asset size; banking vs. fund management; commercial vs. investment banking; and foreign operations in the United States.

- **Asset size of Euro area, U.S., U.K., and Japanese financial sectors** (Figure 7.1). The Euro area financial system is the largest, and the U.S. financial system the most complex/diverse, the latter with large and distinct investment banking and money fund segments. Data on universal banks (for non-U.S. jurisdictions) are from the *GFSR*'s Statistical Appendix; on (U.S.) insured depositories and investment banks (including holding companies) from the Fed's *Flow of Funds*; and on (all) funds from *Lipper*.
- **Overall foreign bank claims on the United States** (Figure 7.2). Bank claims on the United States are dominated by Northern European, Japanese, and Canadian banks, with the majority originated by foreign branches and subsidiaries in the United States. Country-level data on bank claims and overall data on dollar claims by foreign banking offices in the United States are from the BIS; firm-level data on U.S. claims (proxied by total assets) of foreign-owned U.S. large bank holding companies (BHCs in the top-50) and foreign-owned U.S. primary dealers are from the Fed's *Bank Holding Company Performance Reports* and SEC filings, respectively.
- **Bank claims on the United States by country** (Figure 7.3). U.K., German, and Irish bank claims on the United States are dominated by large BHCs focused on investment banking (defined as large foreign BHCs with above-median ratios of noninterest income to total income), and Swiss claims are dominated by two large U.S. primary dealers (engaged predominantly in investment banking activities). Canadian claims are held mostly by large BHCs focused on commercial banking, and the firm-level composition of Japanese, French, Dutch and Spanish claims remaining mostly unidentified (suggesting a higher share of direct crossborder lending perhaps). Data sources as in previous figure.
- **Role of U.S. large BHC subsidiaries of foreign banks** (Figures 7.4 to 7.5). In all but two cases (BNP Paribas and Bank of Nova Scotia) activities of U.S. large BHC subsidiaries are more focused on investment banking (proxied by the ratio of noninterest income to total income) than the rest of the group; U.S. BHC assets vary from over one-third of group assets (Allied Irish) to under 3 percent (BNP Paribas), with a weighted average share of 11 percent. Data on BHCs are from the *BHC Performance Reports* and on global parent groups from MCMFA.

[17] Prepared by Ashok Bhatia (SPR).

Figure 7.1: S4 Financial Intermediaries, 2009



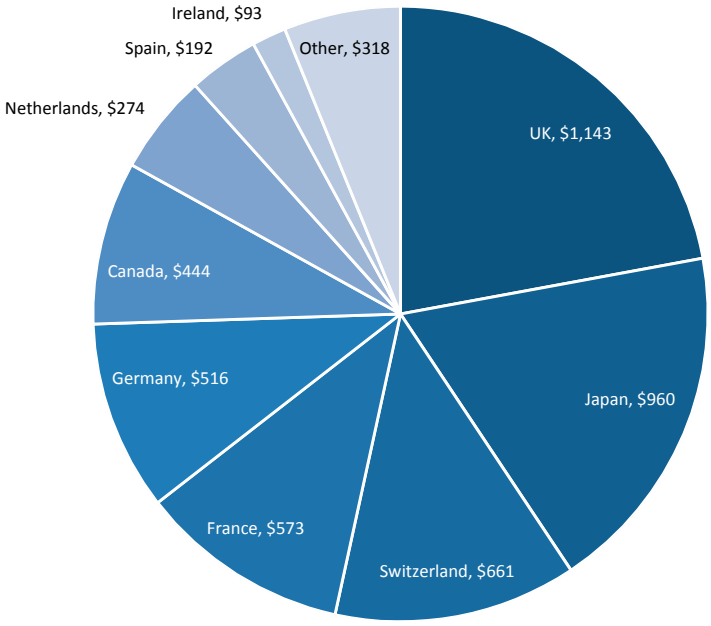
Sources: Federal Reserve, *Flow of Funds Accounts of the United States*; Lipper; and Fund staff estimates.

Figure 7.2: Foreign Bank Claims on and in the United States, March 2010

(In billions of dollars)

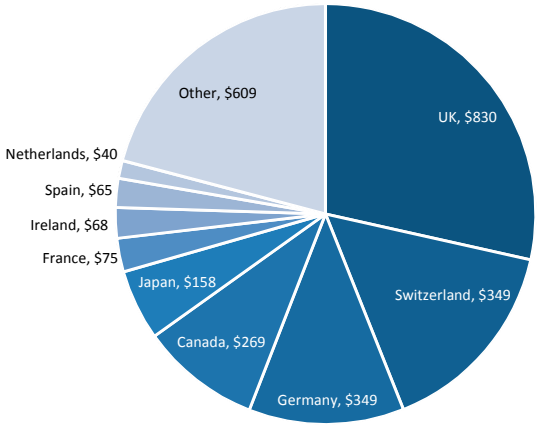
Consolidated U.S. Claims of BIS Reporting Banks on Ultimate Risk Basis, by Nationality of Reporting Banks

Total = $5.175 trn.



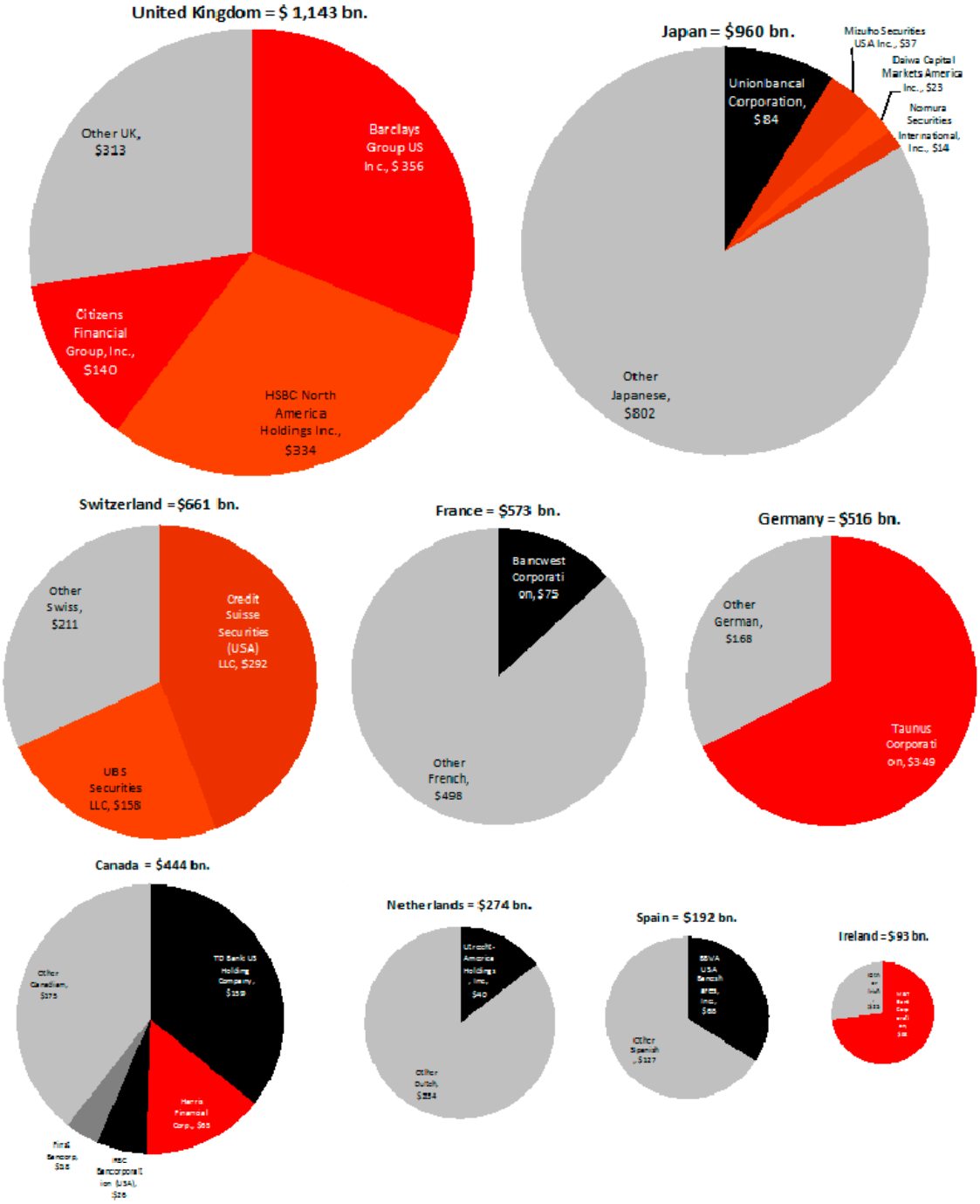
Dollar Claims of U.S. Offices of BIS Reporting Banks on U.S. Residents, by Nationality of Foreign Owned Large BHCs and Primary Dealers

Total = $2.914 trn.



Sources: Bank for International Settlements, *BIS Quarterly Review*, and Federal Reserve, *Bank Holding Company Performance Reports*

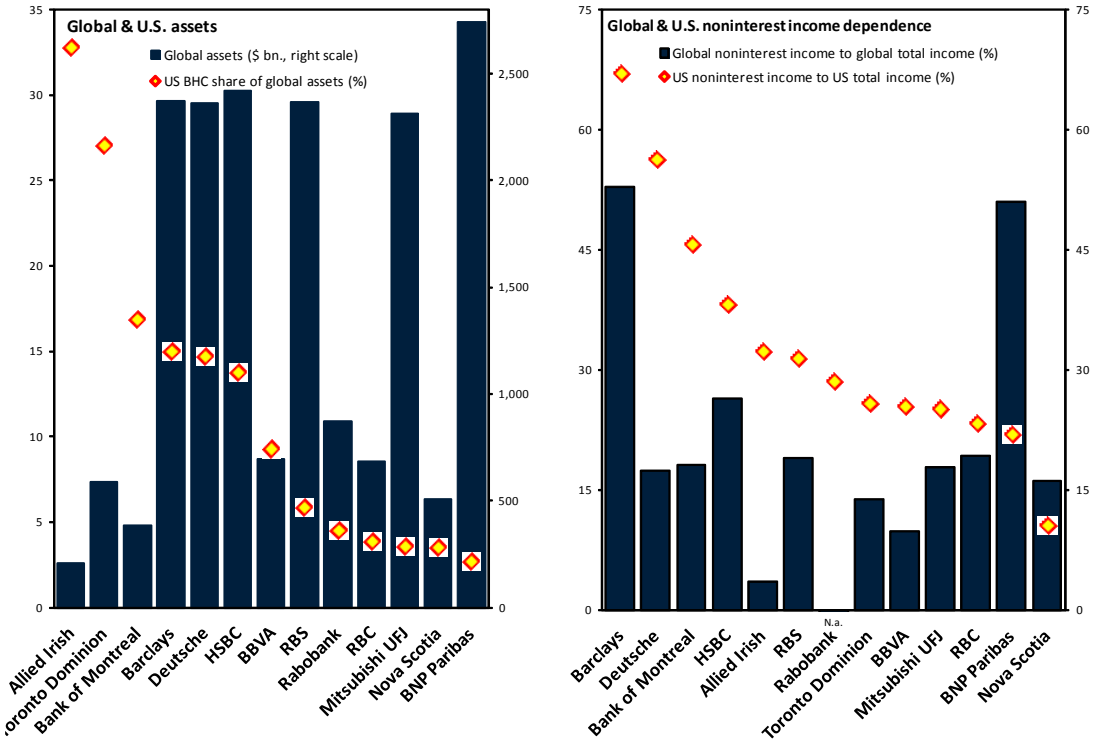
Figure 7.3. Consolidated U.S. Claims of BIS Reporting Banks on Ultimate Risk Basis, by Foreign-Owned Large BHC or Primary Dealer, March 2010 (In billions of dollars)



Key: Red/orange for investment banks/primary dealers; black/dark gray for commercial banks; light gray for unallocated.

Sources: Bank for International Settlements, *BIS Quarterly Review;* and Federal Reserve, *Bank Holding Company Performance Reports*.

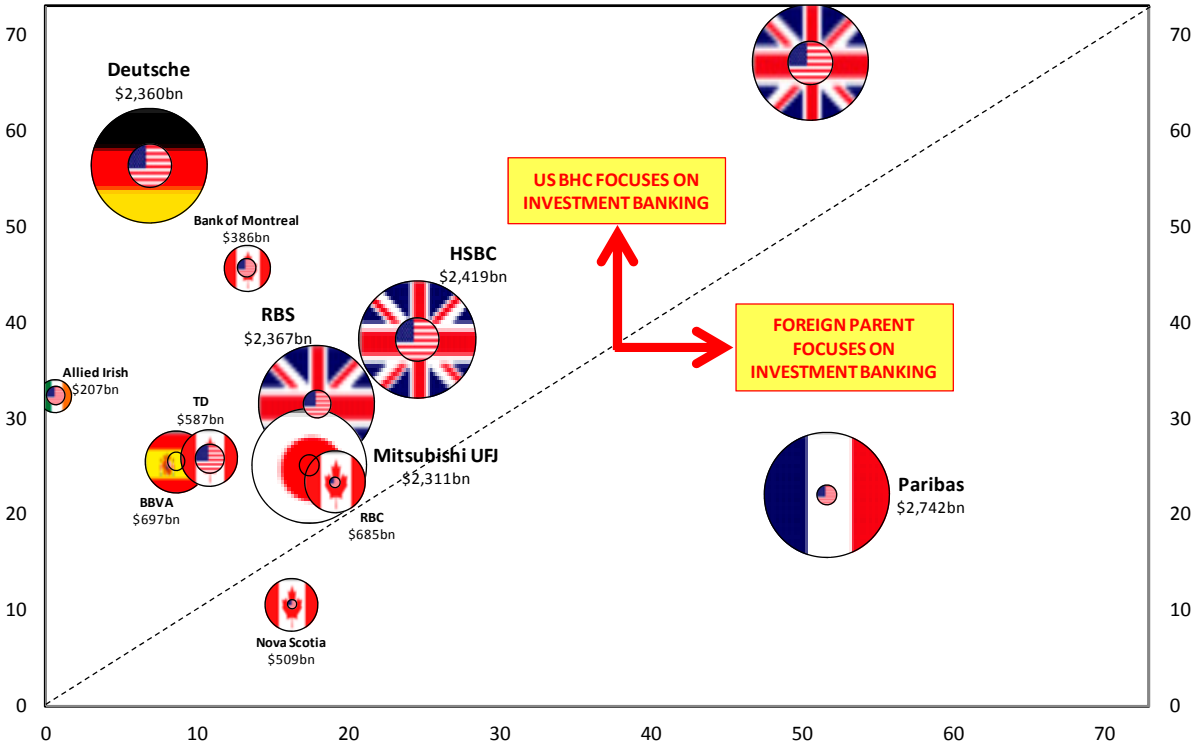
Figure 7.4: Foreign Owners of Large BHCs in the United States,



Sources: Federal Reserve, *Bank Holding Company Performance Reports*; and Fund staff estimates.

Figure 7.5: Business Models of Foreign Banks with U.S. BHC Subsidiaries, June 2010

Axes indicate nonint. income % of total income; bubbles indicate assets

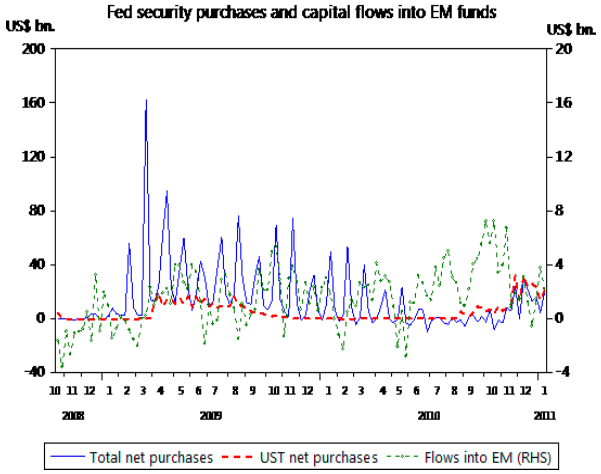


Sources: Federal Reserve, *Bank Holding Company Performance Reports*; and Fund staff estimates.

VIII. U.S. Monetary Policy Spillovers: Quantitative Easing and Capital Flows into Emerging Markets[18]

The effects of the Fed's quantitative easing (QE) announcements and actual purchase operations on capital flows into emerging markets (EMs) are investigated using a VAR on weekly data. QE1 and QE2 announcements seem to have affected such capital flows, while actual Fed net asset purchases did not.

A vector autoregression (VAR) analysis is conducted looking at the impact of quantitative easing on capital inflows into emerging markets. Weekly data from 2003 were collected on Fed purchases of assets (broken down into Treasury, Agency, and mortgage backed securities—the latter a good proxy for QE1 operations), flows into EM bond and equity mutual funds (divided between equity and bond flows), as well as oil and nonoil commodity prices and global risk aversion (proxied by the VIX). The Fed and mutual fund series (shown in the text chart) all end on Wednesdays, so other financial variables (commodity prices, the VIX) were also defined as of Wednesday close. In addition, the VAR included QE 1 and 2 announcements using the same dates as Chapter II. Most of these are FOMC announcements, which by chance normally also occur on Wednesday afternoons. These dates are moved to the following week as they occur right at the end of the weekly period (results using the announcement week are similar).



The baseline specification is a VAR with the following ordering: Fed net asset purchases, dummies for QE1 and (separately) QE2 announcements dates, and net flows into EM funds. This was considered to be the most plausible line of causation. The analysis is also extended to look at the role of global risk aversion and commodity prices both as a conduit for Fed actions as well as an independent driver of EM capital flows.

Reflecting limited degrees of freedom, formal tests for the appropriate number of lags in the VAR varied from very short (when degrees of freedom were included in the test) to quite long when they were not. A relatively long lag was chosen—6 weeks to be precise. The lag length has limited effects on the results, although it does tend to increase the significance of QE2 announcements over the longer term.

[18] Prepared by Trung Bui (SPR)

Findings

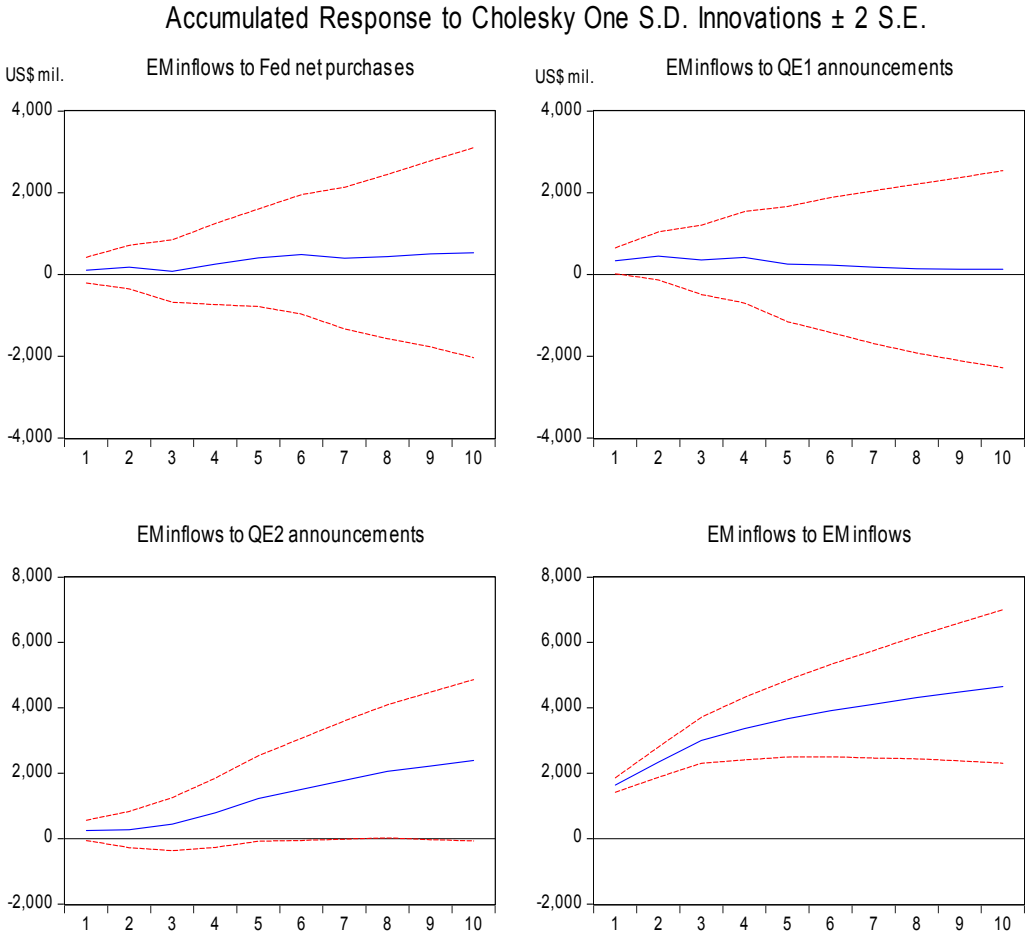
Fed announcements of QE seem to have a positive impact in driving net flows to EM but actual Fed asset purchases do not (Figure 8.1). The top left panel of the Figure indicates that Fed purchases of assets did not have a significant impact on EM capital flows over time. By contrast, QE1 and QE2 announcements are found to be significant on impact. The long-term impact diverges, with QE1 announcement effects becoming smaller and insignificant while cumulative capital flows in response to QE2 announcements grow over time and remain (marginally) significant. The extended VAR shows similar responses.

EM flows respond to the decline in global risk aversion and higher commodity prices when global market conditions are added to the VAR (Figure 8.2). Global market conditions were included by adding (changes in) the VIX and in oil prices in the VAR, (ordered after Fed purchases and announcements and before flows to EM funds). Impulse responses show a self-reinforcing relationship between declines in the VIX and increases in oil prices, both of which significantly contribute to flows to EMs. Results using (nonoil) commodity prices show a different linkage between global risk aversion and commodity prices but generate similar positive impacts on EM inflows.

Flows into equity market funds explain the positive response of EM flows to increases in oil prices. By separately analyzing inflows into EM bond and equity funds, the results indicate higher oil (and nonoil commodity) prices have driven larger flows into equity funds, but have little impact on bond flows.

The effects of Fed QE announcements and asset purchases on oil prices and global risk aversion have the expected sign but are not statistically significant (Figure 8.3). Fed purchases have a (marginally) significant positive impact on oil price when MBS purchases are included, suggesting that the response of oil prices is a feature of QE1 operations, while the (small) decline in the VIX seems to be associated to non-MBS purchases, i.e. to both QE programs. Responses of the VIX and oil prices to QE announcements generally have the expected sign but are not significant except for the immediate impact of QE1 announcements on the VIX. This impact could be related to the unanticipated nature of the first QE program, which was intended to alleviate the financial markets stresses at the height of the global crisis. Further analysis is required in order to ascertain whether Fed operations have been successful at decreasing perceived market risks.

Figure 8.1: Accumulated Responses of EM Inflows – Baseline VAR



Note: Impulse responses are extracted from the corresponding multivariate VAR

Figure 8.2: Accumulated Responses of Selected Variables – Extended VAR

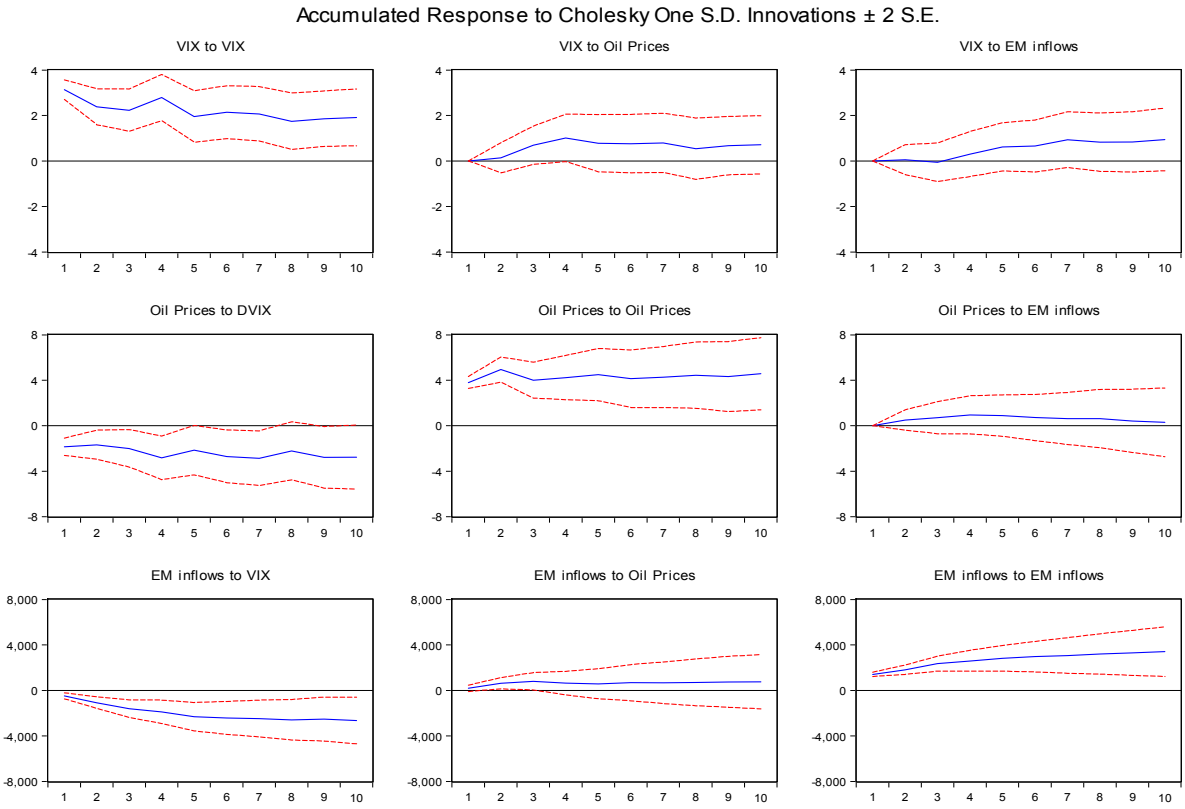
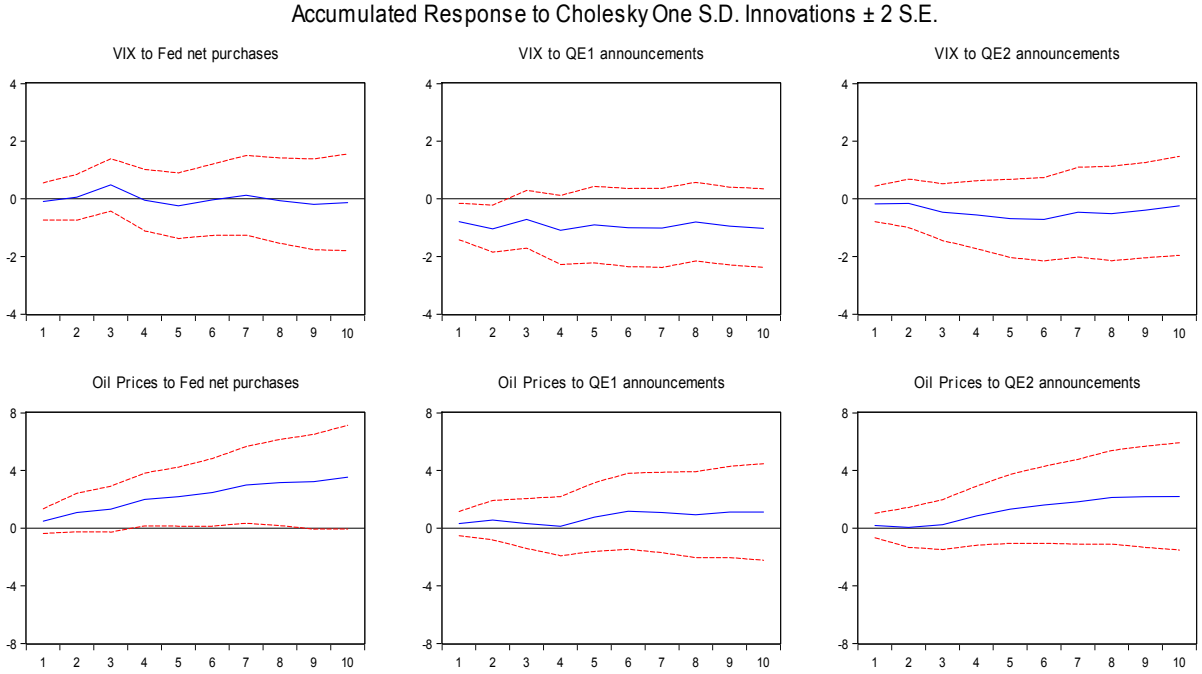


Figure 8.3: Accumulated Responses of VIX and Oil Prices to QE Actions



IX. U.S. Growth Spillovers: Monetary Policy[19]

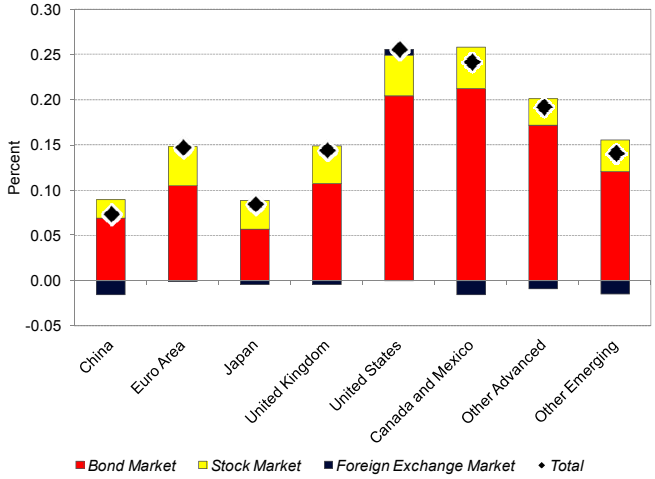
Spillovers from a variety of U.S. monetary policy measures are analyzed using a refined version of the structural macroeconometric model of the G-20 documented in Vitek (2010).[20] Spillovers are found to be large and mainly conveyed through asset price links.

A. Spillovers from U.S. Monetary Stimulus

This section analyzes spillovers from conventional and unconventional monetary stimulus measures in the United States. The conventional monetary stimulus measure under consideration is an unanticipated reduction in the nominal policy interest rate, while the unconventional monetary stimulus measures are quantitative easing programs, namely QE1 and QE2. The calibration of our scenarios is based on an event study analysis of the international bond, stock, and foreign exchange market impacts of these monetary stimulus measures.

Conventional U.S. monetary stimulus measures generate substantial output gains in the rest of the world (Figure 9.1). Our scenario features an unexpected percentage point decrease in U.S. policy rates which reduces long term nominal yields by 65 basis points in the United States, by 10 to 54 basis points in other advanced economies, and by zero to 45 basis points in emerging economies (see II). Furthermore, negative equity risk premium shocks raise equity prices by 3.9 percent in the U.S., by 1.9 to 3.0 percent in other advanced economies, and by zero to 3.4 percent in emerging economies. Finally, exchange rate risk premium shocks appreciate the currencies of other advanced economies by 0.9 to 1.2 percent with respect to the dollar, and of emerging economies by zero to 1.1 percent. Under this scenario, we estimate peak output gains of 0.3 percent in the U.S., of 0.1 to 0.3 percent in other advanced economies, and of around zero to 0.2 percent in emerging economies. The transmission of these output gains is estimated to occur primarily via the bond markets.

Figure 9.1: Peak Output Gains, Typical Monetary Stimulus

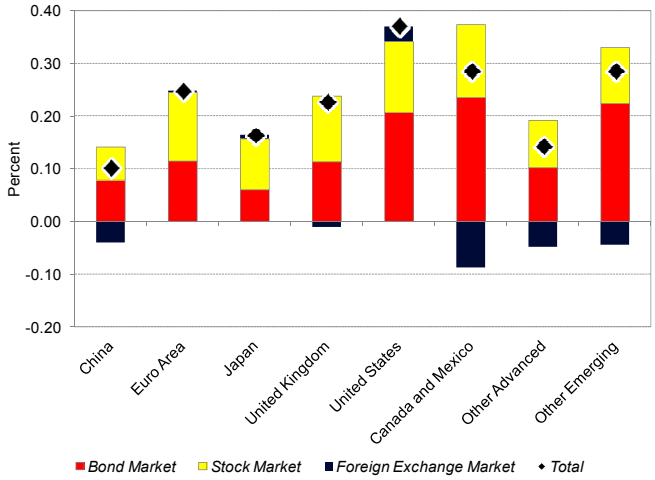


[19] Prepared by Francis Vitek (SPR).

[20] Vitek, F. (2010), Monetary policy analysis and forecasting in the Group of Twenty: A panel unobserved components approach, *International Monetary Fund Working Paper*, 152.

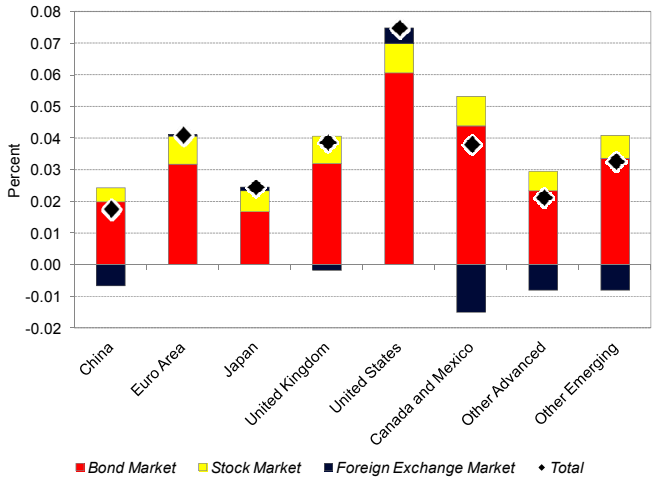
QE1 is estimated to have generated even larger output gains in the U.S. and the rest of the world (Figure 9.2). Our scenario features negative term premium shocks which reduce long term nominal interest rates by 65 basis points in the U.S., by 10 to 27 basis points in other advanced economies, and by 0 to 100 basis points in emerging economies. Furthermore, negative equity risk premium shocks raise equity prices by 11.7 percent in the U.S., by 5.6 to 8.9 percent in other advanced economies, and by zero to 10.2 percent in emerging economies. Finally, exchange rate risk premium shocks appreciate the currencies of other advanced economies by zero to 5.5 percent with respect to the dollar, and of emerging economies by zero to 5.4 percent. Under this scenario, we estimate peak output gains of 0.4 percent in the U.S., of 0.1 to 0.3 percent in other advanced economies, and of around zero to 0.4 percent in emerging economies. The transmission of these output gains is estimated to occur primarily via the bond and stock markets.

Figure 9.2: Peak Output Gains, QE1



QE2 is estimated to have generated modest output gains in the U.S. and the rest of the world (Figure 9.3). Our scenario features negative term premium shocks which reduce long term nominal interest rates by 20 basis points in the U.S., by 3 to 8 basis points in other advanced economies, and by zero to 14 basis points in emerging economies. Furthermore, negative equity risk premium shocks raise equity prices by 0.8 percent in the U.S., by 0.4 to 0.6 percent in other advanced economies, and by zero to 0.7 percent in emerging economies. Finally, exchange rate risk premium shocks appreciate the currencies of other advanced economies by zero to 0.9 percent with respect to the dollar, and of emerging economies by zero to 1.0 percent. These foreign financial spillover effects are small compared to typical monetary policy event even given the smaller change in U.S. bond yields compared to the scenario discussed earlier. Under this scenario, we estimate peak output gains of 0.1 percent in the U.S., of close to zero percent in other advanced economies, and of close to zero to 0.1 percent in emerging economies. The transmission is estimated to occur primarily via the bond markets.

Figure 9.3: Peak Output Gains, QE2

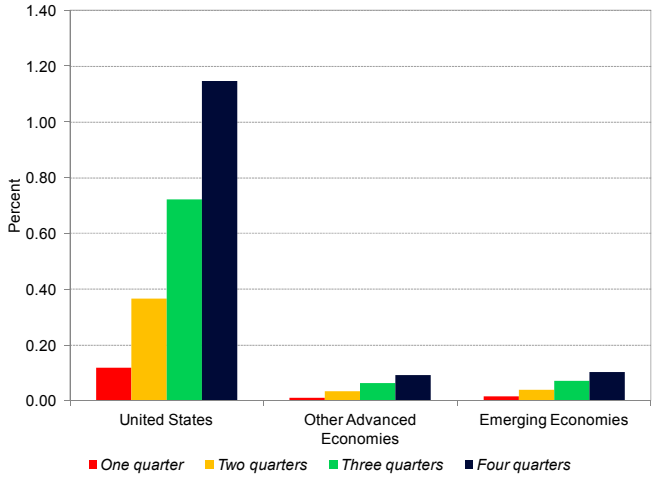


B. Spillovers from Delayed Withdrawal of U.S. Monetary Stimulus

This section analyzes spillovers from delayed withdrawal of monetary stimulus in the United States. These scenarios formalize the monetary policy strategy for escaping from a liquidity trap recommended by Eggertson and Woodford (2003).[21] They argue that by credibly committing to extend a zero interest rate policy beyond the time at which its monetary policy rule prescribes a positive setting, the central bank can stimulate the economy out of a liquidity trap. Essentially, by committing to reduce future short term real interest rates, the central bank is committing to generating an economic boom once the economy is out of the liquidity trap, raising expected future inflation and lowering the current long term real interest rate.

A delayed withdrawal of monetary stimulus in the U.S. is estimated to generate modest spillovers (Figure 9.4). At the current juncture, we estimate a peak output gain in the United States of 0.12 to 1.15 percent, depending on the duration of the delay. In other advanced economies, our estimated weighted average peak output gain ranges between 0.01 and 0.09 percent, while in emerging economies it ranges between 0.01 and 0.10 percent, reflecting their greater trade openness and less flexible exchange rate regimes. Note that these simulation results are generated from sequences of negative monetary policy shocks in the United States, implying smaller spillovers than would result from sequences of internationally correlated risk premium shocks calibrated to match the international financial market impacts of U.S. monetary policy announcements.

Figure 9.4: Peak Output Gains

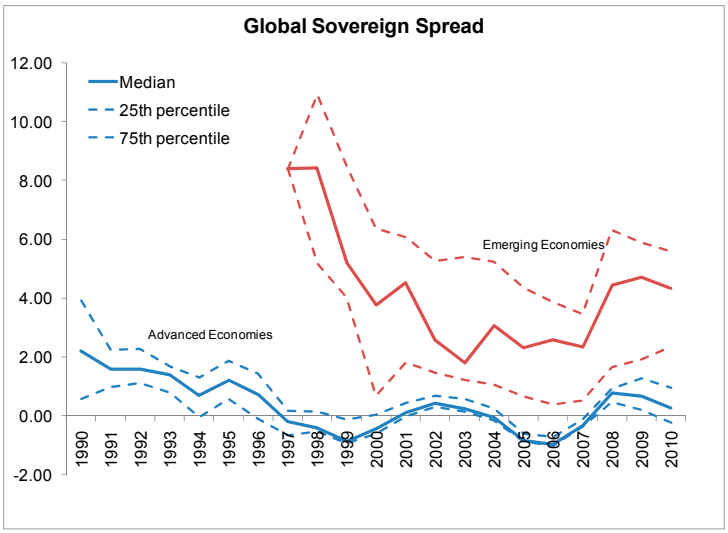


[21] Eggertsson, G. and M. Woodford (2003), The zero bound on interest rates and optimal monetary policy, *Brookings Papers on Economic Activity*, 1, 139–211.

X. U.S. Fiscal Spillovers: Global Financing Conditions[22]

Spillovers from U.S. fiscal policy outcomes to financial conditions in the rest of the world are analyzed. Holding other factors constant, the direct estimated effect of a one percentage point increase in the U.S. federal debt ratio (excluding Fed holdings) on sovereign spreads is about 2 basis points, with a stronger effect in emerging markets.

The analysis is based on annual panel regressions using local-currency sovereign bond yields from 41 countries over 1990–2010. The regression results suggest that an increase in the U.S. federal debt tends to be in the long term associated with an increase in the sovereign borrowing costs in both emerging markets and advanced economies, pointing to a global negative portfolio balance effect from expansionary U.S. fiscal policy.



The panel regressions include a comprehensive set of global and local determinants of borrowing spreads. The regressors can be divided into three groups: (1) U.S. policies and outcomes, including the publicly-held federal debt (excluding the Federal Reserve holdings of Treasuries), as a share of either U.S. or global GDP, growth, and yield on the 10-year Treasury bond; (2) local policies and outcomes such as public debt, growth, and inflation differential vis-à-vis the United States; and (3) other controls including foreign exchange reserves, current account balance, quality of political institutions, volatility, global cycle, financial openness, and the depth of financial markets.

The regression results suggest that higher U.S. federal debt is in the long run associated with higher borrowing costs in both emerging markets and advanced economies.[23] The estimated effect of U.S. federal debt on global sovereign spreads is statistically and economically significant (Table 10.1). Holding other factors constant, the direct estimated effect of a one percentage point increase in the U.S. federal debt ratio (excluding the Fed holdings) on sovereign spreads is about 2 basis points, with a stronger effect in emerging

---

[22] This section was prepared by Martin Sommer and Grace Bin Li (WHD).

[23] This finding is consistent with earlier analyses of dollar-denominated emerging market spreads in Celasun (2009) and Alper, Forni, Qian (2010).

markets. The findings remain broadly unchanged in alternative regression specifications including direct measures of expectations about debt, growth, and inflation, or time dummies and regional and other factors. Of course, the U.S. fiscal policy can affect global borrowing costs through other channels—in particular, by raising the Treasury yields, and possibly also by elevating market volatility (as captured by the VIX). Laubach (2009) estimates the elasticity of the long-term Treasury yields to a prospective one percentage point increase in the federal debt at about 3 basis points. While the upward pressure on U.S. yields is not apparent at the moment due to weak private demand and safe haven flows, such pressures are expected to resume in the future as the economy recovers (Celasun and Sommer, 2010). Adding the estimate of pass-through from long-term Treasury yields into spreads to the direct effect estimated by Laubach, the overall increase in local borrowing costs could eventually be some 5 basis points per an additional percentage point of U.S. federal debt. This is significant given the projected increase in the U.S. public federal debt from 36 percent of GDP before the crisis to 70 percent of GDP this year. However, the numerical estimate of spillovers should be interpreted with much caution and a case could be made that the estimate presents an upper bound—with the U.S. debt levels significantly higher than in the past, investors may attach lower "convenience value" to their Treasury holdings and the foreign lending rates could therefore increase by less than suggested by the regression results.[24]

Strong domestic policies and institutions can reduce borrowing costs and (eventual) negative spillovers from the rapidly-increasing U.S. public debt. Indeed, emerging market funding costs have fallen significantly over the past couple of decades reflecting improved policies and institutions. Going forward, extending such gains would help offset funding pressures due to higher U.S. debt ratios. For example, the regression results suggest that reducing the local public debt ratio by 10 percent of GDP lowers the borrowing spread by 10–100 basis points depending on the context. Meanwhile, improving institutional quality (as measured by the ICRG Composite Index) by 1 standard deviation of cross-country experiences could reduce the borrowing spread by 60–100 basis points. The panel regressions also provide some tentative evidence that countries with good policies and institutions are somewhat less sensitive to the negative spillovers from higher U.S. debt (Table 10.2). This would be consistent with the well-established fact that lower quality borrowers tend to be affected more by funding pressures in global financial markets. In sum, the analysis reinforces the call for early agreement on a comprehensive U.S. medium-term fiscal consolidation plan in light of the potentially negative domestic and global effects of rising U.S. debt.

[24] A similar argument was made by Krishnamurthy and Vissing-Jorgensen (2008) who found a negative correlation between the size of U.S. federal debt and the spread between U.S. corporate and Treasury yields.

Table 10.1: Baseline Regressions. Dependent variable: Spread over 10-year Treasuries 1/

VARIABLES	(1) Full Sample	(2) Emerging markets	(3) Advanced economies	(4) Full Sample	(5) Emerging markets	(6) Advanced economies
U.S. policies and outcomes						
Federal Debt minus Fed Holdings of Treasuries (% of US GDP)	0.023***	0.057**	0.025***			
	[2.713]	[2.837]	[4.147]			
Federal Debt minus Fed Holdings of Treasuries (% of World GDP) 2/				0.126***	0.280***	0.123***
				[3.232]	[4.058]	[3.779]
U.S. interest rates (long-term bond)	0.298***	0.738***	0.300***	0.279***	0.639**	0.285***
	[5.073]	[2.970]	[5.504]	[4.805]	[2.935]	[5.324]
U.S. growth	-0.04	0.007	-0.117**	-0.064	-0.011	-0.142***
	[-0.737]	[0.0678]	[-2.739]	[-1.143]	[-0.109]	[-3.339]
Domestic policies and outcomes						
Public debt (% of GDP)	0.012**	0.119**	0.006**	0.012***	0.114**	0.006**
	[2.687]	[2.928]	[2.308]	[2.736]	[2.681]	[2.426]
Growth	-0.126***	-0.123	-0.098***	-0.119***	-0.112	-0.094***
	[-3.625]	[-1.657]	[-3.444]	[-3.429]	[-1.512]	[-3.256]
Inflation differential	0.167***	0.203***	0.090*	0.168***	0.209***	0.092*
	[3.403]	[6.947]	[1.733]	[3.495]	[7.178]	[1.787]
Other controls						
FX reserves (% GDP)	-0.036***	-0.120***	-0.016	-0.037***	-0.110**	-0.017
	[-3.180]	[-2.955]	[-1.411]	[-3.232]	[-2.752]	[-1.521]
Current account (% GDP)	-0.022	-0.219**	0.017	-0.024	-0.223**	0.016
	[-0.640]	[-2.665]	[0.755]	[-0.705]	[-2.830]	[0.724]
Political institutions (ICRG)	-0.080***	-0.111	-0.065**	-0.080***	-0.1	-0.070**
	[-2.721]	[-0.970]	[-2.283]	[-2.707]	[-0.834]	[-2.494]
VIX	0.069**	0.016	0.156***	0.062**	0.011	0.146***
	[2.446]	[0.378]	[4.606]	[2.191]	[0.238]	[4.574]
VIX* Moody's Rating	-0.027***	0.01	-0.059***	-0.027**	0.01	-0.058***
	[-2.754]	[0.441]	[-4.788]	[-2.684]	[0.431]	[-4.961]
Constant	5.289**	2.296	3.755	5.168**	1.466	4.115*
	[2.243]	[0.258]	[1.556]	[2.159]	[0.153]	[1.723]
Observations	539	110	429	539	110	429
R-squared	0.415	0.712	0.439	0.415	0.715	0.433
Number of ifscode	41	16	25	41	16	25

Robust t-statistics in brackets
*** p<0.01, ** p<0.05, * p<0.1

1/ Regressions use the OLS estimator. The GMM estimates using lagged values of variables as instruments are similar.
Sample: 41 countries, annual data, 1990-2010
Moody's rating = 3 (Aaa, Aa), 2 (A, Baa), 1 (Ba, C), 0 = Caa or lower
2/ Results are qualitatively similar when either world total saving or world private saving are used as the denominator.

Table 10.2: Regressions with Interaction Terms 1/

Interaction Variable	(1) Full Sample	(2) Emerging markets	(3) Advanced economies
U.S. Federal debt * Domestic public debt	+	+	+
U.S. Federal debt * Domestic growth	+	-	+
U.S. Federal debt * FX reserves	-	-	-
U.S. Federal debt * Political institutions	-	-	-
U.S. Federal debt * Current account balance	-	-	-
U.S. Federal debt * VIX	-	+	-

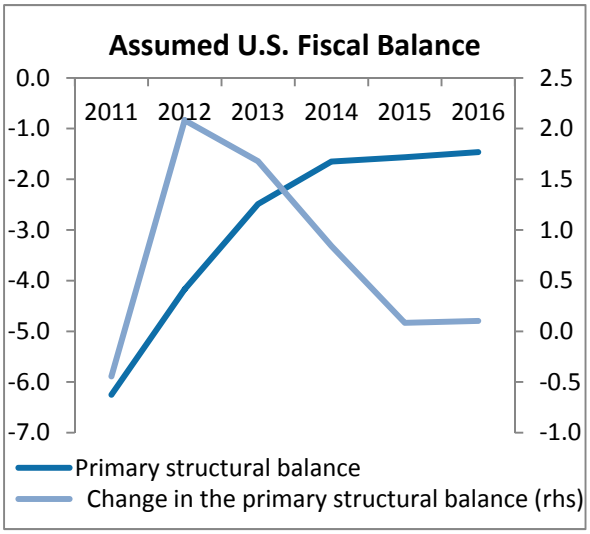
1/ Red denotes a statistically significant interaction term.

XI. U.S. Growth Spillovers: Fiscal Policy

Spillovers from projected fiscal consolidation in the United States are estimated using two alternative models: the Global Integrated Monetary and Fiscal (GIMF) model, and a structural macroeconometric model of the G-20. It also presents simulation results for U.S. sovereign debt crisis scenarios generated with the G-20 model. There are significant long-term gains in output from consolidation while the short-term losses are generally small.

A. Spillovers from U.S. Fiscal Consolidation: Analysis Using GIMF[25]

U.S. fiscal policy can affect output in other countries both by its effects on trade and by its effect on world interest rates. Analysis using the GIMF model suggests that the stimulus measures in 2009 and 2010 raised demand in the United States and, to a lesser extent, the rest of the world.[26] Correspondingly, a fiscal tightening from 2011 onward can be expected to have negative spillovers for external demand.[27] In the case of new fiscal consolidation that achieves permanent debt reduction, these negative effects are mitigated by the positive effects of a long-run reduction in world interest rates. The assumed fiscal balance profile is shown in the text figure. Roughly half of the fiscal tightening is assumed to come from increases in labor income taxes from their 2010 levels, with reductions in government consumption and transfers accounting for most of the rest.[28]



Short-run output spillovers from fiscal tightening in the United States to other countries are uniformly negative, but relatively small in size. GDP in other regions falls by a fraction of the fall in U.S. GDP, and recovers more quickly. There are two main reasons for

---

[25] Section prepared by Alasdair Scott, with inputs from Ben Hunt and Stephen Snudden (RES) and Martin Sommer (WHD).

[26] GIMF is a multi-country structural model covering the global economy. In each region, households, firms and fiscal and monetary policy authorities interact in goods and labor markets, with implications for prices, interest rates, exchange rates, and external balances. For the purpose of these exercises, the model is noticeable for its detailed fiscal structure, having several different types of government expenditures and taxes, and its non-Ricardian behavior.

[27] See, for example, the October 2010 *World Economic Outlook* and the references contained therein.

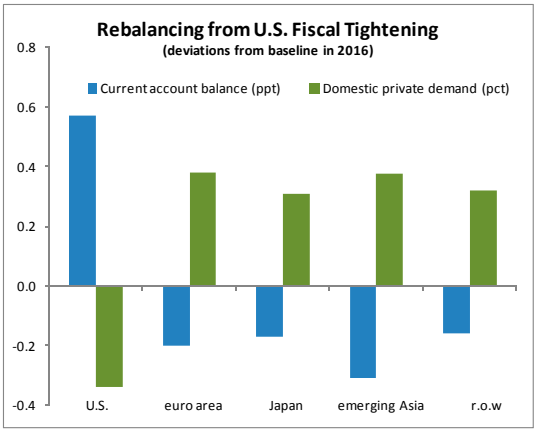
[28] In addition to these fiscal shocks, nominal interest rates are fixed in the US and euro area for the first year, mimicking the current scenario of rates at the lower nominal bound.

such a result. First, without any other shocks, the scenario focuses on trade linkages and not financial linkages; outside of Canada and Mexico, the direct trade impact is relatively small. Second, domestic demand in other regions responds rapidly to higher anticipated income as a consequence of lower interest rates.

Long-run spillovers from fiscal consolidation are uniformly positive. A fiscal consolidation that permanently reduces public debt causes real interest rates to fall and output to rise. Because the U.S. economy is large in capital markets, world interest rates also fall, with a positive impact on output in other regions.

Total Contribution to Growth from Changes in U.S. Fiscal Balance

	United States	Euro Area	Japan	Emerging Asia	Remaining Countries
2009	1.4	0.1	0.1	0.2	0.1
2010	1.1	0.2	0.2	0.4	0.2
2011	-0.3	0.0	0.0	-0.1	0.0
2012	-1.3	-0.2	-0.2	-0.3	-0.1
2013	-1.0	-0.1	-0.1	-0.2	-0.1
2014	-0.8	-0.1	-0.1	-0.2	-0.1
2015	0.1	-0.1	-0.1	0.0	0.0
2016	0.4	0.0	0.0	0.1	0.0



There are significant implications for trade and the composition of demand. Although the net effects on output for other countries are small relative to the impact on U.S. output, there are nonetheless important effects on trade and domestic demand in other countries. The composition of output in the United States shifts away from domestic toward external demand. The converse holds for other countries. Hence, although other countries benefit from lower interest rates, trade balances deteriorate to accommodate U.S. fiscal consolidation.[29]

[29] The shocks are run under the assumption that nominal exchange rates in all other countries are free floating. Hence the burden of the necessary real exchange rate adjustments is taken up by nominal rates instead of goods prices and wages.

Variations on these scenarios illustrate a number of points:

- *Spillovers are less severe when fiscal policies are anticipated and credible.* Private agents anticipate the long-run benefits; consumption and investment start to improve much earlier. Consequently, spillovers to other regions are smaller, with less pressure on external rebalancing and capital flows.

- *The balance between short-run costs and long-run benefits depends on how efficiently the deficit reduction is directed.* The long-run effect depends on incentives to increase supply; in the model, lower labor or capital income taxes are more effective than, say, reducing (lump-sum) transfers exclusively, or reducing public consumption. In the short run, output falls by less in a scenario in which the same overall improvement in primary balances is financed by lump-sum taxes, for example.

- *Spillovers to other countries are less severe when monetary policy is able to accommodate domestic fiscal consolidation*. If U.S. nominal policy rates were able to fall, the effects are less severe, because there is less excess supply in the domestic economy that has to be exported and because U.S. private demand for other regions' goods is supported.

- *A "front-loaded" fiscal adjustment that achieves the same debt reduction but is more aggressive from the start has a larger short-run cost to U.S. aggregate demand.* Consequently, the negative spillovers onto demand in other regions are more severe, and the dollar depreciation and swings in the trade balance are larger.

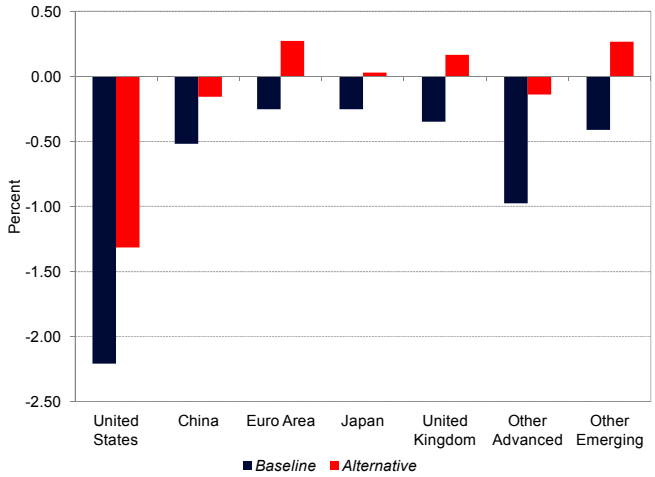
- *Spillovers could be affected by changes in risk premia, in addition to trade channels.* Simulations suggest that if market concern over U.S. public debt were elevated, a front-loaded fiscal consolidation might have less of a negative effect on U.S. and world demand to the extent that it reduced risk premia. The reverse also applies: a consolidation that is not viewed as credible or effective at securing sustainable public balances could have a negative effect on risk premia. It is difficult to say how large the increases in interest rates could be, but simulations suggest that plausible changes in risk premia can have larger effects than those seen when focusing on trade linkages alone.

B. Fiscal Consolidation Scenarios: G-20 Model Simulation Results[30]

This section analyzes spillovers from projected fiscal consolidation in the United States. This analysis is based on scenarios simulated with a refined version of the structural macroeconometric model of the G-20 documented in Vitek (2010).[31] Our baseline scenario abstracts from any decline in long term nominal interest rates as a result from U.S. fiscal consolidation, while our alternative scenario accounts for the possibility of such declines, to varying degrees worldwide. Both scenarios abstract from monetary policy stabilization worldwide in order to isolate the effect of fiscal policy.

We estimate that projected U.S. fiscal consolidation would generate substantial domestic output losses. Under our baseline scenario, we estimate a cumulative output loss of 2.2 percent over the period 2011–2016. This scenario is based on the projected path of the fiscal impulse in the April 2011 WEO, which implies a cumulative fiscal consolidation of 2.5 percent of output. Under our alternative scenario, which assumes that the long term nominal interest rate in the U.S. declines by 39 basis points by 2014, we estimate a cumulative output loss of 1.3 percent. The calibration of this scenario is based on Laubach (2009), who estimates that a one percent reduction in the ratio of government debt to output is associated with a 3 to 4 basis point decline in the long term nominal interest rate.[32]

Figure 11.1: Cumulative Output Effects, 2011–2016



Projected U.S. fiscal consolidation is estimated to generate variable spillovers to the rest of the world. Under our baseline scenario, estimated cumulative output losses for other advanced economies range from 0.1 to 1.4 percent over the period 2011–2016, while for emerging economies they range from 0.1 to 1.0 percent. Our alternative scenario assumes that 16 to 66 percent of the declines in the long term nominal interest rate in the U.S. pass through to other advanced economies while zero to 69 percent pass through to emerging economies, based on an event study analysis of the international bond market impacts of

---

[30] Section prepared by Francis Vitek (SPR).

[31] Vitek, F. (2010), Monetary policy analysis and forecasting in the Group of Twenty: A panel unobserved components approach, *International Monetary Fund Working Paper*, 152.

[32] Laubach, T. (2009), New evidence on the interest rate effects of budget deficits and debt, *Journal of the European Economic Association*, 7, 858–885.

fiscal policy announcements (see Chapter II). Under this scenario, estimated cumulative output effects for other advanced economies range from a loss of 0.5 percent to a gain of 0.4 percent, while for emerging economies they range from a loss of 0.2 percent to a gain of 0.6 percent. Under both scenarios, estimated cumulative output losses in the rest of the world are generally increasing with the degree of trade integration with the United States.

C. Sovereign Debt Crisis Scenarios: G-20 Model Simulation Results[33]

This section presents simulation results for sovereign debt crisis scenarios originating in the United States featuring alternative degrees of financial market contagion. These simulation results are generated with a refined version of the structural macroeconometric model of the G-20 documented in Vitek (2010).[34]

Our first scenario features a sovereign debt crisis contained within the United States. A sudden loss of confidence in fiscal sustainability there is represented by a positive term premium shock which in isolation would raise its long term nominal interest rate by 450 basis points on impact. Heightened risk aversion also afflicts the U.S. stock market, an effect represented by a positive equity risk premium shock which in isolation would reduce equity prices by 60 percent on impact. Finally, loss of confidence by households and firms causes them to postpone their consumption and investment expenditures, decreasing domestic demand by 1 percent, while a fiscal consolidation reaction by the government reduces it by a further 2 percent. This contained sovereign debt crisis is estimated to generate weighted average peak output losses of 4.4 percent in the United States, of 0.5 percent in other advanced economies, and of 0.7 percent in emerging economies.

Under our second scenario, heightened U.S. risk aversion spreads to bond and stock markets worldwide. This scenario augments our first scenario with term premium shocks which raise long term nominal interest rates in all other advanced economies by 180 basis points, and all emerging economies by 270 basis points. In addition, equity risk premium shocks reduce equity prices in all other advanced economies by 30 percent, and all emerging economies by 45 percent. Finally, loss of confidence decreases domestic demand in all other economies by 1 percent, while fiscal consolidation reactions reduce it by a further 1 percent in other advanced economies. This contagious sovereign debt crisis is estimated to generate weighted average peak output losses of 4.9 percent in the United States, of 3.6 percent in other advanced economies, and of 3.5 percent in emerging economies.

---

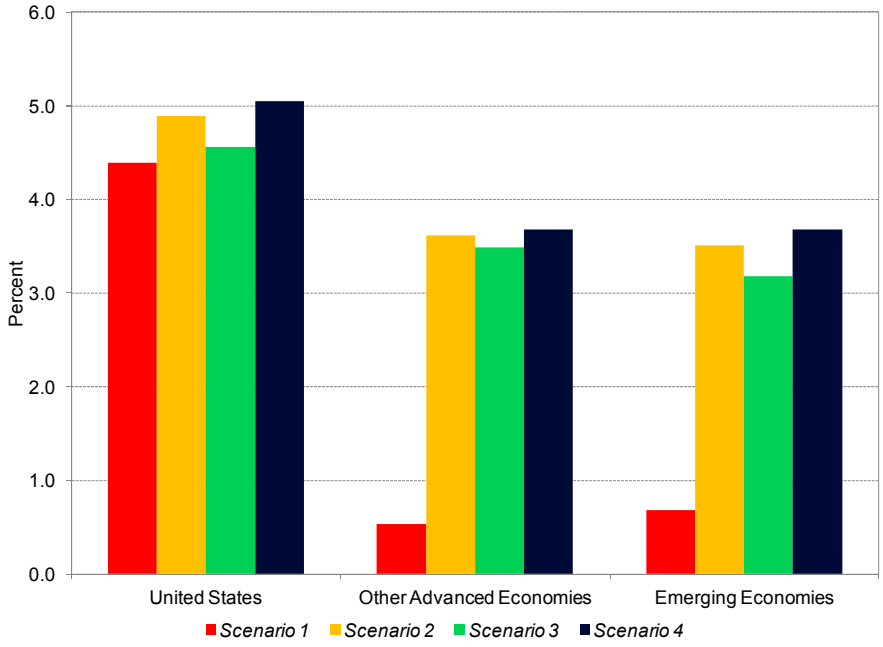
[33] Section prepared by Francis Vitek (SPR).

[34] Vitek, F. (2010), Monetary policy analysis and forecasting in the Group of Twenty: A panel unobserved components approach, *International Monetary Fund Working Paper*, 152.

Our third scenario combines bond and stock market collapses worldwide with a run on the dollar. This scenario augments our second scenario with exchange rate risk premium shocks which in isolation would depreciate the dollar by 30 percent in nominal effective terms on impact. The implied real effective appreciation pressure on other currencies is disinflationary, raising the scope for monetary policy loosening to mitigate output losses in affected economies. This contagious sovereign debt crisis is estimated to generate weighted average peak output losses of 4.6 percent in the United States, of 3.5 percent in other advanced economies, and of 3.2 percent in emerging economies.

Under our fourth scenario, heightened risk aversion afflicts bond and stock markets worldwide and there is a flight to quality. This scenario augments our second scenario with exchange rate risk premium shocks which in isolation would appreciate the dollar by 15 percent in nominal effective terms on impact. The implied real effective depreciation pressure on other currencies is inflationary, reducing the scope for monetary policy loosening to mitigate output losses in affected economies. This contagious sovereign debt crisis is estimated to generate weighted average peak output losses of 5.1 percent in the United States, of 3.7 percent in other advanced economies, and of 3.7 percent in emerging economies.

Figure 11.2: Peak Output Losses

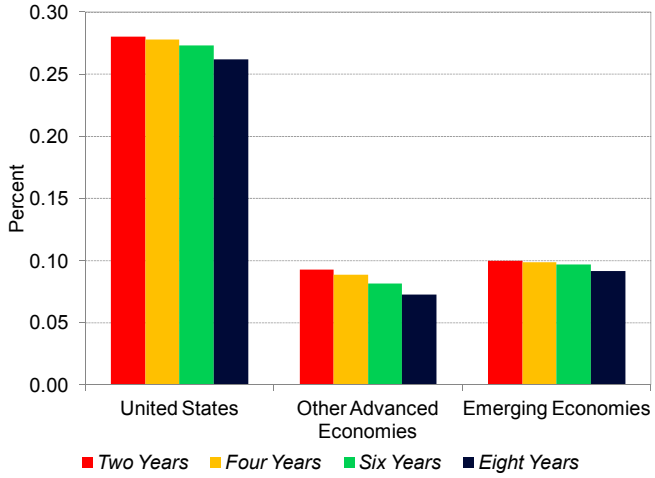


XII. U.S. Financial Spillovers: Raising U.S. Capital Adequacy Requirements[35]

Spillovers from a regulatory increase in capital adequacy requirements in the United States are analyzed. Under our baseline scenario, it is estimated that a binding one percentage point increase in U.S. capital adequacy requirements would generate substantial spillovers.

The focus of this chapter is on the transitional costs of higher capital requirements, as opposed to the permanent net benefits accruing from less frequent and severe banking crises. This analysis is based on scenarios simulated with an extended and refined version of the structural macroeconometric model of the world economy, disaggregated into its fifteen largest national economies, documented in Vitek (2009).[36] These scenarios abstract from monetary policy stabilization and assume that the macroeconomic effects of this regulatory measure are transmitted exclusively via a permanent increase in the spread between commercial bank lending and deposit rates. Under our baseline scenario, the extent to which this interest rate spread increases varies across economies in proportion to the ratio of credit provided by commercial banks incorporated in the United States to total credit. Our alternative scenario abstracts from this cross-border bank lending channel.

Figure 12.1: Peak Output Losses Under Baseline Scenario



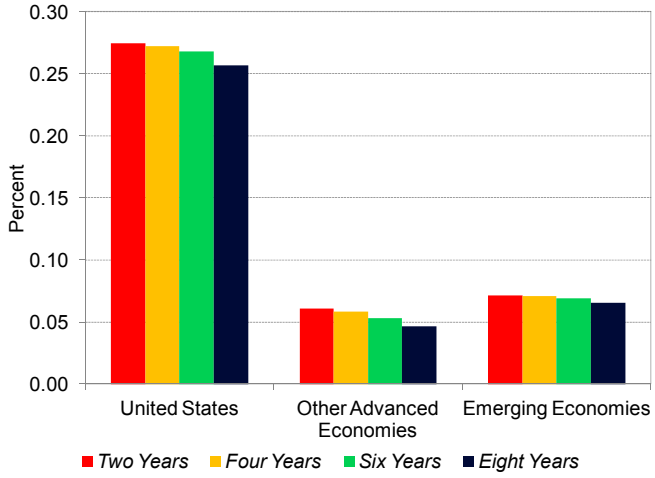
Under our baseline scenario, it is estimated that a binding one percentage point increase in U.S. capital adequacy requirements would generate substantial spillovers (Figure 12.1). A capital requirement shock is analogous to a permanent monetary policy shock, and is transmitted via the interest rate, exchange rate, and cross-border bank lending channels of monetary policy. In the United States, we estimate a peak output loss of 0.26 to 0.28 percent, depending on the speed of implementation. In other advanced economies, our estimated peak output losses range from 0.05 to 0.19 percent, while in emerging economies they range from 0.05 to

[35] Prepared by Francis Vitek (SPR).

[36] Vitek, F. (2009), Monetary policy analysis and forecasting in the world economy: A panel unobserved components approach, *International Monetary Fund Working Paper*, 238.

0.16 percent. These estimates are based on a 0.12 percent increase in the interest rate spread, following MAG (2010).[37]

Figure 12.2: Peak Output Losses Under Alternative Scenario



Abstracting from cross-border lending links, we estimate that the same increase in U.S. capital adequacy requirements as before would generate only modest spillovers (Figure 12.2). The substantial reduction in peak output losses in the rest of the world relative to our baseline scenario reflects the importance of the cross-border bank lending channel of monetary policy, due to the high dependence of other advanced and emerging economies on credit provided by commercial banks incorporated in the United States. In other advanced economies, our estimated peak output losses range from 0.03 to 0.16 percent, while in emerging economies they range from 0.03 to 0.12 percent, in spite of their greater trade openness and less flexible exchange rate regimes. These output losses primarily reflect reduced export demand from the United States, mitigated by real effective currency depreciations in the rest of the world.

[37] Macroeconomic Assessment Group (2010), Assessing the macroeconomic impact of the transition to stronger capital and liquidity requirements, *Financial Stability Board and Basel Committee on Banking Supervision Final Report*.

XIII. U.S. FINANCIAL SPILLOVERS: BANKING SYSTEM RISKS[38]

The potential for spillover effects arising from U.S. banking sector vulnerabilities to large shocks remains a key concern for maintaining financial stability amid the impact of more stringent regulatory standards. U.S. policy measures have helped reduce the link between individual and system-wide risks in the banking sector, with positive spillovers abroad.

A. Examining the Potential Spillover of Systemic Risk

The analysis compares the relationship between individual and systemic (solvency) risk of major banks in Europe and the United States during the credit crisis.[39] The systemic risk is defined as the joint default risk among all sample banks in each jurisdiction based on the multivariate distribution (MGEV) of joint CDS spread movements defined by a non-parametric dependence function.[40] This dependence measure is combined with the marginal distributions of these individual CDS spread movements, which are assumed to be generalized extreme value (GEV). In contrast, individual risk is defined as the average default risk weighted by the total assets of sample banks in each jurisdiction.

Two types of credit default swap (CDS) prices are used in this analysis as a measure of solvency risk: (i) the actual one-year CDS spread (obtained from proprietary data providers (Bloomberg and MarkIt)) as well as (ii) the fair value (or "synthetic") CDS spreads over a one-year risk horizon (extracted from equity prices via an advanced version of contingent claims analysis, or CCA).[41]. The latter CDS spreads are generally higher than the actual CDS spreads, which reflect only the residual solvency risk of banks due to implicit or explicit government guarantees as a result of being systemically important.

The analysis finds that both systemic and individual risk culminated in the first quarter of 2009. This was followed by a persistent decline in individual risk until end-2009, and an

---

[38] Prepared by Andreas (Andy) Jobst (MCM).

[39] The sample includes the following banks: Barclays, BNP, Deutsche Bank, Santander, UBS and Unicredit (for Europe) as well as Bank of America, Citigroup, Goldman Sachs, and J.P. Morgan (for the United States).

[40] Gray, D. F. and A. A. Jobst, 2009, "Higher Moments and Multivariate Dependence of Implied Volatilities from Equity Options as Measures of Systemic Risk," *Global Financial Stability Report*, Chapter 3, April (Washington: International Monetary Fund), pp. 128–131. Gray, D. F. and A. A. Jobst, 2010, "New Directions in Financial Sector and Sovereign Risk Management, *Journal of Investment Management*, Vol. 8, No.1, pp.23–38. Jobst, A. A. and H. Kamil, 2008, "Stock Market Linkages Between Latin America and the United States During 'Tail Events'," *in Latin American Linkages to Global Financial Market Turbulence*, Regional Economic Outlook (Washington: Western Hemisphere Department, International Monetary Fund), pp. 35–36.

[41] Gray, D. F, and A. A. Jobst, 2011, "Modeling Systemic and Sovereign Risk" in: Berd, Arthur (ed.) *Lessons from the Financial Crisis* (London: RISK Books), pp. 143–85.

eventual stabilization of system-wide risk at an elevated level in the wake of U.S. policy announcements (Figures 13.1–13.4). Systemic risk subsequently declined in anticipation of a series of U.S. policy measures in early 2010, such as the announcement of the "Volcker Rule" on restricted proprietary trading and the proposed imposition of a financial crisis responsibility tax. These policy measures consolidated a trend towards lower systemic risk in the U.S. banking sector. The interaction between individual and systemic risk was similar in both the United States and Europe, with the exception of a slower decline of systemic risk (if measured by synthetic CDS) in Europe during the first half of 2010.

More importantly, the slope of the relationship between individual and systemic risk appears to have flattened over time. Analysis of this relationship is complicated by periods in which the expected positive relationship between individual and system risk does not hold. However, there appear to be three periods of relative stability: (i) from the Lehman collapse to June 2009; (ii) from July 2009 through the announcement of Volcker rule (January 2010); and (iii) after the announcement of the Volker rule. As can be seen in Figures 13.1 and 13.2, the usually positive relationship between U.S. banks' individual risk and systemic risk flattened after the announcement of the Volcker rule. A similar pattern seems to be true for European banks, suggesting positive spillovers.

B. Examining the Tail Dependence between U.S. and European Banking Sector Risks – Dynamic Dependence Structure Model (DDS)

This section assesses the potential for such vulnerabilities to spillover to European banks (based on the DDS model to quantify the dependence structure).[42] *The analysis finds that cross-border linkages of banking sector risk have increased dramatically during the credit crisis, especially for very large increases of default risk until mid-2009. After a noticeable decline during the first half of 2010 amid lower systemic risk in the U.S. banking sector, spillover effects have reemerged in the wake of persistent turmoil in the European periphery.*

In this analysis, the DDS model – based on the concept of multivariate extreme value theory (EVT) – is used to assess the potential for spillovers effects from joint banking sector distress ("tail risk") in Europe and the United States. It shows whether extreme cross-border linkages exist and how these might change over time, acknowledging that large shocks are transmitted differently than small shocks. These linkages are measured as dependence values,[43] which are calculated iteratively as central estimates on daily

[42] The sample of banks is the same as in Section A.

[43] Conventional correlation coefficients are seriously misleading in the presence of skewed distributions and high volatility, mainly because they detect only linear dependence between *two* variables whose marginal distributions are assumed to be distributed normally – an ideal assumption rarely encountered in practice.

Figure 13.1: United States: Comparison of Individual and Systemic Risk in the Banking Sector - *based on synthetic CDS spreads (CCA Equity Put)*

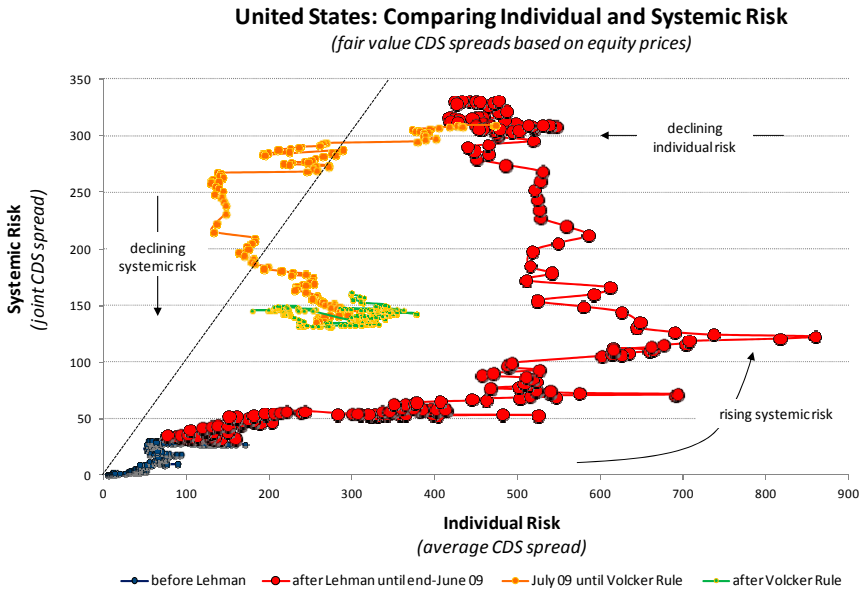


Figure 13.2: United States: Comparison of Individual and Systemic Risk in the Banking Sector - *based on actual CDS spreads*

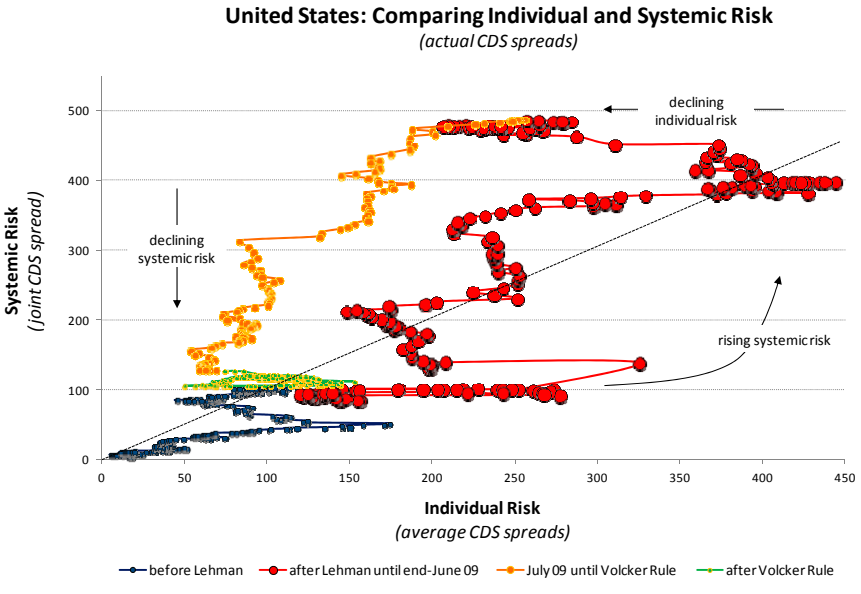
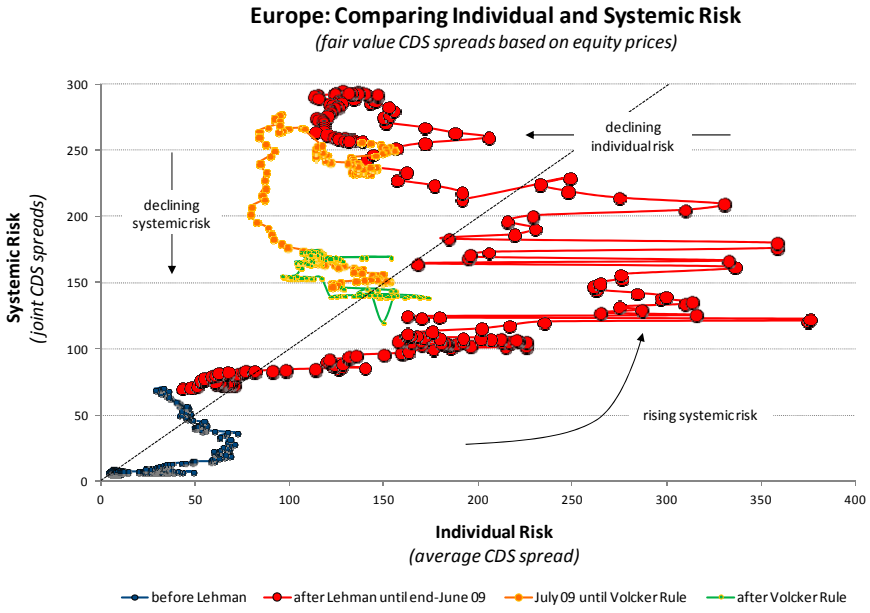
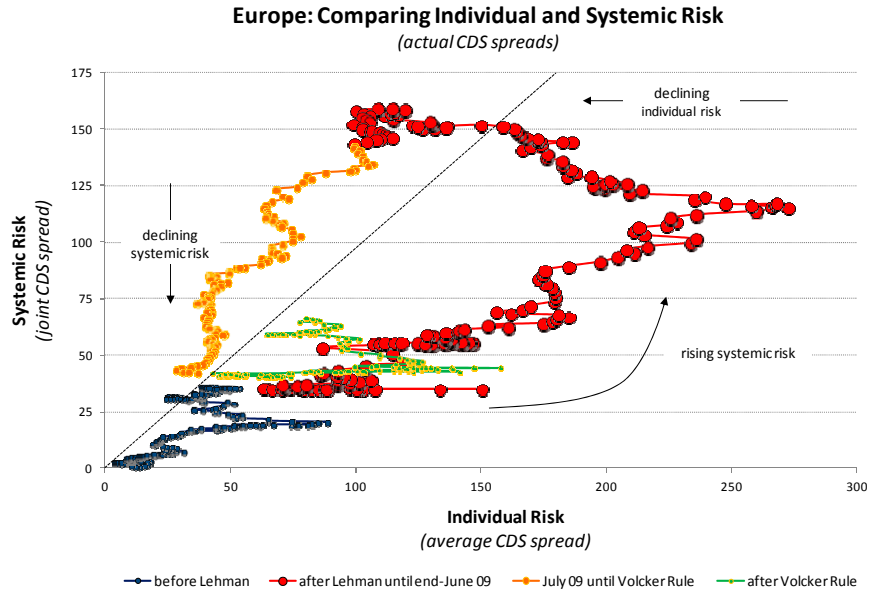


Figure 13.3: Europe: Comparison of Individual and Systemic Risk in the Banking Sector - *based on synthetic CDS spreads (CCA Equity Put)*



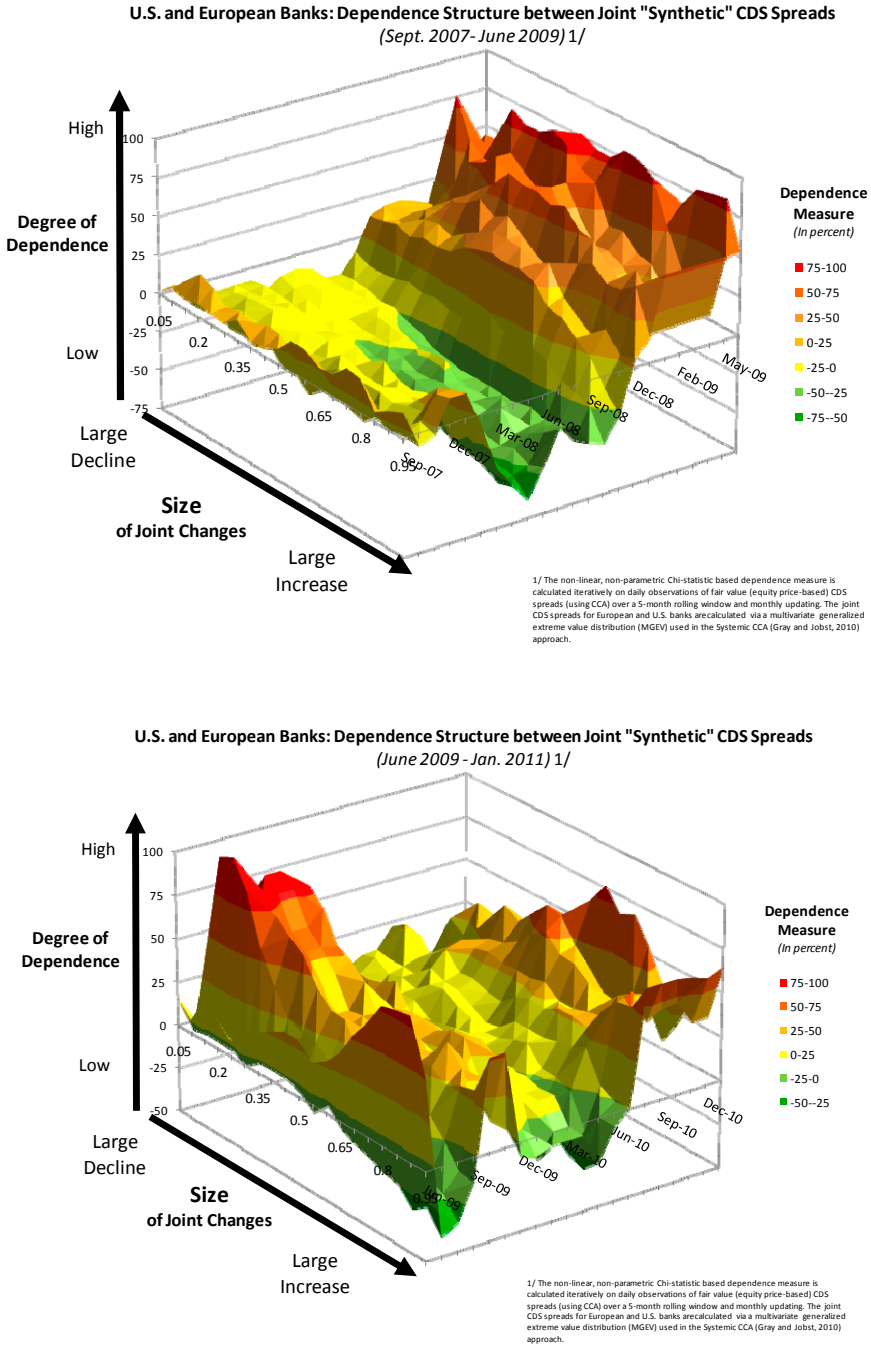
Sample period: 06/26/07-09/10/10 (1,135 obs.) of daily observations. The fair value CDS spreads are defined as equity-implied "synthetic" one-year CDS spreads and are aggregated via a multivariate distribution to derive a measure of systemic risk [based on an advanced CCA framework, Gray and Jobst (2010)].

Figure 13.4: Europe: Comparison of Individual and Systemic Risk in the Banking Sector - *based on actual CDS spreads*



Sample period: 06/26/07-09/10/10 (1,135 obs.) of daily observations. The one-year CDS spreads and are aggregated via a multivariate distribution to derive a measure of systemic risk [based on an advanced CCA framework, Gray and Jobst (2010)].

Figure 13.5: Dynamic Dependence Structure – Spillover between the U.S. and European Banking Sector (2007–2011).

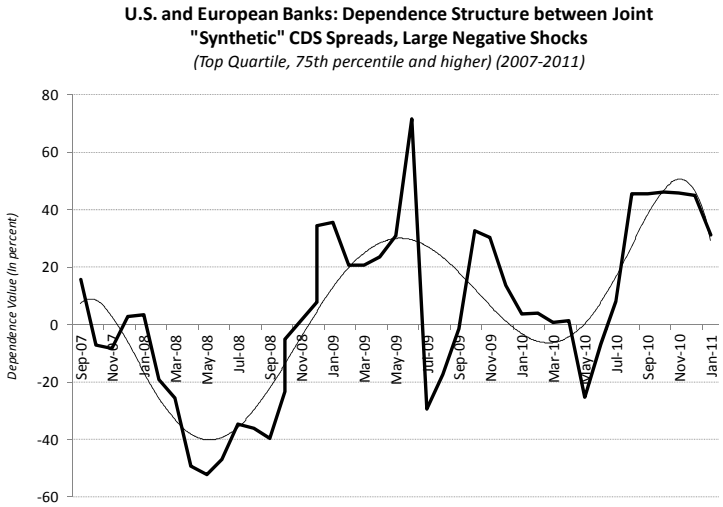


Note: The non-linear, non-parametric Chi-statistic based dependence measure is calculated iteratively on daily observations over a 5-month rolling window and monthly updating. The inputs are the joint fair value CDS spreads of sample banks in each Europe and the United States, calculated via a multivariate generalized extreme value distribution (MGEV) used in the Systemic CCA (Gray and Jobst, 2010) approach.

observations within a sliding one-year rolling window that is updated monthly.[44] The three-dimensional charts below (see Figure 13.5) show the dependence between joint changes in fair value one-year credit default swap (CDS) spreads (extracted from equity prices via an advanced version of CCA) since the onset of the credit crisis and during the European sovereign crisis.

The dependence value between banks in Europe and the United States is derived after calculating the joint default risk among all sample banks within each jurisdiction. The multivariate distribution (MGEV) of joint CDS spread movements of all sample banks in Europe and the United States is estimated separately before the magnitude of bilateral linkages between the banking sectors in Europe and the United States are determined. The dependence structure is derived using the same methodology as in Section A. Based on the joint changes in CDS spreads of European and U.S. banks, the bilateral dependence measure is derived.[45]

Figure 13.6: Dynamic Dependence Structure – Spillover between the U.S. and European Banking Sector (2007–2011).



This framework was also used to assess spillover effects of U.S. policy announcements during the credit crisis on banking sector risks in both the United States and Europe.

---

[44] This measure is better suited to analyzing joint tail risks, because it links the univariate marginal distributions of multiple asset prices in a way that formally captures both their linear and non-linear dependence over time.

[45] Coles, S. G., Heffernan, J. and J. A. Tawn, 1999, "Dependence Measures for Extreme Value Analyses," *Extremes*, Vol. 2, pp. 339–65. Poon, S.-H., Rockinger, M. and J. Tawn, 2003, "Extreme Value Dependence in Financial Markets: Diagnostics, Models, and Financial Implications," *The Review of Financial Studies*, Vol. 17, No. 2, pp. 581–610. Jobst, A. A., 2007, "Operational Risk – The Sting is Still in the Tail But the Poison Depends on the Dose," Journal of Operational Risk, Vol. 2, No. 2 (Summer), 1–56.

To this effect, the DDS model is adapted to an event study framework using a sliding window of three months and daily updating to examine changes in the dependence measure in both banking sectors in response to significant U.S. policy announcements.

Examining the dependence at varying magnitudes of shocks over time illustrates the dynamic characteristics of potential tail risk between the United States and Europe. The analysis finds that cross-border linkages of banking sector risk have increased dramatically during the credit crisis, especially for very large increases of default risk until mid-2009. Until the end of 2009, the potential for spillovers was also more pronounced for declines in market-perceived solvency risk (i.e., lower CDS spreads) – but such declines were much smaller than increases during 2009.

After having waned over the first half of 2010 (see Section A above), spillover risks reemerged in the wake of persistent turmoil in the European periphery. Spillover effects from solvency shocks in the banking sector stabilized briefly during mid-2010 amid lower levels of systemic risk. While system-wide default risk in the U.S. banking sector appears to have leveled off over time, during the last months of 2010, however, cross-border linkages to European peers exhibit growing susceptibility to common shocks and almost reached credit crisis levels in January 2011.