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Global Financial Stability Report

Grappling with Crisis Legacies

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PREFACE

The *Global Financial Stability Report* (GFSR) assesses key risks facing the global financial system with a view to identifying those that represent systemic vulnerabilities. In normal times, the report seeks to play a role in preventing crises by highlighting policies that may mitigate systemic risks, thereby contributing to global financial stability and the sustained economic growth of the IMF's member countries. Against the background of the weak economic recovery and slippage in global financial stability, the current report highlights how risks have changed over the last six months, traces the sources and channels of financial distress, with an emphasis on sovereign vulnerabilities and contagion risks, notes the pressures arising from growing investor search for yield, discusses the implications of changes to global asset allocation patterns, and provides considerations on operationalizing macroprudential policies.

The analysis in this report has been coordinated by the Monetary and Capital Markets (MCM) Department under the general direction of José Viñals, Financial Counsellor and Director. The project has been directed by Jan Brockmeijer and Robert Sheehy, both Deputy Directors; Peter Dattels and Laura Kodres, Assistant Directors; and Matthew Jones and Chris Walker, Deputy Division Chiefs. It has benefited from comments and suggestions from the senior staff in the MCM department.

Contributors to this report also include Ruchir Agarwal, Sergei Antoshin, Serkan Arslanalp, Jaromír Beneš, Ken Chikada, Julian Chow, Francesco Columba, Alejo Costa, R. Sean Craig, Reinout De Bock, Morgane de Tollenaere, Alexander Demyanets, Joseph Di Censo, Michaela Erbenova, Luc Everaert, Pascal Farahmand, Vincenzo Guzzo, Kristian Hartelius, Sanjay Hazarika, Cheng Hoon Lim, Changchun Hua, Anna Ilyina, Gregorio Impavido, Silvia Iorgova, Michael Kamya, William Kerry, Peter Lindner, Estelle Xue Liu, Yinqiu Lu, Kasper Lund-Jensen, Rebecca McCaughrin, André Meier, Paul Mills, Srobona Mitra, Aditya Narain, Erlend Nier, Mohamed Norat, S. Erik Oppers, Samer Saab, Marta Sánchez Saché, Christian Schmieder, Tiago Severo, Tao Sun, Narayan Suryakumar, Takahiro Tsuda, Han van der Hoorn, and Ann-Margret Westin. Ivailo Arsov, Martin Edmonds, Oksana Khadarina, and Yoon Sook Kim provided analytical support. Gerald Gloria, Nirmaleen Jayawardane, Juan Rigat, and Ramanjeet Singh were responsible for word processing. Joanne Blake and Gregg Forte, of the External Relations Department, and Florian Gimbel, of MCM, edited the manuscript. The External Relations Department coordinated production of the publication.

This particular issue draws, in part, on a series of discussions with banks, clearing organizations, securities firms, asset management companies, hedge funds, standards setters, financial consultants, central bank reserve managers, sovereign wealth funds, and academic researchers. The report reflects information available up to August 31, 2011.

The report benefited from comments and suggestions from staff in other IMF departments, as well as from Executive Directors following their discussion of the GFSR on August 31, 2011. However, the analysis and policy considerations are those of the contributing staff and should not be attributed to the Executive Directors, their national authorities, or the IMF.

The following symbols have been used throughout this volume:

. . . to indicate that data are not available;

— to indicate that the figure is zero or less than half the final digit shown, or that the item does not exist;

– between years or months (for example, 2008–09 or January–June) to indicate the years or months covered, including the beginning and ending years or months;

/ between years (for example, 2008/09) to indicate a fiscal or financial year.

"Billion" means a thousand million; "trillion" means a thousand billion.

"Basis points" refer to hundredths of 1 percentage point (for example, 25 basis points are equivalent to 1/4 of 1 percentage point).

"n.a." means not applicable.

Minor discrepancies between constituent figures and totals are due to rounding.

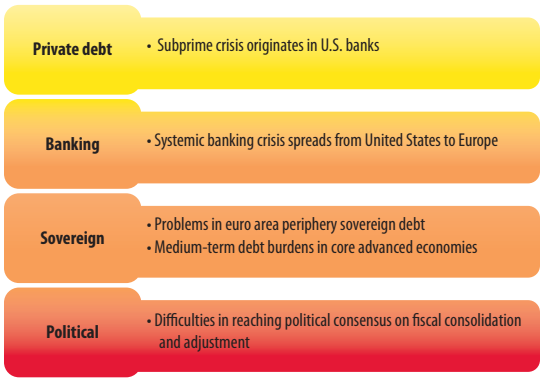
As used in this volume the term "country" does not in all cases refer to a territorial entity that is a state as understood by international law and practice. As used here, the term also covers some territorial entities that are not states but for which statistical data are maintained on a separate and independent basis.

The boundaries, colors, denominations, and other information shown on the maps do not imply, on the part of the International Monetary Fund, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.

EXECUTIVE SUMMARY

Financial stability risks have increased substantially over the past few months. Weaker growth prospects adversely affect both public and private balance sheets and heighten the challenge of coping with heavy debt burdens. Public balance sheets in many advanced economies are highly vulnerable to rising financing costs, in part owing to the transfer of private risk to the public sector. Strained public finances force policymakers to exercise particular care in the use of fiscal policy to support economic activity, while monetary policy has only limited room to provide additional stimulus. Against this backdrop, the crisis—now in its fifth year—has moved into a new, more political phase (Figure 1.1). In the euro area, important steps have been taken to address current problems, but political differences *within* economies undergoing adjustment and *among* economies providing support have impeded achievement of a lasting solution. Meanwhile, the United States is faced with growing doubts over the ability of the political process to achieve a necessary consensus regarding medium-term fiscal adjustment, which is critically important for global stability. As political leaders in these advanced economies have not yet commanded broad political support for sufficiently strengthening macro-financial stability and for implementing growth-enhancing reforms, markets have begun to question their ability to take needed actions. This environment of financial and political weakness elevates concerns about default risk and demands a coherent strategy to address contagion and strengthen financial systems.

Figure 1.1. Phases of the Crisis



Indeed, a series of shocks have recently buffeted the global financial system: fresh market turbulence emanating from the euro area periphery, the credit downgrade of the United States, and signs of an economic slowdown. In the euro area, sovereign pressures threaten to reignite an adverse feedback loop between the banking system and the real economy. The euro area sovereign credit strain from high-spread countries is estimated to have had a direct impact of about €200 billion on banks in the European Union since the outbreak of the sovereign debt crisis in 2010. This estimate does not measure the capital needs of banks, which would require a full assessment of bank balance sheets and income positions. Rather, it seeks to approximate the increase in sovereign credit risk experienced by banks over the past two years. These effects are amplified through the network of highly interconnected and leveraged financial institutions; when including interbank exposures to the same countries, the size of spillovers increases by about one half. Banks in some economies have already lost access to private funding markets. This raises the risk of more severe deleveraging, credit contraction, and economic drag unless adequate actions are taken to deal with the sources of sovereign risk—through credible fiscal consolidation strategies—and to address the potential consequences for the financial system—through enhancing the robustness of banks.

This *Global Financial Stability Report* cautions that low policy rates, although necessary under current conditions, can carry longer-term threats to financial stability. With growth remaining sluggish in the advanced economies, low rates are appropriate as a natural policy response to weak economic activity. Nevertheless, in many advanced economies some sectors are still trapped in the repair-and-recovery

phase of the credit cycle because balance sheet repair has been incomplete, while a search for yield is pushing some other segments to become more leveraged and hence vulnerable again. Moreover, low rates are diverting credit creation into more opaque channels, such as the shadow banking system. These conditions increase the potential for a sharper and more powerful turn in the credit cycle, risking greater deterioration in asset quality in the event of new shocks. Stepped-up balance sheet repair and appropriate macroprudential policies can help contain these risks.

Emerging market economies are at a more advanced phase in the credit cycle. Brighter growth prospects and stronger fundamentals, combined with low interest rates in advanced economies, have been attracting capital inflows. These flows have helped to fuel expansions in domestic liquidity and credit, boosting balance sheet leverage and asset prices. Especially where domestic policies are loose, the result could be overheating pressures, a gradual buildup of financial imbalances, and a deterioration in credit quality, as nonperforming loans are projected to increase significantly in some regions. At the same time, emerging markets face the risk of sharp reversals prompted by weaker global growth, sudden capital outflows, or a rise in funding costs that could weaken domestic banks. This report finds that the capital adequacy of banks in emerging markets could be reduced by up to 6 percentage points in a severe scenario combining several shocks. Banks in Latin America are more vulnerable to terms-of-trade shocks, while banks in Asia and emerging Europe are more sensitive to increases in funding costs.

Risks are elevated, and time is running out to tackle vulnerabilities that threaten the global financial system and the ongoing economic recovery. The priorities in advanced economies are to address the legacy of the crisis and conclude financial regulatory reforms as soon as possible in order to improve the resilience of the system. Emerging markets must limit the buildup of financial imbalances while laying the foundations of a more robust financial framework. In particular:

- *Coherent policy solutions are needed to reduce sovereign risks in advanced economies and prevent contagion.* The euro area summit of July 21 and subsequent announcements by the European Central Bank are substantial steps to enhance the crisis management framework of the euro area. However, it is paramount to ensure swift implementation of the agreed steps and to consider further enhancements in the economic and financial governance framework of the euro area. The United States and Japan must address sovereign risk through strategies that consolidate fiscal policy over the medium term, particularly given the many adverse global economic and financial repercussions that would follow from failure to adequately deal with U.S. fiscal problems.
- *Credible efforts are required to strengthen the resilience of the financial system and guard against excesses.* Appropriate fiscal action, combined with measures to strengthen banks through balance sheet repair and adequate capital buffers, can help break the link between sovereign risk and banks. If a country's fiscal measures are successful in restoring the long-term sustainability of its public finances, its sovereign risk premium will come down, and this will reduce pressures on banks. Nevertheless, in view of the heightened risks and uncertainties—and the need to convince markets—some banks, especially those heavily reliant on wholesale funding and exposed to riskier public debt, may also need more capital. Additionally, the amount of new capital needed would also depend, in part, on the credibility of the macroeconomic policies pursued to address the roots of sovereign risk. Building capital buffers would also help support lending to the private sector. Weak banks would have to be either restructured or resolved. Any capital needs should be covered from private sources wherever possible, but in some cases public injections may be necessary and appropriate for viable banks. Stronger macroprudential measures may be required to contain risks associated with a prolonged period of low interest rates and credit cycle risks.
- *Emerging market policymakers need to guard against overheating and a buildup of financial imbalances through adequate macroeconomic and financial policies.* Stress tests show that there is a

case for further strengthening bank balance sheets across many emerging markets.

- *The financial reform agenda needs to be completed as soon as possible and implemented internationally in a consistent manner.* This includes the finalization of Basel III, the treatment of systemically important financial institutions, and addressing the challenges posed by the shadow banking sector.

Chapter 2 of this report, "Long-Term Investors and Their Asset Allocation: Where Are They Now?" looks at the forces driving the global asset allocations of long-term, real-money institutional investors and the potentially lasting effects of the crisis on their investment behavior. Public and private pension funds, insurance companies, and the asset managers who assist them are found to have altered their behavior during the crisis by pulling away from risky, illiquid assets. The chapter cautions that the generalized move to safer, more liquid securities may limit the stabilizing role that long-horizon investors can play in global markets.

The chapter finds an acceleration of the long-term trend toward emerging market assets. The main determinants are strong prospects for domestic economic growth and lower perceived country risk rather than interest rate differentials. Outflows from emerging market debt and equity funds could be large—in some cases larger than in the crisis itself—if the fundamental factors that drive these flows were to change. For these economies, that threat underscores the importance of policies aimed at maintaining strong and stable growth as well as financial system resiliency.

Chapter 3, "Toward Operationalizing Macroprudential Policies: When to Act?" searches for variables that can serve as indicators of systemic events. It finds that, among credit variables, annual growth of the credit-to-GDP ratio above 5 percentage points can signal increased risk of a financial crisis about two years in advance. This is especially so if credit includes direct cross-border loans from foreign financial institutions. Importantly, credit-based indicators are far more effective if combined with other variables, as this allows for a better understanding of the underlying cause of the increase in credit. This reduces the risk of inappropriate use of macroprudential policies when the expansion of credit is supporting healthy economic growth.

Lastly, the chapter sheds light on the application of policy instruments to mitigate the buildup of systemic risks. It examines how countercyclical capital buffers, a key macroprudential tool, can prevent destabilizing cycles. Interestingly, the ability of countercyclical capital requirements to mitigate systemic risk is unaffected by exchange rate regimes. This suggests that such a tool may be widely effective across a number of different types of economies. Overall, the chapter takes a step forward in the design and operation of macroprudential frameworks—a topic under intense discussion in many countries following the crisis.

CHAPTER 1

OVERCOMING POLITICAL RISKS AND CRISIS LEGACIES

Global Stability Assessment

For the first time since the October 2008* Global Financial Stability Report*, risks to global financial stability have increased (Figures 1.2 and 1.3), signaling a partial reversal in progress made over the past three years. The pace of the economic recovery has slowed, stalling progress in balance sheet repair in many advanced economies. Sovereign stress in the euro area has spilled over to banking systems, pushing up credit and market risks. Low interest rates could lead to excesses as the "search for yield" exacerbates the turn in the credit cycle, especially in emerging markets. Recent market turmoil suggests that investors are losing patience with the lack of momentum on financial repair and reform (Box 1.1). Policymakers need to accelerate actions to address long-standing financial weaknesses to ensure stability.

Overall *macroeconomic risks* have increased, reflecting a significant rise in sovereign vulnerabilities in advanced economies. The World Economic Outlook (WEO) baseline has shifted downward since April 2011, as the recovery appears more fragile. Weaker growth prospects and higher downside risks have contributed to concerns about debt sustainability, especially in the euro area periphery. Downgrades in sovereign ratings have spread beyond Greece, Ireland, and Portugal into the larger countries of the European periphery. Elsewhere, political risks to achieving medium-term fiscal adjustment have risen in a few advanced economies, notably the United States and Japan. Many sovereigns are vulnerable across multiple dimensions, raising market concerns about debt sustainability.

Note: This chapter was written by Peter Dattels (team leader), Sergei Antoshin, Serkan Arslanalp, Julian Chow, Sean Craig, Reinout De Bock, Alexander Demyanets, Morgane de Tollenaere, Joseph Di Censo, Martin Edmonds, Michaela Erbenova, Luc Everaert, Vincenzo Guzzo, Kristian Hartelius, Sanjay Hazarika, Changchun Hua, Anna Ilyina, Matthew Jones, William Kerry, Peter Lindner, Estelle Liu, Rebecca McCaughrin, André Meier, Paul Mills, Aditya Narain, Mohamed Norat, Samer Saab, Marta Sánchez Saché, Christian Schmieder, Narayan Suryakumar, Takahiro Tsuda, and Chris Walker.

Market and liquidity risks have risen, partly as a result of increased macroeconomic and sovereign risks. Higher volatility and rising yields on government bonds issued by countries on the periphery of the euro area are threatening a loss of investor confidence, weakening the investor base, and further driving up funding costs. As a result, public debt has become more difficult to finance, while higher sovereign risk premiums are disrupting bank funding markets. These concerns are eroding confidence in broader markets (Figure 1.4), reflected in a two-notch contraction in *risk appetite* since the April 2011 *Global Financial Stability Report* (GFSR).

Credit risks have risen as sovereign strains have spilled over to the banking system in the euro area. This GFSR assesses the impact of the rise in sovereign credit risk on the financial system and its negative implications for funding markets and for the flow of credit to the real economy.

Monetary and financial conditions remain unchanged from the April 2011 GFSR. This GFSR cautions that low interest rates, although necessary under current conditions, can carry longer-term financial stability risks. With balance sheet repair still incomplete in many advanced economies, and notwithstanding the overall pullback in risk appetite, the search for yield is pushing some market segments to become vulnerable and overleveraged, contributing to future risks.

Emerging markets risks have increased. Rapid domestic credit growth, balance sheet releveraging, and rising asset prices may ultimately lead to deteriorating bank asset quality in emerging markets as the credit cycle matures. At the same time, emerging markets remain vulnerable to external shocks. The analysis in this report reveals that a sudden stop of capital flows coupled with a rise in funding costs and a fall in global growth could strain capitalization in emerging market banks.

Deep-seated challenges remain, and rapid progress is needed to increase financial system robustness. The economic and financial context for fiscal adjustment and

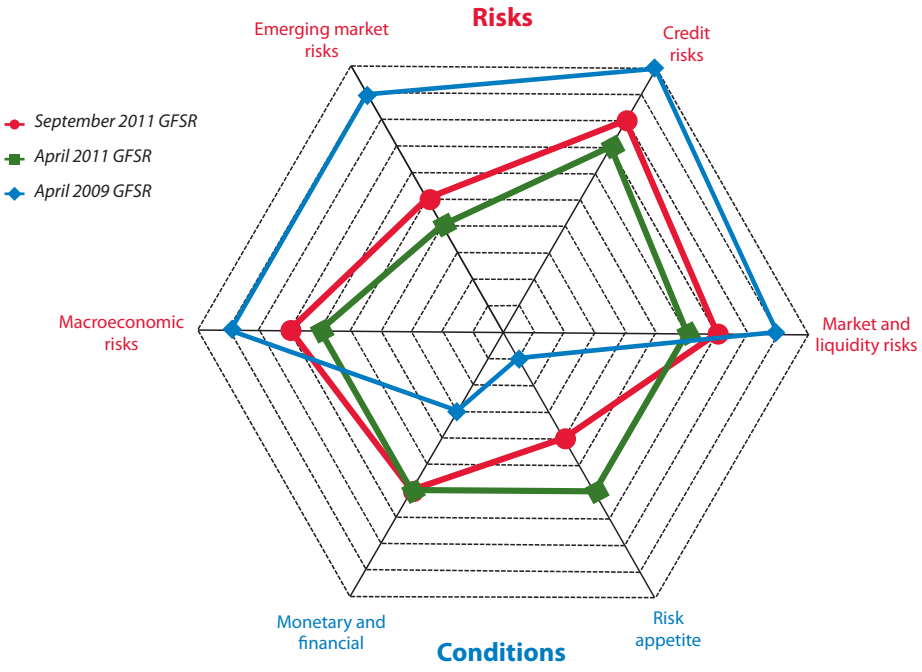
reducing bank risks is daunting. First, most advanced economies are facing a combination of relatively low inflation and subdued real growth. This limits the scope for growing the denominator of the debt-to-GDP ratio and highlights the importance of structural measures to raise potential growth rates. Second, in many countries, the peak in sovereign debt burdens coincides with that of private debt burdens (Table 1.1). The consequence is likely to be a prolonged period of economy-wide deleveraging. Third, bank balance sheets are more extended, and though some repair has occurred, they remain highly leveraged and vulnerable to both economic and funding shocks. Fourth, cross-border dimensions increase the vulnerability of global financial stability to shocks, making the system more fragile and subject to contagion risks. Fifth, and perhaps most crucially, the policy tools available in most advanced economies are geared to combating temporary liquidity shocks rather than tackling concerns about solvency. The result is that balance sheets have not been "cured," and the financial system remains highly vulnerable to sovereign risks. As discussed in the final section of this chapter, financial stability requires addressing these underlying vulnerabilities, mitigating the risks of contagion and spillovers, raising the capital buffers in banks, and completing the financial reform agenda.

Sovereign Vulnerabilities and Contagion Risks

Sovereign balance sheets remain fragile in a number of advanced economies despite steps toward fiscal consolidation. The lack of sufficient political support for medium-term fiscal adjustment and growth-enhancing reforms worsens funding pressures for sovereigns amidst a softer growth outlook. These pressures increase the risk that the debt dynamics of vulnerable sovereigns will slide into a spiral of deterioration in the absence of a coherent policy framework and adequate backstops to prevent the spread of contagion.

The spillover of sovereign risks to the banking sector has put funding strains on many banks operating in the euro area and depressed their market capitalization. Analysis quantifies the substantial impact that the spillovers from high-spread euro area sovereigns have had on the European banking systems and that help explain current levels of market

Figure 1.2. Global Financial Stabillity Map

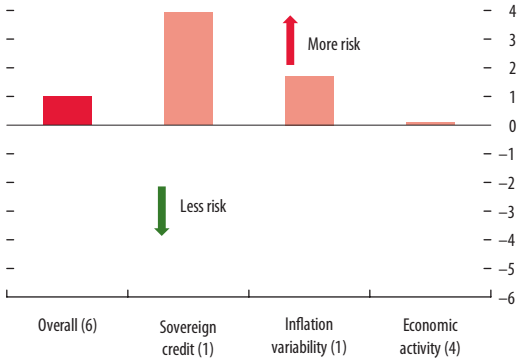


Source: IMF staff estimates.
Note: Away from center signifies higher risks, easier monetary and financial conditions, or higher risk appetite.

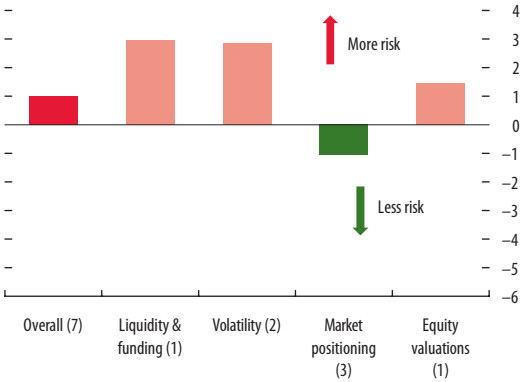
Figure 1.3. Global Financial Stability Map: Assessment of Risks and Conditions

(In notch changes since the April 2011 GFSR)

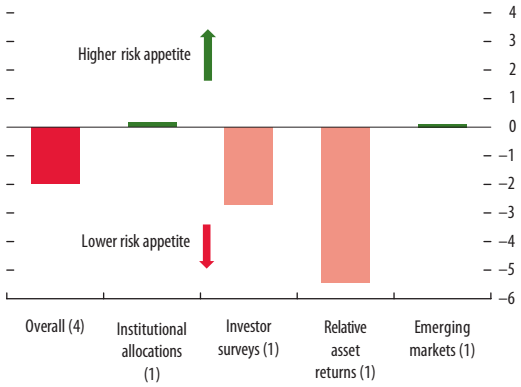
Macroeconomic risks rose, reflecting an increase in sovereign risk in advanced economies, and unexpected weakness in economic activity.



Market and liquidity risks also rose, as greater volatility led to heightened uncertainty about future funding conditions.

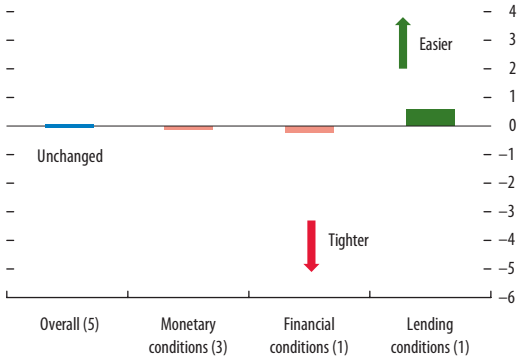


Risk appetite dropped, prompting investors to reduce exposure to sovereign and macroeconomic risks.

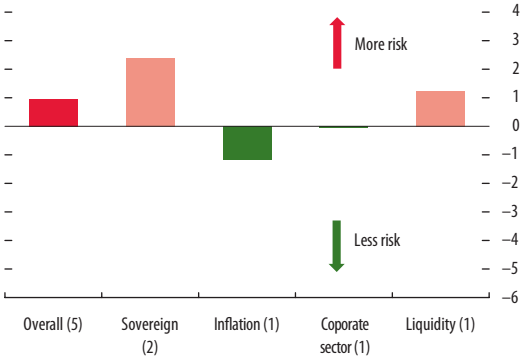


Credit risk rose, as concern over banks' sovereign exposures drove up market measures of contagion risk.

Monetary and financial conditions were broadly unchanged, with interest rates in advanced economies remaining near record lows…



…pushing investors into a search for yield that has contributed to strong capital inflows and high credit growth in EMs, raising *emerging market risks*.



Source: IMF staff estimates.

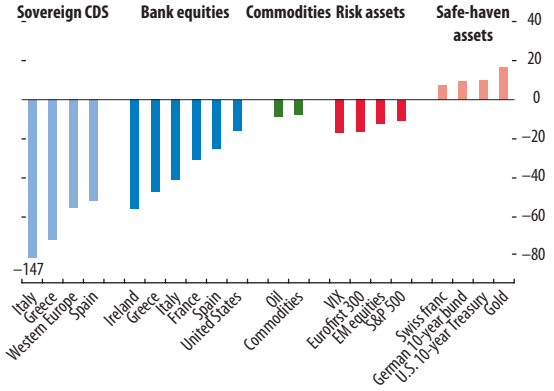
Note: Changes in risks and conditions are based on a range of indicators, complemented with IMF staff judgment (see the April 2010 GFSR, especially Annex 1.1, and Dattels and others, 2010, for a description of the methodology underlying the Global Financial Stability Map). Overall notch changes are the simple average of notch changes in individual indicators. The number next to each legend indicates the number of individual indicators within each subcategory of risks and conditions. For lending standards, positive values represent slower pace of tightening or faster easing.

stress.[1] These effects are amplified through the network of highly interconnected and leveraged financial institutions. The impact of these spillovers has been greatest on the most exposed banks in high-spread euro area countries. The disruption to funding markets could spread further, which would increase deleveraging pressures on banks and reduce credit growth in the most affected economies, reigniting a negative feedback loop with the real economy.

Credible efforts are required to strengthen the resilience of the financial system. Appropriate fiscal action, combined with bank balance sheet repair and adequate levels of capital, can help break the link between sovereign risk and banks. Weak banks need to be restructured and where necessary resolved. If private capital is not available and national public balance sheets have no spare capacity, EU-wide public backstops for banks should be used.

Figure 1.4. Asset Price Performance since the April 2011 GFSR

(In percent; VIX in percentage points; VIX and sovereign CDS are inverted)



Sources: Bloomberg L.P.; and IMF staff estimates.
Note: CDS = credit default swap; VIX = implied volatility index on S&P 500 index options; and EM = emerging market.

The crisis legacy has left public balance sheets vulnerable.

After four years of financial crisis, public balance sheets have been saddled with onerous debt burdens and sharply higher funding needs (Table 1.2). Lower tax revenue, weaker growth prospects, and large-scale support for ailing financial institutions have driven public finances into precarious territory. In many cases, these challenges have been added to a legacy of fiscal irresponsibility, as some governments lived beyond their means during more benign times. Policymakers in many advanced economies have begun to address these challenges by tightening the fiscal stance and laying out multiyear plans for deficit reduction. Indeed, as described in the IMF's September 2011 *Fiscal Monitor*, progress has been substantial in a few cases, notably in parts of the European Union.

Despite progress toward fiscal consolidation, policymakers and political leaders have not yet commanded broad political support for medium-term fiscal adjustment and growth-enhancing reforms. Some countries, notably Japan and the United States, need to formulate and implement credible medium-term plans to address looming fiscal challenges. At the same time, a more fragile growth outlook and deteriorating market sentiment over recent months have increased market pressures on sovereigns to adjust further, just to achieve their original targets.[2]

Markets have reacted to increased risks to policy implementation and a weaker growth outlook with higher sovereign risk premiums and successive rating downgrades or negative outlooks. Some sovereigns find themselves with challenges across multiple dimensions, with weak balance sheets increasing funding pressures (Figure 1.5). These sovereigns are especially prone to periodic bouts of financial market volatility, as changing fundamentals or political developments can dramatically shift the investor base and their perceptions about debt sustainability.

The recent political brinksmanship over raising the U.S. debt ceiling created significant market volatility.

The U.S. federal debt ceiling has been in place for several decades, but its nominal nature has

[1]The set of high-spread euro area countries is the same as that used in the April 2011 GFSR (Belgium, Greece, Ireland, Italy, Portugal, and Spain). This diverse group includes program and nonprogram countries and wide differences in debt burden indicators, as shown by Tables 1.1 and 1.2. The grouping reflects the market pressures that governments in these countries have faced (as measured by bond spreads) and is not an assessment of their sovereign and other economic fundamentals.

[2]For a more detailed analysis, see the IMF's *Fiscal Monitor*, September 2011.

Table 1.1. Indebtedness and Leverage in Selected Advanced Economies[1]
(Percent of 2011 GDP except as noted)

	United States	Japan	United Kingdom	Canada	Euro area	Belgium	France	Germany	Greece	Ireland	Italy	Portugal	Spain
Government gross debt, 2011[2]	100	233	81	84	89	95	87	83	166	109	121	106	67
Government net debt, 2011[2,3]	73	131	73	35	69	80	81	57	n.a.	99	100	102	56
Primary balance, 2011[2]	-8.0	-8.9	-5.6	-3.7	-1.5	-0.3	-3.4	0.4	-1.3	-6.8	0.5	-1.9	-4.4
Households' gross debt[4]	92	77	101	n.a.	70	53	61	60	71	123	50	106	87
Households' net debt[4,5]	-232	-236	-184	n.a.	-126	-195	-137	-132	-57	-67	-178	-123	-78
Nonfinancial corporates' gross debt[4]	90	143	118	n.a.	138	175	150	80	74	245	110	149	192
Nonfinancial corporates' debt over equity (percent)	92	181	83	70	106	48	69	92	182	90	125	136	134
Financial institutions' gross debt[4]	94	188	547	n.a.	143	112	151	98	22	689	96	61	111
Bank leverage[6]	12	24	24	18	26	30	26	32	17	18	20	17	19
Bank claims on public sector[4]	8	80	9	19	n.a.	23	17	23	28	25	32	24	24
Total economy gross external liabilities[4,7]	151	67	607	98	169	390	264	200	202	1,680	140	284	212
Total economy net external liabilities[4,7]	16	-54	11	12	13	-40	10	-41	104	98	26	106	88
Government debt held abroad[8]	30	15	19	16	25	58	50	41	91	61	51	53	28

Sources: Bank for International Settlements (BIS); Bloomberg, L.P.; EU Consolidated Banking Data; U.S. Federal Deposit Insurance Corporation; IMF, International Financial Statistics, Monetary and Financial Statistics, and World Economic Outlook databases; BIS-IMF-OECD-World Bank Joint External Debt Hub (JEDH); and IMF staff estimates.

[1]Cells shaded in red indicate a value in the top 25 percent of a pooled sample of all countries shown in the table from 1990 through 2009 (or longest sample available). Green shading indicates values in the bottom 50 percent, and yellow in the 50th to 75th percentile. The sample for bank leverage data starts in 2008 only.

[2]World Economic Outlook projections for 2011.

[3]Net general government debt is calculated as gross debt minus financial assets corresponding to debt instruments.

[4]Most recent data divided by annual GDP (projected for 2011). Nonfinancial corporates' gross debt includes intercompany loans and trade credit, and these can differ significantly across countries.

[5]Household net debt is calculated using financial assets and liabilities from a country's flow of funds data.

[6]Leverage is defined as the ratio of tangible assets to tangible common equity for domestic banks.

[7]Calculated from assets and liabilities reported in a country's international investment position.

[8]Most recent data for externally held general government debt (from JEDH) divided by 2011 GDP from WEO. Note that debt data from the JEDH are not comparable to WEO debt data when they are at market value.

Box 1.1. Market Confidence Deteriorates amid Policy Uncertainty

Recent market developments illustrate how political uncertainty and the perception of a weak policy response to stress can rapidly erode market confidence.

The failure to stem contagion risks and credibly address sovereign and banking system strains—assessed in detail in this GFSR—has led to a wide-scale pullback in risk assets, stoked fears of recession, and sent investors rushing into safe havens (first figure). Market volatility increased markedly beginning in mid-July. The main triggers appear to have been

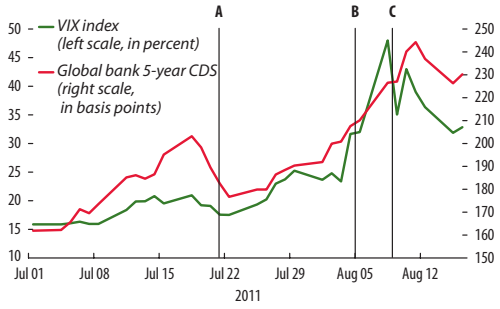
- the protracted impasse over the debt ceiling in the United States;
- S&P's subsequent downgrade of the U.S. sovereign credit rating;
- rising concerns about potential downgrades of European sovereigns still rated AAA; and
- renewed economic growth concerns.

Although the euro area summit of July 21 was an important step toward enhancing the crisis management framework, markets worried about the length of the political process required to implement the summit's decisions and whether the adopted solutions would be sufficient. The latest bout of market volatility has reminded some investors of the collapse in asset prices following the September 2008 Lehman Brothers bankruptcy. Although the current reaction has not been as severe or as widespread as it was after that event, risk perceptions are greater for European banks and sovereigns (second figure). There is a risk of a further deterioration if appropriate policies are not implemented.

As discussed in the main text, contagion has spread deeper into the euro area, highlighting the speed with which failure to address legacy problems and structural weaknesses can propel financial markets into a downward spiral. Spreads on CDS (and, to a lesser extent, on underlying debt) widened on high-spread sovereigns as well as on AAA-rated euro area credits. Sovereign strains spilled into those parts of the euro area banking system perceived to be heavily exposed to the euro area periphery, or to have a greater reliance on dollar or short-term funding, or to have an insufficient capital base. These strains have raised concern in some cases over

Note: Prepared by Kristian Hartelius, William Kerry, and Rebecca McCaughrin.

Recent Market Turbulence



Sources: Bloomberg L.P.; and IMF staff estimates.
Note: Asset-weighted average of individual bank credit default swaps.
Vertical lines:
A = EU summit.
B = S&P downgrade of U.S. government debt.
C = ECB resumes purchases of government debt.

bank capital cushions and increased bank funding costs. The sharp declines in bank equity prices prompted U.S. money funds to further reduce lending to European banks, leading to higher dollar funding costs for these banks and a widening of the dollar-euro basis spread. Euro area interbank financing conditions deteriorated amid rising counterparty concerns, pushing the Euribor-OIS spread to its widest level since April 2009 (third figure).

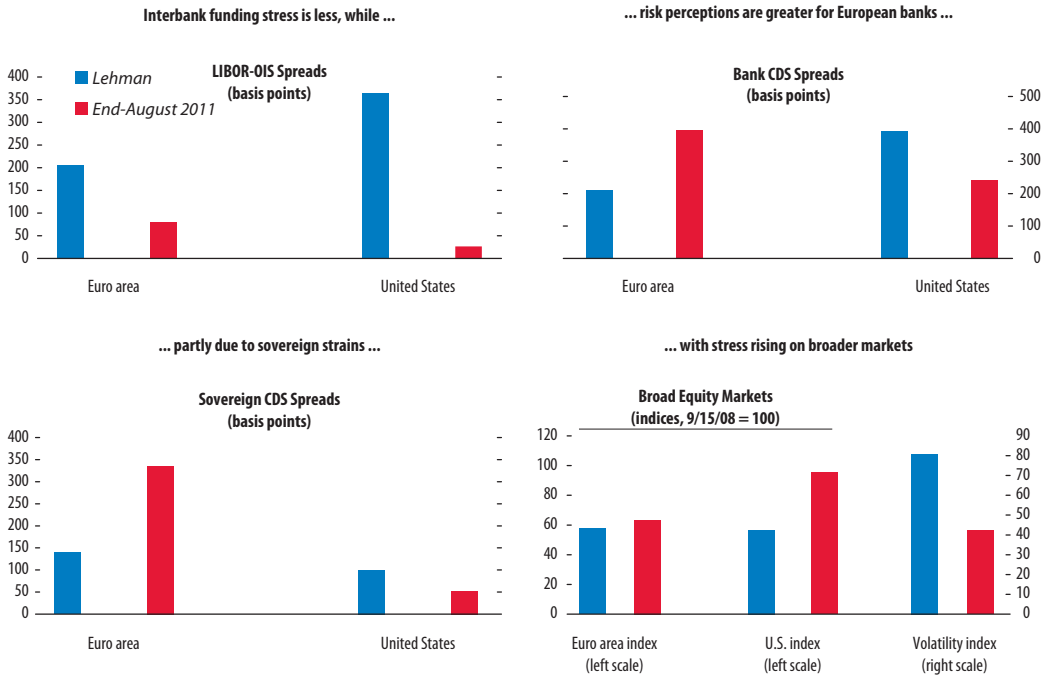
Increased and spreading volatility—exacerbated by tightening credit lines, increased margin requirements, and shallow summer liquidity conditions—led to a broader pullback in global risk assets (such as corporate and emerging market credit) and greater demand for traditional safe-haven assets (including gold, U.S. Treasuries, Japanese yen, Swiss francs, and Singapore dollars). The fall in risk appetite, along with weaker growth prospects, drove U.S. real rates into negative territory and led to a sell-off in growth-sensitive equities and commodities.[1] Asset prices of U.S. banks were especially hard hit, as investors perceived some banks as having insufficient capital and funding bases, given their large portfolios of legacy mortgages and the weak economic outlook.

As market stress intensified, the European Central Bank (ECB) responded by extending purchases

[1]During a period of two weeks, $7.3 trillion in global equity market wealth was wiped out. In comparison, in the two weeks after the Lehman Brothers bankruptcy, global equity market wealth fell by $11 trillion.

Box 1.1 *(continued)*

What's Different after "Lehman"?



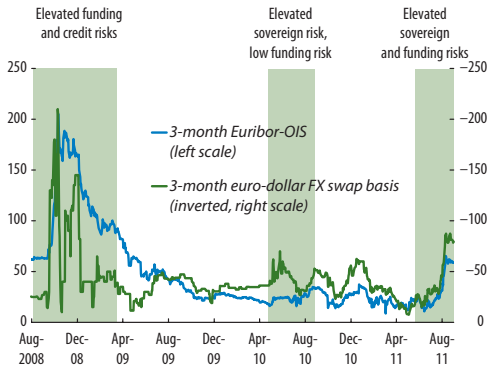
Sources: Bloomberg L.P.; and IMF staff estimates.
Note: Lehman Brothers declared bankruptcy on September 15, 2008.

under its Securities Market Programme to the government bonds of Italy and Spain and increasing its term liquidity provision. The Federal Reserve conditionally pledged to keep interest rates low and signaled a readiness to employ a range of tools; Swiss and Japanese authorities resumed intervention in the foreign exchange market; regulators instituted short-selling bans on selected European equities; and the Federal Reserve and major central banks announced coordinated dollar auctions. For now, these actions have helped to slow the downward spiral, but liquidity conditions are still tight, and sentiment remains fragile.

The latest bout of volatility demonstrates that high hurdles for debt rollover can telescope concerns over medium-term debt sustainability into more immediate sovereign funding stress (third figure). The episode also serves as a reminder that bank funding and capital constraints can generate deleveraging pressures and establish a negative feedback loop to the real economy. Until a sufficiently comprehensive strategy is in place to address sovereign contagion, bolster the resilience of the financial system, and reassure market participants of policymakers' commitment to preserving stability in the euro area, markets are likely to remain volatile.

Euro Area Funding and Dollar Liquidity Risks

(In basis points)



Sources: Bloomberg L.P.; and IMF staff estimates.

Table 1.2. Sovereign Debt: Market and Vulnerability Indicators

(Percent of 2011 projected GDP except as noted)

	Fiscal and Debt Fundamentals[1]			Financing Needs[5]		External Funding	Banking System Linkages			Sovereign Credit		Sovereign CDS
	Gross general government debt[2]	Net general government debt[3]	Primary balance[4]	Gross general government debt maturing plus budget deficit		General government debt held abroad[6]	Domestic depository institutions' claims on general government[7]		BIS reporting banks' consolidated international claims on public sector[8]	Rating/outlook (notches above speculative grade/outlook as of 8/31/11)[9]		Five-year (basis points) (as of 8/31/2011)
							Percent of 2011 GDP	Percent of depository institutions' consolidated assets				
	2011	2011	2011	2012	2013							
Australia	22.8	7.7	-3.4	5.1	4.3	9.6	2.2	1.2	2.6	9	Stable	69
Austria	72.3	52.5	-1.3	9.2	9.4	55.5	15.0	4.5	10.6	10	Stable	113
Belgium	94.6	79.9	-0.3	22.2	21.8	58.2	22.7	7.8	12.9	9	Negative	228
Canada	84.1	34.9	-3.7	18.6	17.3	16.2	18.5	9.9	3.1	10	Stable	n.a.
Czech Republic	41.1	n.a.	-2.7	11.7	12.1	11.2	16.6	14.1	3.3	6	Stable	107
Denmark	44.3	1.8	-2.6	10.8	10.1	17.9	14.7	3.7	4.7	10	Stable	98
Finland	50.2	-59.7	-1.5	8.3	8.0	39.1	6.0	2.3	8.9	10	Stable	65
France	86.9	81.0	-3.4	20.8	20.2	50.3	16.8	4.3	7.4	10	Stable	153
Germany	82.6	57.2	0.4	10.5	8.1	41.4	22.9	7.5	9.3	10	Stable	75
Greece	165.6	n.a.	-1.3	16.5	14.9	91.3	28.3	12.4	18.2	-8	Negative	2233
Ireland	109.3	98.8	-6.8	13.9	14.9	60.8	24.6	2.8	6.4	2	Negative	768
Italy	121.1	100.4	0.5	23.5	18.9	51.4	31.7	13.2	11.4	7	Negative	361
Japan	233.1	130.6	-8.9	58.6	53.6	15.1	80.2	24.3	1.4	7	Negative	104
Korea	32.0	30.8	3.3	1.0	-0.1	3.8	5.7	4.2	3.2	5	Stable	127
Netherlands	65.5	30.6	-2.2	16.0	16.4	37.9	13.5	3.6	7.0	10	Stable	78
New Zealand	35.3	7.8	n.a.	9.3	11.6	20.7	7.7	4.2	2.8	9	Negative	80
Norway	55.4	-161.0	9.3	-1.0	0.9	23.9	n.a.	n.a.	8.1	10	Stable	44
Portugal	106.0	101.8	-1.9	22.3	21.0	53.3	24.0	7.2	12.4	0	Negative	914
Slovak Republic	44.9	n.a.	-3.3	14.2	14.2	17.1	18.1	21.1	4.9	6	Stable	158
Slovenia	43.6	n.a.	-4.8	8.2	5.7	29.7	10.3	7.2	6.3	8	Negative	182
Spain	67.4	56.0	-4.4	20.6	19.4	28.4	24.2	7.4	6.2	8	Negative	357
Sweden	36.0	-20.8	0.3	3.6	0.5	12.6	6.4	2.4	4.0	10	Stable	52
United Kingdom	80.8	72.9	-5.6	14.7	13.3	18.7	8.9	2.0	2.2	10	Stable	75
United States	100.0	72.6	-8.0	30.4	29.1	29.6	7.7	5.4	3.4	9	Negative	50

Sources: Bank for International Settlements (BIS); Bloomberg, L.P.; IMF: International Financial Statistics database, Monetary and Financial Statistics database, World Economic Outlook database (WEO); BIS-IMF-OECD-World Bank Joint External Debt Hub (JEDH); and IMF staff estimates. Note that debt data from the JEDH are not comparable to WEO when they are at market value.

Based on projections for 2011 from the September 2011 World Economic Outlook (WEO). Please see the WEO for a summary of the policy assumptions. Debt data from the JEDH are not comparable to WEO debt data when they are at market value.

[1] As a percent of GDP projected for 2011.

[2] Gross general government debt consists of all liabilities that require future payment of interest and/or principal by the debtor to the creditor. This includes debt liabilities in the form of SDRs, currency and deposits, debt securities, loans, insurance, pensions and standardized guarantee schemes, and other accounts receivable.

[3] Net general government debt is calculated as gross debt minus financial assets corresponding to debt instruments. These financial assets are: monetary gold and SDRs, currency and deposits, debt securities, loans, insurance, pension, and standardized guarantee schemes, and other accounts receivable.

[4] Primary balance is general government primary net lending/borrowing balance. Data for Korea are for central government.

[5] As a proportion of WEO projected GDP for the year. Note that for Greece these numbers have been calculated assuming a successful debt exchange operation with 90 percent participation.

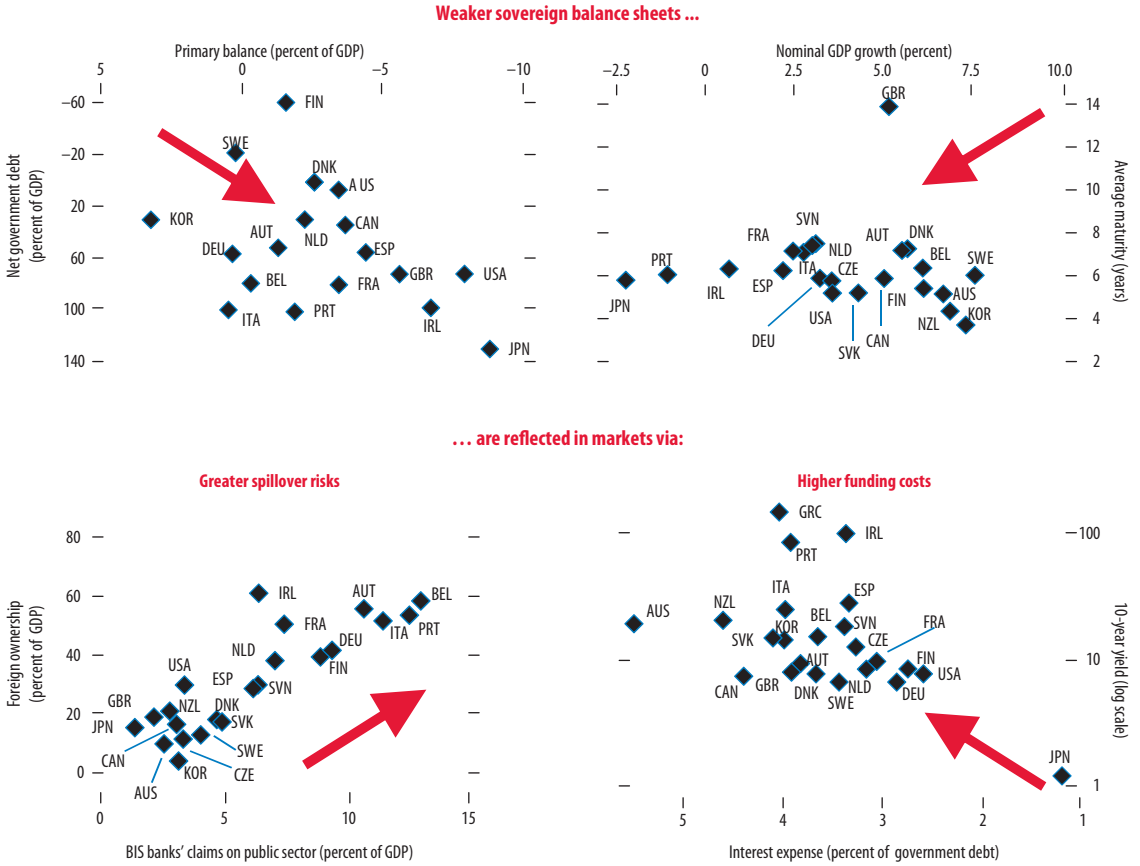
[6] Most recent data for externally held general government debt from the JEDH divided by projected 2011 GDP. Depending on the country, the JEDH reports debt at market or nominal values. New Zealand data are from Reserve Bank of New Zealand.

[7] Includes all claims of depository institutions (excluding the central bank) on general government. U.K. figures are for claims on the public sector. Data are for second quarter of 2011 or latest available.

[8] BIS reporting banks' international claims on the public sector on an immediate borrower basis as of December 2010, as a percentage of projected 2011 GDP.

[9] Based on average of long-term foreign currency debt ratings of Fitch, Moody's, and Standard & Poor's agencies, rounded down. Outlook is based on the most negative of the three agencies' ratings.

Figure 1.5. Sovereign Vulnerabilities and Market Pressures



Sources: Bank for International Settlements (BIS); IMF: International Financial Statistics database, World Economic Outlook database; BIS-IMF-OECD-World Bank Joint External Debt Hub; and IMF staff estimates.

Note: See Table 1.2 for a description of the variables. Average maturity and 10-year yield on government debt are from Bloomberg (7/25/2011). Nominal GDP growth is for 2011 based on WEO projections. Foreign ownership refers to the sovereign bond holders.

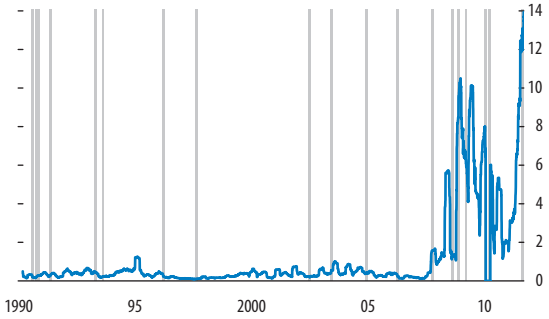
failed to provide any control over rising debt-to-GDP ratios driven by separate budgetary processes. Moreover, the unpredictable political process that accompanies increases in the debt ceiling erodes confidence in policymaking and triggers spurts of market volatility (Figure 1.6).[3] During the latest episode, rates on near-term Treasury bills and other money market instruments spiked; repo transaction volumes fell as corporations, money funds, and others shifted holdings into cash; the Treasury bond curve steepened sharply; sovereign credit default swap (CDS) spreads inverted as one-year rates reached record highs; and a flight to quality drove flows into alternative assets like gold, the Swiss franc, and foreign AAA-rated sovereign debt. (Box 1.2 discusses market indicators for assessing U.S. sovereign risk.)

Because challenges to achieving the longer-term sustainability of U.S. government debt remain unaddressed, they could potentially reignite sovereign risks, with important adverse market implications and global repercussions.

At the eleventh hour, U.S. policymakers agreed to raise the debt ceiling to a level adequate only to get past the November 2012 elections and cut the

[3]Since 1962, the U.S. Congress has approved a debt ceiling increase 74 times, including 11 times since 2002.

Figure 1.6. Historical Volatility in One-Month Treasury Bills during Debt Ceiling Negotiations
(In percent)



Sources: Bloomberg L.P.; and IMF staff estimates.
Note: Vertical lines mark dates of changes in debt ceiling.

deficit by an initial $917 billion, to be followed by at least $1.2 trillion of additional cuts over a 10-year period. The debt reduction plan marks an important step toward fiscal stabilization, but it does not put the United States on a sustainable fiscal trajectory. And although market pressures receded, the debt reduction plan was insufficient to avoid a (one-notch) downgrade of U.S. sovereign debt by Standard & Poor's. This, in turn, led to market fears that other important sovereigns could be downgraded, augmenting sovereign strains in the euro area.

While a one-notch downgrade of U.S. debt is likely to have only a limited long-term market impact, a larger or broader downgrade would have far more serious implications, adversely affecting global confidence. Possible channels and effects include:

- *Increased Treasury risk premiums.* Historical precedents in advanced economies indicate little sustained impact on yields following a downgrade (Figure 1.7).[4] Those data show that, in the case of a single-notch or even a two- or three-notch downgrade from AAA, yields rise marginally in the run-up to the downgrade but more than fully recover within a year. That pattern is most consistent in the case of a single-notch downgrade from AAA by only one credit rating agency (as was the case in the U.S. episode). Indeed, 10-year Treasury yields have fallen by roughly 50 basis points since S&P's downgrade. However, a more pronounced downgrade has historically had a more sustained impact, with government bond yields rising more sharply and for a longer period.
- *Loss of liquidity advantage.* U.S. Treasury securities were not unique in their top rating: a number of other sovereigns have equally high credit ratings. But what still sets Treasuries apart is their exceptionally high liquidity. A multinotch downgrade would likely erode that advantage.
- *Destabilizing impact on broader leveraged markets.* Given the widespread role that Treasuries play in financial transactions, further downgrades would likely prompt lenders to increase haircuts on repo positions, leading to a rise in margin calls. This could, in turn, lead to a round of deleveraging, with some impact on asset prices as some borrowers are forced to curtail positions financed with Treasuries as collateral.[5]
- *Forced asset sales.* Although most institutional investors are either free from ratings restrictions or have the flexibility to ease them, especially if the downgrade is small, a larger downgrade could lead to some forced sales of Treasuries.
- *Effects on other securities.* Further downgrades would likely erode the reserve status of the dollar; weaken counterparty confidence of large investors; and possibly lead to ratings downgrades on debt issued by other U.S. entities (especially Fannie Mae and Freddie Mac), municipalities, insurance companies, banks, and other financial institutions. This would likely be accompanied by repricing across a wide range of assets priced off the Treasury curve, further exacerbating collateral

[4]Since 1990, there have been roughly 70 sovereign downgrades by the top three rating agencies (Moody's, Fitch, and Standard & Poor's) across 12 countries. The downgrade episodes included in this analysis were Belgium (1998); Canada (1994–95); Finland (1990, 1992–93); Greece (1998, 2004, 2009–11); Ireland (2009–11); Italy (1991–93, 1995–96, 2004, 2006, 2011); Japan (1998, 2000–02, 2009–11); New Zealand (1991, 1998); Portugal (2005, 2009–11); Spain (1992, 2009–11); Sweden (1991–95); and the United States (2011). Episodes were based on changes (excluding warnings) in long-term debt ratings, and the impact was based on average changes in 10-year government bond yields over selected periods in each country.

[5]Nearly $4 trillion in U.S. government securities are used as collateral in repo agreements, futures, clearinghouses, and OTC derivatives. Prime brokers increased haircuts on Treasury securities from 0.25 percent to 3 percent in late 2008 after Lehman Brothers collapsed and the Reserve Primary Fund "broke the buck."

Box 1.2. How Concerned Are Markets about U.S. Sovereign Risks?

Although markets signaled increased concerns after the U.S. downgrade, they appear to remain confident that stress will be contained. This relatively sanguine view potentially creates a false sense of security: By reducing the urgency to act, it increases the potential for a negative credit event to have a significant adverse market reaction.

Financial markets can provide important signals on market concerns about sovereign risk. The figure in this box summarizes a set of indicators used by market participants to assess concerns about U.S. sovereign risks. None of the measures perfectly captures concerns: Other fundamental and technical factors can also affect market pricing, there is a wide range of potential scenarios and outcomes, and markets may overstate or understate risks. Still, taken together, the indicators may provide useful high-frequency signals on perceptions about sovereign risks. Overall, they suggest that market-implied U.S. sovereign risks have increased, but pricing is still below maximum levels despite a U.S. rating downgrade by Standard & Poor's, an increased potential for a further U.S. downgrade, increased concerns about sovereign debt risks globally, and limited progress in U.S. domestic debt consolidation.[1]

Some metrics in the figure that are signaling increased risks include nominal and real Treasury rates, swaps, and other rate curves which have steepened (though yields generally remain below historical averages), suggesting increased concerns about long-term debt consolidation.[2] Longer-dated swaption volatility is close to its highest level, as the shape of the curve has fluctuated more, reflecting concerns about a wider range of possible outcomes. At the same time, both near- and long-term CDS spreads have widened, suggesting increased demand for protection against default. The dollar has weakened against both the euro and a broad basket of currencies, and gold prices have continued to surge, suggesting some loss of confidence in the dollar's status as a reserve currency and concerns about external financing needs.

However, other markets are signaling more modest concerns. For example, 30-year swap spreads are not signaling extreme stress, even though they have tended to be well-correlated with CDS spreads and a steepening in the Treasury curve during spikes in sovereign risk; the spreads between U.S. Treasuries and German bunds are contained; and most funding market conditions paint a fairly benign picture.[3]

Other metrics underscore the U.S. Treasury market's relative resilience: Auctions have been well received, prime brokers have not increased haircuts, repo volumes normalized following a brief period of volatility during the debt ceiling impasse, major institutions have not substantially altered their holdings of Treasuries relative to cash or other assets, and liquidity in the Treasury market has not been impaired.

A number of financial market issues and considerations may be limiting the stress arising from sovereign risk concerns:

- *Countervailing pressures.* Factors such as flight-to-quality flows generated by concerns over growth prospects and European sovereign risks are considered more significant market drivers.

Note: Prepared by Rebecca McCaughrin.

[1]Granted, changes in market pricing reflect information other than sovereign risk, such as changes in expectations on interest rates, growth, and inflation as well as technical factors like market liquidity, hedging activity, and supply-demand dynamics. For instance, renewed concerns about downside risks to economic growth and a reduction in interest rate expectations may be obfuscating or dominating market concerns about sovereign risks.

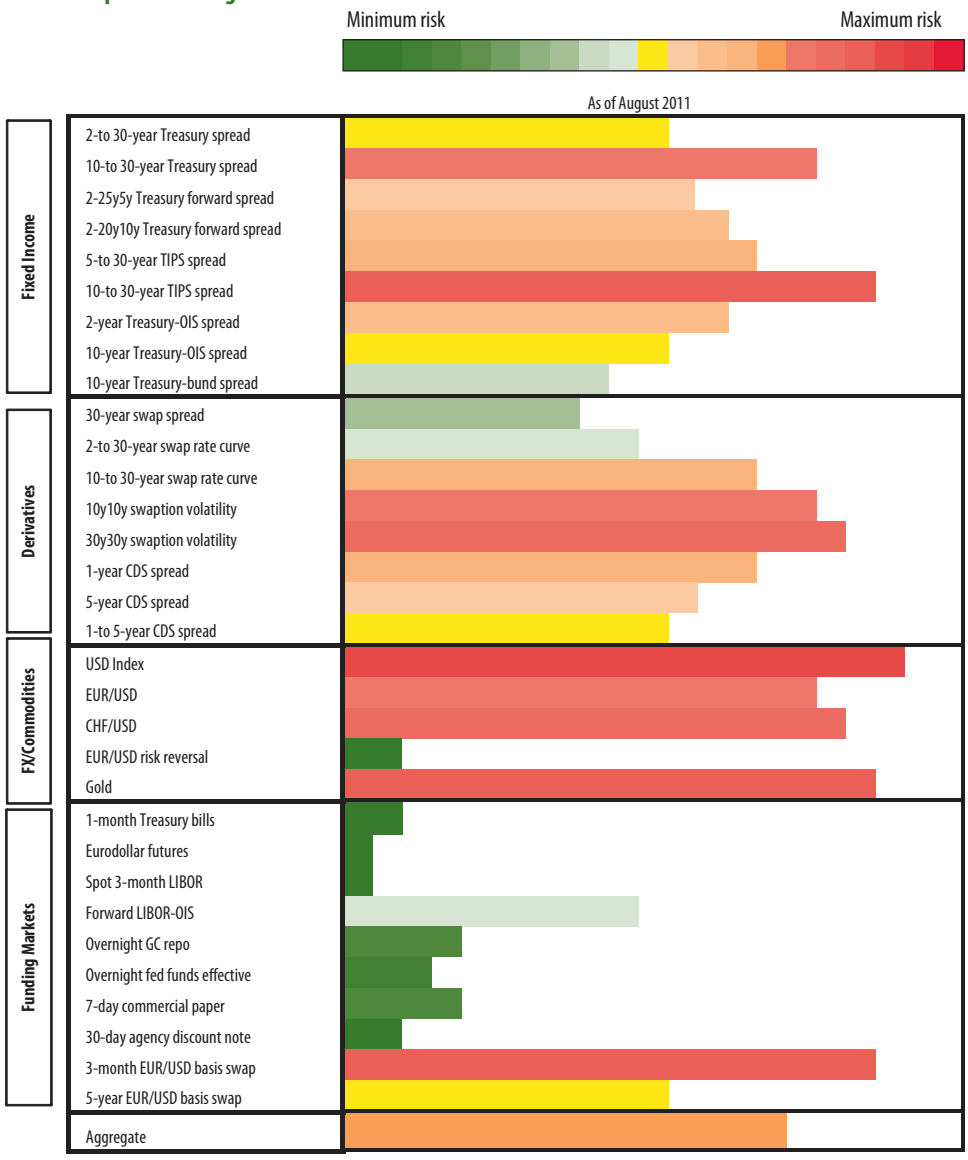
[2]Curvature depends on the market's horizon. A steepening may reflect market concerns about debt deterioration in the longer run, whereas a flattening may suggest more immediate concerns and the expectation that a missed coupon payment in the near term will prompt more urgent action on fiscal reform in the longer run. With the increase in the debt ceiling, markets are now generally concerned that longer-term debt consolidation will be further delayed.

[3]Interest rate swap spreads are an indicator of the relative risk of private versus government long-term bonds. The interest rate swap market is very liquid, and, as a derivatives market, it is not affected by the supply-demand imbalances of the Treasury market.

[4]Apart from two special episodes, one in 1933 and the other in 1979. The United States defaulted in 1933 when it left the gold standard and canceled bondholders' option to be repaid in gold. In April–May 1979, there was a technical default when payments on maturing Treasury bills were delayed by a processing glitch (see Zivney and Marcus, 1989).

Box 1.2 *(continued)*

Market-Implied Sovereign Risk Monitor



Sources: Bloomberg L.P.; and IMF staff estimates.

Note: The figure represents the average pricing of each underlying indicator during August 2011 compared with maximum and minimum daily levels prevailing over the period January 1, 2009, to the present. January 1, 2009, roughly marks the point at which the financial crisis started to morph into more of a sovereign credit crisis and thus provides a useful basis for comparison. Green signifies that current pricing is closest to the minimum prevailing level or relative complacency on fiscal risks; red signifies proximity to the maximum prevailing level or increased alarm. The aggregate measure is a simple, unweighted average of the underlying market indicators.

Box 1.2 *(continued)*

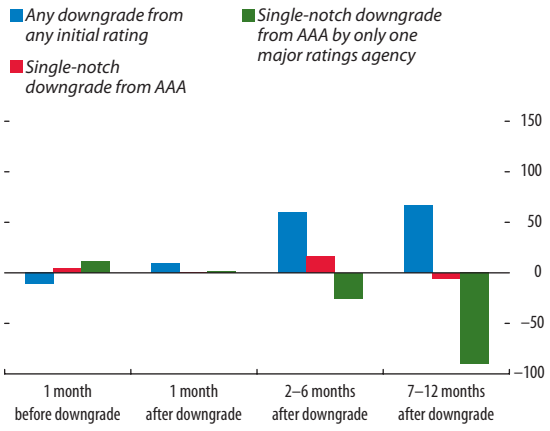
- *Past is prologue.* Many take comfort from the fact that the U.S. government has never defaulted.[4] Even in the event of a cash crunch, most expect the U.S. Treasury to prioritize payments.
- *A lack of substitutable assets.* Market participants are confident that no other market is sufficiently deep and liquid to supplant the U.S. Treasury market, which suggests that Treasury investors are a captive investor base.
- *The effect of haircuts.* Increased haircuts may (perversely) increase demand for Treasuries. Since Treasury securities are used as collateral to meet margin requirements in a wide range of transactions, some market participants argue that a downgrade would (paradoxically) increase demand for Treasuries as margin calls increase.
- *Flexibility in mandates.* Market participants argue that rating-constrained investors would likely adjust their mandates to allow them to purchase lower-rated debt.
- *Extraordinary policy actions.* In the event of increased instability in the Treasury market, market participants expect the Federal Reserve to act as a backstop through another round of quantitative easing or some other unconventional measure.

In sum, while market pricing suggests increased concerns about the buildup of fiscal risks, overall signals are still fairly mixed and are below maximum levels.

The policy risk: The lack of a strong market signal may create a false sense of security, thereby reducing the urgency to act and increasing the potential for a negative credit event to produce a significant adverse market reaction. As the main text indicates, a multinotch downgrade or default could increase term premiums, lead to a loss in liquidity, and—given the widespread role that Treasuries play in the pricing and collateralization of other assets—have a destabilizing impact on broader markets and market sentiment.

mark-downs and haircut increases. Additional downgrades would also likely raise concerns about potential downgrades of other AAA-rated sovereigns. To some extent, these fears are already materializing, with spreads widening on a number of highly rated European sovereign debt and CDS credits.

Figure 1.7. Change in Advanced Economy Government Bond Yields around Sovereign Debt Downgrades
(In basis points)

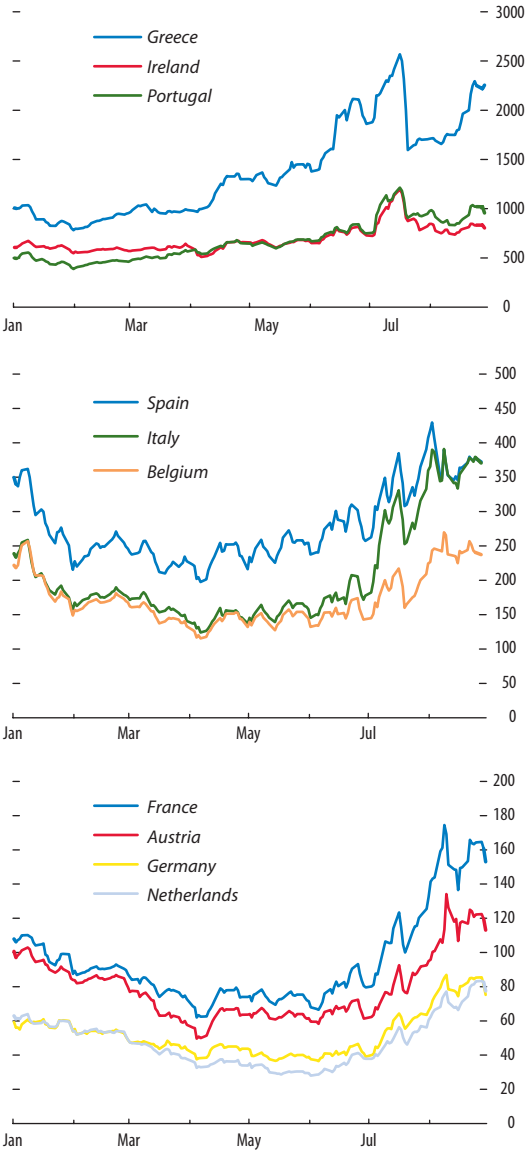


Sources: Bloomberg L.P.; Haver Analytics; and IMF staff estimates.

Parts of the euro area remain vulnerable to contagion and weakening fundamentals and to the risk of multiple equilibria.

The vulnerabilities highlighted earlier have been a key focus in euro area sovereign bond markets in the past six months. Spreads have climbed to record levels (Figure 1.8) as political differences *within* economies undergoing adjustment and *among* economies providing support have complicated the task of achieving a durable solution. Investors fear that the voluntary private sector participation in debt restructuring that is now envisaged in Greece could set a precedent for other program countries. Difficult political dynamics and increasing concerns about the growth outlook have also raised uncertainty about broader fiscal adjustment in

Figure 1.8. Developments in Sovereign Credit Default Swap Spreads, 2011
(Five-year tenors, basis points)



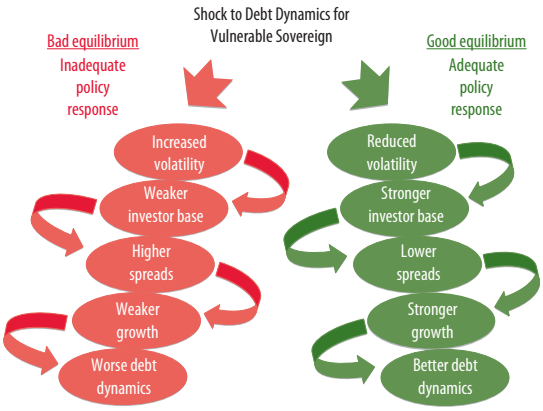
Source: Bloomberg L.P.

Italy. Given the systemic size of the bond markets in Italy and the sovereign funding needs there, these risks have become key drivers of market conditions, increasing the potential for spillovers across different asset markets.

With fragile balance sheets and debt sustainability influenced heavily by expectations, debt markets can become subject to multiple equilibria. Sovereigns with major vulnerabilities are prone to a sudden loss of investor confidence in their debt sustainability if fundamentals deteriorate sharply. This can result in higher volatility, which would erode the demand for their bonds and weaken their investor base, driving up funding costs for themselves and their banks and potentially choking off economic activity (Figure 1.9). Sovereigns that are unable to mount a credible policy response in the face of such challenges can become mired in a bad equilibrium of steadily deteriorating debt dynamics.

The recent turmoil has been concentrated in European sovereign debt markets. While the euro area greatly benefits its members by broadening and deepening the degree of financial integration across the region, the extensive cross-border bank and fund holdings of sovereign debt in the euro area have facilitated the rapid transmission of shocks across financial markets. The threshold for cross-border asset reallocations is also lowered because domestic savers can now choose from a large stock of high-quality assets in other parts of the area without incurring exchange rate risk.

Figure 1.9. Debt Dynamics

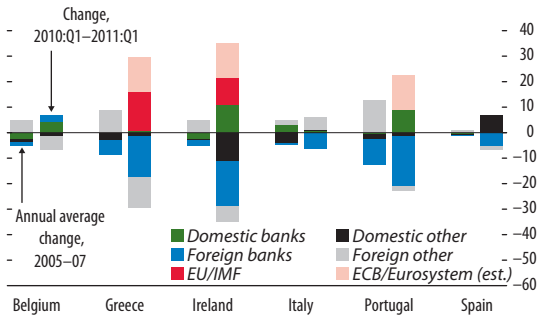


Recent developments in the wider euro area government bond market underscore investor sensitivities.

The stability of the investor base has been a particularly critical determinant of the recent debt dynamics in the euro area. For the program countries, the hollowing out of the investor base has been a significant factor in the eventual cutoff from funding markets (Figure 1.10). Over the past year, foreign banks have reduced their share of Italy's and Spain's total government debt outstanding, although foreign nonbanks have remained net buyers in Italy. The latter's high rollover funding needs for its sovereign debt make it vulnerable to a pullback in demand by domestic banks and institutional investors, who already have significantly more domestic sovereign exposure than their euro area counterparts.

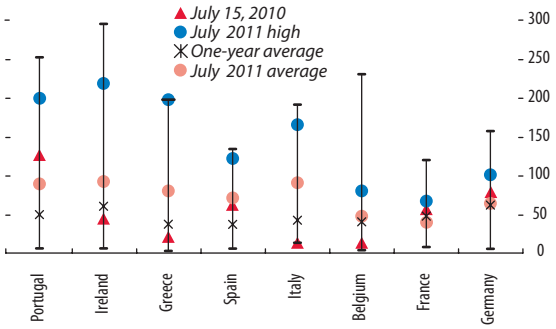
The dramatic price action in sovereign debt markets during July 2011 demonstrated how shocks to fundamentals and market sentiment in vulnerable sovereigns can create a corrosive dynamic that spills over to broader debt markets. Sovereign bond spreads for the peripheral euro area countries rose to record levels with extreme volatility and spillovers to Italy and Spain (Figure 1.11). Previously, Italy's 10-year spread over German bunds had been relatively stable, around 150 basis points during 2011, as investors had taken comfort from the relatively low level of private sector debt in Italy, the well-developed domestic investor base for government bonds, and the bonds' high degree of liquidity. These factors

Figure 1.10. Changes in the Sovereign Investor Base
(In percent)



Sources: BIS Banking Statistics; European Central Bank; European Union; Eurostat; IMF-World Bank Quarterly External Debt Statistics; national central banks; and IMF staff estimates.

Figure 1.11. Bond Market Volatility
(Realized volatility of two-year government bond yields in basis points)



Sources: Bloomberg L.P.; and IMF staff estimates.
Note: Vertical lines represent the range of realized volatility for the period.

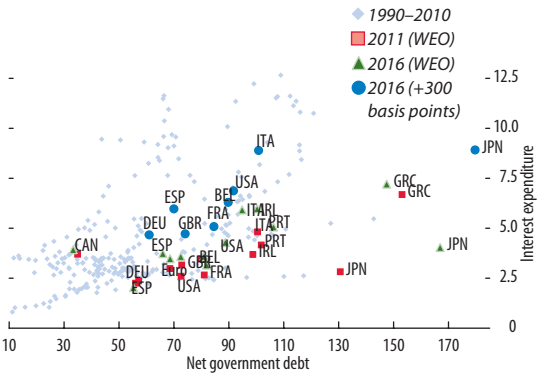
resulted in many investors in euro area sovereign bonds holding long-Italy positions against their benchmarks to compensate for short positions in program countries, leaving the market vulnerable to a sharp correction.

Like the debt path of many advanced economy sovereigns, Italy's remains highly sensitive to a rise in funding costs (Figure 1.12).[6] In such circumstances, a change in fundamentals (such as expected growth or fiscal adjustment) can cause a substantial shift in expectations about debt sustainability. This can make normally liquid bond markets more vulnerable if marketmakers and investors pull back from risk when volatility rises.[7] The turmoil in the trading for Italy's debt in July and August illustrates how such bouts of volatility, if left unchecked, has the potential to erode a sovereign's investor base and lead to a permanent repricing of debt.

[6]See the September 2011 *Fiscal Monitor*, Appendix A.4, for additional illustrations of the sensitivity of advanced economies to interest rate shocks.

[7]Investors in longer-term sovereign bonds are generally seeking stable nominal returns. When their holdings of such bonds become subject to higher and more volatile yields involving credit risk, they will often shift their exposures to safer instruments. In Italy, the relative paucity of stock lending by domestic institutions, plus measures to address settlement failures in June 2011 (see European Repo Council, Update, March 2011), may also have reduced the ability of marketmakers to cover short positions, thereby exacerbating market volatility and spread widening.

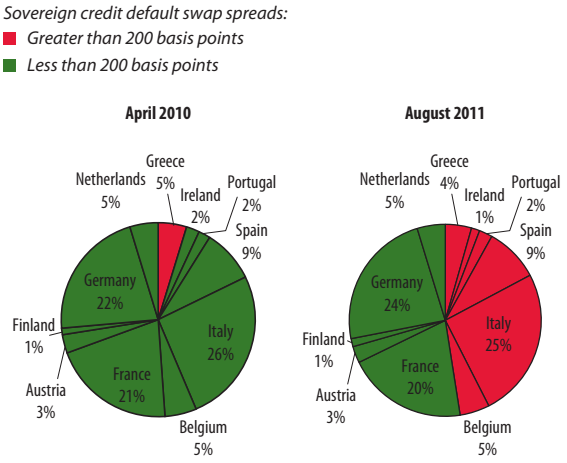
Figure 1.12. Financing Sensitivity to an Interest Rate Shock
(In percent of GDP)



Sources: Bloomberg L.P.; IMF, World Economic Outlook database; and IMF staff estimates.

Note: WEO projections for 2011 and 2016. In addition, we calculate interest rate expenditures for 2016 when the sovereign refinances 300 basis points above current market forward rates, taking the detailed profile of future funding needs into account and assuming a constant maturity structure of issuance. The baseline in our forward-rate-based methodology differs from that in WEO projections. Assumptions on assets do not deviate from the baseline WEO scenario. For Greece, gross government debt.

Figure 1.13. Size of High-Spread Euro Area Government Bond Markets
(In percent of total euro area government debt)



Sources: Bank for International Settlements; Bloomberg L.P.; and IMF staff estimates.

Note: The size of the euro area government debt market was €6.5 trillion as of end-2010. Components may not sum to 100 because of rounding.

Sovereign strains have spilled over to the EU banking system, increasing systemic risks.

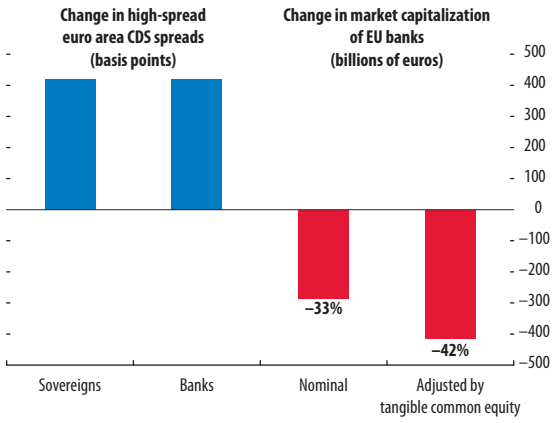
Sovereign risks have spilled over to the banking system, and these spillovers have grown as the sovereign crisis has spread from Greece to Ireland and Portugal, and then to Spain, Belgium, and Italy. Nearly half of the €6.5 trillion stock of government debt issued by euro area governments is showing signs of heightened credit risk (Figure 1.13).

As a result, banks that have substantial amounts of more risky and volatile sovereign debt have faced considerable strains in markets.[8] Figure 1.14 shows that high-spread euro area bank credit default swaps have widened by around 400 basis points since January 2010, in line with the increase in sovereign credit default swap spreads. At the same time, the equity market capitalization of EU banks has declined by more than 40 percent. These market pressures have intensified in recent weeks.

[8]As discussed in previous GFSRs, there has also been a feedback from some banking sectors to their governments through an increase in the sovereigns' contingent liabilities. Box 1.2 in the October 2010 GFSR describes a model, based on a contingent claims analysis, for assessing such risk transmission between sovereigns and banks.

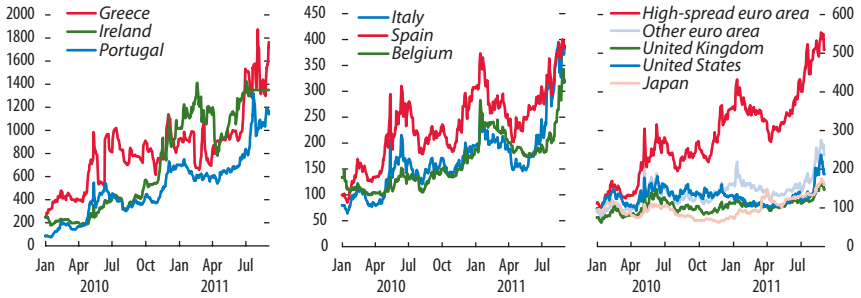
Spillovers from high-spread euro area sovereigns have affected local banking systems but have also spread to institutions in other countries with operations in the high-spread euro area and with cross-border asset holdings. In addition to these direct exposures, banks have taken on sovereign risk indirectly by lending to banks that hold risky

Figure 1.14. European Credit Risks and Market Capitalization
(Change since January 2010)



Sources: Bloomberg L.P.; and IMF staff estimates.

Figure 1.15. Spreads on Bank Five-Year Credit Default Swaps
(In basis points)



Sources: Bloomberg L.P.; and IMF staff estimates.
Note: End-2010 asset-weighted spreads for a sample of banks in each economy. High-spread euro area countries are Belgium, Greece, Ireland, Italy, Portugal, and Spain.

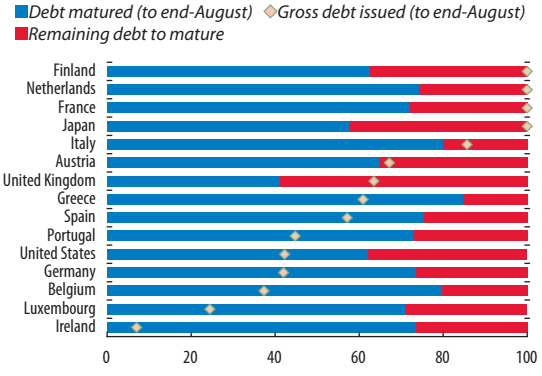
sovereigns. Banks are also affected by sovereign risks on the liabilities side of their balance sheet as implicit government guarantees have been eroded, the value of government bonds used as collateral has fallen, margin calls have risen, and bank ratings downgrades have followed cuts to sovereign ratings.

All of this has increased the riskiness of exposures to banks in the high-spread euro area. Because banks lend to banks, the system is highly interconnected, both within and across borders. Consequently, the banking system can amplify the size of the original sovereign shock through funding markets. Indeed, sovereign spillovers have also had an impact on bank funding markets. This can be illustrated by the sharp widening in credit default swap spreads for banks in the high-spread euro area countries (Figure 1.15);[9] the continued reliance of banks in Greece, Ireland, and Portugal on central bank liquidity support; and the difficulties that some banks in these countries have had in issuing debt (Figure 1.16).[10]

This GFSR seeks to explain why bank equity and funding markets are under strain. It measures the size of credit-related strains emanating from a widening group of euro area sovereign bond markets that have come under pressures and their spillover to banks. It measures the impact of this increase in credit risk since the end of 2009 on bank exposures to selected sovereigns and banks (an integral part of sovereign spillovers). These sovereign credit strains are a signal of vulnerability, as they have become substantial in magnitude and have continued to mount (see Box 1.3).

However, it is important to note that the exercise is not a calculation of the capital needs of banks (that could be different from the size of spillovers in this report). Determining capital needs would call for a full-fledged stress test that seeks to identify the full range of stresses and offsets covering all balance

Figure 1.16. Bank Debt Issuance as a Percent of Maturing Debt, 2011



Sources: Dealogic; and IMF staff estimates.
Note: For presentational purposes, the chart maximum is set to 100.

[9]The importance of bank funding costs has been recognized in the stability analysis carried out as part of the recent Financial Sector Assessment Program Updates for the United Kingdom and Germany, as documented in the respective Financial System Stability Assessments (IMF, 2011a and 2011c).

[10]In some countries banking sector deleveraging has reduced the amount of debt that needs to be issued this year relative to the amount maturing. This would be reflected by a low percentage of gross debt issuance shown in Figure 1.16.

Box 1.3. Quantifying Spillovers from High-Spread Euro Area Sovereigns to the European Union Banking Sector

European banks have become vulnerable to perceived increases in sovereign risk. In order to help explain the significant market pressures that some banks are facing in funding and equity markets, the analysis in this chapter aims to quantify the spillovers from high-spread euro area sovereigns to the European banking sector. This box discusses the choices made in methodology and their implications.

Since the outbreak of the sovereign crisis in 2010, sovereign bonds in several euro area countries are no longer perceived by markets as "risk free." This exercise seeks to measure the impact of this increase in credit risk on bank exposures to selected sovereigns and interbank exposures (an integral part of sovereign spillovers). These estimated sovereign credit risks serve as a vulnerability indicator, as they have become substantial in magnitude and have continued to mount. This box also reviews accounting and regulatory practices and discusses the extent of recognition of sovereign strains. This exercise is not aimed at calculating the net impact of gains and losses on sovereign debt, nor is it intended to determine the size of bank capital needs, which would call for a full-fledged stress test.

Methodological Choices

In undertaking this exercise, several key methodological choices have been made—specifically: (i) the countries included as a source of sovereign strains; (ii) the class of assets included—exposures to sovereigns and interbank exposures; (iii) the market price/instrument used to measure credit strains; and (iv) the extent of balance sheet coverage. Since these choices have important implications for the resulting estimates, it is necessary to clarify the economic rationale behind them and the sensitivity of the results.

Country coverage:[1] The analysis is based on the six high-spread euro area countries. This group includes the three program countries—Greece, Ireland, and Portugal—and the three countries that have more recently experienced market strains and widening financing spreads—Belgium, Italy, and Spain. As shown in Figure 1.13, this group accounts for about half of the euro area government bond market. The decision to limit the analysis to high-spread countries is motivated by the desire to better isolate the source of current market strains. Arguably, credit strains have increased somewhat in other euro area countries, and if the analysis were to be extended to all euro area sovereigns, the estimated impact of sovereign credit risk—measured by CDS spreads—would be higher.

Assets: In addition to banks' sovereign exposures, we include bank exposures to banks located in the high-spread euro area.[2] Interbank exposures are an integral part of sovereign spillovers because of contemporaneous linkages between sovereign and bank credit risks, complex interconnectedness of the banking system, and substantial holdings of interbank debt. Banks located in the high-spread euro area are directly affected by sovereign credit risks through both the asset and liability sides of the balance sheet, as evidenced by close correlation of sovereign and bank credit spreads.[3]

Credit risk measure—bond yields or bond spreads? Credit risks are commonly assessed using credit

Note: Prepared by Sergei Antoshin and William Kerry.

[1]The analysis is conducted for 20 banking systems in the European Union as well as for the sample of banks in the European Banking Authority's (EBA) 2011 stress test. Spillovers are quantified by applying an estimate of the increase in credit risk to the latest available balance sheet data on a consolidated basis. The exercise includes exposures to sovereigns and banks in the high-spread euro area. For the banking system exercise, domestic exposures—such as Greek bank exposures to the Greek sovereign—are estimated from data published with the EBA 2011 stress test. These data are adjusted to the banking system level using information on the coverage of the EBA stress test. International exposures are from the Bank for International Settlements (BIS) dataset. For some banking systems, data on cross-border exposures are not available from the BIS data, so cross-border exposures from the EBA dataset are used. Exposures for the individual bank exercise are taken from the EBA dataset.

[2]The exercise uses latest available balance sheet data, so some of the exposures—such as securities held in the trading and available-for-sale portfolios—may be recorded at fair value. In the EBA dataset, around 12 percent of government exposures are in the trading book and a further 49 percent are held as available for sale. As we apply changes in credit spreads to these marked-down exposures, we may underestimate total spillovers for the period since end-2009.

[3]Interbank exposures are reduced by adjusting for repos using the data available. Nevertheless, interbank deposits may still include some collateralized exposures, which may experience less deterioration in credit quality than that implied by CDS spreads.

Box 1.3 *(continued)*

spreads for a wide range of risky assets—including bank debt, corporate debt, and emerging market government and corporate debt—although the market may overshoot during periods of market strain. Credit spreads or bond spreads—rather than bond yields—are used to isolate the credit risk component and to remove the effect of the risk-free rate. For this reason we choose to use sovereign CDS spreads.[4] The change in credit risk is calculated from the end of 2009, before the escalation of the sovereign crisis, to September 2011. Similarly, this analysis could have been done using bond spreads to German bunds and is shown to give very similar results (see first table). For comparison purposes, if government bond yields were used instead of CDS spreads, the total impact from the high-spread euro area would be 31 percent lower for sovereign exposures (see first table), largely reflecting the decline in the risk-free rate.[5]

Should safe-haven gains be included? The increase in sovereign credit risk and the widening of spreads have been accompanied by flows into "safe havens" such as German bunds, which have risen in price, creating a capital gain for banks that are holding these bonds. One might argue that these gains offset some of the potential losses from holdings of riskier sovereign debt. However, this exercise is focused on measuring the vulnerability of banks to rising sovereign risks. Netting the gains from safe-haven bonds would mask the overall size of the problem, and could not be a panacea for the sovereign crisis. In addition, the distribution of gains from holdings of highest quality government bonds within the banking system is uneven—with banks in the high-spread euro area holding relatively fewer—resulting in increased segmentation of funding markets in the euro area. Importantly, if safe-haven gains are included, the exercise ought to be broadened to a stress test that would include the full range of banks' assets affected by the crisis. This would include other risky assets, such as holdings of bank equities, corporate bonds and loans, and other assets originated in the high-spread euro area. Including other private sector exposures would be expected to generate an additional sizeable impact, as corporate credit spreads are often significantly correlated with sovereign credit spreads.

Spillovers from High-Spread Euro Area Sovereigns to the European Banking System
(In billions of euros)

Spillovers from exposures to sovereigns in:	Basis of Spillover Calculation		
	CDS spreads	Bond spreads	Bond yields
Greece	56	55	53
Ireland	7	7	5
Portugal	17	18	16
Belgium	9	9	2
Italy	71	70	41
Spain	44	43	23
Total	**204**	**202**	**142**

Source: IMF staff estimates.

Note: Based on changes in market prices from the end of 2009 to September 2011.

Recognition of Sovereign Strains in Bank Capital

This exercise is not intended to measure the losses and gains that arise from the change in bond prices, some of which is due to increased sovereign risk. Nonetheless, increased losses owing to increased default risk or declines in market value are partly taken into capital.

Loss recognition and its impact on capital are determined by accounting and regulatory standards and how those standards are put into practice, which can vary from bank to bank and country to

[4]Changes in credit risk are estimated from CDS spreads (S) by converting them into synthetic prices (P) using $P_t = exp(-S_t T)$. The calculation uses a weighted average maturity (T) and a matching CDS spread. For sovereign exposures, the weighted average maturity is calculated from the EBA dataset. For interbank exposures, weighted average maturities are estimated using information on maturities of bank bonds issued by institutions from the high-spread euro area countries and on an assumed three-month maturity of interbank lending.

[5]There are other reasons for not choosing bond yields. Downward shifts in the yield curve and its flattening generally have an adverse impact on bank income margins that would have to be taken into account. In high-spread euro area countries, rising bank credit spreads also have an impact on net interest income, as funding costs increase and often become prohibitive, while the extent of the pass-through to customers is limited, especially for retail loans. This has so far been mitigated in part by the increased recourse to central bank funding.

Box 1.3 *(continued)*

European Banks: Loss Recognition on Sovereign Exposures

	Percent of Total Exposures[1]	Accounting Standards		Accounting Practices	Regulatory Standards	Regulatory Practices
		Impact	Valuation method		Impact on regulatory capital	
Trading book	12	Realized loss/gain in profit and loss account	Fair value	Generally MTM. Mark-to-model if the market is inactive. At some banks, internal models for "illiquid" assets are used.	Yes	Yes
Available for sale	49	Unrealized loss/ gain, impact on equity	Fair value	Generally MTM. Mark-to-model if the market is inactive. At some banks, internal models for "illiquid" assets are used.	Basel II is silent; under Basel III, yes, in the future	Varies: in many cases, losses are added back to capital
Held to maturity	39	Provisions in profit and loss account	Amortized cost, net of any impairment provision, based on "incurred loss"	Provisions mostly taken on eligible Greek government debt.	Yes	Yes

[1]Based on the European Banking Authority's data on banks' exposures to high-spread euro area sovereigns. Held-to-maturity value is calculated as the residual.

MTM = mark to market.

country. The points below summarize the current state of play (see also second table).

Trading book. Securities held in the trading book are mostly marked to market, so losses go through profit and loss accounts and are recognized in equity capital. However, accounting standards allow the use of internal models in the event of an inactive market. Around 12 percent of sovereign exposures (based on the EBA dataset) are held in the trading book and their fair value should be fully reflected in both accounting and regulatory capital measures.

Available for sale. Accounting rules state that the available-for-sale (AFS) portfolio should be marked to market and recorded in tangible common equity. Recent criticisms expressed by the International Accounting Standards Board (IASB) concerning the treatment of Greek government debt suggest that banks have recognized losses in an inconsistent fashion, sometimes reclassifying government debt as illiquid and in some cases using internal valuation models instead of market prices. From a regulatory perspective, Basel II is silent on the treatment of unrealized AFS losses, resulting in diverging practices across countries. Unrealized losses (as well as unrealized gains) on the AFS portfolio have not always been incorporated in regulatory capital calculations.[6]

Held to maturity. There are several issues with the implication of the accounting rules determining the provisions associated with sovereign exposures in the held-to-maturity (HTM) portfolio. The calculation process (which is based on internal models) underestimates the effect of credit risk deterioration and therefore will produce lower provisions than marking to market. This is partly because the current approach is based on "incurred loss"; thus, risks—unless materialized—cannot be quantified.[7] As a result, provisioning has been predominantly on the sovereign debt of Greece eligible for the ongoing debt exchange process, in some cases amounting to 21 percent of face value.

[6]This will change under Basel III, as institutions will be required to take unrealized AFS losses into account in their regulatory capital calculations; and the BCBS will continue to review the appropriate treatment of unrealized gains.

[7]The IASB is currently finalizing a new approach based on "expected loss" that will replace the existing IAS 39 arrangements. These are due for release shortly.

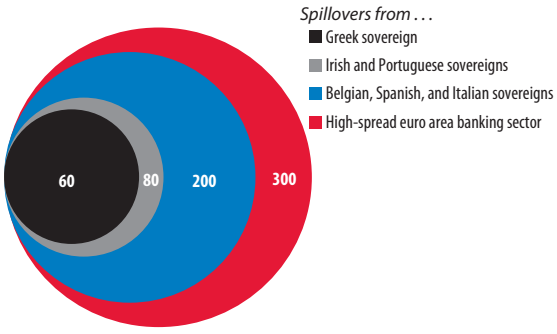
Box 1.3 *(continued)*

In sum, although losses are likely to have been recognized in the trading book, loss recognition has been slow and inconsistent in the banking book. To improve transparency, more clarity in the accounting standards is required for the application of mark-to-market valuation for thinly traded government bond markets and the method of provisioning in HTM should be revisited. In addition, more consistency is needed in the recognition of AFS losses in regulatory capital across jurisdictions (see the discussion in the "Policy Priorities" section of the main text).

sheet assets, liabilities, and income/losses on banks. A typical stress test would have several components that are beyond the scope of this exercise. For example, it would include an economic scenario that would result in rising losses on bank's loan books, a marking to market of securities, including corporate bonds, and a projection of new income and how this would be affected by funding strains. In addition, it would include the size of capital buffers and provisions available to cushion increased losses, and from there it would derive a capital need.

The epicenter of sovereign risk has been Greece, which generated the first of four waves of spillover to European banks. The analysis suggests that, first, spillovers on European bank exposures to the Greek sovereign have amounted to almost €60 billion (Figure 1.17). Second, as sovereign risks spread to other governments, the spillovers to banks have mounted. If the sovereign stresses in Ireland and Portugal are included, the total spillover rises to €80 billion. Third, the governments in Belgium, Italy, and Spain have also come under market pressure; incorporating credit risks from these sovereigns into the analysis further raises the total estimated spillover, to about €200 billion. Fourth, bank asset prices in the high-spread euro area have fallen in concert with sovereign stresses, leading to a rise in the credit risk of interbank exposures; including those exposures increases the total estimated spillover to €300 billion overall. Although these numbers are based on market assessments of credit risk, which may reflect a degree of overshooting, the underlying problems that they highlight are real.

Figure 1.17. Cumulative Spillovers from High-Spread Euro Area Sovereigns to the European Union Banking System
(Billions of euros)



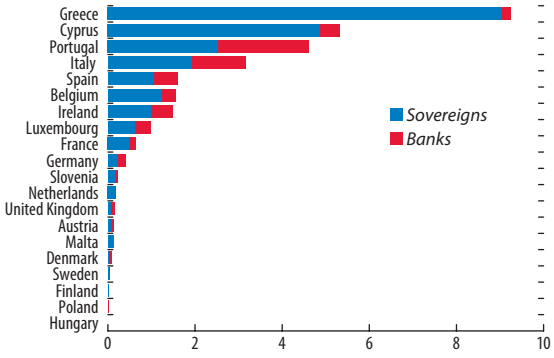
Source: IMF staff estimates.
Note: The size of the circles is proportional to the size of the spillover. Includes banking systems in 20 European Union countries. The high-spread euro area countries are Belgium, Greece, Ireland, Italy, Portugal, and Spain. Figures are rounded to the nearest 10 billion euros.

Banking systems in the high-spread euro area are likely to be most affected.

This aggregate picture masks a heterogeneous range of spillovers on country banking systems (Figure 1.18). High-spread euro area systems have faced the most severe spillovers from their local sovereigns. The key exception to this is Cyprus, which has high spillovers from bank exposures to the Greek sovereign. A number of other banking systems such as those of Luxembourg, France, and Germany have experienced spillovers from the high-spread euro area to their foreign operations or cross-border exposures, but these represent a smaller percentage of assets. Finally, several European banking systems have had little or no spillover from high-spread euro area sovereigns.

Conducting the analysis on individual bank balance sheets confirms the results of the aggregate

Figure 1.18. Spillovers from High-Spread Euro Area Sovereigns to Country Banking Systems
(In percent of assets)

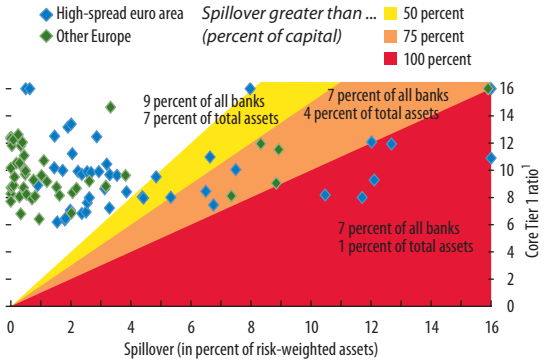


Source: IMF staff estimates.
Note: The high-spread euro area countries are Belgium, Greece, Ireland, Italy, Portugal, and Spain.

exercise.[11] Banks from the high-spread euro area have had the greatest spillovers (Figure 1.19). But even within banks in these countries, the spillovers have been uneven. There are also a few banks from other countries where spillovers have been large.

Overall, only a small number of banks in the sample fall in the red zone of Figure 1.19. These banks represent about 1 percent of assets in the sample, while 22 percent of banks in the sample, representing 12 percent of assets, fall in the red, orange, and yellow zones, where spillovers represent more than half the level of core Tier 1 capital. Some of these spillovers will have been recognized by banks, but the full extent to which losses on government bonds have been recognized in bank accounts is unclear (see Box 1.3).

Figure 1.19. Distribution of Spillovers from High-Spread Euro Area Sovereigns to European Banks



Source: IMF staff estimates.
Note: For presentational purposes, the cutoff points for capital ratios and spillovers are 16 percent. The high-spread euro area countries are Belgium, Greece, Ireland, Italy, Portugal, and Spain. Data are based on the sample of 90 EU banks in the EBA 2011 stress test.
[1]Includes core Tier 1 capital at end-2010, actual equity raising in January–April 2011, and commitments for equity raisings made by April 2011.

[11]The individual bank exercise was applied to the sample of banks in the European Banking Authority stress test.

Spillovers could spread to other financial institutions.

Insurance companies have also been affected by sovereign credit risk spillovers through their direct holdings of both sovereign and bank debt. The spillovers to insurance companies were assessed in a manner similar to that for banks.

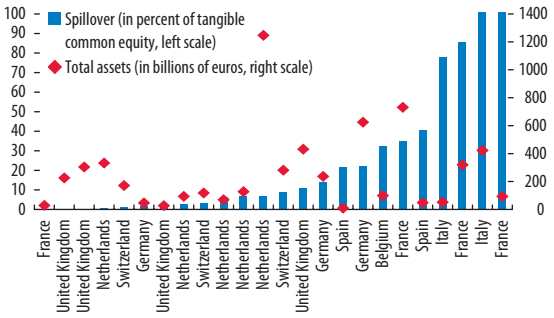
Disclosure of the insurance sector's exposures to the high-spread euro area, however, remains limited and mostly voluntary,[12] so the analysis could be applied only to selected large insurers from data they have published on sovereign exposures. Nevertheless, spillovers are significant at a number of large insurers, particularly in France and Italy (Figure 1.20). All told, spillovers amounted to more than 20 percent of tangible common equity for about 38 percent of large insurers (representing 39 percent of total assets in the sample).[13] These results, however, may overestimate the ultimate impact of sovereign risks on insurers as, in contrast to banks, insurers can mitigate their spillovers by passing on costs to policyholders.

For other financial institutions—such as pension funds and sovereign wealth funds—exposures to high-spread euro area sovereign credit risk are even less clear, but these entities are less likely to have a significant impact on the financial system, as their positions are largely held in unleveraged portfolios.

[12]The disclosures of insurance companies and other nonbank financial institutions (NBFIs) could be improved. Information on NBFIs is one of the main themes of the G-20 Data Gaps Initiative. The IMF, in collaboration with the Financial Stability Board, is working to improve the information on NBFIs as well as on G-SIFIs (global systemically important financial institutions) and to expand the number of countries reporting Financial Soundness Indicators for NBFIs. See www.imf.org/external/np/g20/pdf/063011.pdf.

[13]The sample comprises 24 large insurers registered or with a significant share of operations in Europe.

Figure 1.20. Spillovers from High-Spread Euro Area Sovereigns to Insurers
(Based on gross exposures)



Source: IMF staff estimates.

The potential exists for funding market disruption to intensify.

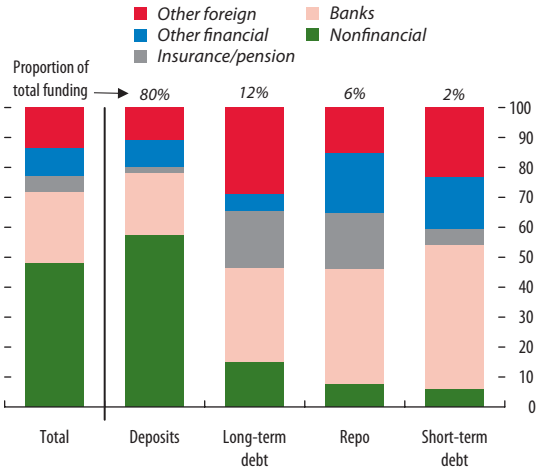
A number of factors could cause the disruption to funding markets to spread and intensify. Banks affected by sovereign spillovers might decide to pull back funding to other banks to reduce credit risk or even to preserve liquidity in anticipation of future funding problems. That could be significant given the highly interconnected nature of the global banking system: interbank funding represents about one-fourth of total financing for the banking sector (Figure 1.21).[14]

Also, banking groups that operate across national borders pose risks to banking systems. Banks facing funding pressures could reduce or withdraw intragroup financing from foreign branches to help preserve liquidity, thereby transmitting the funding shortages from one country to another. This is particularly an issue for those emerging market banking systems with a large foreign presence and considerable intragroup financing.

Other financial institutions—such as insurance companies, pension funds, and money market funds—are the source for nearly one-fifth of banking financing (see Figure 1.21). The role of these institutions in debt and repo markets is much greater, so any cutback in funding could significantly disrupt wholesale funding markets.

[14]The recent Financial Sector Assessment Program Updates for Sweden and the United Kingdom note vulnerability to liquidity stress due to heavy reliance on short-term wholesale funding (IMF, 2011b and 2011c).

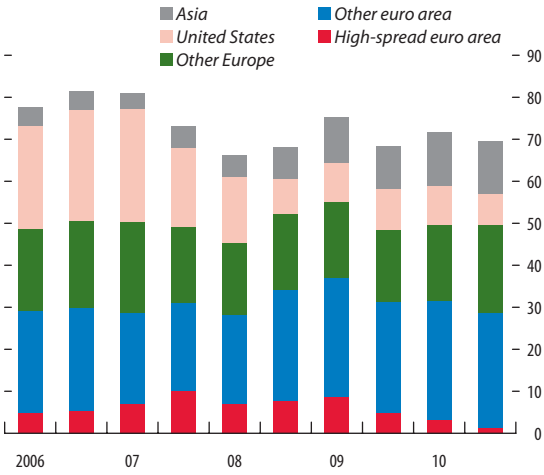
Figure 1.21. Advanced Economy Bank Funding by Source, 2011:Q1
(In percent)



Sources: Bank for International Settlements; national authorities; and IMF staff estimates.
Note: Aggregate funding of banks located in the euro area, Japan, the United Kingdom, and the United States. "Banks" includes institutions in the domestic economy and rest of the world.

Indeed, U.S. money market funds have reduced their funding of euro area banks, particularly institutions in high-spread countries (Figure 1.22). As Box 1.4 discusses, this has already created some pressures in dollar funding markets. If investors

Figure 1.22. U.S. Prime Money Market Fund Exposures to Banks
(Percent of total assets)



Source: Fitch.
Note: The high-spread euro area consists of Belgium, Greece, Ireland, Italy, Portugal, and Spain.

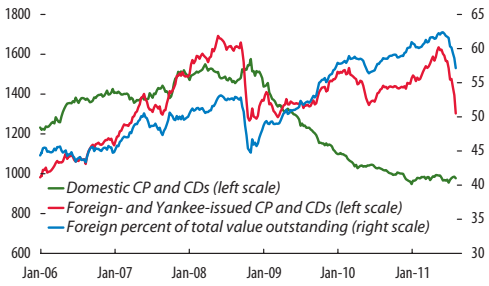
Box 1.4. Why Do U.S. Money Market Funds Hold So Much European Bank Debt?

Given their sizable holdings of European bank paper, U.S. money market mutual funds are a potential transmission channel of the European sovereign debt crisis. Why have the money funds built up such a large exposure, and what are the implications if they significantly reduce it?

With $2.7 trillion in assets, U.S. money market mutual funds (MMMFs, or money funds) are systemically important institutions. Prime MMMFs account for the largest share of the market, representing $1.6 trillion, or around 60 percent, of total MMMF assets. The remaining 40 percent is in government and tax-free money funds.[1]

A number of factors have reduced the supply of dollar-denominated money market instruments in recent years, from a peak of about $12 trillion in 2008 to about $9.1 trillion currently.[2] First, the collapse in the ABCP conduit model during the crisis shrank the stock of investible ABCP paper.[3]

Outstanding Dollar-Denominated Commercial Paper and Time Deposits, by Issuer
(In billions of U.S. dollars except as noted)



Sources: Federal Reserve; and IMF staff estimates.
Note: CD = certificate of deposit; CP = commercial paper.

Note: Prepared by Rebecca McCaughrin.

[1]Prime MMMFs invest in high-quality, short-term credit instruments—primarily certificates of deposit (CDs), repurchase agreements (repos), commercial paper (CP), asset-backed CP (ABCP), short-term corporate notes, and other money funds. Government and tax-free funds invest mainly in Treasuries, agency debt, and municipal bonds.

[2]This figure includes the outstanding stock of repurchase agreements, Treasury bills, commercial paper, banker's acceptance paper, large time deposits, and other instruments.

[3]The stock of ABCP fell from a precrisis level of $1.2 trillion to about $380 billion. ABCP conduits are bankruptcy-remote special-purpose vehicles that issue short-term paper backed by the cash flows from physical assets. Before the financial crisis, banks relied on ABCP conduits as a short-term funding vehicle backed mostly by mortgage-related assets. Deterioration in the underlying assets and the inability of conduits to roll over their paper eventually led to the contraction in the ABCP market.

Second, the supply of Treasury bills was curtailed by flight-to-quality flows and the mid-2011 end of the U.S. Treasury's Supplementary Financing Program.[4] Third, the supply of CP declined as U.S. nonfinancial corporations built up large cash positions. Fourth, the supply of agency notes declined as Fannie Mae and Freddie Mac were wound down. Fifth, banks' reduced dependence on wholesale funding cut the supply of bank CDs.

In response to the decrease in the supply of domestic dollar-denominated instruments, MMMFs increased their holdings of dollar-denominated foreign debt and so-called Yankee paper (the latter being dollar-denominated debt issued in the United States by foreign entities), especially by European banks with a small deposit base seeking to finance their large dollar-denominated assets. Until recently, the stock of dollar-denominated foreign- and Yankee-issued CP and CDs had grown to more than 60 percent of the outstanding stock of financial and nonfinancial CP and CDs, up from 45 percent in 2008 (first figure). As a result of sovereign stress, money funds gradually reduced their exposure to euro area banks in early 2010, paring exposures further in mid-2011 to 23 percent of total assets (table).

Any change in MMMF willingness to hold European bank paper is likely to affect the cost and availability of dollar funding. The MMMFs have provided a convenient way for U.S. branches and subsidiaries of foreign banks to build up precautionary dollar reserves (second figure).[5] Ample

[4]The Treasury program temporarily added as much as $200 billion to the supply of Treasury bills.

[5]U.S. branches and subsidiaries of foreign banks sometimes channel dollar funding to their overseas parent offices. Beginning April 1, 2011, the Federal Deposit Insurance Corporation (FDIC) started to assess domestic banks a fee based on their total assets, but branches and subsidiaries of foreign banks that are not insured by the FDIC are exempt. This risk-free arbitrage for foreign banks has likely led to excess liquidity being channeled to their U.S. offices because they are still

Box 1.4 *(continued)*

Prime Money Fund Exposure to Short-Term Bank Credit, as of End-June 2011

(In billions of U.S. dollars except as noted)

	ABCP/CP/CD	Repo	Total	Percent of Total Prime Assets
Europe	547	128	675	41.2%
Euro area	331	46	377	23.0%
Austria	1	-	1	0.1%
Belgium	1	-	1	0.1%
France	182	18	200	12.2%
Germay	48	23	71	4.3%
Ireland	-	-	-	0.0%
Italy	8	-	8	0.5%
Luxembourg	1	-	1	0.1%
Netherlands	85	5	90	5.5%
Spain	5	-	5	0.3%
Other Europe	216	82	298	18.2%
Denmark	10	-	10	0.6%
Norway	12	-	12	0.7%
Sweden	46	-	46	2.8%
Switzerland	37	28	65	4.0%
United Kingdom	111	54	165	10.1%

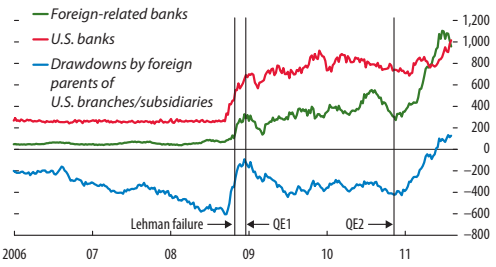
Sources: Investment Company Institute; and JPMorgan Chase.

Note: Monthly portfolio holdings of top 18 money market funds.

ABCP = asset-backed commercial paper; CD = certificates of deposit; CP = commercial paper.

Reserves of U.S. Banks and U.S. Offices of Foreign Banks

(In billions of U.S. dollars)

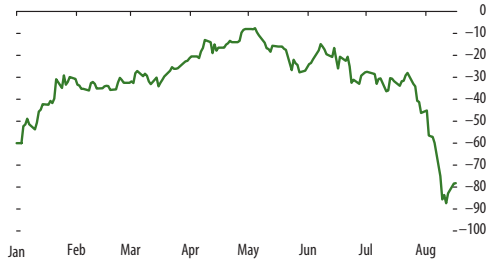


Sources: Federal Reserve; and IMF staff estimates.

Note: A more negative drawdown implies increased funding provided by U.S. offices of foreign banks to parent offices, while a less negative drawdown implies foreign parents are draining less liquidity from their U.S. operations. QE1 and QE2 are announcements of quantitative easing.

Three-Month Euro–Dollar FX Swap Basis, 2011

(In basis points)



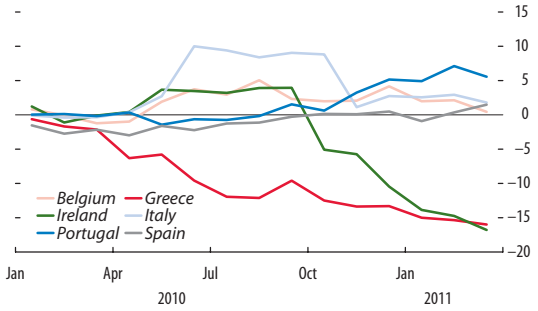
Source: Bloomberg L.P.

funding had also helped to contain pressures in dollar funding markets despite intensifying sovereign risk. That is no longer the case: Offshore dollar-denominated issuance by European banks and dollar-denominated foreign issuance has begun to decline, as money funds are reluctant to increase exposure to European banks and pressures in dollar funding markets have risen (third figure). The cushion of reserves built up by U.S. branches of European banks helps to buy time, but the cushion is at risk of being depleted if a pullback by the money funds is accompanied by a generalized rise in risk aversion among other lenders. This could lead to further pressures in bank funding markets.[6]

eligible to hold reserves at the Federal Reserve for 25 basis points. The FDIC exemption, as well as excess dollar liquidity created by the Federal Reserve's second round of quantitative easing and the increase in offshore dollar funding by foreign parent banks, has led to an accumulation of cash in U.S. offices of foreign banks. If needed, these reserves could be funneled to foreign parents.

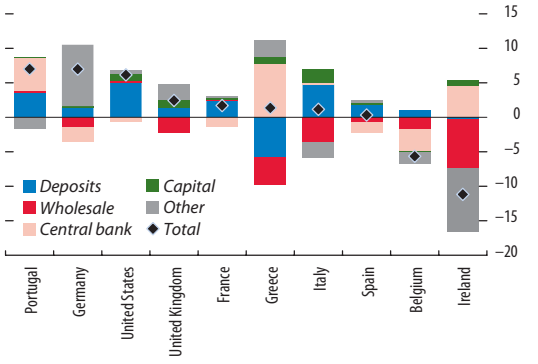
[6]A more general pullback by money market funds could also lead to higher funding costs and difficulties in rolling over funding at municipalities and other issuers. Tax-exempt mutual funds currently hold $300 billion in municipal paper, which is helping to fund roughly 12 percent of state and local government liabilities.

Figure 1.23. Deposit Growth in High-Spread Euro Area Countries
(Cumulative percent change since end-2009)



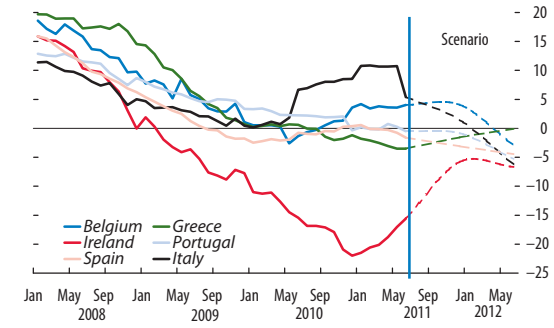
Source: Haver Analytics.

Figure 1.24. Contributions to Change in Bank Balance Sheets since End-2009
(In percentage points)



Sources: European Central Bank; Haver Analytics; and IMF staff estimates.
Note: "Other" includes liabilities to nonresidents (which, for euro area banking systems, are residents outside the euro area).

Figure 1.25. Deleveraging Scenario: Change in High-Spread Euro Area Bank Credit to the Nonfinancial Private Sector
(In percent, year-on-year)



Sources: Bloomberg L.P.; Haver Analytics; and IMF staff estimates.
Note: The dotted lines are estimates based on the assumption that banks are unable to obtain funding in markets.

in money market funds become concerned about potential losses from euro area banks and seek to redeem their money, money market funds might pull back further from bank funding.

The disruption in euro area wholesale funding markets could also spread to depositor funding. At banks in Greece and Ireland, both wholesale and customer deposits have fallen since the end of 2009 (Figure 1.23). It is essential to prevent these withdrawals from moving into a more virulent phase, as has happened in past emerging market crises.

A worsened funding market would pressure banks to deleverage.

Funding strains are likely to increase deleveraging pressures on banks. Indeed, there have been significant reductions in wholesale and nonresident funding in several European countries since the end of 2009 (Figure 1.24). In some cases, this has been associated with planned deleveraging of banking systems. But in other countries, such as Greece, deleveraging has been prevented only by an increase in central bank liquidity support. The important recent decision by the European Central Bank to offer six-month liquidity is, therefore, likely to help address pressures in bank funding markets. But the scale of support that may be needed to tackle the full consequences of sovereign spillovers could well be large. In the long run, such support would be neither healthy nor sustainable for the banking system.

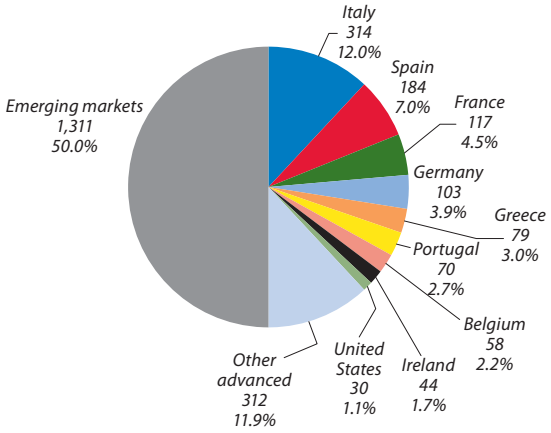
These deleveraging pressures, if not effectively countered, risk pushing down credit growth to levels even lower than the current anemic rates in many high-spread euro area countries (Figure 1.25). The September 2011 *World Economic Outlook* discusses the impact of lower credit growth on economic activity. It is projected that banks will respond to a fall in capital by raising interest rates on their loans and restricting lending to the economy. As a result, it is estimated that, in a downside scenario, growth in the euro area and the United States could decline relative to the WEO baseline by 3.5 percentage points and 2.2 percentage points, respectively.

Spillovers could also spread to derivatives and other financial markets.

Sovereign risks could also spill over to credit derivatives markets. Some investors have bought credit default swaps on sovereign debt to hedge their direct exposures to sovereigns, while other investors have used the market to express a view on a country. There is some risk that a credit event that triggered sovereign credit default swaps could place strains on institutions that have sold credit protection; however, these risks appear contained given the relatively small size of outstanding credit default swap markets for the countries with the widest spreads (Figure 1.26).

Also, the contagion to financial markets could widen if investor risk appetite is weakened by sovereign stress, especially if the current crisis spreads and intensifies. This could create a second round of impacts on financial institutions, including banks and insurance companies, particularly if they are forced to sell assets at low prices, for example if they face a rationing of funding market liquidity.

Figure 1.26. Sovereign Credit Default Swaps: Gross Outstanding Amount
(In billions of U.S. dollars and percent of total)



Source: The Depository Trust & Clearing Corporation.
Note: Global total was $2.6 trillion at week ending August 5, 2011.

Comprehensive, coherent policies are needed to resolve sovereign risks, increase the resilience of the European banking sector, and prevent contagion risks.

Appropriate fiscal action, combined with measures to strengthen banks through balance sheet repair and adequate levels of capital, can help to break the link between sovereigns and banks. If a country's fiscal measures are successful in restoring the long-term sustainability of public finances, its sovereign risk premium will be reduced, putting public debt on a "good equilibrium" path. This will go a long way toward reducing pressures on banks. Nevertheless, in view of the heightened risks and uncertainty—and the need to convince markets—a number of banks, especially those exposed to strained public debt (directly or through cross-border holdings) and most of those dependent on wholesale financing, may also need more capital. Additionally, the amount of new capital needed would also depend, in part, on the credibility of the macroeconomic policies pursued to address the roots of sovereign risk.

The various channels of propagation from sovereign risk into the wider economy carry an enormous potential for contagion. First, some European banks urgently need to bolster their capital levels to mitigate the risks posed by these spillovers and to help restore funding market confidence. This conclusion echoes the call from the European Banking Authority (EBA) for strengthening the capital positions both at failing institutions and at those that passed the 2011 stress test but which were nonetheless close to the minimum capital threshold and were carrying significant sovereign exposures.[15] In current market conditions, however, this may not always be possible, so public backstops first at the national level and ultimately through the European

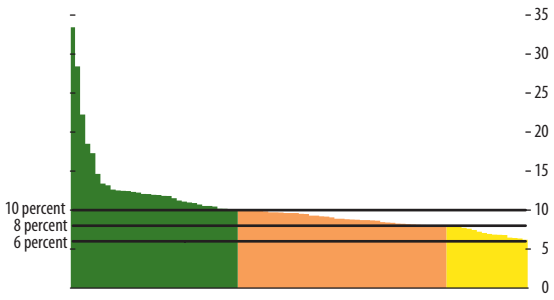
[15]The European Banking Authority's 2011 stress tests found that, at the end of 2010, 20 banks would fall below the 5 percent core Tier 1 ratio threshold over the two-year horizon of the exercise. Taking into account capital raising actions implemented by end-April 2011, 8 banks in the aggregate were €2.5 billion below the capital threshold. A further 16 banks had a core Tier 1 ratio of between 5 and 6 percent at the end of the stress test. The stress test results were published along with very detailed information about bank balance sheets. Adoption of this elevated level of transparency for bank disclosure at the national level would represent further progress.

Financial Stability Facility should be used to provide capital to banks as needed.

Second, capital is also required by weaker institutions with high leverage and remaining exposures to poorly performing assets. These banks need to be restructured and, where necessary, resolved in order to reduce overcapacity in the system as well as to improve the profitability and resilience of the remaining institutions. Banks have started to raise equity and have plans to increase capitalization further through issuance or government support. But even after these plans have been accounted for, banks representing nearly one-fifth of total assets of institutions in the EBA 2011 stress test would have core Tier 1 capital below 8 percent (Figure 1.27).

Third, lower leverage is required by investors to cope with uncertainty over economic prospects and sovereign risks in the euro area. This is particularly the case in Europe, where banks have a relatively high reliance on wholesale funding and are more vulnerable to funding shocks. The more uncertain operating environment is prompting creditors to require capital buffers that are above regulatory minima to continue to lend to banks. Having adequate capital is necessary to avoid banks being pushed to deleverage through asset sales as well as by restricting new credit and cutting contingent credit lines, thereby exacerbating the economic slowdown.

Figure 1.27. European Bank Core Tier 1 Ratios
(In percent of risk-weighted assets)



Sources: European Banking Authority; and IMF staff estimates.
Note: Includes core Tier 1 capital at end-2010, actual equity raising from January to April 2011, and commitments for equity raisings and government support made by April 2011.

Is the Search for Yield Leading to Credit Excesses?

The combination of low interest rates and tight credit spreads is generating a search for yield that could jeopardize financial stability. In advanced economies, safeguarding stability calls for greater emphasis on balance sheet repair so as to avoid credit cycle excesses. Being further along in the credit cycle, emerging markets need policies to guard against a buildup of financial imbalances and to strengthen the resilience of their financial systems.

The April 2011 GFSR emphasized that policymakers must shift their focus from maintaining accommodative macroeconomic policies to strengthening balance sheets and reducing debt burdens through structural approaches. Although necessary under current conditions, low rates threaten financial stability if they are prolonged and are not accompanied by balance sheet repair and prudential oversight. In particular, maintaining low real risk-free yields at a time when some credit cycles are shifting into the expansion phase could set the stage for credit excesses while leaving balance sheets vulnerable to a downturn. Although recent economic fragilities may reduce the propensity to take risk, they are also likely to lead to a weakening in credit fundamentals. Finally, with bank balance sheets still in need of repair, low rates may divert credit creation into more opaque channels, such as the shadow banking system.

The flow of capital away from the low interest rates in advanced economies and toward the brighter growth prospects elsewhere is intensifying the expansion of domestic liquidity, credit, balance sheet leverage, and asset prices in emerging market economies. Combined with stimulative domestic policies, these pressures raise the risk of overheating and a buildup of financial imbalances that could erode asset quality even if demand and credit conditions normalize. We model such a scenario in this section. At the same time, with the increase in global stability risks, emerging markets may face an external shock in the form of a sharp reduction in global growth and a reversal in capital flows, and emerging market banks could be weakened by a rise in funding costs. We model the implications for the

capital strength of emerging market banks under such a scenario.

Where are we in the credit cycle?

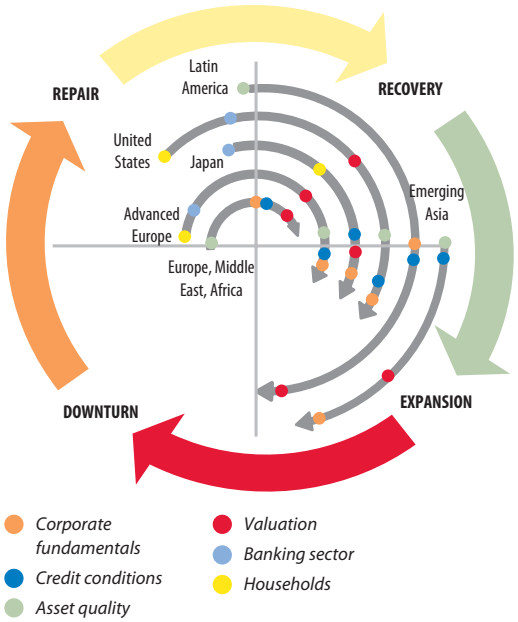
Unless an economy is operating under financial and monetary policies appropriate to its stage of the credit cycle, imbalances can occur. The traditional credit cycle goes through four distinct phases in sequence: *repair* (cleansing balance sheets); *recovery* (restructuring, increasing margins, falling leverage); *expansion* (rising leverage, increasing volatility, increased speculation); and *downturn* (falling asset prices, increased defaults). We assessed the trend of various credit metrics in several countries and regions to pinpoint their current location in the credit cycle.[16] Generally speaking, the global financial crisis has left advanced economies at an earlier phase in the credit cycle and allowed emerging markets to move further along it (Figure 1.28).

- The United States straddles the recovery and expansion phases of the credit cycle. This reflects a bifurcation among sectors: on the one hand, households and banks are still repairing balance sheets. Household leverage remains elevated, and a large shadow inventory of houses continues to dampen housing prices and exacerbate negative equity, in turn posing risks to bank balance sheets (Figure 1.29).[17] A weaker economic trajectory and mounting legal pressures on U.S. banks with large mortgage-related exposures are likely to further exaggerate these risks. On the other hand, large nonfinancial corporations are moving closer to the expansionary phase: Profits have returned to precrisis levels, cash balances are still at record highs, funding pressures are limited (as firms took advantage of lower rates mostly to refinance rather than fund capital expenditures), default rates are low (and are expected to remain contained

[16]The metrics include credit growth, lending conditions, leverage, interest coverage, free cash flow, capital expenditures, EBITDA (earnings before interest, taxes, depreciation, and amortization) margins, bond yields, housing prices, default rates, nonperforming loans, price-to-book ratio, gross debt, foreclosures, delinquencies, and capital flows. Our assumption that the repair and recovery phases of the cycle roughly mirror the expansion and downturn phases produces a cycle of quartiles. The current value of each credit metric was compared to the range of values in each phase and placed accordingly. Data availability varies across regions. For the euro area, some variables include the entire region and others only selected countries.

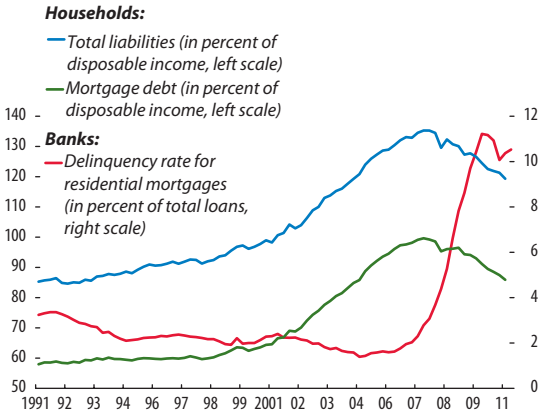
[17]See the discussion of mortgage principal reductions in the April 2011 GFSR, pp. 28–35.

Figure 1.28. Phases of the Credit Cycle



Source: IMF staff estimates.

Figure 1.29. U.S. Household Debt and Mortgage Delinquencies

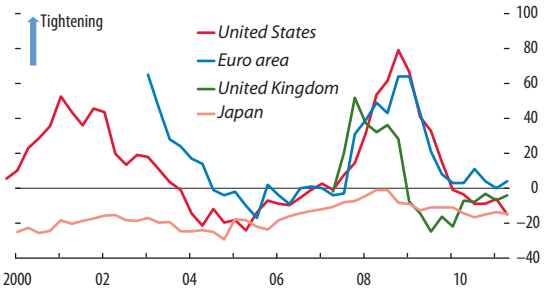


Sources: Federal Reserve; Haver Analytics; and IMF staff estimates.

because the funding gap is low), and bank lending conditions and capital market financing remain easy.[18] Until the recent bout of economic weakness, there were signs that corporate credit metrics had reached an inflection point: organic growth was weakening, and share repurchases, mergers and acquisitions, and leveraged buyout (LBO) activity were gaining momentum.

- The euro area remains at an earlier stage of the credit cycle, in part because the economic cycle is lagging and the repair of bank balance sheets has lagged that in the United States (see the April 2011 GFSR). Household leverage is still too high (especially in the euro area periphery), while some banks continue to struggle with funding pressures, deteriorating asset quality, and an insufficient capital base. Firms continue to deleverage, and corporate downgrades continue to exceed upgrades. Credit conditions (Figure 1.30) remain difficult, and near-term funding pressures are still high.
- Japan is somewhere between recovery and expansion. Corporate leverage is at precrisis levels, bank lending conditions are fairly loose, and, despite the strong yen, corporate earnings have rebounded sharply, as they have in the United Kingdom and the United States.

Figure 1.30. Bank Lending Conditions for Nonfinancial Corporations
(Net percentage of respondents reporting tightening loan standards)



Sources: Haver Analytics; national authorities; and IMF staff estimates.
Note: For Japan and the United Sates, a simple average of responses from small, medium-size, and large firms.

[18]Smaller firms, which are weighed down by still-weak demand and inconsistent access to credit, continue to lag the rest of the sector.

- Except in the Europe, Middle East, and Africa (EMEA) region, emerging markets are the furthest along in the credit cycle, as they were hit less hard by the global financial crisis and their growth remains strong. Credit growth has continued to expand at a fast clip—especially compared with that in advanced economies—while strong demand for their assets is contributing to releveraging of corporate balance sheets, particularly in Asia and Latin America. The EMEA region is still in the recovery phase except for Turkey, where credit grew rapidly until June 2011 as households and smaller enterprises leveraged. The combination of releveraging and rapid credit growth is stretching valuations. Underwriting standards may be weakening, and due diligence is becoming more lax amid increased lending to weaker credits.

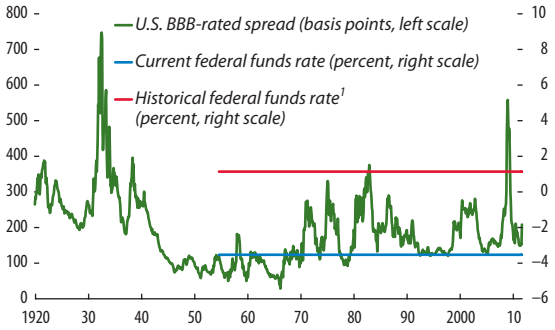
Low interest rates and abundant liquidity have spurred the search for yield...

In the advanced economies, real interest rates are much lower and liquidity is more abundant than is normal for this point in the cycle. For example, the real federal funds rate has historically been at around 1 percent—well above the current rate—whenever spreads on investment-grade corporate bonds (a proxy for the credit cycle) reached current levels (Figure 1.31). A similar situation is evident in other advanced economies, where countercyclical policy stimulus resulted in ultralow policy rates, quantitative easing, and large-scale refinancing operations. With low or negative real interest rates, yields on a wide range of asset classes are too low to meet the return targets for many pension funds and insurance companies or to maintain positive portfolio returns for asset managers.

...leading to a compression in spreads that may not be fully justified by fundamentals...

While the cyclical pattern has not changed, this credit cycle has been faster and more pronounced than in the past because of rapid central bank easing. From as long ago as the 1930s, no other cycle has seen corporate credit spreads narrow from such elevated levels in such a short period. Only in the

Figure 1.31. U.S. BBB-Rated Corporate Credit Spreads versus Real Federal Funds Rate



Sources: Deutsche Bank; Haver Analytics; national authorities; and IMF staff estimates.
[1]Prevailing federal funds rate when credit spreads were historically within 50 basis points of current levels.

1930s credit cycle were spreads as elevated as they were in this one, but then it took nearly twice as much time for spreads to normalize.

Credit spreads have also narrowed sharply in Europe and Asia, although not to the same extent as in the United States. Other credit metrics exhibit a similar pace and magnitude of change: earnings, the credit rating upgrade-to-downgrade ratio, and default rates have all improved sharply. The global default cycle has been shorter than in earlier cycles in which defaults had reached similar peaks. Low rates have enabled issuers to quickly refinance into longer-dated debt, swap unsecured debt for secured financing, and refinance debt to more manageable repayment levels.

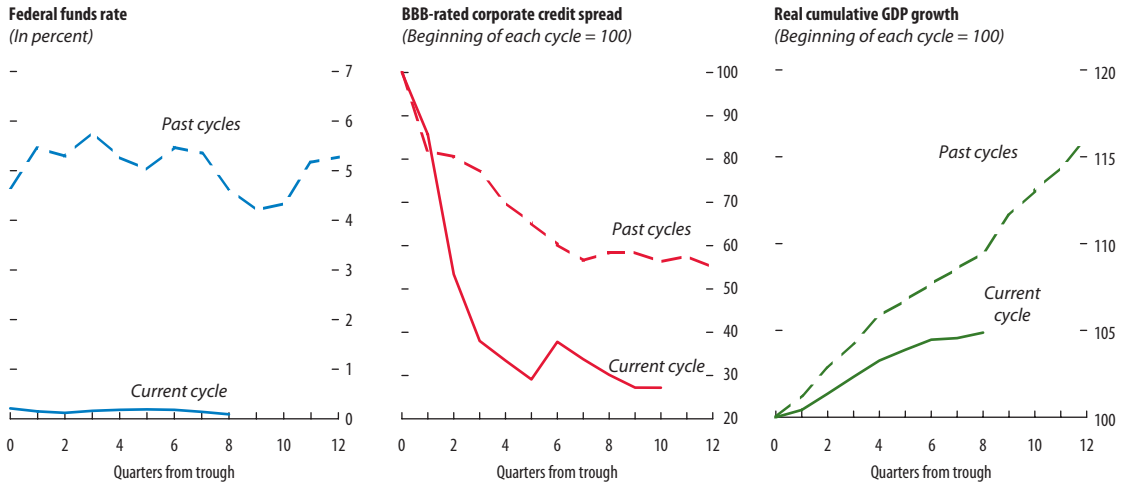
...especially when viewed against the anemic economic recovery.

The overall tightening of corporate credit spreads is occurring against a backdrop of a relatively tepid economic recovery. The current economic cycle is lagging the trajectory of the last 14 cycles, going back to 1929, yet investment-grade spreads have narrowed more sharply and more quickly than during prior cycles as large liquidity injections spread into credit markets and other risky assets (Figure 1.32). A rapid snap-back in spreads could impose losses, thereby undermining corporate as well as funding market confidence.

And as spreads narrow, investors have started to increase leverage to enhance yield, including through the shadow banking system.

Investors have continued to exercise discipline, as lessons from the crisis remain fresh and as concerns about a growth slowdown have returned. However,

Figure 1.32. Current versus Past U.S. Credit and Economic Cycles: Nominal Federal Funds Rate, BBB-Rated Corporate Spread, and Real Cumulative GDP Growth



Sources: Deutsche Bank; Haver Analytics; National Bureau of Economic Research (NBER); and IMF staff estimates.
Note: Economic cycles based on quarterly data for real GDP since 1929; estimates for 1929–1947 interpolated from annual data.

at the margin, the sustained period of low yields has prompted some investors (especially those with return targets) to take on more credit, liquidity, structural, and duration risk or to increase leverage to enhance returns.[19] While welcome as an indication that credit flows remain largely unimpeded, this trend may have stability implications if it gains momentum.

At the start of the year, the strategies employed by investors to increase yield included extending duration and purchasing less liquid and lower quality assets. As spreads continued to narrow, financial leverage began to rise, as manifested by (i) greater use of leverage (e.g., hedge fund leverage ratios have risen since the start of the year, and in general the use of total return swaps has increased); (ii) more issuance of products with embedded leverage (e.g., structured notes; Figure 1.33);[20] and (iii) increased provision of leverage (e.g., by some prime brokers, though levels are not yet excessive). Overall leverage is not particularly high by historical standards—and in fact there have been some recent reversals—but such trends bear close monitoring.

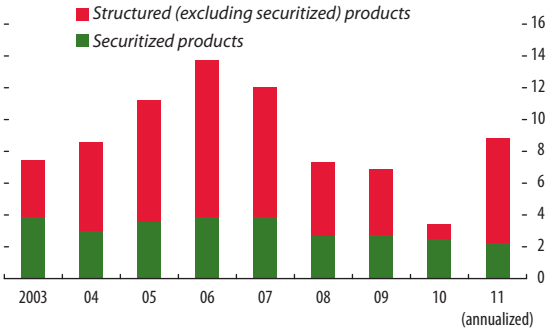
There are also signs of "style drift," or increased cross-over investment, which is consistent with the search for yield.

To compensate for low returns on traditional products, new investor classes are gravitating to unorthodox market sectors. For instance, high-yield funds are shifting into equity tranches and alternative assets, nonspecialized investors are gravitating to structured products (e.g., collateralized loan obligations and mortgage-related credit), and retail investors are increasingly seeking out leveraged loan mutual funds and complex types of exchange traded funds (ETFs).

[19]As Chapter 2 documents, pension funds and insurance companies have increased their allocations to commodities, real estate, private equity, and other alternative assets to maintain yield.

[20]Securitized markets have been slower to recover, with private residential mortgage markets mostly closed. Structured products include medium-term notes, constant-maturity swaps and constant-maturity Treasury notes, various types of range accrual notes, inverse floaters, various types of step-up notes, and various types of linked notes. Securitized products include asset-backed securities, residential mortgage-backed securities, commercial mortgage-backed securities, collateralized debt obligations, collateralized loan obligations, collateralized mortgage obligations, and other structured credit products.

Figure 1.33. Global Securitized and Structured Products Issuance
(In trillions of U.S. dollars)



Sources: Association for Financial Markets in Europe; Bloomberg L.P.; Securities Industry and Financial Markets Association; and IMF staff estimates.
Note: For definition of products, see text note 20.

The trend toward riskier investments has been underscored by an increase in alternative investment vehicles. At $1.8 trillion, the assets of global hedge funds are up 25 percent since the trough in late 2009 (Figure 1.34). New private equity transactions as well as refinancings of existing LBOs are also on the rise. Having stayed on the sidelines for some time, private equity funds have sizable cash levels and are increasing leverage.[21] While the shift into such investment vehicles may help reduce direct risks to the banking system, their greater opacity and potentially riskier investment strategies create additional challenges.

More broadly, with bank balance sheets still in need of repair, credit is increasingly being intermediated through nonbank channels.

The current credit cycle has been distinguished in the United States and, to a lesser extent, in Europe by a shift from banks to the capital markets as the preferred source of corporate financing (Figure 1.35), even though bank lending conditions have eased. The shift reflects the fact that asset markets have been normalizing more rapidly than banking systems. Nonfinancial corporations are determined not to

[21]At 5-times, leverage ratios are slightly above the historical average but still below the 11- to 12-times level at the peak of the crisis.

be beholden to banks, given the uncertainty about future commitments. As the source of funding has shifted from banks to markets, the bifurcation between small and large firms has deepened. Small and medium-sized enterprises (SMEs)—which tend to be almost exclusively reliant on bank financing—are getting left behind, while larger firms have easy access to cheap credit.[22]

Pockets of leverage could become excessive in some segments.

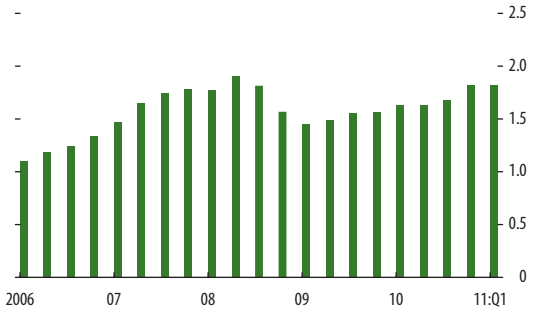
The high-yield bond market and the leveraged loan market have been especially affected by the search for yield. Issuance has risen (Figure 1.36), while strong demand has enabled issuers to extract more favorable terms, leading to spread compression, weaker covenants, and a greater degree of leverage. Furthermore, compared with more traditional institutional investors that are locked in, retail investors have expanded into the leveraged loan segment through mutual funds and ETFs, whose liquidity could become strained in the event of a pullback.

These conditions increase the potential for a sharper and more powerful turn in the cycle.

The trade-off between macroeconomic and financial stability risks needs to be carefully considered. Stability risks are still in their infancy, but with interest rates lower than they usually are at this point in the cycle, there is a potential for a greater deterioration in credit quality down the road. Moreover, because yields have narrowed during a relatively weak economic recovery, there is less of a buffer once the cycle finally turns. The shift away from bank financing exposes corporate issuers to the fickleness of capital markets. Furthermore, the shift into weaker-quality credits, combined with leverage, can be risky if not properly managed. While dimmer prospects for economic growth may temporarily slow this momentum, safeguarding stability calls for greater emphasis on balance sheet repair so that interest rates can be normalized and credit cycle

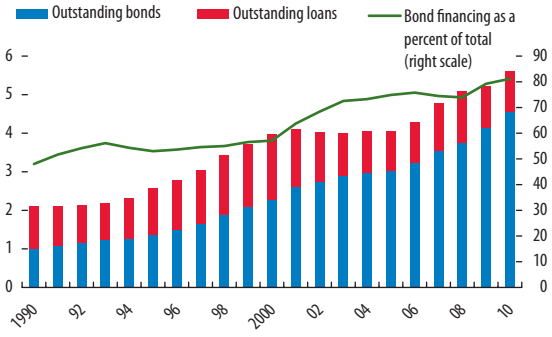
[22]Credit conditions continue to normalize for SMEs, but credit extension is inconsistent, and the cost of credit is still elevated.

Figure 1.34. Hedge Fund Assets under Management
(In trillions of U.S. dollars)



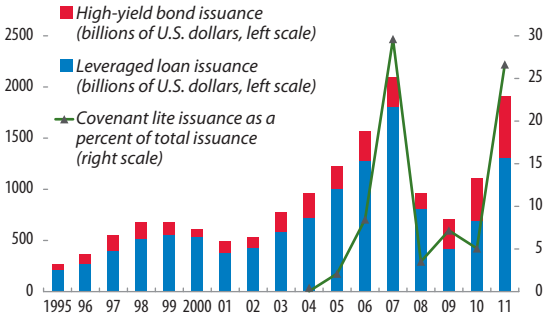
Source: Hedge Fund Research; and IMF staff estimates.

Figure 1.35. Financing by U.S. Nonfinancial Corporations
(In trillions of U.S. dollars except as noted)



Sources: Federal Reserve; Haver Analytics; and IMF staff estimates.

Figure 1.36. High-Yield Gross Issuance and Leveraged Loan Covenants



Sources: Bank of America Merrill Lynch; and Bloomberg L.P.
Note: Issuance data for 2011 annualized; covenant lite 2011 data as of Q2.

excesses avoided in mature markets. These risks are even more apparent in emerging markets.

Low rates and unfinished balance sheet repair in advanced economies have helped spur flows into emerging markets...

Net capital flows to emerging markets remained relatively strong—although volatile—during the first half of 2011 (Figure 1.37), reflecting higher nominal interest rates, the perception that currencies will appreciate, and relatively strong fundamentals. In turn, the elevated inflows, surging credit growth, and rising debt issuance are supporting a releveraging of balance sheets.

Net capital inflows to emerging markets have not been excessively strong by historical standards. However, portfolio and bank-related (other) inflows have dominated inflows, particularly in EMEA and Asia (Figure 1.38). The volatile nature of portfolio flows means that they could reverse rapidly if investors take fright or valuations are perceived as too stretched.

...as the search for yield directs flows into emerging market corporate debt securities...

Over the past year, flows into emerging market corporate external debt have surpassed flows into U.S. high-yield debt on an asset-weighted basis. Gross issuance accounted for nearly half of all new private credit in some regions (e.g., Latin America). This is part of a cyclical and structural trend, with emerging market corporate debt increasingly viewed as a substitute for U.S. high-yield debt (Figure 1.39).

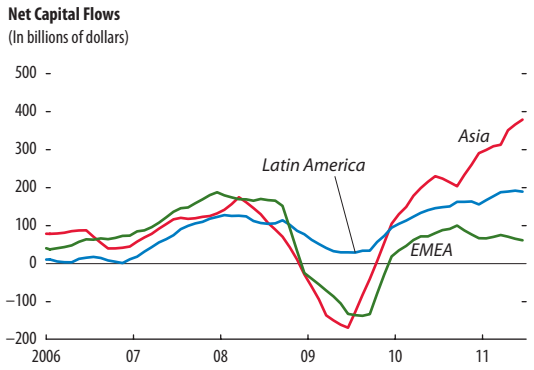
...which may lead to a mispricing of credit risk and a weakening of due diligence.

The issuance of emerging market corporate debt is on track to reach another record high this year, with firms in Latin America and Asia leading the expansion. High issuance can represent a healthy development to the extent that some previously credit-constrained companies gain access to capital markets; but the risk is that large capital flows may be moving too quickly into this asset class, potentially leading to mispricing and a sudden reversal. Reports of accounting scandals and fraudulent practices suggest that due diligence is slackening, and investors have continued to move down the credit spectrum (Figure 1.40).

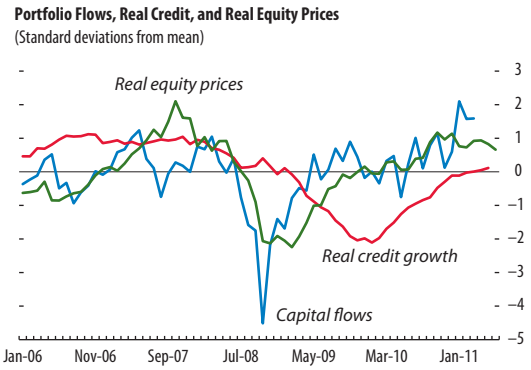
Emerging market credit risk is being "exported" to international investors.

In response to tightened prudential regulations and, for some sectors, less accommodative domestic credit conditions, emerging market corporations have shifted into international debt issuance, effectively

Figure 1.37. Emerging Markets: Capital Flows, Credit, and Equity Prices

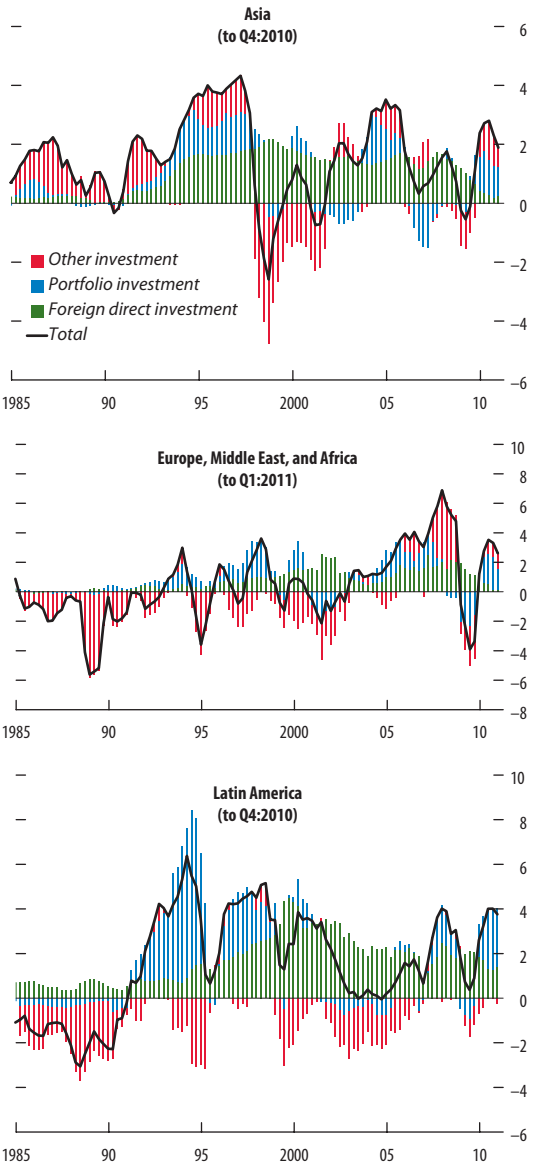


Sources: Bloomberg L.P.; CEIC; and IMF staff estimates.
Note: Twelve-month moving sums. Asia = China, Indonesia, India, Korea, Malaysia, and Thailand. Latin America = Brazil, Chile, Colombia, Mexico, and Peru. EMEA = Hungary, Poland, Russia, Turkey, and South Africa.



Sources: CEIC; IMF, International Financial Statistics database; and IMF staff estimates.

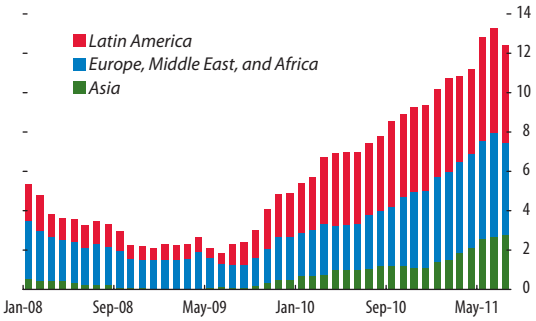
Figure 1.38. Net Capital Flows by Region
(Percent of aggregate GDP, four-quarter moving average)



Sources: Haver Analytics; IMF, International Financial Statistics database; and IMF staff estimates.

Note: Asia = China, India, Indonesia, Korea, Malaysia, Philippines, Taiwan Province of China, and Thailand; Europe, Middle East, and Africa = Egypt, Hungary, Israel, Poland, Russia, South Africa, and Turkey; Latin America = Argentina, Brazil, Chile, Colombia, Mexico, and Peru.

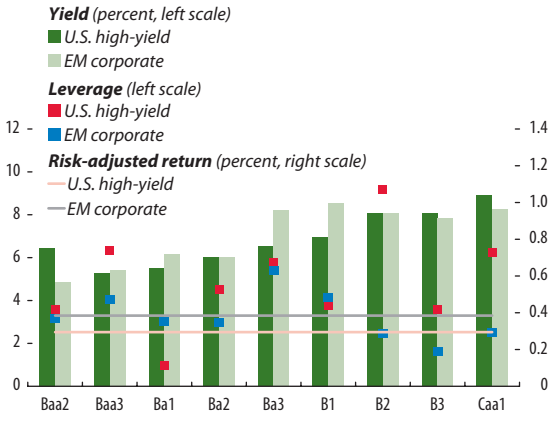
Figure 1.39. Emerging Market Corporate External Issuance
(In billions of U.S. dollars, 12-month moving average)



Sources: Dealogic; and IMF staff estimates.

exporting credit risk overseas (Figure 1.41). For example, offshore debt issuance by Chinese firms has surged as credit has been tightened onshore. Chinese companies are also motivated to borrow in dollars to benefit from lower interest rates, ample foreign demand, and expected appreciation of the renminbi. Large property developers have been among the most active external issuers, as their access to mainland credit has been curtailed by official measures to cool the property market.

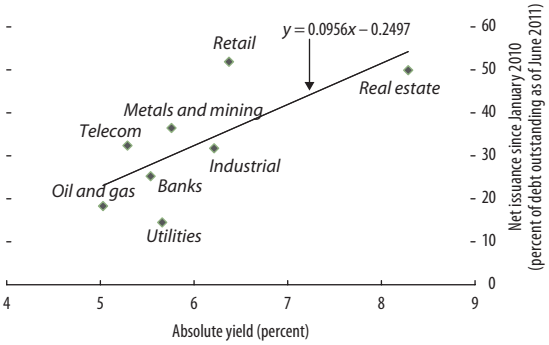
Figure 1.40. Emerging Market Corporate versus U.S. High-Yield Debt: Yields, Leverage, Returns



Sources: Bank of America Merrill Lynch; JPMorgan Chase & Co.; and IMF staff estimates.

Note: Leverages calculated as total debt/EBITDA. Returns are estimated for the six months through June 2011.

Figure 1.41. Emerging Markets External Corporate Issuance, by Sector



Sources: Bank of America Merrill Lynch; JPMorgan Chase & Co.; and IMF staff estimates.

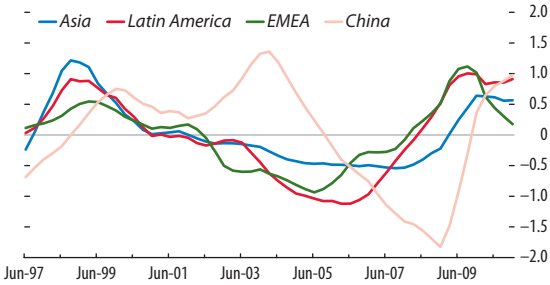
At the same time, rapid growth of domestic credit may weaken the quality of bank assets.

Rapid credit growth in many emerging markets raises the risk of deteriorating credit quality. During credit booms, strong balance sheets tend to generate excessive lending against inflated collateral values (Figure 1.42), while the herd behavior of bank managers tends to cause a deterioration in credit quality. China is arguably at an advanced stage of the credit cycle, reflecting the legacy of its policy-induced lending boom of 2009–10, which has already brought asset quality concerns to the fore (Box 1.5). In other emerging markets, including Brazil and Turkey, credit quality appears strong on the surface, but rapid growth in domestic credit—particularly to the household sector—poses a key challenge to future stability.

As the credit cycle advances, some markets for high-end real estate are showing signs of bubble dynamics. Although this is most evident in Hong Kong SAR and Singapore—prices there have been fueled by negative real interest rates, demand from wealthy mainland investors, and the booming financial sector—several other major cities have also seen large price gains. For now, low leverage in this market segment appears to be limiting the risks to financial stability. However, if price corrections spread to lower-income segments and other markets where leverage is higher, there could be broader effects on economic activity and financial stability. It is reassuring, therefore, that recent tightening measures in Hong Kong SAR and Singapore appear to have had some effect in slowing speculative activity and that increased property supply is seen as a powerful tool to combat price increases (Box 1.6).

Figure 1.42. Emerging Markets: Total Credit to the Nonbanking Sector

(Deviation from 1996–2010 trend, in Z-scores)



Sources: Bank for International Settlements; IMF, International Financial Statistics database; and IMF staff estimates.

Note: Total credit is scaled by GDP and includes total domestic credit by banks, external loans to nonbank sector, and nonfinancial corporate external and domestic debt issuance. Four-quarter moving average of deviation from a 1996–2010 trend. EMEA = Europe, Middle East, and Africa. Z-score = standard deviations from mean.

Historical experience suggests that bank asset quality in many emerging markets is likely to deteriorate in coming years...

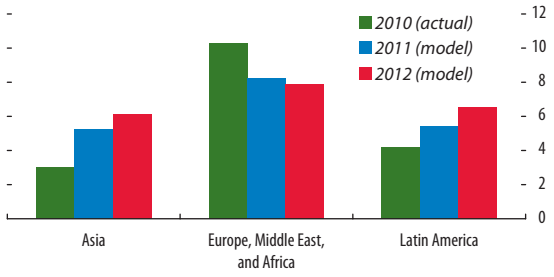
Econometric analysis indicates that sizable capital inflows, favorable terms of trade, and strong real growth have all contributed to credit creation in emerging markets.[23] Our model predicts that nonperforming loan (NPL) ratios will rise in many emerging markets, even in a baseline scenario in which external and domestic variables normalize gradually as the expansion phase of the credit cycle reaches its end (Figure 1.43). The predicted increase is largest in Asia, where strong credit growth has been supported by accommodative monetary policy, and NPL ratios are at recent lows. In central and eastern Europe, on the other hand, the model does not project a deterioration in credit quality under the base case, as credit growth has been muted in recent years.

...and emerging markets remain vulnerable to external shocks...

Sovereign risks in the euro area, or fiscal strains elsewhere, could spill over to global markets,

[23]See Annex 1.1 for technical details. The macroeconomic scenarios underlying the analysis were built using a panel VAR approach.

Figure 1.43. Model Prediction for NPL Ratios in 2011 and 2012 Based on 2010 Values
(In percent; no shock)



Sources: Bankscope; IMF, International Financial Statistics database, World Economic Outlook database; and IMF staff estimates.
Note: Forecasts based on a panel VAR with ratio of private credit to GDP, NPL ratio, ratio of net capital flows to GDP, and growth rates of terms of trade and real GDP. NPL = nonperforming loan. See Annex 1.1.

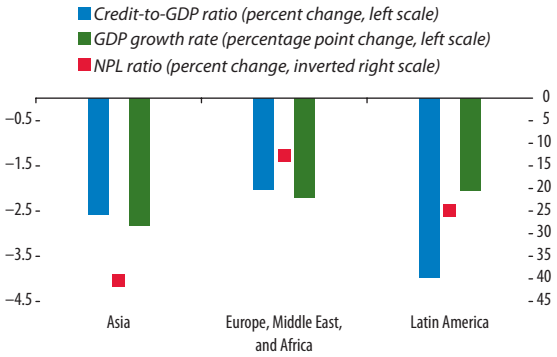
resulting in risk retrenchment, a reversal of capital inflows, and a decline in commodity prices. Our analysis indicates that vulnerabilities to a sudden stop currently are less elevated in EMEA than in Asia and Latin America, which are at more advanced phases of the credit cycle and have had sharper recent increases in foreign currency liabilities than EMEA. The analysis also indicates that a negative terms-of-trade shock would have the largest impact in Latin America, which has benefited from favorable terms-of-trade shifts in recent years (Figures 1.44 and 1.45).

. . . which could pressure emerging market banks.

The vulnerability of growing loan books to macroeconomic shocks means that emerging market policymakers need to carefully monitor the strength of bank balance sheets. An analysis using economic capitalization measures indicates that the capital adequacy of banks in all emerging market regions could be considerably impacted by shocks in GDP growth, terms of trade, and funding costs (Table 1.3). Banks in Latin America would suffer a larger impact from terms-of-trade shocks, while banks in Asia and EMEA would be somewhat more sensitive to a 300 basis point increase in funding costs, as they operate in an environment of lower interest rates.[24] In an

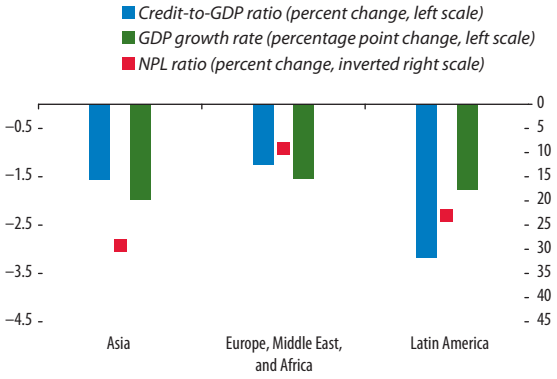
[24]Economic capitalization measures are based on the use of risk weightings adjusted for changes in credit risk using parameters underlying the Basel II internal ratings based (IRB) method. Such weightings usually differ from regulatory capital adequacy weightings based on Basel I. Emerging market banks usually do not use economic capitalization measures to report balance sheet strength and therefore tend to overstate the capital cushion available under stress. The IRB/Basel II approach results in lower capital adequacy ratios and higher risk-weighted assets than does the Basel I approach, as it adjusts for credit risk on the entire loan book, not just on rated securities. The negative GDP growth shock corresponds to around 1.3 standard deviations for each region.

Figure 1.44. Impact when Net Capital Flows Decline



Sources: Bankscope; Haver Analytics; IMF, International Financial Statistics database, World Economic Outlook database; and IMF staff estimates.
Note: Response to decline in net capital flows of two standard deviations (8.7 percentage points, calculated from pooled sample). Shown are responses relative to the baseline in a panel VAR with ratio of private credit to GDP, NPL ratio, ratio of net capital flows to GDP, and growth rates of terms of trade and real GDP. See Annex 1.1.
NPL = nonperforming loan.

Figure 1.45. Impact when Terms of Trade Decline



Sources: Bankscope; Haver Analytics; IMF, International Financial Statistics database, World Economic Outlook database; and IMF staff estimates.
Note: Response to terms-of-trade deterioration of two standard deviations (15.8 percentage points, estimated from pooled sample). Shown are responses relative to the baseline in a panel VAR with ratio of private credit to GDP, NPL ratio, ratio of net capital flows to GDP, and growth rates of terms of trade and real GDP. See Annex 1.1.
NPL = nonperforming loan.

Table 1.3. Emerging Market Banks: Sensitivity to Macroeconomic and Funding Shocks
(Percentage point deviations from baseline capital adequacy ratios in 2013)

	GDP Growth Shock (5 percentage points lower than WEO)	Terms-of-Trade Shock (two standard deviations)	Funding Shock (300 basis points)	Combined Shock
Europe, Middle East, and Africa	-3.4	-1.1	-1.2	-5.1
Latin America	-4.5	-1.5	-0.8	-5.7
Asia	-1.3	-0.7	-1.3	-2.5

Sources: Bankscope; IMF, International Financial Statistics database, World Economic Outlook database; and IMF staff estimates.

Note: Red cells indicate the largest deviation for the indicated shock, yellow cells the smallest. Capital adequacy ratios calculated as regulatory capital divided by risk-weighted assets using economic (Basel II internal ratings based) risk weights. See Annex 1.1.

exceptionally severe case, in which all three types of shocks occur simultaneously, simulations suggest that the absolute changes to capital adequacy ratios would be similar across regions, whereas Asian capital buffers would be somewhat slower to recover in the absence of capital injections, given the weaker outlook for asset quality in Asia over the medium term (Figure 1.46).[25]

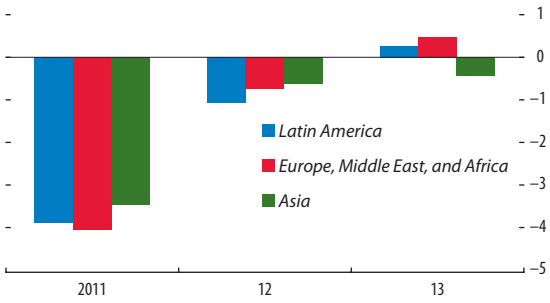
A balanced policy response is needed to safeguard against overheating risks and to strengthen financial resilience.

Although the intensity of capital inflows in emerging markets has abated somewhat, and policymakers have generally tightened monetary policies, risks of overheating and asset price bubbles persist in some countries (Table 1.4). Structural fiscal deficits are still large; inflation, credit growth, and corporate leverage have continued to rise; and debt and equity valuations appear stretched.

Emerging market policymakers need to guard against a buildup of financial imbalances, making use of both conventional and macroprudential measures. The rapid growth in credit raises risks of deteriorating asset quality, and policymakers need to closely monitor the health of bank balance sheets, preferably using economic capitalization measures when testing for resilience to adverse shocks. Corporate leverage is also rising, and weaker

[25]However, it should be noted that governments in Asia arguably have the strongest ability to inject capital into their banking systems if needed.

Figure 1.46. Change in Capital Adequacy Ratios under Combined Macro Shocks
(In percentage points, using Basel II IRB risk weights)



Sources: Bankscope; IMF, International Financial Statistics database, World Economic Outlook database; and IMF staff estimates.

Note: IRB = internal ratings based. See Annex 1.1.

firms are increasingly accessing capital markets. This could make corporate balance sheets more vulnerable to external shocks. With strong domestic demand pressures, especially in Asia and Latin America, tighter macroeconomic policies are needed to avoid overheating and prevent an accumulation of financial risks. Macroprudential tools and, in some cases, a limited use of capital controls, can play a supportive role in managing capital flows and their effects. However, they cannot substitute for appropriate macroeconomic policies. Moreover, the analysis shows that in the face of sharply higher global risks, emerging markets would not escape financial distress, suggesting that in some countries, an increase in bank capital would be warranted to buffer against global shocks.

Table 1.4. Macroeconomic and Financial Indicators for Selected Economies

(Shaded cells represent five economies with highest values for each indicator)[1]

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI
	Net portfolio inflows[2]		Inflation			External and domestic policies			Credit			Corporate leverage[12]		Asset valuations[13]		Non-FDI external financing needs[14]
	Equities	Debt	Level[3]	Change[3]	Output gap[4]	Official reserves[5]	Real interest rate[6]	Structural fiscal balance[7]	Credit to private sector[8] Level[9]	Credit to private sector[8] Change[10]	Bank loans to deposit ratio[11]	Debt/equity Nonfinancial	Debt/equity Financial	Equities	Debt	
Europe, Middle East, and Africa																
Egypt	n.a.	n.a.	-0.1	-0.1	n.a.	-3.9	-3.6	n.a.	-1.9	5.8	0.5	-0.7	0.3	n.a.	n.a.	1.3
Hungary	-0.1	-0.1	-1.2	-0.9	-2.4	8.1	2.0	-4.8	-0.4	-2.0	1.5	1.0	0.4	-1.0	-0.8	-0.6
Poland	1.9	0.6	0.7	1.9	0.4	4.9	0.3	-6.1	1.5	7.9	1.1	-0.5	-0.9	-0.9	-1.1	3.2
Russia	0.2	-0.1	-0.7	3.5	-2.1	3.4	0.2	-0.3	0.6	10.0	1.1	1.2	0.3	-0.5	-1.2	-5.8
Israel	-2.1	2.8	0.6	1.6	0.7	6.6	-0.3	-3.1	-2.1	8.2	1.0	1.0	1.5	-0.7	-0.2	0.1
South Africa	-0.2	0.6	-0.1	1.6	-1.3	1.9	0.7	-3.7	0.2	4.5	1.2	0.0	0.4	-0.1	-1.4	1.2
Turkey	0.1	2.2	-1.2	-1.3	2.0	3.1	-0.2	-2.1	1.9	27.8	0.8	0.2	-0.3	-0.4	0.3	8.6
Asia																
China	-0.1	0.2	1.4	3.2	n.a.	12.7	1.3	-1.8	1.6	21.7	0.8	0.6	0.2	0.2	n.a.	-7.0
India	2.4	n.a.	1.0	-1.1	0.2	2.2	0.1	-8.3	1.0	26.3	0.8	2.6	-0.6	0.5	-1.1	1.4
Indonesia	-0.4	1.4	-0.8	-1.6	-0.0	6.0	1.0	-1.7	0.9	19.4	0.8	-0.5	-0.4	0.8	0.4	-1.6
Korea	0.4	0.9	1.6	2.2	-0.1	3.5	-0.9	2.1	-0.0	7.5	1.4	-0.7	-0.4	-0.1	1.2	0.1
Malaysia	n.a.	n.a.	0.5	1.6	0.4	16.5	-0.3	-5.7	1.2	9.0	0.9	-0.1	-0.7	0.1	0.3	-9.5
Philippines	-0.8	1.5	-0.3	0.8	n.a.	9.8	-0.6	n.a.	1.2	13.3	0.6	3.8	-0.3	0.1	n.a.	-2.3
Taiwan Province of China	-2.0	-2.0	-0.1	0.0	n.a.	n.a.	-0.0	-4.2	-2.8	8.1	0.7	-0.5	-0.9	-0.5	0.5	-9.2
Thailand	-0.6	1.8	0.4	0.6	0.5	11.1	-0.4	-2.3	1.5	10.7	1.0	-0.5	-0.5	0.6	1.0	-5.3
Latin America																
Brazil	2.0	-0.0	1.2	2.3	n.a.	3.9	5.8	-2.9	1.9	25.5	0.8	0.3	1.7	0.3	0.4	-0.3
Chile	-0.4	0.9	-0.2	0.7	0.1	4.8	1.5	-1.7	-0.8	1.4	1.4	-0.2	-0.7	1.2	-0.7	-4.3
Colombia	n.a.	0.1	-0.9	1.1	0.1	1.6	1.1	-3.1	1.7	16.6	1.7	0.3	-0.1	1.4	n.a.	1.2
Mexico	-0.6	1.8	-0.9	-0.1	n.a.	2.3	0.9	n.a.	0.8	9.7	0.7	-0.6	n.a.	0.6	-1.4	-0.9
Peru	0.1	1.7	0.3	1.5	0.2	7.4	0.8	-0.2	1.1	15.5	0.8	-1.0	0.7	0.6	-0.7	-1.7

Sources: Bank for International Settlements (BIS); Worldscope; Bloomberg, LP.; Consensus Economics; Haver; IBES; IMF: International Financial Statistics database, World Economic Outlook database; and IMF staff estimates.

Note: FDI = foreign direct investment; EMEA = Europe, the Middle East, and Africa. In the following notes, Z-score = number of standard deviations from the mean.

[1]In each column except VII and VIII, red cells signal two highest values and yellow cells signal next three highest values; in columns VII and VIII, colors signal lower values.

[2]In percent of GDP, 4Q moving average, in Z-scores. Mostly up to March 2011.

[3]July 2011 levels in Z-scores relative to 2004–11 period, and change in year-on-year inflation in July 2011. For the Philippines, June 2011 data; for India, the wholesale price index.

[4]In percent of potential GDP, 2011 (September 2011 WEO).

[5]Gross international reserves minus gold, year-on-year changes in June 2011; for Egypt and Peru, updated to May 2011 as a percent of 2010 GDP.

[6]Policy rate as of end-August 2011 minus 2011 inflation expectations, in percent.

[7]Estimates of 2011 structural balance, in percent of potential GDP.

[8]Total credit to households and businesses obtained from domestic and international banks and capital markets.

[9]Deviations from 1996–2010 trend, in Z-scores in December 2010.

[10]In percent, annual change to December 2010.

[11]Calculation is based on the International Financial Statistics database, mostly updated to 2011:Q1. For China, loans are banking sector claims on other sectors; and deposits are calculated as the sum of time, savings, and demand deposits.

[12]In Z-scores, up to December 2010.

[13]Z-scores of valuation ratios for equities (average of price-to-book ratio and dividend yield) at May 2011 and of deviations from estimated equilibrium values for local government bond yields at March 2011 (see April 2010 GFSR, Annex 1.9).

[14]Current account balance plus net FDI inflows (reverse signs) in percent of GDP, 2011 (September 2011 WEO). Positive number represents financing need.

Box 1.5. Gauging Financial Stability Risks in China

China's post-2008 credit boom has left a legacy of doubtful loans, especially to local government entities. China experienced one of the highest rates of credit expansion in the world during 2009–10 as the authorities boosted bank-financed investment spending (first figure). Many of those investment projects are thought to lack longer-term commercial viability, putting the repayment of the underlying debt in doubt. As a result, analysts are projecting significant write-downs on exposures to the local government sector, whose actual and contingent liabilities amounted to 27 percent of GDP at end-2010.

Recent policy tightening has slowed headline loan growth, but other forms of credit have surged. Policy tightening has relied to a large extent on credit ceilings. As such, the effect has been asymmetric: while favored borrowers (e.g., those with particularly strong credit profiles or operating in priority sectors) continue to obtain loans at very low real interest rates, other companies are rationed out of the market. Moreover, the tighter supply of bank loans has fueled rapid growth in alternative forms of credit (second figure). These include:

- bank acceptance bills and trust loans, now also regulated more tightly;
- intercorporate lending and credit from small loan companies; and
- funding from banks based in Hong Kong SAR and offshore bond markets.

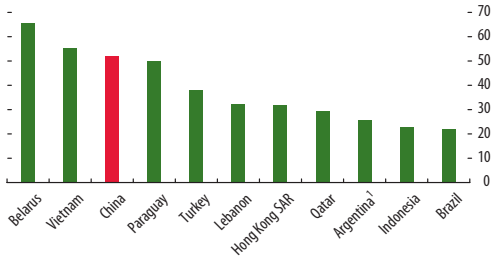
As a result, China has an unusually high level of gross debt. Based on the authorities' "total social financing" (TSF) data, the stock of domestic loans reached 173 percent of GDP at end-June.[1] This places China well above the levels of credit typically observed among countries at the same income level, although private-sector leverage has remained moderate (third figure).

A long-running real estate boom in China adds another layer of risk. According to official data, property prices have risen 60 percent since end-2006. Private-sector estimates suggest an even greater run-up in prices in some areas. Meanwhile, there is anecdotal evidence that many newly built units remain unoccupied, with investors focused exclusively on expected price gains. In this environment, the authorities' current efforts to cool the market might induce a sharper-than-expected correction in prices, depressing collateral values. A weaker property market could also put further pres-

Note: Prepared by André Meier.

[1]Computed as the sum of total bank loans and the cumulative flow of net new credit since 2002 from similar TSF components (trust loans, bank acceptance bills, and entrusted loans).

Cumulative Real Growth of Bank Credit, 2009–10
(In percent)

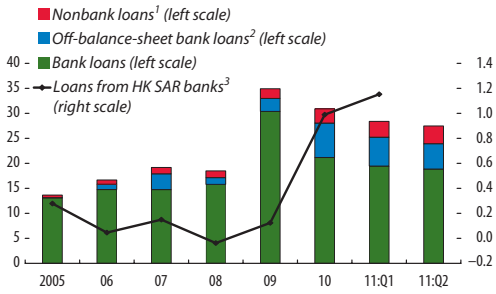


Sources: IMF, International Financial Statistics and World Economic Outlook databases.

Note: Nominal growth in domestic bank credit between end-2008 and end-2010, deflated by CPI inflation.

[1]Calculations are based on official CPI data. The authorities have committed to improving the quality of Argentina's official CPI to bring it into compliance with the obligations under the IMF's Articles of Agreement. Until the quality of data reporting has improved, IMF staff will use alternative measures of inflation for macroeconomic surveillance, including estimates by provincial statistical offices and private analysts, which have been considerably higher than official inflation since 2007.

China: Contributions to Net New Credit
(Percentage points of GDP)



Sources: Hong Kong Monetary Authority; People's Bank of China; and IMF staff estimates.

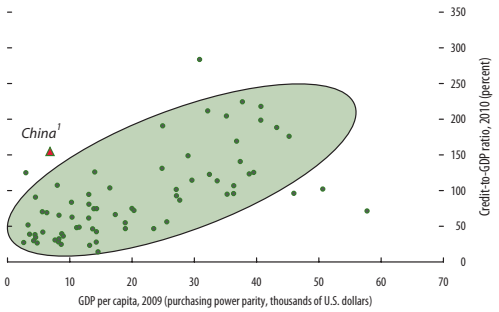
[1]Entrusted loans, i.e., brokered loans provided by nonbanks.

[2]Bank acceptance bills and trust loans.

[3]Computed as total net lending to the mainland by banks based in Hong Kong SAR minus change in renminbi deposits in the Hong Kong SAR banking system.

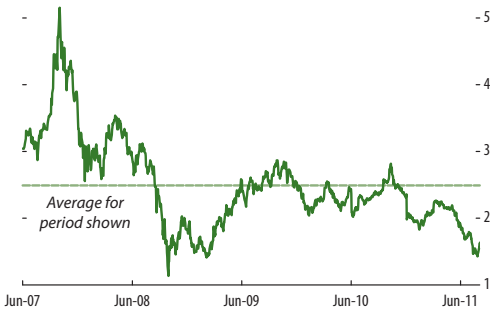
Box 1.5 *(continued)*

Credit-to-GDP Ratio versus GDP per Capita



Sources: CEIC; IMF, International Financial Statistics database; World Bank, World Development Indicators; and IMF staff estimates.
[1]Includes bank acceptances, trust loans, and entrusted loans, together estimated to be at 21.5 percent of GDP at end-2010.

Price-to-Book Ratio of the Largest Listed Chinese Banks



Sources: Bloomberg L.P.; and IMF staff estimates.

sure on local governments, which rely heavily on revenue from land sales.

Against this backdrop, financial markets have recently signaled growing concerns. Although investors have maintained a generally favorable outlook for the Chinese economy, many worry that the ongoing policy tightening might expose vulnerabilities related to the property and credit booms. One indication of such concerns is the slump in bank equities (fourth figure). From a recent peak of 2.8 times book value in late 2010, the median valuation of the largest listed banks has fallen to 1.6. Meanwhile, many property developers have seen their funding costs rise as high as 16 percent in the offshore dollar bond market. Aside from sector-specific woes, this repricing reflects general investor concern over corporate governance following a string of allegations concerning fraud and misreporting. Lastly, some investors have sought protection against broader risks associated with macroeconomic-financial linkages by buying sovereign credit default swaps or renminbi put options.

Still, while they believe it will be costly, most analysts consider that the likely fallout from China's credit boom will be manageable. One key source of confidence is China's strong fiscal position, including a large stock of public-sector assets and low central government debt. Nevertheless, even those buffers do not preclude significant bouts of uncertainty as to how losses will ultimately be allocated among the banks' private investors and local and central governments. To the extent that the government needs to step in, the consequence could be a substantial worsening of China's public debt metrics and a narrower scope for future fiscal stimulus.

Box 1.6. Can Macroprudential Policies Contain the Property Boom?

Property price increases are most pronounced in large cities in Asia and Latin America (first figure). Many of these locations are financial centers where the expansion of foreign banks and companies, along with rising local incomes, boosts demand for high-end property. Emerging market price increases since 2009 have been largest in Hong Kong SAR, which has taken the lead in using macroprudential policies to dampen real estate speculation and cool the market. Authorities in Hong Kong SAR have directly targeted the property market through increases in supply, hikes in property transaction taxes, and cuts in maximum loan-to-value (LTV) ratios.

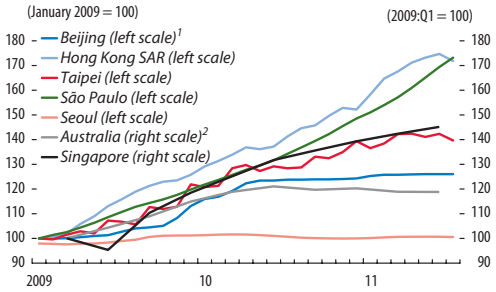
According to a model of property prices in Hong Kong SAR that we developed (table), increases in land supply and real interest rates have lasting impacts on prices, while a tightening of the LTV limits has a temporary impact.[1] A hike in the property tax rate has a very short and not statistically significant effect on price, but the rate declines the longer a property is held, and it appears to have discouraged speculative activity.

- A 1 percent increase in land supply drives property prices down by 0.8 percent but with a significant lag.
- A 1 percentage point increase in the real interest rate is associated with a price decline of around 1.6 percent.
- A 10 percentage point cut in the maximum LTV ratio slows property price inflation by a cumulative 6.8 percentage points, while a hike in the property transaction tax has no discernible effect.

Note: Prepared by R. Sean Craig, Estelle Xue Liu, and Changchun Hua.

[1]Our model of property prices in Hong Kong SAR implements the Engle-Granger error-correction methodology and consists of two equations, one long term and one short term (table). The first equation estimates, in levels, the long-run cointegration relationship between aggregate property prices and a set of independent variables. The second equation estimates the dynamic short-run relationship between the change in the property price, changes in the independent variables, and the LTV ratio and transaction tax, which are stationary variables. It contains the error-correction term, which shows how quickly the actual price, p, converges to the "equilibrium" property price, p^*, determined by the long-run equation.

Property Price Indices in Selected Large Cities



Sources: CEIC: Haver Analytics; and IMF staff estimates.
[1]Old and new data series for Beijing are combined using month-on-month change.
[2]Eight capital cities.

Also according to the model, the rapid rise in Hong Kong property prices is due to very favorable macroeconomic conditions (the actual observed property price remains within two standard devia-

Econometric Model of Hong Kong SAR Residential Property Price

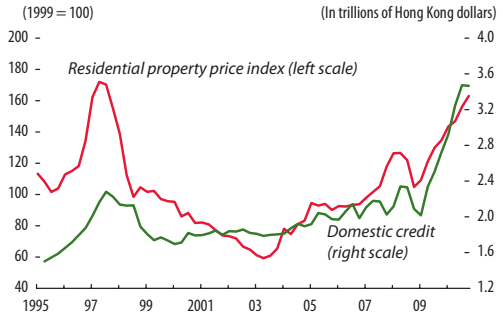
	Long-Run Equation: Log of Real Property Price (levels)	Short-Run Equation: Change in Log of Real Property Price
Real interest rate	-0.016**	-0.007
Log of real GDP per capita	1.468***	2.304***
Log of real domestic credit	0.291**	0.098
Log of land supply (lagged)	-0.794***	-0.414
Log of construction cost index	0.488***	0.254*
Loan-to-value ratio		0.644***
Property transaction tax rate (percent)		0.003
Error correction term (deviation of actual price from equilibrium price estimated in long-run equation)		-0.666***

Source: IMF staff estimates.

Note: ***, **, * indicate significance at the 1, 5, and 10 percent levels respectively. Not shown: constant, dummies for 2003 SARS crisis and 2008 global financial crisis.

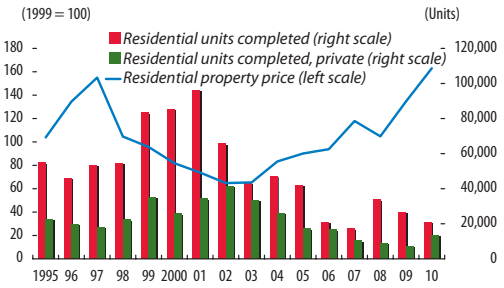
Box 1.6 *(continued)*

Residential Property Prices and Domestic Credit in Hong Kong SAR



Sources: CEIC; and IMF staff estimates.

Residential Property Price and Apartment Supply in Hong Kong SAR



Sources: CEIC; Haver Analytics; and IMF staff estimates.

tions of the model's "fitted" price). The price rise is well explained by strong GDP growth, a declining real interest rate (partly owing to a rise in inflation), and the surge in domestic credit, which may be proxying for the favorable financial environment (second figure). A cutback in land supply and, in turn, a drop in new apartment supply was exacerbated by the global financial crisis and put significant upward pressure on property prices (third figure).

The Hong Kong SAR experience suggests that narrowly targeted measures, such as cuts in LTV ratios, can temporarily slow the rate of increase in property prices, but to achieve lasting effects, policies must focus on the fundamental determinants of property prices. Increases in housing supply, in particular, could exert strong downward pressure on property prices in Hong Kong. Macroprudential policies affecting the macroeconomic determinants can also play a role. For example, efforts by the Hong Kong authorities to tighten bank liquidity to enhance financial stability, together with increased loan demand, have pushed up lending rates.

Policy Priorities

Time is running out to address existing vulnerabilities. The set of policy choices that are both economically viable and politically feasible is shrinking as the crisis shifts into a new, more political phase. Negative surprises and the intensification of risks have raised the urgency of prompt policy action to strengthen the global financial system. The need for a more robust financial framework is heightened by the limited room to deploy further fiscal and monetary policy stimulus. In the advanced economies, the priorities are to repair public balance sheets (in the United States, Europe, and Japan) and private balance sheets that are clearly overstretched (U.S. households, European banks). In addition, global financial regulatory reforms need to be concluded as soon as possible and implemented internationally. Emerging market policymakers face a contrasting challenge of limiting the buildup of financial imbalances, often in the midst of expansionary conditions, while continuing to build a robust financial framework.

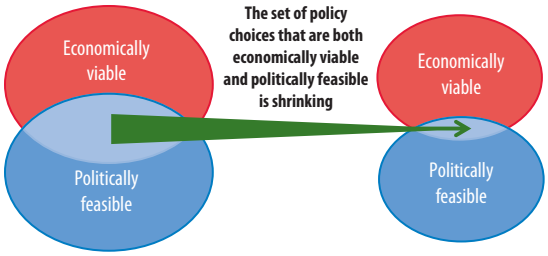
In the context of weaker growth prospects, the global financial system has experienced a range of shocks that have set back progress toward financial stability. One source of the shocks is the periphery of the euro area, where turbulence has spilled over to global financial markets. A second source is the ongoing U.S. fiscal policy impasse and the related downgrading of U.S. debt. A third source is uneven progress in repairing

bank balance sheets and in shoring up their capital positions. As a result, some sectors in many advanced economies appear trapped in the repair-and-recovery phase of the credit cycle even as low policy rates carry the risk that some segments will become overleveraged. In contrast, emerging markets are at a later stage in the credit cycle. Some face risks of overheating, and the financial systems of many are vulnerable to a possible global growth slowdown and reversal in capital flows.

The crisis has entered a new and more complex political phase.

The weakening outlook for growth, coupled with heavy debt burdens on both private and sovereign balance sheets, presents heightened risks to global financial stability. With the crisis now entering its fifth year, and with sovereign and central bank balance sheets already heavily extended, the range of policy options has become much more limited (Figure 1.47). Fiscal space is limited in many advanced economies, and immediate fiscal consolidation is needed in economies under market pressure. On the monetary front, policy rates across the advanced economies are at, or near, the zero boundary. Such an accommodative stance provides scope for balance sheet repair for banks and households but only limited repairs have occurred so far. Markets perceive major political economy difficulties as policymakers struggle to raise support for painful adjustment measures selected from a rapidly shrinking set of feasible choices. Policymakers have only limited time to reinforce credibility and build defenses against potential systemic shocks. As a result, with the limited resources still available, policymakers' focus should be on "curing" overstretched balance sheets through raising bank capital buffers or household debt write-downs.

Figure 1.47. Available Set of Policy Choices Is Shrinking



Comprehensive and coherent policy solutions are needed to effectively address sovereign risks and prevent contagion.

In the United States, policymakers need to further address the legacy of overstretched household balance sheets. Targeted policies to reduce debt would lower the likelihood of a sustained period of low demand as households attempt to return to financial solvency. In particular, a more ambitious program of mortgage modifications involving principal write-downs (potentially offset by granting lenders options on house price increases) would help address problems associated with household negative equity. Transforming unsold foreclosed residential housing stock into viable rental units would also reduce the supply overhang while boosting construction employment relatively quickly. Restoring confidence in the stability of the U.S. housing market is the key to bolstering the prospects for U.S. banks dented of late by the growth slowdown and legacy legal liabilities.

The important decisions by the euro area summit of July 21 and subsequent announcements by the ECB added to the enhanced crisis management tools of the euro area (see Box 1.7). The new framework improves the debt sustainability of program countries—in part by aligning official lending support with market incentives—and expands the flexibility of the European Financial Stability Facility (EFSF). Notably, the EFSF's ability to buy back bonds in the secondary market should help reduce the volatility of yields and spreads; and providing loans to sovereigns to strengthen capital buffers of the banking system will address contagion between sovereigns and banks. The net effect of the changes will be to improve the policy options available for preemptive action against market volatility. Meanwhile, continued ECB interventions into the larger sovereign debt markets under the Securities Markets Programme will help to stabilize markets, lower funding costs, and reduce the likelihood that vulnerable sovereigns will be pushed toward destabilizing debt dynamics.

However, investor confidence will likely depend on how swiftly those changes are adopted and whether the size of the EFSF is viewed as sufficient to match its expanded role. The recent widening of spreads

Box 1.7. Euro Area Developments in Crisis Management

Over the past year, the sovereign crisis in the euro area has substantially deepened, drifting in the direction of a self-fulfilling negative spiral. Fully aware of the need to halt these adverse dynamics, policymakers have pledged to do whatever it takes to safeguard the stability of the euro area. This has translated into successive packages of measures to support this commitment.

While implementation of the crisis management measures still needs to be completed, and further measures are likely to be necessary, the steps undertaken thus far are necessary building blocks of a definite solution of the crisis. They took place in a challenging environment, including legal (treaty) prohibitions of collective support among euro area member states, a public hostile to financial markets following taxpayer funded bailouts, and a long-term focus on the restoration of market discipline through private sector bail-ins.

Recognizing the need for a comprehensive approach, policymakers worked along four broad dimensions: national policy actions to ensure sound fiscal fundamentals and restore competitiveness; unconventional central bank support; creation of a safety net for euro area members losing access to market-based financing; and strengthening the economic governance of the euro area to prevent a recurrence of present tensions. While it is clear that national action to secure fiscal sustainability and restore growth are essential, the existence of a monetary union required action also at the euro area level. In addition, the banking authorities of the European Union have conducted rounds of coordinated EU-wide stress tests with high levels of transparency and disclosure.

Central Bank Support

The European Central Bank has been providing the first line of defense against financial instability. Liquidity provision to the banking system, first made necessary by the global financial crisis, has remained in place and has been adjusted as needed to mitigate tensions in the financial system. Refinancing operations are being conducted with fixed-rate tender procedures with full allotment, currently with maturities of up to six months, against very broad collateral that includes the sovereign securities of countries receiving financial assistance. Since May 2010, the ECB has also been operating a Securities Markets Programme (SMP) under which it has been buying sovereign securities in the secondary market to help establish orderly sovereign debt markets, thus preserving the effectiveness of the transmission mechanism of monetary policy. In August 2011, the ECB stepped up this program, also intervening in the markets for the sovereign debt of Italy and Spain. Total SMP purchases through September 2, 2011, amount to €130 billion.

A Euro Area Safety Net

National authorities have been working on a safety net to assist countries facing difficulties in accessing markets in the context of adjustment programs under strict conditionality. In May 2010, euro area member states put together a package of bilateral loans to assist Greece. The European Council set up a European Financial Stabilization Mechanism and a European Financial Stability Facility (EFSF). These facilities have subsequently been used to assist Ireland and Portugal. In December 2010, the Council approved a limited treaty change to establish a permanent crisis management mechanism—the European Stability Mechanism (ESM). In March 2011, it clarified key operational parameters of the ESM. It was decided to raise the effective size of the EFSF to €440 billion and allow it to intervene in primary debt markets. Finally, in July 2011, euro area heads of state and government made several key decisions. They lengthened the maturity and lowered the interest rate on EFSF loans to member states; and they significantly broadened the mandate of the EFSF/ESM to include the provision of precautionary arrangements, the provision of loans to sovereigns not in a program for the purpose of restoring capital buffers, and the ability to purchase sovereign bonds in secondary markets. The July decisions are going through the process of national parliamentary approval.

Note: Prepared by Luc Everaert

Box 1.7 *(continued)*

Strengthened Economic Governance

Efforts are under way to significantly improve governance of fiscal policy and other policies that have contributed to the imbalances at the root of the current crisis. Most notable is the so-called six-pack of legislative proposals currently before the EU parliament. These initiatives seek to strengthen the preventive and corrective arms of the Stability and Growth Pact, better enforce budgetary surveillance, upgrade national budgetary frameworks, and introduce and enforce an excessive imbalances procedure to prevent and correct broader macroeconomic imbalances. In March 2011, the Euro Plus Pact was endorsed by all euro area member countries (and by a few countries outside the euro area) to strengthen competitiveness and increase the quality of economic policy coordination. Euro area member states have also adopted the European Semester, which establishes a peer review of national budget plans before they are finalized and is being implemented for the 2012 budget year.

on the sovereign debt of Belgium, Italy, and Spain indicates that the proposals have yet to resolve the financing risks for these countries, in spite of the relevant domestic measures recently adopted by them. In particular, markets indicate doubt regarding the flexibility of the new approach and the adequacy of the new funding that it makes available. The dependence of the EFSF's current AAA rating on the AAA ratings of its sovereign guarantors adds a further possible contagion link. At the same time, an expansion in the EFSF balance sheet may provoke investor concerns over the potential supply of EFSF paper and the robustness of the facility's AAA rating. These concerns reinforce the need for sustained balance sheet repair for weaker sovereigns.

Well-timed and credible fiscal adjustment plans are needed to anchor expectations around sustainable debt paths and bolster confidence in banks by reducing sovereign credit spreads. Thus far, only a few vulnerable sovereigns have taken meaningful steps to allay financial concerns about their solvency or liquidity. Many still need to develop plans for fiscal consolidation based on conservative assumptions for revenue and growth and incorporating transparency regarding unfunded and contingent liabilities. Market credibility can also be bolstered through appropriate institutional constraints on the path of the deficit, provided that they allow for countercyclical fiscal policy. Euro area sovereign issuers could reduce their potential vulnerability to liquidity concerns by seeking to extend average maturities while maintaining higher cash buffers.

Comprehensive and coherent policy solutions are also needed to increase the resilience of the European banking sector.

While there have been improvements in financial sector balance sheets, progress on banking system repair needs to further advance in Europe. Successive stress tests have provided welcome transparency but a number of banks still need to reach adequate levels of capital, and others still have to be restructured or resolved. Now that banks and other investors are agreeing to incur losses on some of their holdings of Greece's government bonds, European bank regulators and auditors urgently need to establish a uniform basis for valuing—and taking write-downs on—sovereign bonds held in banks' "available for sale" and "hold to maturity" books.

Banks continue to face funding challenges as analysts and creditors adjust nominal capital levels for potential losses on sovereign bonds, and some banks in countries on the euro area periphery remain heavily dependent on the ECB for liquidity support. Many banks are vulnerable to a further tightening in funding conditions.

Together with policy action to bolster the long-term sustainability of public finances, credible efforts to strengthen the resilience of the financial system are urgently needed. A number of banks must raise capital to help ensure the confidence of their creditors and depositors. Without additional capital buffers, problems in accessing funding are likely to create deleveraging pressures at banks, which will force them to cut credit to the real economy. Where

Box 1.8. The Status of Regulatory Reform

The April 2011 GFSR took stock of the effort to convert the G-20 financial reform agenda into international standards and national regulation. Since then, significant progress has been made in developing an approach to deal with systemically important financial institutions (SIFIs):

- Agreement has been reached on the methodology for identifying global systemically important banks (G-SIBs) and the additional capital that they should hold to reflect the systemic risk that they pose. Under this arrangement (BCBS, 2011), globally active banks are ranked according to five indicators (size, cross-jurisdictional activity, substitutability, complexity, and interconnectedness), which can be supplemented with supervisory judgment. Currently, 28 globally active banks have been identified as G-SIBs that must meet an additional capital requirement of between 1 percentage point and 2.5 percentage points of risk-weighted assets, depending on their systemic importance. A steeper surcharge of 3.5 percentage points has been created to serve as a disincentive for any bank to materially increase its systemic importance.
- Only common equity can be used to meet the capital requirement, although contingent capital could be used to meet any additional national requirements. This cautious approach to contingent capital is prudent, given that it remains untested in stress situations. Failure to meet the requirement will entail the same consequences as a breach of the capital conservation buffer, i.e., restrictions on dividends and stock buybacks.
- The list of G-SIBs will be reviewed every year; the methodology and threshold scores will be reviewed every three to five years. Implementation will begin in 2016, along with a capital conservation buffer. The review of the list of G-SIBs will be carried out by an international Peer Review Council of bank supervisors. Whether to disclose the names of G-SIBs remains an unsettled issue: although there are many merits to disclosure, avoiding the impression that the named banks are being officially classified as "too important to fail" is a challenge.

Note: Prepared by Aditya Narain and Michaela Erbenova.

More work is needed to extend the G-SIB framework to other sectors, such as insurance, and to institutions that are systemically important at a national level.

An important component of dealing with global SIFIs (G-SIFIs) is international consistency and compatibility in resolution approaches to avoid ad hoc policy responses. The July 2011 release of a consultation package on the resolution of G-SIFIs (FSB, 2011a) was an important milestone. The consultation package included establishing national resolution authorities; a resolution toolkit that facilitates preservation of essential financial functions; recommendations on cross-border resolution based on cooperation agreements and alignment of home-host strategies; adjusting the way firms are organized to enhance resolvability; and a mechanism for assessing implementation. Many of the proposed measures break new ground and will require reconciliation with national legal systems. The proposed timeline envisages that by December 2012 the home authorities of G-SIFIs will have entered into cooperation agreements with key host authorities and will have completed their recovery and resolution planning as well as resolvability assessments.

With measures now well in train to address the buildup of risks in banks, any shifting of risk to less regulated "shadow banks" must be closely monitored. As a first step in thus extending the regulatory perimeter, the Financial Stability Board agreed on a broad definition of the shadow banking system (FSB, 2011b), reflecting the fact that many different kinds of entities qualify in different jurisdictions. Next steps involve an enhanced process for monitoring the risks in the shadow banking system—including in money market funds and other shadow banking entities, in securitization, and in securities lending and repos—and the ties of these entities and activities to the banking sector. Given the heterogeneity of institutions and the wide ranging differences in their importance ("materiality") in national systems, achieving agreement and moving to implementation could be a drawn-out process.

The key issue underlying all the regulatory reform proposals is ensuring their effective imple-

Box 1.8 *(continued)*

mentation, both nationally and internationally. Concern over that issue has been voiced in many advanced economies. In the United States, the Dodd-Frank legislation takes a position on some of the areas still under discussion, but the slow implementation of Basel II in the United States has raised questions about U.S. implementation of Basel III. The prompt initiation by the European Commission of the process to implement Basel III with the proposed Capital Requirements Directive (CRD4) is welcome. However, the maximum harmonization espoused in the proposals, along with some differences from Basel III to tailor it to the European context, has raised concerns that reforms may lose some of their effectiveness, especially in the light of prevailing balance sheet uncertainties. It may lead to initiatives by other jurisdictions to also tailor the regulations, departing from the objective of achieving a common set of international standards. The role of the international institutions charged with surveillance of national financial systems will remain key to ensuring that consistency in implementation keeps the international playing field level.

possible, this capital should be raised privately. But in the current environment, public injections may be necessary for banks unable to raise sufficient private capital. In this regard, national backstops should be used wherever the fiscal space exists, while the decision to allow the EFSF to support such measures if necessary is welcome. Adequate capitalization and, where required, restructuring of viable institutions, need to be combined with a reduction in excess capacity, in order to raise profitability within some banking markets. In addition, building capital buffers would help support lending to the private sector.

The U.S. debt ceiling debate highlighted the distance between the political parties in addressing the country's fiscal crisis.

The debate over the debt ceiling highlighted the importance of U.S. creditworthiness for global financial stability. To reinforce that creditworthiness, the United States should act urgently to place its debt on a credible downward trajectory over the medium term through reform of both its entitlement and tax systems to reduce long-term commitments and raise structural revenues. If this is achieved, the U.S. Congress should consider amending the federal debt ceiling as a control device, as it can raise near-term concerns over a technical default while inducing artificial liability management operations by the U.S. Treasury. Similarly, Japan needs to formulate a credible plan to address its long-term fiscal deficit and debt problems before domestic investors lose confidence in the ability of future taxpayers to shoulder the burden—especially at higher interest rates—as the aging population runs down its savings.

Major progress at the international level has allowed the focus of financial reform to shift to implementation.

Policy actions aimed at repairing public and private balance sheets need to be complemented with the continued pursuit of the regulatory reform agenda (Box 1.8). Recent recommendations from the Basel Committee on Banking Supervision and the Financial Stability Board represent significant progress in enhancing capital requirements for bank and nonbank financial institutions. At the national level, regulators should act to introduce the higher capital and liquidity requirements of the Basel Committee's Basel III standards as soon as feasible. In particular, it is now all the more imperative that regulators act to reduce the potential for contagion from weakly capitalized and unprofitable banks. This is key to avoid deleveraging via credit contraction. Coordination among regulators is important to prevent risks from migrating to jurisdictions with weak regulations. Capital surcharges may help address some of the moral hazard advantages that accrue to large, systemically important financial institutions (SIFIs), although their status as such reinforces SIFIs' perceived creditworthiness. Hence, as currently planned, authorities need to complement capital surcharges with credible measures to enable

swift resolution of such institutions through so-called living wills and adequate national and cross-border resolution regimes, aided by an international registry of legal entities. All such measures should be implemented in a coordinated fashion by national authorities and in a manner that limits the risk of cross-border spillovers.

Measures to enhance the resilience of banks should be coupled with an appropriate treatment of risks in the shadow banking sector through adequate monitoring and regulation. This is essential to avoid having tighter bank regulation push additional risky activity into currently unregulated or lightly regulated financial sectors.

Authorities should resist "repression" of financial markets and signals.

With sovereigns under financing stress and economies struggling to deleverage, policymakers may be tempted to suppress or circumvent financial market processes and information. To be sure, such repression can be a legitimate response to extreme financing pressures (such as by maintaining negative real policy rates) or international capital flows. Nevertheless, policies that require private savings to be invested in government bonds are likely to result in the long-term misallocation of capital. Moreover, attempts to suppress adverse indications of sovereign risk (be they credit ratings, CDS positions, or other indicators) may ultimately undermine market liquidity and the credibility of the authorities.[26] Similarly, measures to restrict specific market activities, such as limits on the short-selling of stock, may be useful to break adverse market dynamics in the short run, but they are unlikely to be effective for long and often bring about undesirable consequences.

Policymakers in many emerging market economies must guard against a buildup of financial imbalances.

Not all emerging market economies are undergoing rapid credit expansion, but many—particularly in Asia and Latin America—are still experiencing relatively buoyant conditions. Policymakers in those economies need to be vigilant against excesses that can exacerbate future downswings. Domestic credit growth that is above trend and well above nominal GDP growth is an area of concern, particularly where new credit is directed toward consumption rather than investment. As demonstrated by the analysis above, larger capital cushions for banks in emerging markets—notably EMEA and Asia—could significantly reduce financial system vulnerability to macroeconomic shocks. Conventional monetary and fiscal policy tools can be usefully supplemented in many cases with macroprudential measures such as targeted reserve requirements and increased risk weightings on bank capital. Macroprudential measures can be usefully deployed to help contain risks, while in certain cases capital controls can play a supportive role in managing capital flows and their effects. However, they cannot substitute for appropriate macroeconomic and prudential policies; administrative measures tend to impose significant costs, and their effectiveness typically diminishes over time.

As the global growth outlook softens, emerging markets may be cushioned by still-strong domestic demand, but they are unlikely to be fully insulated. This may especially be the case for major exporters of commodities. Such countries need to prepare for the materialization of "tail risks," that is, of low-probability but highly destructive global economic crises. They can do so by controlling liquidity and currency mismatches of local borrowers, ensuring that local banks are robustly capitalized, and developing resilient local financial capital markets and infrastructures.

[26]Banning "naked" sovereign CDS positions, or imposing private losses without triggering CDS, could easily increase contagion rather than reduce it. The alternatives for counterparties seeking to hedge their sovereign exposures are either to rapidly institute proxy hedges in liquid alternatives (through shorting government bonds, equities of systemic banks, or the currency) or to cut country exposure by rapidly reducing credit lines to nonfinancial businesses and banks.

Annex 1.1. Macro-Financial Linkages in Emerging Markets and Impact of Shocks on Bank Capital Adequacy Ratios[1]

This annex describes the time series methodology behind the simulation exercise presented in Figures 1.43–1.45. We use a panel VAR to assess the vulnerability of a large group of emerging markets to external shocks such as a sudden reversal in capital flows or a deterioration of the terms of trade.

A closely related model yielding similar results (including net interest income but without net capital flows) is then used to calculate different scenarios for the sensitivity analysis of emerging market banks as presented in the main text in Figure 1.46 and Table 1.3. We employ a new IMF solvency framework and econometric modeling to assess the vulnerability of emerging market banks to macroeconomic and financial shocks.

Estimating Macro-Financial Linkages in Emerging Markets

Data

The dataset contains annual observations for 25 emerging markets from 1996 to 2010 where available. The countries included in the sample are Argentina, Brazil, Bulgaria, Chile, China, Colombia, the Dominican Republic, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, Ukraine, Uruguay, and Venezuela. The NPL ratio (nonperforming loans as a share of total loans) is collected from Bankscope. Real GDP, terms of trade, and price indices are from the World Economic Outlook database. Private credit series are from the IMF's International Financial Statistics (IFS) database or country authorities (through Haver Analytics). Net capital flows are from the IFS database and exclude reserve accumulation.

Modeling and Estimation

To model the relationship between macroeconomic aggregates and financial variables, we extend the fixed-effects panel VAR model in IMF (2010, Box 1.2, pp. 18–19).[2] We follow a general-to-specific approach and start with a set of important macroeconomic and financial variables. Our final specification is a model with one lag and five variables: (1) real credit as a share of GDP, (2) the NPL ratio, (3) net capital flows as a share of GDP, (4) changes in terms of trade, and (5) real GDP growth. Models with more lags show widening confidence bands, and are more difficult to interpret economically, leaving the model with one lag as the preferred specification.

Given positive, one standard deviation Choleski shocks, the impulse response functions (Figure 1.48) have expected signs and are statistically significant. Estimating the model in growth rates yields similar results.

Response to External Shocks

Country fixed effects are used when simulating the model. We feed 2010 values into the model to predict NPL ratios for 2011 and 2012 (Figure 1.43). Figure 1.44 shows model-implied changes in credit (share of GDP), GDP growth, and the NPL ratio when the Choleski innovation corresponding to net capital flows (as a share of GDP) drops 8.7 percent. The shock is calibrated to match a two standard deviation change in net capital flows (as a share of GDP). Figure 1.45, on the other hand, shows model-implied changes when the Choleski innovation on the terms of trade equation falls 15.8 percent (two standard deviations of the pooled sample).

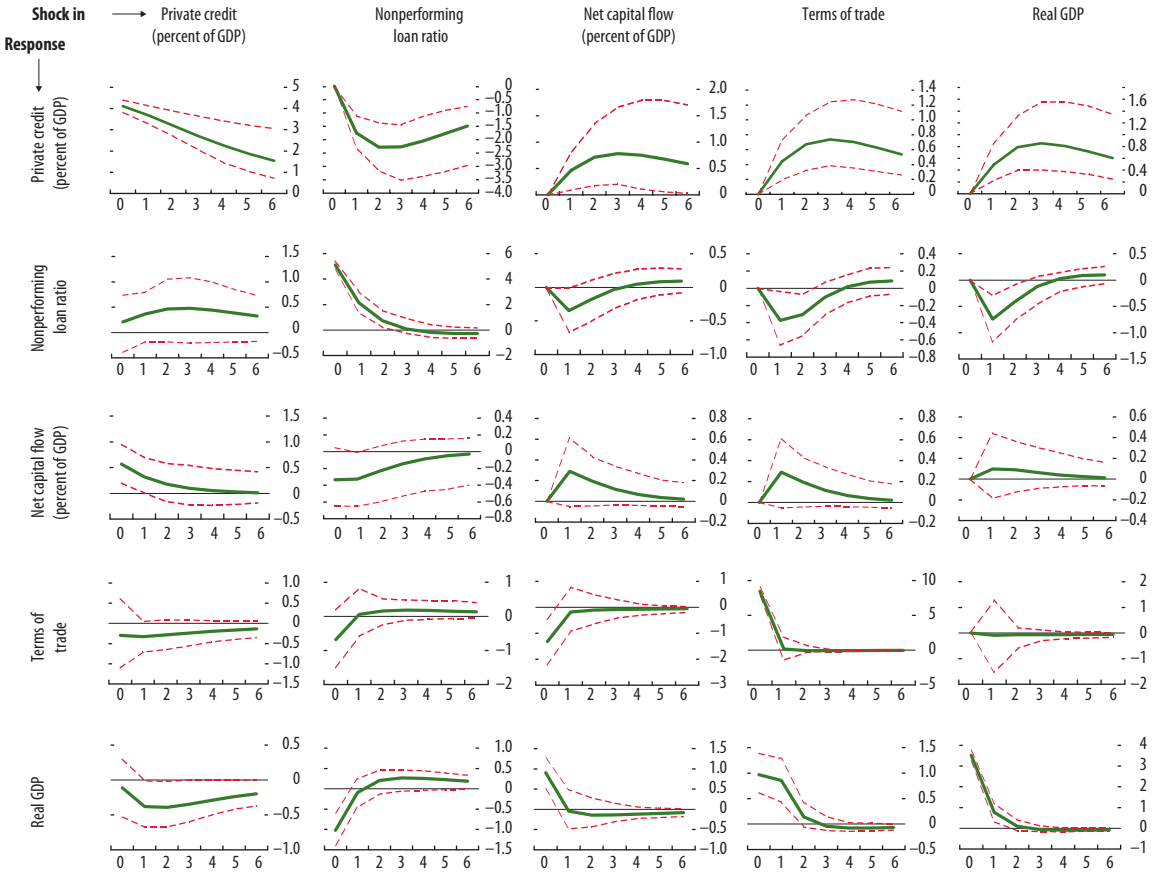
Impact of Shocks on Capital Adequacy Ratios of Emerging Market Banks

We employ a new IMF solvency framework and econometric modeling to assess the vulnerability of emerging market banks to macroeconomic and financial shocks (see Figure 1.46 and Table 1.3). Our sample includes 347 banks in 17 emerging markets.

[1]Prepared by Reinout De Bock and Alexander Demyanets.

[2]The code used to estimate the model and produce impulse response functions was written by Inessa Love, of the World Bank.

Figure 1.48. Impulse Responses: Model Specification 1



Sources: Bankscope; IMF, International Financial Statistics database, World Economic Outlook database; and IMF staff estimates.
Note: Values on horizontal axis are years after shock. Dashed red lines show 90 percent confidence bands. Cholesky orthogonal shocks of one standard deviation.

Solvency Analysis

We use the balance sheet based solvency analysis framework presented in Schmieder, Puhr, and Hasan (forthcoming). The framework has been developed to enrich the existing tests in terms of risk sensitivity, allowing for an economic rather than regulatory assessment of bank capitalization, and recently applied in several countries as part of the IMF surveillance work. We measure bank capitalization based on total capital adequacy ratios. We adjust risk-weighted assets (RWA) for changes in credit risk using parameters—probability of default (PD), loss-given-default (LGD) ratios, and exposures at default—underlying the Basel II internal ratings based (IRB) method.

In our framework, strained conditions in credit risk affect bank solvency through an increase in expected losses (with a negative impact on net income, income effect) *as well as* an increase in the riskiness of the performing loans portfolio (unexpected losses, risk effect), resulting in higher RWAs and lower capital adequacy ratios (compared with Basel I and the Basel II standardized approach). The reason for the lower capitalization ratios in economic terms is that (i) the risk effect dominates the income effect and (ii) the risk weights computed on the basis of credit risk parameters are higher than under Basel I or the standardized approach (i.e., higher than 100 percent)—driven by higher

levels of the LGD ratio and PD in emerging markets compared with advanced economies.

VAR model and Simulation

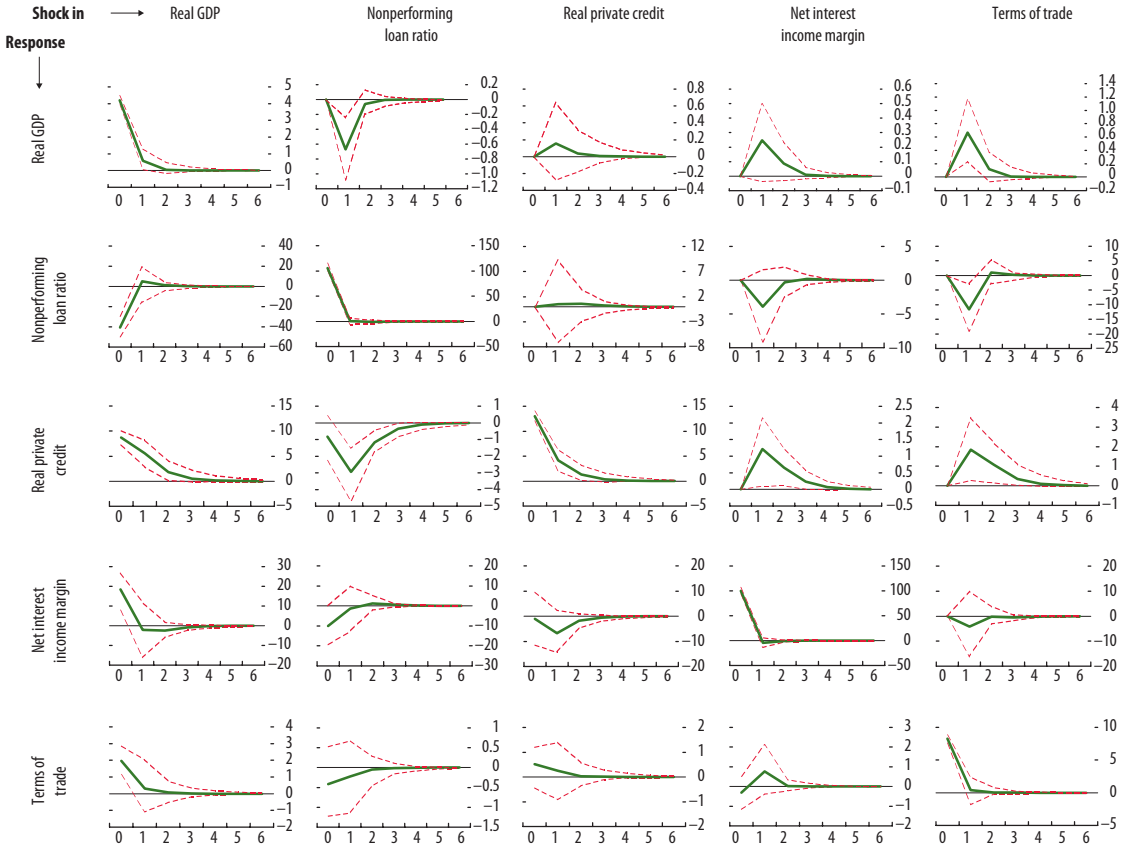
Our final specification for the solvency analysis is a fixed-effects panel VAR estimated on the sample of 25 emerging markets. The VAR includes one lag and five variables: (1) real GDP growth, (2) changes in the terms of trade, (3) changes in the NPL ratio, (4) changes in net interest income margin, and (5) private credit growth deflated by the consumer price index. Again, given positive, one standard deviation Choleski shocks, the impulse response functions (Figure 1.49) have expected signs and are statistically significant.

For the purposes of simulating the model, regional fixed effects are used. The baseline path for the model's variables is generated under the WEO forecast for real GDP growth and terms of trade. A real GDP shock is introduced into the model by taking the difference between the WEO forecast and the model's predicted value and scaling it by the standard deviation of the real GDP shock. A terms-of-trade shock is applied in an analogous manner and is orthogonalized to the GDP shock.

Scenario Analysis

To simulate scenarios of a slowdown in growth and a terms-of-trade shock, we subtract 5 percentage

Figure 1.49. Impulse Responses: Model Specification 2



Sources: Bankscope; IMF, International Financial Statistics database, World Economic Outlook database; and IMF staff estimates.
Note: Values on horizontal axis are years after shock. Dashed red lines show 90 percent confidence bands. Cholesky orthogonal shocks of one standard deviation.

points and two standard deviations from the WEO forecasts for real GDP growth and terms-of-trade in 2011 and 2012, respectively, and the simulated paths for the model variables are generated as in the baseline scenario. The regional model projections are country forecasts weighted by the total assets of the banking sector.

We run four scenarios over a five-year horizon (2011–15): (1) slowdown in growth in 2011 and 2012; (2) deterioration in the terms of trade in 2011 and 2012; (3) increase in funding costs in 2011; and (4) simultaneous shocks to growth, terms of trade, and funding costs.

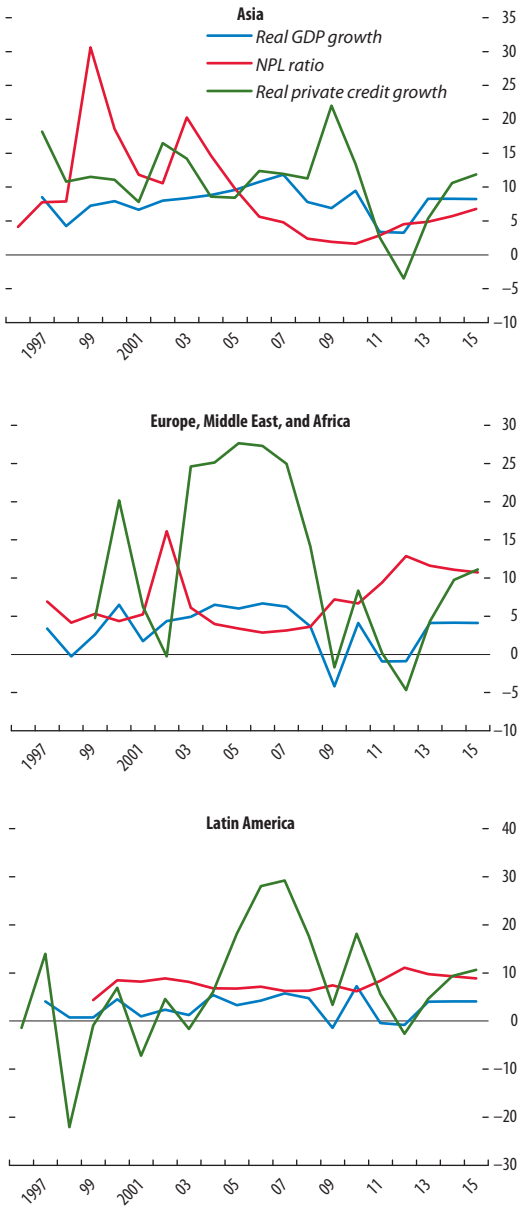
Slowdown in Growth and Terms of Trade

In these scenarios, we estimate the impact of macroeconomic shocks on banks' capitalization levels. The growth shock is calibrated to a 5 percentage point deviation from the WEO baseline forecast for real GDP growth, whereas we use two standard deviations for the terms of trade. We use the projections for NPLs, credit growth, and net interest margins for 2011–15 derived from the VAR modeling and apply them to portfolios of bank loans to determine unexpected losses and net profit. Because NPL ratios overestimate loss rates in a multi-period simulation, we adjust the projected NPL series by the scaling factor calculated as the product of the ratio of reported loan loss provisions to total loans and country-level LGD estimates.

Funding Cost

In this scenario, we assess the effect of an increase in the cost of banking sector funding on capitalization. We apply a one-time shock of 300 basis points in the first year of the exercise and calculate resulting losses as the product of net interest margin and net interest income on the banks' loan portfolio. We assume that changes in the cost of funding do not affect the liabilities side of the balance sheet or the value of the investment portfolios. In order to estimate the impact in a manner consistent with WEO economic forecasts, we draw on the baseline projections for NPL, credit growth, and profit rates from our model.

Figure 1.50. Macro Scenarios under Combined Shocks
(In percent)



Source: Bankscope; IMF, International Financial Statistics database; and IMF staff estimates.

Combined Macro Shocks

In the combined shocks scenario underlying Figure 1.46, we turn on all shocks at the same time. We simulate variable paths under the joint and consecutive real GDP deviation and terms-of-trade shocks and add on an exogenous increase in the cost of funding. The resulting scenario (Figure 1.50) is broadly calibrated to an emerging market financial crisis whereby concerns about macroeconomic slowdown, government policy, and falling commodity prices lead to sudden stops in capital flows and drive emerging market interest spreads to comparable levels.[3]

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[3]In all scenarios, we assume that banks face an effective tax rate of 25 percent and pay out 50 percent of net income as dividends.

CHAPTER 2

Summary

The asset allocation decisions of investors are at the core of financial flows between markets, currencies, and countries. This chapter aims to identify the fundamental drivers for these decisions and determine whether their influence has been altered by the global financial crisis and the subsequent low interest rate environment in advanced economies. In particular, the chapter investigates whether changes in investor behavior pose downside risks for global financial stability.

To set the stage, the longer-term developments in global asset allocation show three main trends: (i) a gradual broadening of the distribution of assets across countries, implying a globalization of portfolios with a slowly declining home bias; (ii) a long-term decline in the share of assets held by pension funds and insurance companies in favor of asset management by investment companies; and (iii) the increasing importance of the official sector in global asset allocation through sovereign wealth funds and managers of international reserves.

The analysis shows that private asset allocation is driven most strongly by positive growth prospects and falling risks in the recipient countries, while interest rate differentials between countries play a lesser role. The analysis does not, however, imply that capital flows in general do not respond to interest rate differentials, since other components, including investment flows of short-term leveraged investors (such as those from the carry trade)—which this chapter does not examine—might still be affected by changes in interest rates.

Beyond these longer-term trends and investment drivers, the empirical results and survey responses indicate that asset allocation strategies of private and official institutional investors have changed since the onset of the global financial crisis. Most importantly, investors are more risk conscious, including regarding the risks associated with liquidity and sovereign credit. Also, the structural trend of investing in emerging market assets has accelerated following the crisis; and with many first-time investors taking advantage of the relatively better economic performance of these countries, the risk of a reversal cannot be discounted if fundamentals (such as growth prospects or country or global risk) change. For larger shocks, the impact of such reversals could be of the same magnitude as the pullback in flows experienced during the financial crisis.

In touching on the potential effect of regulation on the asset allocation of institutional investors, the chapter suggests that initiatives like Solvency II for European insurance companies may push these institutions away from their traditional role of taking on longer-term risky assets, potentially dampening the positive impact of one class of "deep pocket" investors.

Regarding sovereign wealth funds and reserves management, the chapter suggests that sovereign asset allocation may provide a counterweight for changing private sector behavior. As heightened risk awareness and regulatory initiatives push private investors to hold "safer" assets, sovereign asset managers may take on some of the longer-term risks that private investors now avoid.

This chapter aims to describe recent changes in the global asset allocation of long-term investors, explain the drivers of those changes, offer an assessment of the associated risks that may be building up in the context of the current extraordinary economic and policy environment, and investigate their more lasting implications. In particular, it will explore to what extent the persistence of low interest rates in advanced economies has fundamentally altered global asset allocation and associated investment decisions of long-term unleveraged investors and whether any changes in behavior of those investors hold downside risks for global financial stability.

In this context, the chapter will focus on the following questions:

- What are the trends in global asset allocation in the past decade, and what are their determinants? Do trends and determinants differ by country or region?
- Have the financial crisis, the sovereign debt crisis in Europe, and low interest rates in advanced economies fundamentally altered investment decisions, perhaps pressing long-term investors toward riskier investments to augment their poor returns in advanced economies? Are there growing risks for a reversal of investment flows to emerging economies, and if so, how would that affect capital flows? In the longer term, is financial stability compromised as a result of these developments?

The chapter takes as its point of departure the asset allocation decision of the individual investor. This sets it apart from much of the existing literature, which focuses on investment flows from the macroeconomic point of view, and derives most of its analysis from balance of payments flow data.[1] In this chapter's more integrated view, changes in asset allocation over time are the fundamental driver of financial flows into and out of markets, currencies, and countries. We focus on unleveraged (real money) investors, including individuals, public and private pension funds, insurance companies, and managers of sovereign wealth, which together are a sizable source of underlying capital flows.

An extensive literature links asset allocation to an investor's objectives and the risk and return characteristics of individual assets (Annex 2.1). It is assumed that investors behave predictably when such characteristics change: when the return of an asset increases without changes in its riskiness, investors are expected to want to hold more of that asset. Similarly, when an asset is seen as more risky (because its return is more variable, for example, or the risk of default increases) without offering a higher return, investors would want to hold less of it.

The financial crisis has raised the possibility that some of the parameters in these relationships—or even investors' objectives themselves—have changed. Anecdotal evidence abounds, and can sometimes seem contradictory. For example, investors, spooked by the financial turmoil, are said to have become much more sensitized to risk, including to "tail events," that is, events with a small probability but with large (adverse) effects, and are seeking to protect themselves against associated potential losses. Similarly, after disruptions in some markets during the height of the financial turmoil, investors are more focused on market liquidity, which is the ease with which an asset can be sold. These structural changes interact with cyclical factors: despite increased sensitivity to risk, persistent low interest rates may push some investors (especially those with the need to earn a certain minimum return to match expected payouts on their liabilities) to take on additional risk in alternative assets and in smaller, potentially less liquid markets to increase returns on their assets.

The question from the perspective of financial stability is whether any such changes in investor behavior, especially by real-money investors, could be making financial institutions, markets, or economies more vulnerable to unexpected shocks. Such vulnerabilities could result in (i) unexpected large losses for institutional investors (if pension funds and insurance companies take additional risk on their balance sheets), (ii) the risk of disruptions in financial markets (if the demand for assets suddenly changes, thereby affecting prices and market liquidity), or (iii) the risk of economic disruption (if there are large capital flows in or out of countries). These disruptions might

Note: This chapter was written by S. Erik Oppers (team leader), Ruchir Agarwal, Serkan Arslanalp, Ken Chikada, Pascal Farahmand, Gregorio Impavido, Peter Lindner, Yinqiu Lu, Tao Sun, and Han van der Hoorn. Research support was provided by Yoon Sook Kim.

[1]See, for example, Forbes and Warnock, 2011; and IMF, 2011b and 2011c.

be especially acute in less liquid emerging markets. Awareness of such potential outcomes is important for investors so they can adequately protect themselves, as well as for policymakers so they can establish measures to reduce threats to financial stability.

This chapter looks at these issues in detail, using available public and private data, the views of investors and other market participants, and the results of a recent survey conducted by the IMF (Annex 2.2). First, the chapter uses these data sources to look at the two broad categories of investors—private and official holders—focusing on long-term trends from a database of $60 trillion in institutional investments. It also looks at developments in sovereign asset allocation, which covers some $14 trillion in assets. That segment has been growing rapidly in size—and therefore in importance for the overall assessment of implications for financial stability. A detailed database of a subset of equity and bond funds is then used to investigate the fundamental determinants of global asset allocation by private investors, such as economic growth, interest rates, and measures of risk. The chapter also looks at evidence of a shift in investor behavior since the crisis. It then uses the results of the econometric estimates for a "stress test" of investment flows across countries, estimating the effects of large changes in underlying factors on asset allocation flows. The chapter ends with implications of our findings for investors and policymakers.

Longer-Term Trends in Global Asset Allocation

Stylized Facts on Private Sector Institutional Investment

Existing aggregated data do not provide a comprehensive view of asset allocation on a truly global scale, but a dataset from the OECD is useful for analysis of the longer-term trends in the global allocations flowing from advanced economies.[2] The OECD data cover consistent data for assets under management by institutional investors domiciled in 17 OECD countries.[3] They show that after strong growth in the second half of the 1990s and stagnation in the early 2000s, assets almost doubled between 2002 and 2007, to $63 trillion (Table 2.1 and Figure 2.1). During the financial crisis, they declined to about $53

[2]National flow-of-funds data are useful, but higher-frequency data are available for only a few jurisdictions, and methodologies are not fully consistent. The OECD publishes a consistent set covering its membership (*OECD Annual Statistics on Institutional Investors' Assets*), based mostly on flow-of-funds data. The frequency is only annual, and the data are often published with a delay due to the necessary consistency checks and manipulations. Also, the OECD set covers only investment flows originating in OECD countries and does not show the destination of these flows. Private databases covering mutual fund investments at much higher frequency are useful for statistical analysis (see the section below on Determinants of Private Asset Allocation), but the series are of limited length, and their coverage may change over time as individual funds are added to the database.

[3]See note to Table 2.1 for a list.

Table 2.1. Assets under Management by Institutional Investors

	1995	2000	2005	2006	2007	2008	2009
				(In trillions of U.S. dollars)			
Institutional Investors	21.9	33.5	49.0	56.6	62.8	52.5	60.3
Investment funds[1]	6.3	12.1	18.2	21.5	24.9	20.6	24.0
Insurance companies	8.0	10.4	16.3	18.1	19.9	18.3	20.0
Autonomous pension funds	7.2	10.8	14.3	16.5	17.7	13.3	15.9
Other institutional investors	0.5	0.5	0.5	0.6	0.7	0.6	0.7
				(In percent of GDP)			
Institutional Investors	103.0	147.6	162.0	178.1	181.7	143.3	173.7
Investment funds[1]	29.8	53.4	60.3	67.8	72.1	56.3	69.2
Insurance companies	37.7	45.6	53.9	57.1	57.5	50.0	57.7
Autonomous pension funds	33.8	47.4	47.3	51.8	51.2	36.3	45.9
Other institutional investors	2.5	2.2	1.6	1.9	1.9	1.6	2.0

Sources: OECD; and IMF Staff estimates.

Note: Data based on the following 17 OECD countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Japan, Luxembourg, the Netherlands, Norway, Spain, Turkey, the United Kingdom, and the United States. The data may reflect some double-counting of assets, such as those owned by defined contribution pension funds and managed by investment companies.

[1]Investment funds include closed-end and managed investment companies, mutual funds, and unit investment trusts.

trillion at end-2008 before rebounding to $60 trillion at end-2009 (compared with $72 trillion in total bank assets).[4] As a share of GDP, total assets under management rose some 75 percentage points, to over 180 percent of GDP, between 1995 and 2007. They fell to 143 percent of GDP by end-2008, with the largest relative drop in assets for pension funds (which have the largest share of assets in equities).

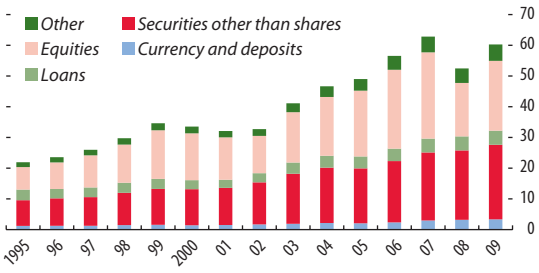
Investors domiciled in the United States still account for almost half of all assets under management in the 17 OECD countries, although their share is declining (Figure 2.2). The most marked change among countries with large investment holdings has been a large drop in the share of Japanese investors. Also, asset concentration has declined, with investments domiciled in the five countries with the largest holdings declining from about 90 percent of total assets in 1995 to about 80 percent in 2009.

The share of assets under management by type of institutional investor has changed considerably over the 1995–2009 period (Figure 2.3). During that time, the share of pension funds and insurance companies declined markedly, while investment funds saw their share increase from 29 percent to 40 percent of total assets under management. This is likely due in part to the long-run shift from (generally corporate) defined benefit to (generally individual) defined contribution pension systems (especially in the United States). Assets in defined contribution plans are increasingly managed by investment funds.

By asset class, the value of securities other than shares (mostly bonds) has risen fairly steadily, while the value of equities has fluctuated more strongly (see Figure 2.1). Equity price declines dominated the decline in the total value of assets under management between 1999 and 2001 and again in 2008. Over the full 1995–2009 period, the proportion of shares and other equities rose to more than two-fifths, and the proportion of loans declined.

The asset allocation of institutional investors differs markedly by country (Figure 2.4). U.S. investors hold about equal shares of equities and bonds, while investors in France hold a majority of assets in bonds

Figure 2.1. Asset Allocation of Institutional Investors
(In trillions of U.S. dollars)



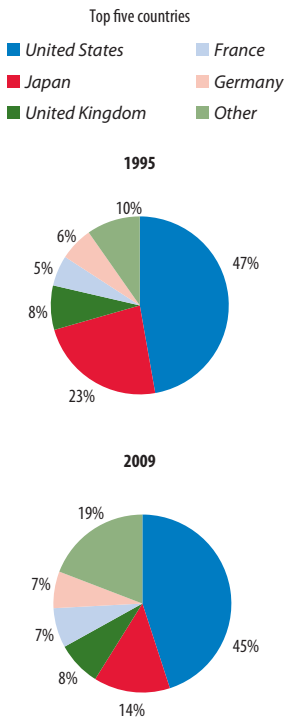
Sources: OECD; and IMF staff estimates.

Note: Data based on the assets under management by institutional investors in 17 OECD countries (see Table 2.1 for list). "Other" includes commercial loans and credits; financial derivatives; short-term investments; investments in hedge funds, private equities, and commodities; and miscellaneous assets.

[4]The OECD dataset does not indicate the effect of valuation changes, but national flow-of-funds data from the G-4 suggest that most of the decline in total assets under management during the crisis was due to valuation changes (especially in equities).

Figure 2.2. Assets of Institutional Investors by Country

(In percent of total assets under management)

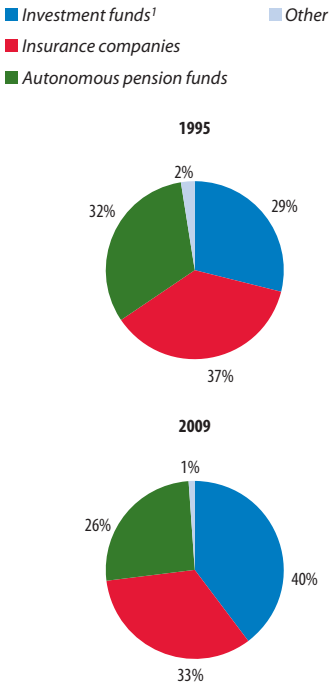


Sources: OECD; and IMF staff estimates.

Note: Data based on the assets under management by institutional investors in 17 OECD countries (see Table 2.1 for list). Percentages may not sum to 100 due to rounding.

Figure 2.3. Assets under Management by Type of Institutional Investor

(In percent of total)

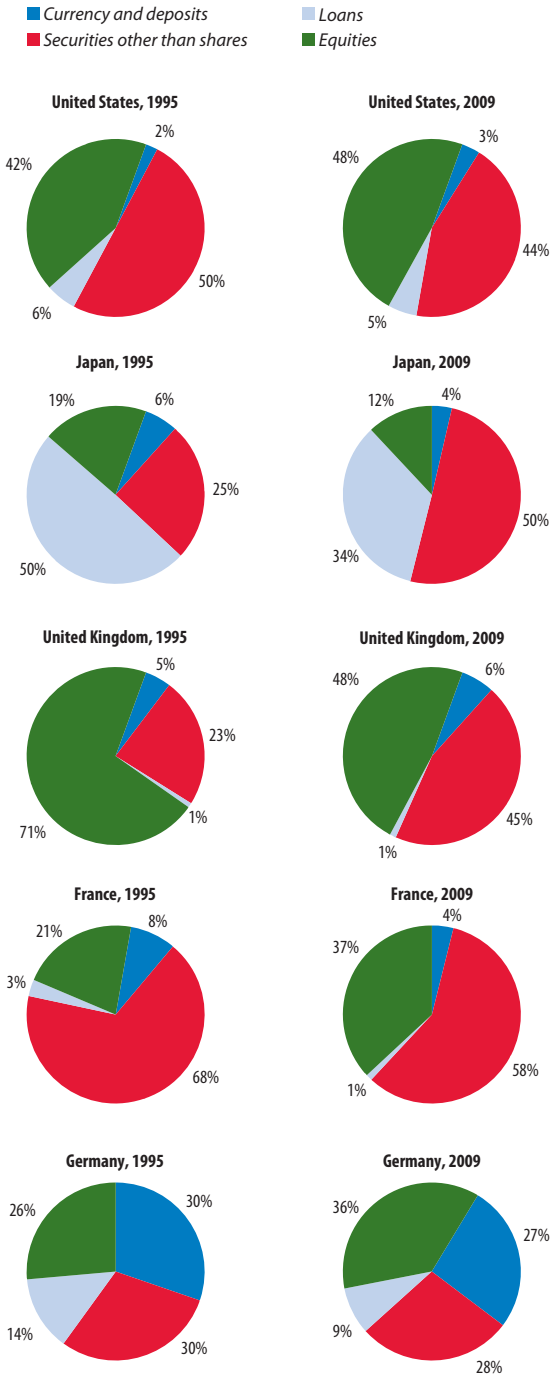


Sources: OECD; and IMF staff estimates.

Note: Data based on the assets under management by institutional investors in 17 OECD countries (see Table 2.1 for list).

[1]Investment funds include closed-end and managed investment companies, mutual funds, and unit investment trusts.

Figure 2.4. Global Asset Allocation of Institutional Investors by Selected Country
(In percent)



Sources: OECD; and IMF staff estimates.
Note: Data based on the assets under management by institutional investors in 17 OECD countries (see Table 2.1 for list). Data exclude assets classified in "other" category.

and those in Germany hold almost one-third of their assets in currency and deposits. Although the shares by asset class have changed over the past decade and a half, the main stylized facts by country remain mostly intact.

The diversity in asset allocation across countries reflects in part differing investment structures, but not differences in holdings by type of investor, which are similar across countries (Figure 2.5). For example, in France, savings for retirement are concentrated in insurance products, and insurance companies globally tend to invest heavily in fixed income securities. In contrast, autonomous pension funds hold more than one-third of institutional assets in the United States, and they generally invest more heavily in equities.

Stylized Facts on Official Sector Investment Vehicles

While the overwhelming majority of financial assets is owned and managed by private investors, sovereign investors have grown to become important players in international capital markets. Sovereign wealth funds (SWFs) hold some $4.7 trillion in assets (SWF Institute, 2011; see Table 2.2 for a selection of SWFs), while international foreign exchange reserves amount to $10 trillion (Figure 2.6).[5] Taken together, the value of assets in SWFs and foreign exchange reserves is equal to about one-fourth of the assets under management of private institutional investors.

The asset allocation of SWFs varies widely depending on their specific objectives. A typical classification of SWFs by objective includes fiscal stabilization funds, national savings funds, pension reserve funds, and reserve investment corporations (IMF, 2007; see also Table 2.23 in Annex 2.3). Equities constitute a significant proportion of the holdings in national savings funds, pension reserve funds, and reserve investment corporations, and those SWFs are likely to have investment objectives similar to private investors. Stabilization funds tend to avoid riskier assets and focus instead on fixed income and cash. Still, specific factors—including the age of the SWF, its investment horizon, its funding source, and vary-

[5]Using the IMF's definition of foreign exchange reserves and sovereign wealth funds; see Annex 2.3.

ing expectations of the relative performance of asset classes—lead to differences in asset allocations even among SWFs with similar objectives (Figure 2.7).

International reserves are held for monetary policy and balance of payments purposes, and therefore reserve managers typically have a much more conservative asset allocation strategy than do SWF managers (Box 2.1). The objectives of reserve managers are traditionally safety, liquidity, and return, in that order (IMF, 2001a). The requirement that reserves be available at short notice and at low cost to meet balance of payments needs and financial stability objectives leads to an allocation that is traditionally dominated by short-term government bonds issued by only a few countries.

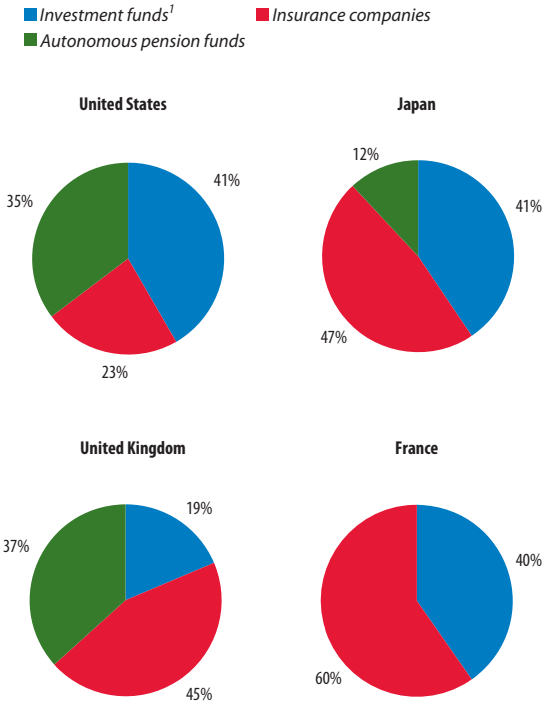
However, global foreign exchange reserve holdings (excluding gold) have grown so fast in recent years that their size for many countries now exceeds that needed for balance of payments and monetary purposes. After having expanded almost fourfold between 2000 and 2008, reserve levels declined briefly during the global financial crisis and then rebounded quickly. Today, reserve levels in several emerging and developing economies well exceed levels traditionally considered adequate (IMF, 2011a).

Therefore, an increasing share of reserves could be available for potential investment in less liquid and longer-term risk assets. A new IMF estimate puts core reserves needed for balance of payments purposes in emerging market economies at $3.0–$4.4 trillion, leaving $1.0–$2.3 trillion potentially available to be invested beyond the traditional mandate of reserve managers, in a manner more like that of SWFs.[6] Some central banks have facilitated this distinction by splitting their reserves into a "liquidity tranche" and an "investment tranche," with the latter aiming to generate a higher return over the long run (Borio and others, 2008). To date, taken together, however, these investment tranches are still small, and government bonds remain the dominant asset class in reserves.

Overall, the above analysis of private and public long-term investors suggests the following longer-

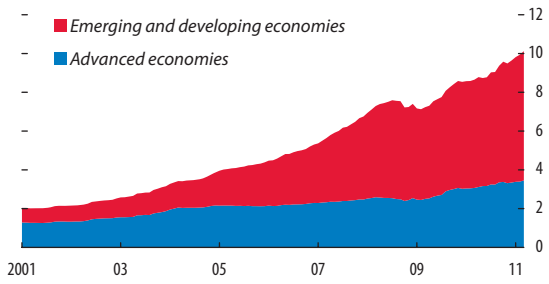
[6]This metric for reserve adequacy is developed in IMF (2011a); the suggested adequacy range is 100–150 percent of the metric based on 2009 data, leading to the ranges given here.

Figure 2.5. Assets under Management by Type of Institutional Investor and Selected Country, 2009
(In percent)



Sources: OECD; and IMF staff estimates.
Note: Data based on the assets under management by institutional investors in 17 OECD countries (see Table 2.1 for list). Percentages may not sum to 100 due to rounding.
[1]Investment funds include closed-end and managed investment companies, mutual funds, and unit investment trusts.

Figure 2.6. Foreign Exchange Reserves, Excluding Gold
(In trillions of U.S. dollars)



Source: IMF, International Financial Statistics.

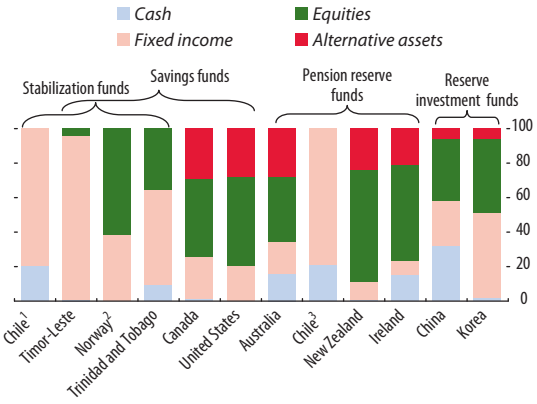
Table 2.2. Assets of Selected Sovereign Wealth Funds
(In billions of U.S. dollars)

Country	Sovereign Wealth Fund	End-2007	End-2010
Australia	The Future Fund	44.9	70.3
Canada	Alberta Heritage Savings Trust Fund	16.7	15.5
Chile	Economic and Social Stabilization Fund	14.0	12.7
Chile	Pension Reserve Fund	1.5	3.8
China	China Investment Corporation	200.0	409.6
Ireland	National Pensions Reserve Fund	31.1	30.3
Korea	Korea Investment Corporation	15.5	37.6
New Zealand	New Zealand Superannuation Fund	10.7	14.0
Norway	Government Pension Fund-Global	373.1	525.1
Singapore	Temasek	134.1	153.0
Timor-Leste	Petroleum Fund of Timor-Leste	2.1	6.9
Trinidad and Tobago	Heritage and Stabilization Fund	1.8	4.0
United States	Alaska Permanent Fund	39.4	38.8

Sources: Sovereign wealth fund websites; and IMF staff calculations.

Note: Australia (January 31, 2008, excluding Telstra); China (September 29, 2007); Singapore (March 31, 2008 and March 31, 2011); and Trinidad and Tobago (September 30, 2007 and September 30, 2010).

Figure 2.7. Selected Sovereign Wealth Funds: Asset Allocation by Type of Fund, December 2010
(In percent)



Sources: Sovereign wealth fund websites; and IMF staff estimates.
Note: Data for China, December 2009. For Australia, excluding Telstra; for Ireland, excluding directed investments.
[1]Economic and Social Stabilization Fund.
[2]Norway's Government Pension Fund has also been classified as a pension reserve fund.
[3]Pension Reserve Fund.

term trends in asset allocation: (i) global assets are being more widely distributed across countries; (ii) in relative terms, assets are being moved from pension funds and insurance companies in favor of management by investment companies; and (iii) the official sector is becoming increasingly important in global asset allocation through SWFs and managers of international reserves. These trends will be explored in more detail in the sections below.

Determinants of Private Asset Allocation

The Role of Private Asset Managers

Private asset managers play a key role in global asset allocation. The real-money managers on which this chapter places its focus (as distinct from managers of leveraged money, such as hedge funds and carry traders) include private wealth managers, mutual fund managers, insurance fund managers, and pension fund managers. They manage institutional money (such as from pension funds and insurance companies) as well as retail funds and private wealth. They allocate investments to equities, fixed income instruments, and a host of alternative investment classes, such as real estate, commodities, and hedge funds.[7]

Private fund managers provide a range of services for their real-money investing clients. Beyond offering a range of investment funds with predefined mandates, their services may include: (i) advice to inform clients' own investment decisions; (ii) fulfilling a broad individual investment mandate for large

[7]Hedge funds are not covered in our investigation directly as asset managers, although they are considered as an "investment class" for private asset managers.

Box 2.1. Asset Allocation of Reserve Managers

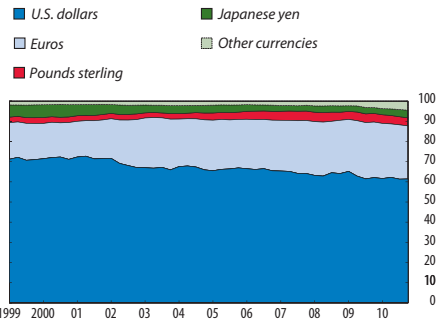
Available data are used to investigate to what extent reserve managers respond to market-based incentives when deciding on the currency composition of international reserves.

The objectives of reserve managers are typically different from those of other investors because reserves are explicitly held for balance of payments or monetary policy purposes. The asset allocation and management of reserves are traditionally driven by safety, liquidity, and return, in that order (IMF, 2001a). Further, trade links and the composition of foreign debt may influence currency preferences of international reserve managers.

Despite these differences in their behavior relative to other investors, reserve managers could nevertheless respond to some of the same incentives that motivate private investors, such as investment returns and measures of risk. For example, in principle, reserve managers can hold their assets in any of several reserve currencies that have deep and liquid exchange markets and that can quickly be converted into a different currency if necessary. Given the dominance of short-term government bonds in reserve managers' portfolios, short-term interest rate differentials between major reserve currency countries could therefore affect their asset allocation.

Considering that the currency composition of reserves is equivalent to their country destination, the question of whether reserve managers allocate assets on the same basis as their private sector counterparts can be examined using the IMF's Currency Composition of Official Foreign Exchange Reserves (COFER) database. The database contains country-level data on currency composition from the 1960s to the present. The COFER information is submitted by IMF member countries on a confidential and voluntary basis; at present, the database covers 56 percent of total world foreign reserves. The COFER data show that, in the aggregate, the currency composition of reserves changed with the introduction of the euro but has been fairly stable in recent years despite large swings in exchange rates (see figure).

Currency Composition of Official Foreign Exchange Reserves
(In percent)



Source: IMF, Currency Composition of Official Foreign Exchange Reserves database.
Note: The figure displays allocated reserves only. Over the observation period, unallocated reserves have roughly doubled as a share of total reserves, from 23 percent in early 1999 to nearly 45 percent at end-2010.

The investigation here uses quarterly data from 1999 to 2010 for 102 countries. The data include a number of the variables used in the main text for the analysis of private mutual fund data; they also include variables to measure the conventional objectives of reserve managers, including debt-to-GDP ratios and export and import propensities. The four dependent variables used here are the shares of total reserves allocated to the four major reserve currencies—the U.S. dollar, the euro, the pound sterling, and the Japanese yen—which constitute more than 90 percent of total reserve holdings for most of the countries in our sample.

The analysis produced the following key results:

- Reserve managers appear to respond to U.S. interest rates: increases in the U.S. dollar interest rate are associated with a rebalancing away from the euro and toward the dollar (first row of the table).
- An increase in the volatility of the euro/dollar exchange rate tends to favor the dollar as a reserve currency at the expense of the euro.
- The shares of the other two main reserve currencies, the pound and the yen, appear to be

Note: Prepared by Ruchir Agarwal. Research assistance was provided by Michael Kamya.

Box 2.1 *(continued)*

unaffected by interest rates or exchange rate volatility.

- Economic growth differentials (which are found to be important for private asset allocation) appear not to be important for the currency composition of international reserves.
- At the start of the global financial crisis (summer of 2007), there was a drop in the share of the U.S. dollar in international reserves that was not related to the other explanatory variables in the regression.

Regression Results for the Currency Composition of Reserves

	U.S. Dollar Share	Euro Share	Pound Sterling Share	Yen Share
U.S. policy rate	0.0048***	-0.0029**	-0.0008	0.0003
Euro policy rate	-0.0016	0.0026	-0.0003	-0.0011
U.K. policy rate	-0.0036	0.0018	0.0011	0.0009
Japan policy rate	0.0146	-0.0112	-0.0015	0.0014
Euro-U.S. exchange rate volatility	0.0109***	-0.0061**	-0.0008	0.0009
U.K.-U.S. exchange rate volatility	-0.0058	0.0015	0.0016	0.0002
Japan-U.S. exchange rate volatility	0.0020	-0.0002	-0.0008	0.0007
U.S. GDP forecasts	-0.0006	-0.0012	0.0001	0.0003
Euro GDP forecasts	0.0010	-0.0029	0.0002	-0.0002
U.K. GDP forecasts	-0.0012	0.0021	0.0007	0.0001
Japan GDP forecasts	0.0011	-0.0002	-0.0003	0.0002
Crisis dummy 1	-0.0158**	0.0013	0.0031	0.0029
Crisis dummy 2	-0.0046	-0.0012	-0.0003	0.0043**

Sources: IMF, Currency Composition of Official Foreign Exchange Reserves (COFER) database; Consensus Economics; and IMF staff estimates.

Note: The table presents results of a system of regression equations estimated using seemingly unrelated regressions. The dependent variables are shares of foreign reserves allocated to the four major reserve currencies. The omitted category is "other" currencies, and the shares of the five categories add up to 1. Data for the dependent variable are from the COFER statistical database, quarterly from 1999 to 2010 for 102 countries. The policy rate variables measure the short-term policy rate for the four major currencies. The exchange rate volatility is computed as the exchange rate volatility of each country (with the U.S. dollar as base currency) over a rolling period of one year. GDP forecasts are mean forecasts of one-year GDP growth acquired from Consensus Economics. Crisis dummy 1 represents the period June 2007–August 2008 (global credit crunch). Crisis dummy 2 represents the period starting in September 2008 (Lehman Brothers bankruptcy). The regression also controls for total government debt-to-GDP ratio, real GDP per capita, import share of GDP, export share of GDP, and foreign exchange regimes. ***, ** , and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels of confidence, respectively, based on robust standard errors.

investors; and (iii) providing "stock picking" services within a more narrowly defined mandate. Thus, their approach to asset allocation ranges from the strategic, or long term, to the tactical, or short term.

Many other institutional investors (including those that determine their own strategic asset allocation) use private asset managers to manage all or part of their portfolio. Consequently, the assets under management of private asset managers include a substantial share of those from pension funds and insurance companies and a small but growing proportion of sovereign assets (Table 2.3).

Table 2.3. Asset Managers' Assets under Management: Origin of Funds
(In percent)

	2006	2008	2010
Pension funds	24.6	26.2	25.8
Endowments	2.4	2.4	2.4
Insurance companies	15.5	17.2	18.0
Sovereigns	0.9	1.2	1.5
Retail	36.2	32.9	33.0
Exchange traded funds	0.2	0.1	0.4
Banks	2.9	2.7	2.7
Unspecified	17.3	17.2	16.3

Source: IMF Survey on Global Asset Allocation.

Note: Figures are averages of 52 respondents.

Factors Determining Private Asset Allocation

What determines the longer-term trends in asset allocation revealed by the OECD data, particularly their geographical destination? The OECD dataset itself is less useful for answering that question because of its annual frequency, slower updates, smaller set of origin countries, and lack of information on the destination country for investments. For our empirical investigation, we use a dataset compiled by Emerging Portfolio Fund Research (EPFR). EPFR provides global fund flows and asset allocation data from some 20,000 equity funds and 10,000 bond funds with $14 trillion in total assets. The investors are a mix of retail and institutional investors; EPFR estimates that 70 percent of assets are institutional, mainly from pension funds and insurance companies. It covers funds registered in most major developed market jurisdictions and offshore domiciles. EPFR samples a subset of funds to give insights into the destination countries for equity and bond investments. Data at a monthly frequency are used below, covering the period from January 2005 to May 2011. EPFR has widened its coverage of fund flows over time, which may raise data consistency issues; the period of study was chosen to minimize these concerns.

Using the EPFR data, this section addresses the following questions: (i) What global and domestic factors have driven the asset allocation of international bond and equity fund investors? and (ii) Has their investment behavior changed fundamentally after the global financial crisis? To capture the truly global picture, a panel regression is estimated covering 50 advanced and emerging market economies for which we have complete and consistent data. The regressions are run separately for equity funds and bond funds, and are estimated for the whole sample and for five geographic groupings separately.[8]

On the basis of theoretical underpinnings (Annex 2.4), the following factors are used in the regression analysis to explain global asset allocation.

- Return factors: (i) policy rate differentials of countries relative to the simple G-4 average; and (ii) the one-year-ahead GDP growth forecast from Consensus Economics.
- Volatility factors: these represent the variance of returns as measured by (i) the volatility of host country expected inflation; (ii) the volatility of GDP growth; and (iii) the volatility of the exchange rate.
- Risk tolerance: perceptions of risk are (i) country risk, as proxied by the measure of country risk compiled by the International Country Risk Group; and (ii) global risk, as proxied by the Chicago Board Options Exchange Market Volatility Index (VIX).
- Other variables of interest: (i) an IMF measure of capital controls (both on inflows and outflows);[9] (ii) the covariance between country returns and world portfolio returns (to capture the diversification effect); (iii) the covariance between country returns and changes in world portfolio returns (to capture intertemporal hedging demand); and (iv) dummies to account for any structural changes in investor behavior that may have occurred after the global financial crisis.[10]

The analysis yields the following main results about the drivers of flows into equity and bond funds (Table 2.4):

- Interest rate differentials in most cases have no statistically significant effect on flows into equity and bond funds. These results are generally invariant to using policy rate differentials relative to the G-4 (as used in the baseline regression), nominal policy rates, nominal or real long-term interest rates (for countries where long-term rates are available), nominal or real long-term interest rate

[8]The regressions are run on flow data, since the stock data are generally nonstationary. The dependent variables are defined for each country as the valuation-adjusted flows into equity and bond funds in the country, divided by the stock at the beginning of the month. All variables are used at a monthly frequency. For variables of higher frequency, the end-of-month value is used. All regressions include country fixed effects to account for any country-specific factors not identified by the other explanatory variables. Dropping country fixed effects does not alter the signs or statistical significance of the results.

[9]The model employs a six-month lagged capital control measure, for two reasons. First, capital control measures are expected to take effect with a time lag. Second, large flows could in fact prompt the imposition of capital controls, forcing an opposite (positive) sign in the regression; the lagged capital control variable addresses this concern of reverse causality.

[10]Two crisis dummies are included, one for the period between June 2007 and August 2008 (global credit crunch) and one for the period starting in September 2008 (Lehman Brothers bankruptcy).

Table 2.4. Summary of Panel Regression Results on Equity and Bond Flows

	Hypothesized Signs		World		Asia		Latin America		Europe, Middle East, and Africa		G-7 Countries		Non-G-7 Advanced Countries	
	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds
Expected return indicators (first moment)														
Policy rate differential (host-G-4 average)	-/+	+	-	-	- **	-	-	-	+	- ***	+	-	+ ***	+
GDP growth forecast	+	+	+ ***	+ ***	+ **	+	+ **	+ ***	+ **	+ ***	+ **	+ ***	+ ***	+ ***
Volatility indicators (second moment)														
Inflation volatility	-	-	-	- **	- **	- **	+	+	+	- *	- *	- **	- **	- **
GDP growth volatility	-	-	- ***	- ***	- ***	- ***	- ***	- ***	- ***	- ***	+	- ***	- ***	- ***
Exchange rate volatility	-	-	- ***	- ***	- **	- ***	-	-	- ***	- ***	- ***	- **	- ***	- ***
Covariance indicators														
Return covariance (cross-country)	-	-	-	- ***	+	- ***	+ ***	- ***	- ***	- ***	+	- ***	+	- ***
Return covariance (intertemporal)	-	-	-	+	+	+ ***	- ***	- ***	+ *	+	- *	+	- ***	-
Risk indicators														
Country risk	-	-	- *	- ***	- **	- ***	-	-	-	- ***	-	-	-	+
VIX Index	-	-	- ***	- ***	- ***	- ***	- ***	- ***	- ***	- ***	- ***	- ***	- ***	- ***
Control variables														
Capital control index	-	-	-	- ***	- ***	-	+	+ **	+	-	- *	- ***	-	- ***
Crisis dummy 1	-/+	-/+	- ***	- ***	- **	- ***	+	- ***	- ***	- ***	- ***	- ***	- ***	- ***
Crisis dummy 2	-/+	-/+	- *	- ***	+	- ***	+ ***	- ***	-	- ***	- ***	-	- ***	- **

Source: IMF staff estimates.

Note: This table summarizes the results of the panel regression on equity and bond flows. +/- indicate the sign of estimated coefficients. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels of confidence based on robust standard errors. Coefficients that are statistically significant and have signs different than expected are in red. Dependent variables are monthly equity and bond flows as a proportion of assets dedicated to each country at the beginning of the month. The policy rate differential is the difference between the policy rate in the host country and the simple average policy rate for G-4 countries. GDP growth forecast is the one-year-forward GDP forecast for the host country, provided by Consensus Economics. Inflation volatility, GDP growth volatility, and exchange rate volatility are the standard deviation of inflation, GDP growth, and exchange rate forecasts, respectively, over the past year. Country risk is a measure of country risk from International Country Risk Group (ICRG). The VIX index is used as a measure of global risk. Return covariance (cross-country) is a measure of the covariance of country returns with the world portfolio return (cross-country correlation factor). Return covariance (intertemporal) is a measure of the covariance of country returns with changes in the world portfolio return (intertemporal correlation factor). Capital control index is the 6-month lagged capital control index produced by the Monetary and Capital Markets Department at the International Monetary Fund. Crisis dummy 1 represents the period June 2007–August 2008 (global credit crunch). Crisis dummy 2 represents the period starting in September 2008 (Lehman Brothers bankruptcy). All independent variables, except for control variables, are in first-differences. A time trend is included.

The regions in the table are broadly based on the Morgan Stanley Capital International (MSCI) regional classification and are as follows:

- Asia (excluding Australia, Japan, New Zealand): China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand
- Europe, Middle East, and Africa (EMEA): Bulgaria, Croatia, Czech Republic, Egypt, Hungary, Nigeria, Poland, Romania, Russia, Saudi Arabia, Slovenia, South Africa, Turkey
- Latin America: Argentina, Brazil, Chile, Colombia, Mexico, Venezuela
- G-7: Canada, France, Germany, Italy, Japan, United Kingdom, United States
- Non-G-7: Australia, Austria, Belgium, Denmark, Finland, Greece, Ireland, Israel, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland

differentials relative to the G-4, and lagged policy rate differentials.[11] The implications of this finding are discussed further below.

- Improving GDP growth prospects in general positively affect flows. Globally, an increase in the forecast GDP growth rate in the investment destination country leads to an increase in bond and equity investments. GDP growth is important for equity investors because higher GDP would lead to higher corporate earnings growth, making equities more attractive. It could also affect bond investors if higher GDP growth reduces credit risk, making bond investments more attractive.
- A rise in country risk generally reduces flows. The regression analysis confirms that, in many cases, an

[11]Because policymakers may use policy rates to dampen undesirable capital flows (which may partly flow into bond and equity investments), the regression may suffer from an "endogeneity" problem. To get around this issue, a regression was run with lagged policy rate differentials. Expected changes in foreign exchange rates (proxied by the forward less the spot rate) are not included in the regression because any expected change would be captured by the interest rate differential through covered interest parity.

increase in country risk in emerging markets reduces their attractiveness for equity and bond investors. The effect is not statistically significant in advanced economies, perhaps partly because these showed little variation in country risk until recently.

- A rise in global risk generally reduces flows. Globally and for all regions, an increase in global risk (proxied by the VIX variable) discourages flows into equities and bonds.
- Lower return covariance generally leads to increased flows. In many cases, lower covariance of a country's equities and bonds leads to higher flows into these investments. This is as expected, since an asset that tends to have low covariance to other assets in the portfolio reduces the risk of the overall portfolio.
- Higher uncertainty tends to reduce flows. Uncertainty about future exchange rates and GDP growth, measured by changes in the volatility of exchange rates and GDP forecasts, are found in general to reduce flows into equities and bonds.
- Capital control measures show only weak effects. Capital control measures negatively affect bond flows on a global scale but not in most of the regressions for emerging markets. This weak finding may result in part because such controls are usually placed on money market and exchange rate instruments and not on longer-term equity and bond investments, where the interests of real-money investors lie; this is consistent with findings in other IMF studies.[12] Also, there is evidence that controls tend to lose effectiveness as market participants find ways to circumvent them, which occurs as long as the return on the controlled transaction exceeds the cost of circumvention.
- The crisis appears to have had an enduring effect on investor behavior. We find structural breaks in investor behavior after the global financial crisis. After the initial stage of the crisis (June 2007 to August 2008), there was a general slowdown in both equity and bond flows to all regions. However, after the second stage (beginning in September 2008), there was an increase in equity flows to Latin America (although there was no statistically significant effect on Asian equity investments). There is for now no firm evidence that these effects have faded.[13]

The above findings show the main "pull" and "push" factors for these investors' asset allocations. The main pull factor is the long-term growth prospects in destination countries, which may be diminished to some extent by rising country risk. The main push factor is the risk appetite of global investors. These factors are robust over the period studied (2005–11).[14]

The most notable of the above findings is that interest rate differentials do not significantly affect real-money investor flows. Neither bond nor equity flows respond to changes in interest rate differentials, globally and for nearly all regions. This result is not fully in line with previous findings (see, for example, IMF, 2011b).[15] A few of the possible explanations are the following:[16]

- The result applies only to real-money flows in and out of bond and equity investment funds. Short-term flows, usually seen as more interest sensitive, are less likely to be invested through these funds; leveraged flows (including from the carry trade), which are not captured in these data, may still respond to differentials in policy rates and other interest rates.

[12]For a detailed discussion see IMF (2010), Chapter 4, "Global Liquidity Expansion: Effects on 'Receiving' Economies and Policy Response Options."

[13]Specifically, the explanatory power of the second crisis dummy variable does not improve significantly if it is terminated before the end of the sample, suggesting that the structural breaks in the regression at the time of the crisis continue through the end of the sample.

[14]The push and pull factors that are found to be important accord with those indicated in the IMF Survey on Global Asset Allocation that accompanied the development of this chapter. The survey is discussed below and in Annex 2.2.

[15]Although Forbes and Warnock (2011) also found weak evidence for the effect of global interest rates on gross capital flows using balance of payments data.

[16]One possible explanation was not borne out in the data. Countries with high interest rate differentials may carry risks of large and sudden devaluations (the "peso problem"). There may therefore be a heterogeneous impact of policy rate differentials on bond flows that may increase the standard error of the estimated coefficient, rendering it insignificant. To try to solve this potential problem, the regression was rerun including an interaction term defined as the product of the policy rate differential and the county risk. Whereas the interest rate differential was positively associated with bond flows when the interaction term is included for the global sample, the results in the regional regressions were unchanged, with bond flows not significantly positively responsive to interest rate differentials.

- The EPFR data include bond funds that hold bonds with a wide range of maturities, which respond differently to changes in rates at different points along the yield curve. Therefore, the effect of short-term rates on bond flows, presumably concentrated on short-term bonds, is obscured by possible differing (and perhaps opposing) effects on long-term bonds. The converse appears also to be true, as using long-term rates in the regressions does not change the results. Thus, whereas different interest rates along the yield curve may affect flows into bonds of different maturities, their effect on total flows into bonds of all maturities is not statistically significant in these data.

The finding of this study that interest rate differentials do not affect bond and equity flows should not be extended to capital flows *in general*, for two reasons. First, flows in and out of bond and equity investments may come out of domestic funds, and to the extent that they do, they would not directly affect capital flows. Second, as noted, capital flows may be dominated by other types of investments, including flows from leveraged investors (such as the carry trade), which this analysis does not cover. Still, for some countries (especially emerging markets, which may have a smaller domestic investor base and are traditionally underweighted in portfolios of international investors), flows in and out of bond and equity funds may to a considerable extent lead to corresponding cross-border flows.[17]

The Risk of Sudden Reversals

The regressions in the previous section found that a number of variables had significant effects on asset allocation, but the question remains, how economically important are these effects? This is important in the context of the potential for sudden reversals of flows. If there are unexpected changes in the risk or return factors that were found in the regressions to be important for global asset allocation, trends in investment flows may reverse. If these reversing flows are large, they may be disruptive to asset markets, and—to the extent that flows out of bonds and equities also exit the country—they would affect the balance of payments.

The econometric results from the previous section allow an examination of this issue through explicit sensitivity analyses, or "stress tests," of investment flows to emerging market regions. In these tests, we apply shocks as follows: (i) a negative shock to the one-year-ahead forecast of the GDP growth rate (a drop in growth expectations), (ii) a positive shock to the variances of the growth forecasts (an increase in the uncertainty to the growth outlook), and (iii) a positive shock to the VIX (an increase in global risk). Besides calculating the effects of these three shocks separately, we also calculate (iv) the impact if all three shocks occur simultaneously.[18] Case (i) could simulate a number of macroeconomic scenarios, including a convergence of global growth rates through a drop in the expected growth rate in emerging economies (leading to a shift of investments away from emerging markets). The shocks are calibrated using historical data by region and are set equal to two standard deviations of the available time series covering 1996–2011, putting them among the 5 percent most severe during that period.[19]

The estimated effects of the simulated shocks are sizeable (Table 2.5 and Figure 2.8). The shocks to growth and global risk each result in annualized monthly flows out of equity funds of around 1 percent of GDP in two of the three regions, and the shock to growth uncertainty has even larger effects. For bonds, the shocks are somewhat smaller than for equities—although still sizeable. In a number of cases, the three shocks examined individually are each of roughly the same order of magnitude as the largest monthly flows out of bond and equity funds during

[17]Specifically, reducing their underweighting in international capital market indices may lead to increased portfolio flows into emerging markets, with corresponding capital inflows.

[18]To do so, we make the considerably simplifying assumption that the shocks have independent effects and are therefore additive.

[19]Regional standard deviations are as follows:
(1) Growth rate—for Asia, 1.98 percent; for Latin America, 1.38 percent; and for the Eastern Europe, Middle East, and Africa group, 1.73 percent.
(2) Forecast variance—0.57 percent, 0.50 percent, and 0.49 percent, respectively.
(3) VIX: 8.08 points for all regions.
The shocks are set equal to two standard deviations of the time series.

Table 2.5. Simulated Effects of Shocks on Regional Flows: Emerging Markets
(Monthly flows in billions of U.S. dollars)

Equity Funds			
	Asia	Latin America	Europe, Middle East, and Africa
	Simulated Effects		
Growth shock	-7.3	-3.2	-2.9
Growth uncertainty shock	-21.8	-6.9	-4.1
Global risk shock	-9.1	-3.6	-1.2
Sum of the above shocks	-38.3	-13.7	-8.2
	Largest Actual, January 2005–May 2011		
Largest net outflows	-11.9	-4.0	-4.4
(month)	(January 2008)	(February 2011)	(June 2006)
Largest net inflows	12.8	5.5	4.0
(month)	(October 2007)	(October 2010)	(January 2006)
Bond Funds			
	Asia	Latin America	Europe, Middle East, and Africa
	Simulated Effects		
Growth shock[1]	...	-1.0	-2.6
Growth uncertainty shock	-4.5	-3.6	-2.0
Global risk shock	-0.6	-0.8	-1.1
Sum of the above shocks	-5.1	-5.4	-5.6
	Largest Actual, January 2005–May 2011		
Largest net outflows	-1.9	-3.3	-2.6
(month)	(October 2008)	(October 2008)	(October 2008)
Largest net inflows	2.4	2.7	2.3
(month)	(April 2010)	(October 2010)	(October 2010)

Sources: IMF staff estimates; and EPFR.

Note: Simulated effects were calculated for respective regions by using the variables from the regressions (see text, "Factors Determining Private Asset Allocation") and applying (i) a negative two standard deviation shock to the one-year-ahead forecast for GDP growth rate; (ii) a positive two standard deviation shock to the variances of the growth forecasts (an increase in the uncertainty to the growth outlook); and (iii) a positive two standard deviation shock to the VIX (an increase in global risk).

[1]For Asia, the parameter was not significantly different from zero.

the crisis. A combined shock to growth, uncertainty, and global risk would lead to flows out of equity funds of between about 2 and 4 percent, larger than (and in some cases a multiple of) the largest outflows that were experienced during the crisis.

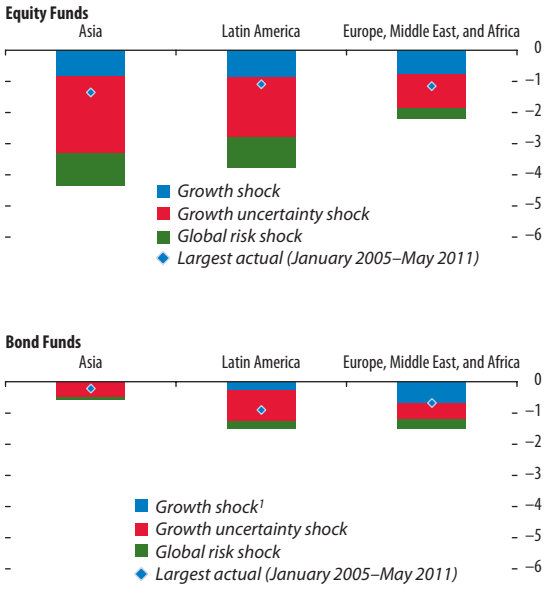
Effects of the Crisis

The empirical results show that investors' asset allocation behavior changed at the time of the crisis. The dummies included in the regressions to capture the effects of the crisis show that globally, and for most regions separately, investors changed their behavior toward equities and bonds in a way not captured by the regular drivers (that is, the other independent variables in the regression). This "crisis effect" began, first, at the onset of the crisis, in mid-2007, and continued around the time of the Lehman Brothers bankruptcy, in September 2008. These were statistically significant changes in behavior, but were they large enough to matter? A useful metric is the Z-score, which relates the size of the change in asset allocation at the time of the crisis to shocks that would normally have been experienced before the crisis.[20] Under the assumption of a normal distribution for shocks to investment flows, a Z-score of about 2 indicates that the shock would be classified as among the 5 percent most severe.

The Z-scores indicate that the crisis effect was quite large for bonds and advanced economy equities (Table 2.6). For bonds, the Z-score was in many cases close to or greater than 2, so that the outflows

[20]The Z-score is the size of the change implied by the dummy coefficient, minus the precrisis mean, divided by the precrisis standard deviation. Note that the Z-score is meaningless if the dummy is not statistically significant, as in such cases there is no statistically significant change at all in asset allocation at the time of the crisis.

Figure 2.8. Simulated Effects of Shocks on Regional Flows: Emerging Markets
(In percent, annualized flows relative to nominal GDP in 2010)



Sources: EPFR; and IMF staff estimates.
Note: For explanation and details, see Table 2.5.
[1]For Asia, the parameter was not significantly different from zero.

from bond funds during the crisis were among the 5 percent most severe compared to the precrisis period. For equities, there is a distinction between emerging markets and advanced markets. In emerging markets, although the coefficients for the first dummy (June 2007–August 2008) were generally significantly negative, the effects were small (i.e., in line with usual volatility in the precrisis period). In addition, the coefficients on the second crisis dummy (beginning in September 2008) were not significantly different from zero, except for Latin America, where the coefficient was positive and significant. In these cases, the low Z-scores imply that investors in emerging market equities continued during and after the crisis to let themselves be guided by the established drivers of asset allocation. Not so in advanced markets, where the "crisis" effect on equity funds was large, with Z-scores around 2, meaning that the crisis-induced outflows from equity funds in advanced markets were among the 5 percent most severe compared to the precrisis period.

How has the crisis changed investors' attitude toward asset allocation—what underlies the structural shifts we found in our analysis? The IMF recently conducted a Survey on Global Asset Allocation of 122 of the largest asset management companies and pension funds and plan sponsors, which collectively had about $20 trillion under management (Annex 2.2). The questions covered subjects such as the trends in total assets, geographical distribution of assets, shifts between asset classes, use of derivatives, the effects of the low interest rate environment, and the outlook for risks and returns. Combining the results of the survey with views gathered from discussions with asset managers offers insights into a number of crisis-related developments in the asset allocation of institutional investors.

The traditional (so-called mean-variance) approach toward a diversified risk-minimizing, return-maximizing portfolio of mainly traditional asset classes is viewed as having been unable to avoid losses during the crisis. As correlations between most traditional asset classes rose toward 1, the benefits of diversification diminished greatly, and most investment strategies suffered large losses. Investors are now looking for other strategies, including those that rely on underlying risk factors rather than

Table 2.6. Evaluating the Economic Significance of Crisis Indicator Coefficients

	World		Asia		Latin America		Europe, Middle East, and Africa		G-7 Countries		Non-G-7 Advanced Countries	
	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds
Crisis dummy 1	-0.723***	-2.388***	-0.516**	-2.216***	0.205	-2.758***	-0.617***	-2.536***	-0.848***	-1.602***	-1.023***	-2.309***
	(-7.155)	(-16.002)	(-2.375)	(-8.895)	(0.927)	(-6.505)	(-3.102)	(-6.603)	(-4.152)	(-4.147)	(-13.087)	(-9.220)
Crisis dummy 2	-0.513*	-2.308***	0.327	-3.597***	1.033***	-4.119***	-1.285	-3.632***	-0.823***	-0.203	-0.741***	-0.906**
	(-1.914)	(-6.899)	(0.843)	(-7.363)	(5.464)	(-6.103)	(-1.104)	(-5.847)	(-3.295)	(-0.391)	(-8.102)	(-2.079)
Precrisis mean	0.61	1.03	0.83	1.16	0.95	1.65	0.45	1.32	0.38	0.34	0.58	0.65
Precrisis standard deviation	1.71	1.74	1.41	1.72	2.43	1.34	2.52	2.36	0.61	1.14	0.67	1.13
Z-score for crisis period 1	-0.78	-1.97	-0.96	-1.96	...	-3.30	-0.43	-1.64	-2.00	-1.70	-2.40	-2.63
Z-score for crisis period 2	...	-1.92	...	-2.76	0.04	-4.32	...	-2.10	-1.96	...	-1.98	-1.38

Source: IMF staff estimates.

Note: In the first two rows the table reports the regression coefficients and standard errors for the two crisis dummy variables from the regression analysis. The next two rows report the mean and standard deviation of the growth of equity and bond flows estimated for the period before June 2007 (the precrisis period). The last two rows report the Z-scores of both equity and bond flows using the mean and standard deviations reported in the previous two rows. The Z-score is defined as the regression coefficient minus the precrisis mean, divided by the precrisis standard deviation, and is one metric for gauging the size of the regression coefficients on the crisis dummy variables. Crisis dummy 1 refers to the period June 2007–August 2008, and crisis dummy 2 refers to the period starting in September 2008. … Indicates that the original estimate is not statistically significant, so no Z-score is calculated.

directly on asset classes for asset allocation decisions (Box 2.2).

However, no consensus on a preferred alternative allocation approach has emerged, and many real-money investors continue to use their traditional approach. Still, investors are planning to add other investment classes to help diversify their portfolios, attributing their lack of diversification in the crisis to their narrow set of investments and short time horizon. These real-money investors (including pension funds and insurance companies) are now more inclined to request asset allocation advice from professional asset managers, and investors' investment mandates are allowing more discretion around strategic allocations.

The precrisis trend toward improved risk management for asset allocation has clearly accelerated recently. Asset managers are paying closer attention to the market risk and credit risk of their portfolios, the value of the positions taken by their traders, and the procedures for countering excessive risks. For their part, investors are paying more attention to the risk management capabilities of their asset managers and are asking for more detailed attribution analysis (the contribution of various factors to losses or gains relative to the benchmark indices). Some investors are also more conscious of tail risk events (those with a low probability but a high impact) and the imprecision with which risks are measured. They are looking for more protection against tail risks, although such protection is difficult to engineer and can be costly. Many investors are avidly interested in it, but so far only a few are willing to pay for it.

Investors have become much more sensitized to the credit risk of sovereign issuers and are discriminating within this previously much more homogeneous asset class. This is particularly true for sovereigns in Europe, and especially in the euro area. Most private and institutional real-money investors exited the sovereign debt markets of the euro area countries seen to have the weakest fundamentals soon after the onset of the sovereign debt crisis, although they continue to be concerned about the implications of the crisis through cross-country and financial institution spillovers for their other investments. At the same time, within the context of improved risk-management systems, some investors (mainly insurers and pension funds) have chosen to hold more emerging market sovereign debt that offers better returns, including the prospect of currency appreciation. Other investors (for example, reserve managers) saw a reinforcement of the practice of holding only the highest quality sovereigns**.**

Investors with a longer horizon appear to have become so sensitive to liquidity risk that they do not want to take on their traditional role of providing market liquidity. Having suffered losses from forced sales during the crisis, many managers of retail mutual funds feel a need to keep them fairly liquid to guard against fire sales. Even long-term real-money investors, who should be able to capture a significant liquidity premium—that is, hold illiquid assets that earn a higher return because of their illiquidity—are hesitant to hold such assets. As noted below, this tendency is also aggravated by solvency regulations and accounting standards.

The crisis has also spurred a "back to basics" approach that seeks a better understanding of the risks involved with derivatives and other hedging instruments. Investors are requesting more information about counterparty risks, and some have limited their asset managers to the use of specific lists of acceptable counterparties. Use of assets as collateral is also being monitored and restricted. Derivatives that are traded or cleared through centralized counterparties are also viewed more favorably, as are more standardized over-the-counter contracts such as currency forwards and swaps. Many of these trends mean that hedging has become more expensive—although most institutional investors are willing to pay for this protection (see Table 2.20, in Annex 2.2).

Despite expectations that the low interest rate environment will be prolonged (Table 2.7), investors are reluctant to acquire more risky assets to increase yield.[21] Given their fixed liabilities, pension funds and insurance companies are feeling the pressure most, as many are still using high expected return targets that cannot be met without taking

[21]This may apply predominantly to pension and insurance companies, which are often required by regulation to follow conservative strategies (see also the section below, "Effects of New Regulatory Initiatives"). See Chapter 1 for a summary of developments for other types of investors.

Box 2.2. A New Asset Allocation Framework Using Risk Factors

Some institutional investors are using a new method of asset allocation, described here.

Asset allocation based on risk factors is gaining recognition among institutional investors. After the financial crisis, some institutional investors started to group investments on the basis of their risk and return profiles rather than according to traditional asset classes such as equities, bonds, and alternative assets. By doing so, asset managers say they are seeking to better understand the risks they are taking and therefore to better manage portfolio risk.

One case in point is the "new alternative asset classification" of the California Public Employees' Retirement System (CalPERS), which became effective in July 2011. The new asset classification consists of five categories—income, growth, real, inflation-linked, and liquidity (see first table). Compared with the traditional classification, this approach provides more information about the risk exposures of the pension fund. The new classification has not immediately changed the overall asset allocation except that the target share of real estate in the portfolio is 3 percentage points higher, cash 2 percentage points higher, and fixed income assets 4 percentage points lower.

Another case of note is that of the Alaska Permanent Fund Corporation, which in 2009 moved away from traditional asset classifications to group its investments by their risk and return profiles (see second table). The fund did not change the long-term target of achieving a 5 percent real rate of return on the assets in which the fund invests, but it judged that the new classification could help it better understand the risk profile of its portfolio. For example, corporate bonds and stocks are grouped together, given that in adverse economic

CalPERS Alternative Asset Classification

			Share (In percent)	
Risk Class	Translating into Asset Class	Purpose	June 2009	July 2011
Income	Global fixed income	Deliver stable income	20	16
Growth	Public and private equity	Positively exposed to economic growth	63	63
Real	Real estate, infrastructure, and forestland	Help preserve the real value of the pension fund	10	13
Inflation-linked	Commodities and inflation-linked bonds	Provide hedging against inflation	5	4
Liquidity	Cash and nominal government bonds	Supply liquidity when needed	2	4

Source: CalPERS.

Alaska Permanent Fund Corporation Asset Allocation

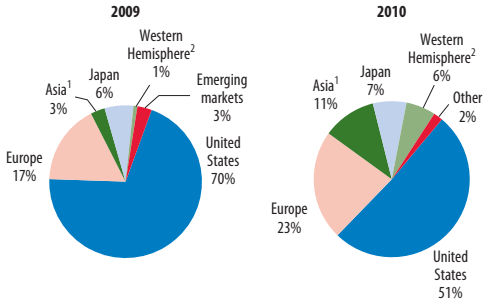
Risk Class	Translating into Asset Class	Purpose	Share, FY2010 (In percent)
Cash	Short-term liquid investments	Meet expected liabilities and manage liquidity needs	2
Interest rates	U.S. government bonds and international government bonds of other advanced economies	Provide insurance against severe equity market corrections	6
Company exposure	U.S. and non-U.S. stocks, corporate investment-grade and high-yield bonds, bank loans and private equity	Benefit in times of growth	53
Real assets	Real estate, infrastructure, and Treasury inflation protected securities	Protect the fund's real value over time	18
Special opportunities	Absolute return, real return mandate, distressed debt, structured credit, and other strategies as they arise	Take advantage of perceived market opportunities	21

Source: Alaska Permanent Fund Corporation.

Note: Prepared by Yinqiu Lu.

Box 2.2 *(continued)*

Alaska Permanent Fund: Regional Asset Allocation
(In percent)



Source: Alaska Permanent Fund Corporation.
[1]Excluding Japan.
[2]Excluding United States.

conditions they may perform similarly to each other. Under the new framework, the share of emerging Asia in the stock portfolio has risen (see figure). Cash was added as an asset class in the fiscal year 2010 allocation so that during periods of market turmoil the fund could avoid the need to sell other assets at fire sale prices to meet expected liquidity needs, especially the annual dividend payment.

Table 2.7. Expected Period before Policy Rate Rise
(In percent of respondents)

	Asset Managers	Pension Funds
In 1 year	0.0	0.0
In 2 years	14.1	12.2
In 3 years	50.0	55.1
In 5 years	20.3	18.4
Beyond 5 years	15.6	14.3

Source: IMF Survey on Global Asset Allocation.

Note: Share of respondents expecting the policy rates in advanced economies to return to end-2007 levels in each time period. Results are for 64 asset manager respondents and 49 pension fund respondents.

on higher-risk assets (see Box 2.3). Still, the IMF survey indicates that only about one-fifth of pension funds surveyed expect higher risk exposure in their portfolios in the next three years (see Table 2.18, in Annex 2.2). In addition, survey respondents indicate that the most important factor in cross-border investment decisions is not the "search for yield," which comes third after diversification and growth prospects (Table 2.8).

Investing in emerging markets is seen as potentially increasing portfolio returns without taking on excessive risk. A number of factors contribute to this view, including (i) underweighting of emerging markets in most portfolios (although exposure was already increasing before the crisis), so that emerging market assets can help diversify portfolios (see Table 2.9); (ii) low returns and increasing risk in advanced economies; (iii) a favorable view of the liquidity available in most large emerging markets; and (iv) an improvement in economic outcomes and a decline in policy risk in emerging markets.

The trend toward increased investment in emerging market equities was interrupted during the crisis, but is generally seen as ongoing (Figure 2.9). Investors were already adding significantly to their holdings in non-G-7 regions before the crisis, before pulling back in 2008. For bond investments, a pullback from all non-G-7 regions to the G-7 had already taken place before the crisis, and the trend toward further diversification is yet to resume fully: today, the non-G-7 share for bonds remains well below its peak in early 2006. However, since the crisis, diversification into the other regions has resumed for equity investments, which are more diversified today than they were before 2008.

Although emerging market assets are becoming more acceptable as a standard class to add to portfolios, a concern remains about their liquidity during a crisis and about other country risks. These concerns are likely to be more of an issue in the fixed income markets than in equities, although

Box 2.3. The Low Interest Rate Environment and Pension Funds

A protracted period of low interest rates has significant negative effects on the funding status of defined-benefit pension plans and could thus eventually have a financial impact on plan sponsors and beneficiaries.

One measure of the funding status, or solvency, of a defined-benefit (DB) pension plan is the ratio of the current market value of plan assets to its obligations. The obligations are the plan's actuarial liabilities, representing the present discounted value of all future retirement benefits earned to date. If the ratio is less than 1, the plan is underfunded.[1]

Declines in interest rates affect the asset and liability sides of a pension plan, as follows:

- They generate capital gains in existing bond holdings and thus increase asset values.[2]
- They lower the discount rate used to calculate the net present value of future benefit payments (typically the yield on long-term, high-quality domestic corporate bonds for accounting, and often long-term government bond yields for prudential regulation purposes) and thus increase the plan's liabilities.

Note: Prepared by Ken Chikada.

[1]For more detailed and technical discussions on the funding status of defined-benefit pension plans, see Impavido (2011).

[2]This represents the direct effect on bond prices only and abstracts from possible additional (macroeconomic) effects on other asset prices, such as stock prices and real estate values.

Hence, all other things equal, the net effect of changes in interest rates on the funding ratio depends on the maturity mismatch between assets and liabilities. As the liability side of pension plans generally has a longer average duration than the asset side, funding ratios tend to deteriorate with declines in interest rates.[3]

In general, declines in long-term interest rates worsen the funding ratio significantly, as illustratively shown in the following sensitivity analysis based on data from the United Kingdom (starting from a base of 100 for both assets and liabilities): a mere 0.1 percentage point decline in the discount rate increases pension liabilities by 2 percent while having only a negligible effect on the asset side (see shaded cells in the table, top panel). A similar effect on the funding ratio would result from a much larger—5 percent—decline in stock prices (shaded cells, bottom panel).

Declines in interest rates also have an income effect: as the higher-yielding bonds mature, they will be replaced with those having a lower yield.

In many major economies, the long-term decline in interest rates and improving life expectancy (the liability effect) have increased liabilities much faster than assets and thus have put downward pressure on funding ratios. Short-term fluctuations correlate with equity price swings (the asset effect), as witnessed by the sharp

[3]In contrast, banks typically have longer maturities for assets than for liabilities.

Impact of Changes in Gilt Yields on U.K. Defined-Benefit Pension Assets and Liabilities from a Base of 100

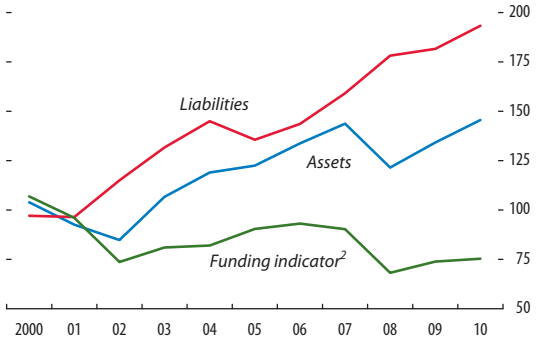
	–0.3%	–0.2%	–0.1%	Base	+0.1%	+0.2%	+0.3%
On assets (A)	101	101	100	100	100	99	99
On liabilities (B)	105	103	102	100	98	97	95
A minus B	–4	–2	–2	0	2	2	4
For comparison: impact of changes in equity prices on defined-benefit pension assets from a base of 100							
	–7.5%	–5.0%	–2.5%	Base	+2.5%	+5.0%	+7.5%
On assets	96	98	99	100	101	102	104

Source: PPF/The Pension Regulator (The Purple Book 2010).

Note: Sensitivity analysis based on dataset of 6,596 U.K. defined-benefit schemes on March 31, 2010. Shaded cells indicate roughly similar order of impacts on the funding ratio stemming from changes in bond yields and equity prices, respectively, assuming both the assets and liabilities start from a base of 100.

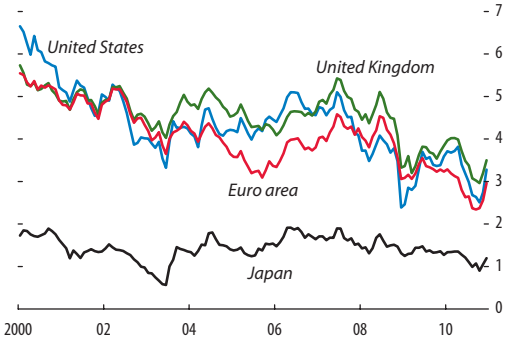
Box 2.3 *(continued)*

Defined-Benefit Pension Funds: Assets, Liabilities, and Funding Indicator for Major Economies[1]
(1998=100)



Sources: TheCityUK; and Towers Watson.
[1]Australia, Canada, France, Germany, Hong Kong SAR, Ireland, Japan, the Netherlands, Switzerland, the United Kingdom, and the United States.
[2]Assets divided by liabilities.

Ten-Year Government Bond Yields
(In percent)



Source: Bloomberg L.P.

drop in pension assets in 2008 and subsequent rebound in 2009 (see first figure).

Countries differ considerably in the stringency of their funding regulations for pension plans and hence in how much time and flexibility are allowed for addressing the underfunding of plans. The differences partly reflect how pension plans are linked financially to their sponsoring employers.[4] Where pension funds are more detached from sponsoring employers, such as in the Netherlands, relatively higher minimum funding ratios are required, as are quicker recovery plans in the event of underfunding. Where benefits are underwritten by sponsoring employers, such as in Japan, the United Kingdom, and the United States, longer recovery plans are allowed, but unresolved underfunding would eventually require increased contributions from employers.

Against this background, pension funds may change their asset allocation to hedge against market risks or to augment yields to improve their funding status. The sponsors may also shift their financial risks to the beneficiaries by closing the DB plan to new employees, or by moving existing staff (if possible) to a defined contribution scheme.

In an environment of persistently low interest rates, plan sponsors commonly hedge interest rate risk on the liability side by increasing asset allocations to bonds and extending their duration, thus decreasing the extent of the maturity mismatch. However, although this strategy helps mitigate adverse effects of further declines in interest rates, it does not necessarily improve an already worsened funding status.

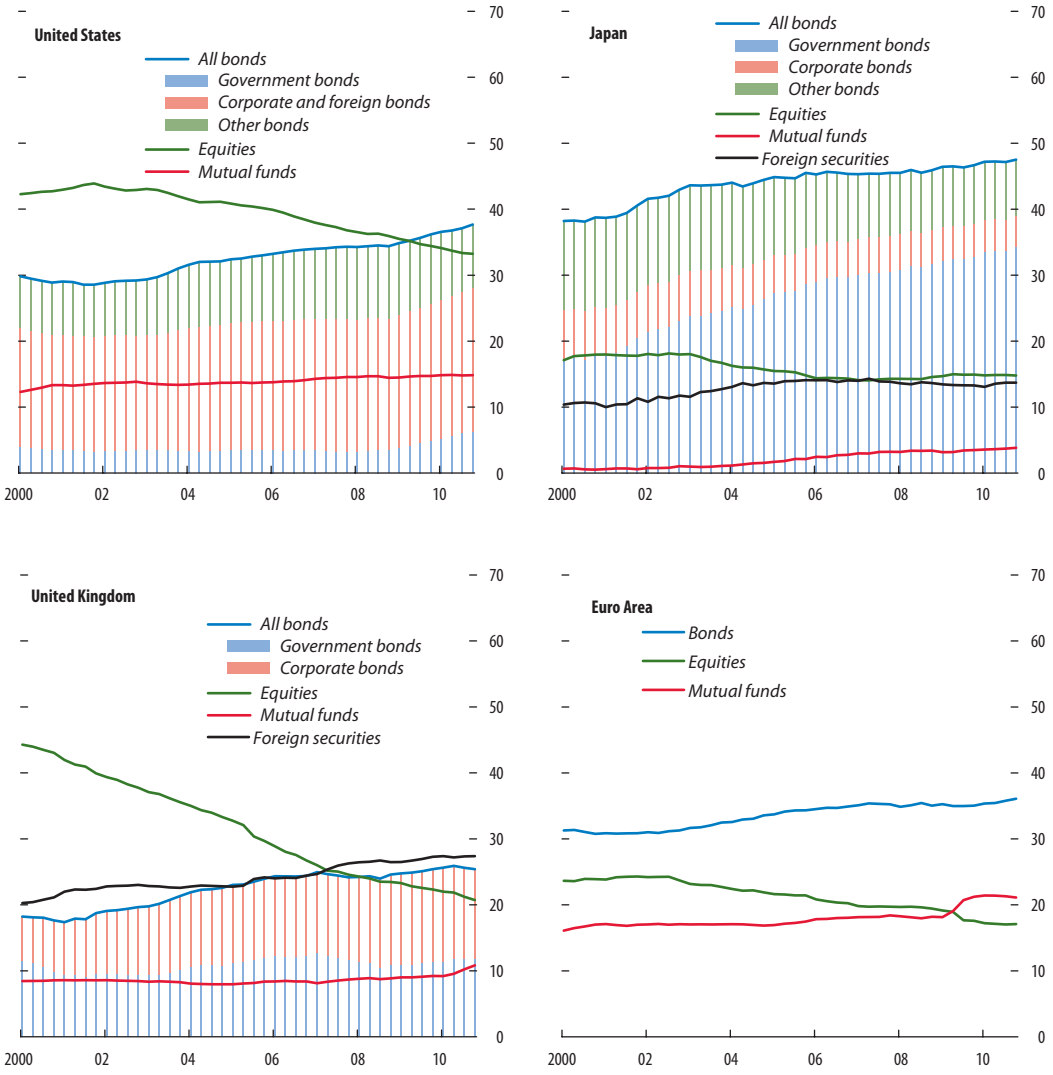
To address worsened funding ratios, long-term institutional investors may potentially be more inclined to "search for yield." That could mean a shift from bonds to equities and a likely increase in the volatility of the value of the portfolio. However, flow-of-funds data for pension funds and insurance companies in the G-4 economies over the past decade show instead a gradual but continuous increase in the bond

[4]Pugh and Yermo (2008); and Yermo and Severinson (2010).

Box 2.3 *(continued)*

Pension Funds and Insurance Companies: Asset Allocation for Selected Advanced Economies

(In percent of total financial assets, adjusted for effects of valuation changes)



Sources: National flow-of-funds data; and IMF staff estimates.

Note: For the United States and the euro area, the bond and equity holdings consist of both domestic and foreign securities. Government bonds for the United States include Treasury bills.

Box 2.3 *(continued)*

holding ratio, after accounting for the effects of valuation changes (see second figure).[5] In other words, rather than trying to enhance yields at the expense of having more volatility risk on the asset side, these investors as a whole seem to have been putting more emphasis on duration matching to address the effects of low interest rates on their liabilities.

[5]Using both flow and stock data from flow-of-funds accounts, an attempt can be made to exclude effects of valuation changes. For example, the bond holdings of an investor at time t can be calculated as follows:

$$\text{Bond holdings}_t = b_t = \frac{B_0 + \Sigma_{k=1}^{t} BF_k}{Q_0 + \Sigma_{k=1}^{t} QF_k}$$

where B_0 is the stock of bonds at $t = 0$; Q_0 is the stock of financial assets at $t = 0$; BF_k is the net acquisition of bonds (transaction flow) at $t = k$; QF_k is the net acquisition of financial assets (transaction flow) at $t = k$.

Table 2.8. Top Five Factors Considered in Cross-Border Investment since End-2006

(Ranked by scores)

	Asset Managers		Pension Funds	
Rank	Factors	Score	Factors	Score
1	Diversification	115	Diversification	106
2	Longer-term growth prospects	113	Longer-term growth prospects	100
3	Search for yield	93	Search for yield	40
4	Sovereign or country risk	60	Range of investments available	33
5	Market liquidity	58	Volatility	32

Source: IMF Survey on Global Asset Allocation.

Note: Shown are the five factors cited most frequently by respondents, who were asked to report their top four factors. Score is calculated as (4 * rank-1 factor) + (3 * rank-2 factor) + (2 * rank-3 factor) + (1 * rank-4 factor). Results are for 61 asset manager respondents and 40 pension fund respondents.

Table 2.9. Regional Allocation

(In percent)

	Asset Managers				Pension Funds			
	Bonds		Equities		Bonds		Equities	
	2006	2010	2006	2010	2006	2010	2006	2010
Own country of domicile	61.0	60.1	47.5	44.8	78.1	75.7	55.5	50.3
East Asia/Pacific	3.4	3.6	8.5	9.0	1.8	2.4	8.6	10.1
Europe	27.2	27.1	28.2	27.1	11.7	11.4	22.1	21.4
Latin America	0.8	0.8	1.8	2.6	0.3	0.9	0.8	2.5
Middle East/North Africa	0.1	0.2	0.2	0.3	0.0	0.3	0.2	0.4
North America	7.1	7.7	11.7	13.0	7.9	8.9	11.6	13.1
South/Central Asia	0.2	0.2	0.8	2.1	0.1	0.4	1.1	2.0
Sub-Saharan Africa	0.0	0.0	0.1	0.2	0.0	0.1	0.1	0.3

Source: IMF Survey on Global Asset Allocation.

Note: For asset managers, figures are averages for 29 respondents for bonds and 32 respondents for equities. For pension funds, figures are averages for 28 respondents.

some stocks became illiquid in the crisis and could do so again. However, the trend toward better risk management also prevails in this case, with many investors discriminating between different emerging markets rather than seeing them as a homogeneous asset class. Nonetheless, investors retain some home or regional bias.

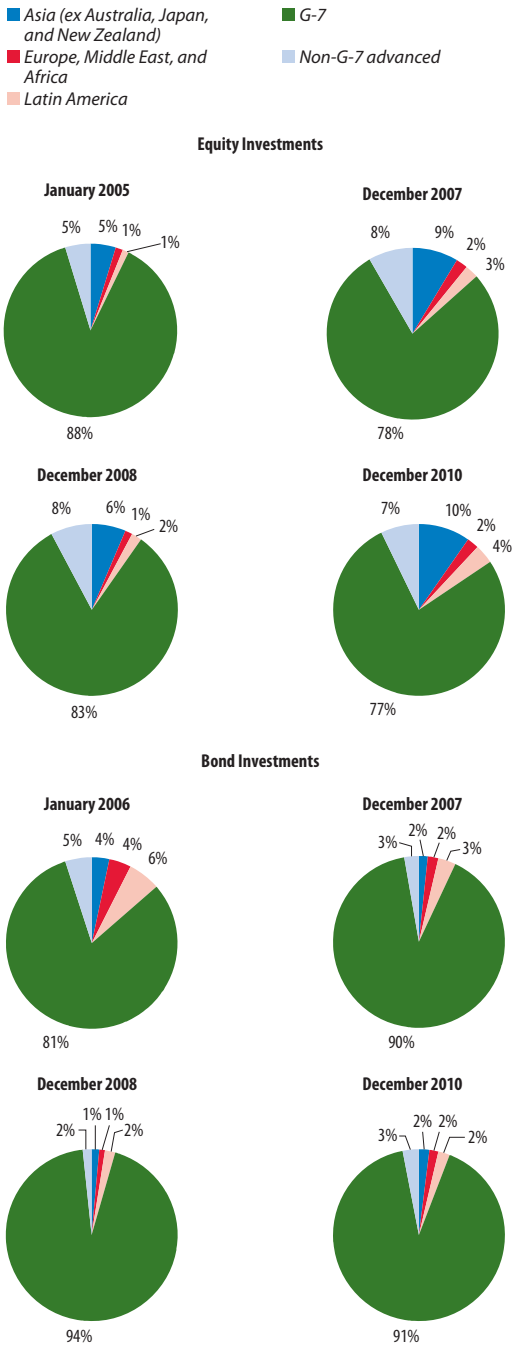
Besides emerging markets, alternative assets are drawing interest, but actual allocations currently show little evidence of a significant shift toward them (Table 2.10). The diversification offered by traditional asset classes provided limited protection during the financial crisis. In isolation, alternative assets (commodities, real estate, private equity, infrastructure, and hedge funds) may well carry higher risks, but their low (or even negative) correlation with other assets means that they may actually lower the risk in the overall portfolio, and the more sophisticated investors understand this mechanism. Still, the low liquidity of some of the alternative asset types is a concern, as investors may not be able to exit easily in times of turmoil.

Effects of New Regulatory Initiatives

Regulation geared toward institutional investors may have significant effects on their asset allocation. Previous studies have suggested a possible shift in asset allocation to bonds from equity as a consequence of a shift toward fair value accounting of pension schemes and related changes in solvency regulations in advanced economies in the mid-2000s (see OECD, 2005; Boeri and others, 2006; and Committee on the Global Financial System, 2007, 2011). Recent other examples of such regulations are the Basel III proposals for banks by the Basel Committee on Banking Supervision and the Solvency II proposals governing capital requirements for insurance companies in the European Economic Area. Both of these initiatives take a risk-based approach to minimum capital requirements.

In discussions as background for this chapter, some insurance companies indicated that Solvency II would encourage investment strategies opposite to those needed if their industry is to return to financial health. They noted that the risk-based capital

Figure 2.9. Regional Distribution of Equity and Bond Mutual Fund Investments[1]
(In percent)



Sources: EPFR; and IMF staff calculations.
[1]See Table 2.4 for list of countries.

Table 2.10. Asset Allocation by Asset Class
(In percent)

	Asset Managers			Pension Funds		
	2006	2008	2010	2006	2008	2010
Traditional asset classes						
Cash	6.9	8.9	6.5	1.7	2.1	2.4
Equities	39.7	31.2	34.5	51.4	40.3	44.9
Bonds	41.9	46.6	46.7	36.0	41.9	37.1
Subtotal	88.5	86.7	87.7	89.1	84.3	84.4
Alternative asset classes						
Real estate	4.4	5.2	4.7	5.2	6.7	5.6
Hedge funds	1.7	2.1	1.4	1.5	2.2	2.2
Private equity	0.5	0.6	0.6	2.7	4.5	4.6
Commodities	0.1	0.1	0.1	0.4	0.6	1.0
Other	4.8	5.4	5.5	1.0	1.7	2.1
Subtotal	11.5	13.3	12.3	10.9	15.7	15.6

Source: IMF Survey on Global Asset Allocation.

Note: Figures are averages for 55 asset manager respondents and 49 pension fund respondents.

charges imposed by Solvency II would discourage equity investments in favor of high-quality fixed-income securities, reducing returns and the flow of funds into new equity and riskier longer-term investments. This was seen as potentially detrimental to the interest of the holders of insurance products, to the extent that this effect is not entirely offset by reducing the portfolio risk for insurance company assets. Although Basel III has less direct effects on real-money investors, there are indirect effects in that these investors will be less inclined to invest in bank debt or equity, which will likely have lower returns due to higher capital and liquidity buffers.

Implementation of Solvency II and other regulatory incentives that aim to make individual institutions "safer" could also affect financial stability in a number of possible ways:

- First, some insurance companies fear that they will have insufficient time to prepare for prescribed changes because of uncertainty about the final content of the regulations. Given the likely long phase-in period, however, the risk of a rush to adjust asset allocations, with potential disruptive effects to asset markets, is probably small, but given the large assets under management in European insurance companies, it cannot be completely discounted.
- Second, pushing insurance companies toward higher-quality fixed-income securities and away from less liquid equities makes them more like other short-term investors, a development reinforced by mark-to-market accounting rules.[22] This lessens the diversity of investor types and raises the risk of similar responses to shocks and could therefore carry financial stability concerns.
- Third, the pressure to enhance yields in the low interest rate environment is growing, and the requirement for insurance companies to hold the bulk of their assets in safe, low-yielding assets may push them to become more aggressive with the remainder of their portfolio and may shorten their investment perspective.[23] Their investment behavior regarding this risky part of their portfolio might well become more volatile, leading to a risk of sudden reversals in some less liquid markets, including in emerging economies.

[22]See Committee on the Global Financial System (2011) and World Economic Forum (2011).

[23]For example, a Towers Watson Survey in June 2011 found that 46 percent of responding insurers were expecting to be more aggressive in their investment strategy in the next year (Towers Watson, 2011).

Conclusions and Policy Implications

The analysis in this chapter suggests that asset allocation by long-term real-money investors is driven most strongly by positive growth prospects and falling risks in the recipient countries; interest rate differentials play a lesser role. For flows into both equities and bonds, investors are focused mostly on growth potential when choosing investment destination countries, although country risk has a clear negative effect. As expected, a decline in global risk aversion increases investment in equities and bonds to all emerging market regions. Investment flows from real-money investors into bonds and equities are generally not significantly affected by differentials in interest rates. Care should be taken, however, not to extend this result to capital flows in general, which have a number of components not covered in this analysis. In particular, the investment flows of short-term leveraged investors (such as those from the carry trade)—which this chapter does not examine—might still be affected by changes in policy rates and other interest rates in the economy.

The implications of these findings for policymakers are that asset-allocation decisions are grounded mostly in the responsiveness and consistency of economic policy, not in specific policy actions. Policies geared toward macroeconomic stability and low inflation will enhance growth, reduce volatility in macroeconomic outcomes, and lower country risk, which the regression analysis in this chapter shows affects real-money investor flows positively. Yet the additional investment flows attracted by macroeconomic stability and strong growth prospects could have potentially destabilizing effects over the longer run, including asset price bubbles and credit booms. Monitoring and possible management of these flows should therefore be part of the larger framework of growth-enhancing policies.[24]

While the trend toward longer-term investment in emerging markets is likely to continue, shocks to growth prospects or other drivers of private investment could lead to large investment reversals. The structural trend of investing in emerging market assets accelerated following the crisis, driven mostly by relatively good economic and investment outcomes. Still, the sensitivity analysis in this chapter showed that a negative shock to growth prospects in emerging markets could potentially lead to flows out of emerging market equities and bonds. These flows could reach a scale similar to—or even larger than—the outflows these countries experienced during the financial crisis. Adverse dynamics are possible in such cases: if countries react with policies that are perceived to raise country or policy risk, this would tend to increase the desire for investors to exit. In addition, the reactions of other types of investors (including those that are leveraged—see Chapter 1) would likely compound these investment outflows, or even initiate them.

Policymakers should prepare for the possibility of a pullback from their markets in order to mitigate the risk of potentially disruptive liquidity problems, especially if market depth may not be sufficient to avoid large price swings. Emerging market policymakers should take advantage of periods of macroeconomic and financial stability to reinforce the resilience of their financial systems. Also, they should prepare contingency plans to maintain liquidity in asset markets during periods of market turmoil, perhaps using sovereign asset managers as providers of liquidity as other investors exit, as some did during the crisis (Box 2.4). Coordination between sovereign wealth managers would be important in these situations, to avoid a repeat of what happened during the crisis, when some reserve managers acted procyclically by moving out of unsecured bank deposits.

The global financial crisis changed longer-term asset-allocation strategies, chiefly by making investors more risk conscious and prompting a greater focus on portfolio risk management. The disruption of liquidity during the crisis and the recent sovereign risk concerns have made investors especially mindful of market liquidity risks and the importance of credit risk in sovereign bond markets—even in the most developed economies. There is strong anecdotal evidence that these events have altered asset allocation frameworks in a structural and lasting way. This structural shift can also be seen in the data: the regressions in this chapter show significant downward shifts in investment flows for the

[24]See Ostry and others (2010).

Box 2.4. Sovereign Asset Management and the Global Financial Crisis

Sovereign wealth funds were affected by, and responded to, the global financial crisis.

The global financial crisis affected all sovereign wealth funds (SWFs). Those that were more heavily invested in equities suffered especially large losses—in some cases, more than 30 percent—from the sharp downturn in prices of risky assets (see first figure). Key to the subsequent recovery of such funds was their ability and willingness to stay invested in risky assets and "ride out" the financial turmoil. As financial market conditions started to improve in early 2009, that longer-term approach paid off.

Governments used SWF assets during the crisis to support their economic, fiscal, and financial stability objectives. The new functions given to SWFs—some in line with their original mandate, others beyond it—included:

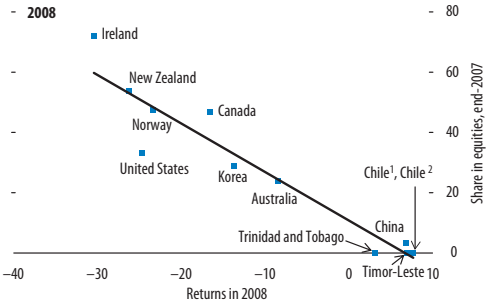
- Stimulus support: Assets of some SWFs financed stimulus packages to support economic activity.
- Deficit financing: Assets were drawn upon to finance rising fiscal deficits.
- Financial stability: Some SWFs were directed to deposit assets in domestic banks as a way to provide liquidity support, while others contributed assets to bank recapitalization. In some cases, SWF assets were earmarked to support deposit insurance schemes or were used to purchase domestic equities to boost markets and investor confidence.

The actions of sovereign wealth managers during the crisis were not always optimal, as some reserve managers acted procyclically by rapidly moving out of bank deposits (see second figure). Surveys, conducted annually by Central Banking Publications, and other studies (Pihlman and van der Hoorn, 2010) confirm that the risk aversion of reserve managers increased and that reserve managers participated in the global flight to quality and liquidity. Those developments were seen most clearly in the flight from unsecured bank deposits: the proportion of total reserves (including gold at market prices) invested in

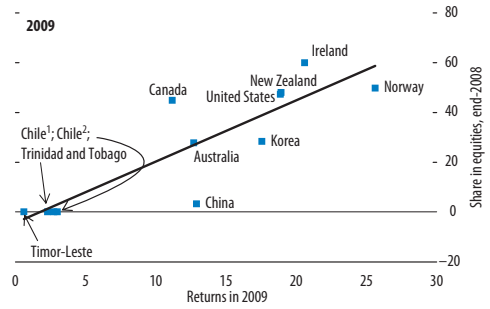
Note: Prepared by Yinqiu Lu, drawing on Kunzel and others (2010).

Sovereign Wealth Funds: Shares in Equities and Returns, 2008 and 2009

(In percent)



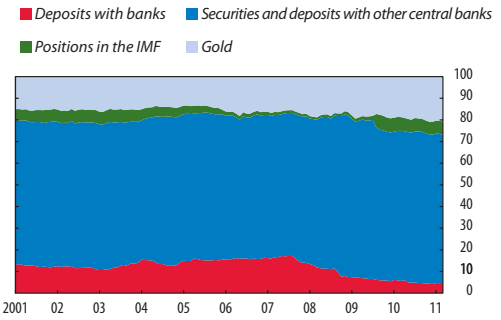
Sources: Sovereign wealth fund websites; and IMF staff calculations.
Note: For Australia, excluding Telstra; for Ireland, excluding directed investments; forChina, the share of equity as of end-2008.
[1]Pension Reserve Fund.
[2]Economic and Social Stabilization Fund.



Sources: Sovereign wealth fund websites; and IMF staff calculations.
Note: For Australia, excluding Telstra; for Ireland, excluding directed investments.
[1]Pension Reserve Fund.
[2]Economic and Social Stabilization Fund.

Instrument Composition of Official Reserves, Including Gold

(In percent)



Source: IMF, International Financial Statistics and Data Template on International Reserves and Foreign Currency Liquidity.

Box 2.4 *(continued)*

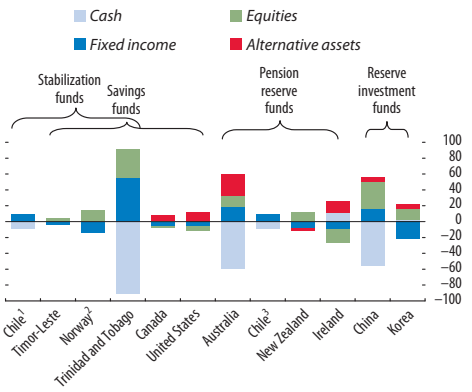
this asset class dropped rapidly from its peak of 17.2 percent in July 2007 to less than 5 percent in June 2010. That large move raised concerns that, by acting procyclically, reserve managers may have inadvertently contributed to the severity of the crisis (Niedermayer, 2009; Pihlman and van der Hoorn, 2010; Mminele, 2011). There have been calls recently to formally address this issue, for example through an update of the IMF's Guidelines for Foreign Exchange Reserve Management.

The asset allocation of SWFs in the aftermath of the crisis—and therefore the extent to which they may take on the risks that may now be avoided by private institutional investors—is subject to contesting influences.

- Like many private investors, SWFs' severe losses in the crisis have likely made them more aware of, and perhaps more averse to, various types of risk. In addition, changing mandates that could now include fiscal, economic, and financial stabilization objectives may require assets to be safer or more liquid.
- By contrast, however, the crisis and postcrisis experience showed sovereign asset managers that (i) additional diversification (including into assets that by themselves may be considered risky) may further reduce portfolio risk, especially in a crisis; and (ii) longer-term strategies, if maintained in times of turmoil, may significantly reduce portfolio damage.
- In addition, as with private investors, SWFs may be pushed toward riskier investments in part to generate higher returns under a potentially prolonged low interest rate environment.

The postcrisis adjustments in the asset allocations of SWFs show that the balance of these factors is pushing SWFs in the direction of providing more risk capital (see third figure). Like private asset managers, SWF managers have enhanced their efforts to diversify portfolios by increasing investments in equities and alternative assets (with some introducing such investment classes for the first time). These new investments have been financed by cash and, to a lesser extent, fixed income holdings. Also, mirroring private trends, many SWFs have increased investments in emerging markets.[1]

Sovereign Wealth Funds: Change in Asset Allocation by Type of Fund, December 2007– December 2010
(In percent)



Sources: Sovereign wealth fund websites; and IMF staff calculations.
Note: For Trinidad & Tobago, the change is between September 30, 2007 and December 31, 2010; for Australia, the change is between January 31, 2008 and December 31, 2010; for China, the change is between December 31, 2008 and December 31, 2009. For Australia, excluding Telstra; for Ireland, excluding directed investments.
[1]Economic and Social Stabilization Fund.
[2]Norway's Government Pension Fund, Global is also classified as a pension reserve fund.
[3]Pension Reserve Fund.

[1]Examples of geographic diversification to emerging markets abound. China Investment Corporation has indicated that it will shift some of its focus to emerging markets (*Financial Times*, January 16, 2011). Singapore's Temasek plans to increase its exposure to emerging markets in Asia, Brazil, and the Russian Federation and reduce its exposure to OECD countries, from one-third to one-fifth of its assets (www.temasek.com.sg/media_centre_news_speeches_120509.htm). Norway has opened offices in Shanghai and Singapore (www.nbim.no/en/press-and-publications/News-List/2010/nbim-opens-new-office-in-singapore).

full period after the start of the crisis in mid-2007, reflecting an adjustment of portfolio flows to the new assessment of risks. There is no evidence so far that this effect is fading. This may be evidence that risk aversion of institutional investors has fundamentally changed.[25]

The low interest rate environment in advanced economies since the crisis has not yet pushed investors into riskier investments to enhance yields but may do so if—as expected—interest rates in advanced economies stay low for an extended period. The results of the IMF Survey on Global Asset Allocation and other information about recent allocations indicate that investors have in general not yet moved into riskier assets to enhance yields.[26] Still, the pressure to do so is already strong and growing, especially for those institutional investors that need to earn a minimum absolute return (such as insurance companies that have sold products with minimum guaranteed returns and pension funds that are underfunded). As the low interest rate environment is expected to last for a number of years, such investors will be increasingly compelled to take on more investment risk as their financial situation continues to be unfavorable.

These financial incentives now facing institutional investors may interact with recent regulatory initiatives in a way that carry risks to financial stability. Initiatives like Solvency II and Basel III aim to make individual financial institutions safer, but may make institutional investors more like other short-term investors. As a result, they would be less likely to act as the "deep pockets" of financial markets that support riskier, long-term investment and are willing to hold such illiquid assets through market downturns. This would lessen their traditional role in fostering financial stability. Also, the requirement for insurance companies to hold the bulk of their assets in safe, low-yielding assets may push them to become more aggressive with the remainder of their portfolio to try to enhance portfolio returns. This may lead them to invest more aggressively in (smaller) emerging markets or alternative assets (commodities, real estate, private equity, infrastructure, and hedge funds). Investment returns on this risky part of their portfolio might well appear more variable under mark-to-market accounting rules (despite the improved diversification at the portfolio level over the longer run). Increased variability of returns may make asset allocation more volatile, leading to a risk of sudden reversals that may adversely affect financial stability, especially in less liquid markets.

As heightened risk awareness and regulatory initiatives are pushing private investors to hold "safer" assets, there may be a role for sovereign investors to take on some of the longer-term risks that private investors now avoid. Although the assets of SWFs are less than one-tenth of the total assets of pension funds and insurance companies, their role is likely to expand as sovereign assets grow. Their original purposes should remain intact, but as their assets grow beyond that needed for their original purpose, authorities could consider how their sovereign investment policies and financial markets can benefit from accommodating the supply of long-term investments. Sovereign asset allocation can also help foster longer-term financial stability, including by offsetting potentially destabilizing private investment behavior, especially during crises. That said, the extent to which SWFs and noncore reserves can be invested in longer-term, less liquid assets should be considered within a comprehensive framework for sovereign assets and liabilities management. Such a framework would link the asset allocation of sovereign investment (including its liquidity, duration, and market risks) to its investment objectives, taking into account its explicit or contingent liabilities.

Monitoring of trends in asset allocation is an additional useful tool to identify potential risks to financial stability, but its effective use will require more accurate, comprehensive, and timely data. Changes in asset allocation by investors are at the core of capital flows between institutions, markets, and countries. Direct monitoring of these changes

[25]Risk aversion is a concept that is considered innate, underpinning an investor's preferences. Changes in risk aversion would affect asset allocation only to the extent that they are not already reflected in shifts because of changes in actual and expected risks and returns. In the regressions, changes in risk aversion could therefore be loosely interpreted as shifts in asset allocation that cannot be explained by the explanatory variables, that is, as a structural break in the regressions.

[26]See, for example, OECD (2011).

will contribute to a more thorough understanding of the resulting flows and allow policymakers to identify more clearly any emerging risks to financial stability. However, relevant public data (mostly from national flow-of-funds accounts) are scarce, available with sometimes significant delays, and with differing methodologies. Private data are more timely and frequent but cover mostly investment funds and fail to capture most bank and official flows. Effective monitoring requires a major compilation effort to create a truly global dataset of higher frequency (at least quarterly, but preferably monthly) that includes asset allocation by type of investor, source and destination of funds, asset class, and maturity.[27]

[27]The IMF is contributing to this effort, including through the G-20 Data Gaps Initiative. See www.imf.org/external/np/g20/pdf/102909.pdf.

Annex 2.1. Asset Allocation: Theory and Practice[1]

Markowitz (1952) changed the way both academics and practitioners look at the portfolio selection problem. Markowitz's mean-variance approach became the basis for modern portfolio theory and the capital asset pricing model (CAPM) as well as for the application of continuous-time mathematics to the portfolio choice problem.

Formally, portfolio shares in the generic mean-variance model represent the solution to the optimization problem

$$\mathbf{w}^{\min} = \min\{\mathbf{w}'\boldsymbol{\Sigma}\mathbf{w}\} \quad (1)$$

subject to

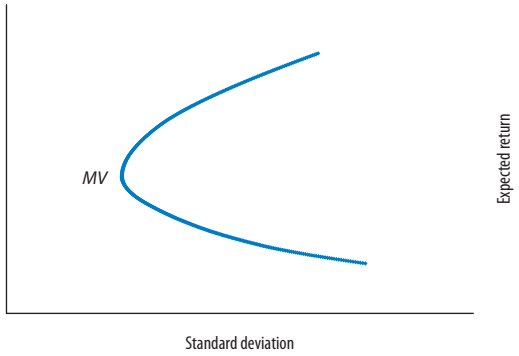
$$\mathbf{w}'\mathbf{r} = \hat{r} \quad (2)$$

and other constraints, where $\mathbf{w}$ is a column vector of portfolio shares, $\mathbf{r}$ is a column vector of expected returns, and $\boldsymbol{\Sigma}$ is the covariance matrix of returns; $\mathbf{w}$ and $\mathbf{r}$ are of dimension $n \times 1$; $\boldsymbol{\Sigma}$ is of dimension $n \times n$; and $\mathbf{w}^{\min}$ is the vector of portfolio shares that minimizes the volatility of the portfolio with expected return $\hat{r}$. Using the portfolio standard deviation σ_p as the only relevant risk measure, solving for different values of $\hat{r}$ yields a surface in σ-r space that represents all the points of a feasible minimum-risk portfolio for a given return, that is, the *minimum-variance frontier* (Figure 2.10). The upper part of the minimum-variance frontier—starting at MV, the point of minimum variance—is called the *efficient frontier*, as these portfolios dominate those on the frontier below MV, which provide a lower return for the same risk.

Starting in the 1970s, the mean-variance approach became the workhorse of most of those who allocate assets. In applied work using this approach, returns were generally assumed to come from a normal statistical distribution, where the mean and variance are sufficient to completely describe the shape of the distribution. The properties of the normal distribution made it easier to calculate various risk measures and simplified some of the mathematics of the model. At a minimum, it provided a benchmark against which other asset allocation models could be compared.

[1]Prepared by Peter Lindner.

Figure 2.10. Minimum Variance Frontier



However, as the mean-variance model became widely adopted for strategic asset allocation, a number of weaknesses to the approach gradually came to the fore.

First, expected returns and the covariance matrix of returns for *all* assets have to be either estimated or derived from analyst estimates. But investors typically have firm ideas about the returns of only a subset of assets. For another set of assets, they might have less precise ideas, and for the remainder, they might not have formed any idea about expected returns. To avoid having to establish a full set of expected returns, many investors simply used historical returns when other estimates were not available. In the case of fixed income assets, yields were often used as the estimate of expected returns. A significant problem is that historical estimates and yields have proved to be bad indicators of future returns. Similarly, although estimates of the matrix of return covariances were initially deemed fairly stable, recent statistical advances have shown that they are time-varying.[2]

A second, more fundamental problem appeared in many applications. When correlations between asset returns were high and they had similar volatilities, small changes in expected returns among them generated dramatic changes in the model-based portfolio allocations that were far greater than most users expected and, if implemented, would have imposed potentially large transaction

[2]Time-varying covariance matrices also presented a problem. However, covariance matrices that are estimated on the basis of a GARCH (generalized autoregressive conditional heteroskedasticity) model can accommodate changing volatilities and correlations.

costs. Those cases showed that mean-variance optimization algorithms do not discriminate well among such assets.

Users dealt with these drawbacks mainly by imposing constraints such as limiting certain assets to a much smaller share than the optimization algorithm would suggest. Although such procedures introduced a degree of arbitrariness, they were more in line with the standard practice that combines investment experience with quantitative methods.[3]

The Black-Litterman (BL) approach seeks to address these issues.[4] It derives a vector of implied expected returns from the existing weights of the market portfolio. Those returns become the starting point for further analysis, to which the investor's own return forecasts and confidence in those forecasts can be added. Further, return forecasts can be formulated on a relative basis (that is, the expected return of asset A is assumed only to be higher than that of asset B) to arrive at the optimal BL asset allocation. In many applications of the BL model, the weights of only those assets for which returns were modified would change appreciably upon recalculation.

Although the BL model alleviates some significant shortcomings of the mean-variance approach, its underlying distributional assumptions still pose particular challenges. These challenges were brought to the fore by ongoing market developments:

- Many assets—for example, options and credit-dependent bonds and derivatives—have returns that cannot be reasonably approximated by a normal distribution. The nonlinear payoff structures of many instruments (including derivatives) made it progressively harder to justify allocation algorithms based on linear approximations.
- A number of events focused attention on "tail risks," which, within the framework of a normal distribution, have an extremely small probability of occurring, but are realized more frequently than predicted by normality (including during the global financial crisis).[5] Also, many standard asset return distributions displayed asymmetry, or "skewness." These observations made the assumption of a normal distribution hard to maintain, and models that incorporate this assumption lead to unexpectedly large losses.

Hence, the global financial crisis weakened investors' trust in the mean-variance model. However, although advances have been made on the quantitative and statistical fronts, and more reliance is being placed on investment experience, no consensus approach has yet emerged to take the place of the mean-variance model.

[3]Doing so allows practitioners to incorporate elements like trading and market impact costs and the potential for market intervention by regulators, which are often hard to model.

[4]See Black and Litterman (1990 and 1992) and Idzorek (2005).

[5]For some assets, datasets, and data frequencies, models calculated probabilities on the order of 1 in 1 trillion for some observed returns—too small to be realistic.

Annex 2.2. Results of the IMF Survey on Global Asset Allocation[1]

In April and May 2011, the IMF asked the approximately 300 largest asset management companies and 200 largest pension funds and plan sponsors in the world to participate in a survey of perceived longer-term trends in global asset allocation.[2] A total of 122 firms participated: 68 asset management companies (hereafter, asset managers) and 54 pension funds or plan sponsors (pension funds). Their responses are summarized below. Survey participants are listed at the end of this annex (Table 2.22).

Assets under Management and Allocation Trend[3]

At year-end 2010, the asset managers in the survey had $16 trillion in assets under management, and the surveyed pension funds had $3 trillion (Table 2.11).[3] The participating asset managers, acting in various capacities, covered a wide range of investor types (Table 2.12).[4]

In terms of asset class allocation, shares for equities declined markedly between end-2006 and end-2010 for the asset managers and pension funds surveyed, while the shares for fixed income rose.[5] Shares for alternative investments (real estate, hedge funds, private equity, and commodities) increased marginally for pension funds after 2006 (Table 2.13).

[1]Prepared by Ken Chikada.

[2]The potential participants were identified with data in Towers Watson (2010a and 2010b) and other relevant information.

[3]The combined amount represented about one-fourth of the world total. The latest available data show that the global fund management industry had $71 trillion in total assets under management at year-end 2009 (TheCityUK, 2010).

[4]To a large extent, asset allocations of asset managers were driven by their clients' demands. Only 17 percent of asset managers replied that their asset allocations were not at all affected by client demands.

[5]The survey aimed to collect quantitative data since 2002, but many participants could not provide consistent data for 2002. We focus here on the data since 2006.

Global Asset Allocation and Underlying Factors

By region, assets were predominantly concentrated in advanced economies, particularly in the G-7 (Tables 2.14 and 2.15). However, allocations to emerging market economies increased noticeably, albeit from very low levels for some regions.

In general, both asset managers and pension funds put substantial importance on economic growth prospects when determining country allocations; in contrast, interest rate differentials between countries were not a dominant factor (Table 2.16). Also, asked specifically what factors led to changes in asset allocations into cross-border investments between end-2006 and end-2010, respondents cited the desire for portfolio diversification as playing a key role (Table 2.17).

The Low Interest Rate Environment and Risk-Return Profiles

After end-2006, a majority of asset managers and pension funds put more emphasis on controlling risk than on enhancing returns, and some even lowered their exposures to risky assets and accepted lower returns (Table 2.18).

A majority of asset managers and pension funds expected policy rates in advanced economies to remain below end-2007 levels for at least the next three years (Table 2.19).

Use of Derivatives

The hedging instruments most frequently used by asset managers and pension funds were currency forwards and futures, followed by options/swaptions and interest rate swaps (Table 2.20). Asset managers used a wider set of instruments more extensively than pension funds and used them more to enhance yields than did pension funds (Table 2.21). Consistent with the trend mentioned above to reduce risk exposures, usage of most hedging instruments increased since end-2006 for both asset managers and pension funds.

Table 2.11. Survey Participants' Assets under Management

(In billions of U.S. dollars)

	Asset Managers				Pension Funds			
	2002	2006	2008	2010	2002	2006	2008	2010
Assets under management	6,014	13,055	12,501	16,248	1,509	2,807	2,862	3,368
Number of respondents	51	63	67	68	52	53	53	54

Source: IMF Survey on Global Asset Allocation.

Table 2.12. Asset Managers' Assets under Management: Origin of Funds

(In percent)

	2006	2008	2010
Pension funds	24.6	26.2	25.8
Endowments	2.4	2.4	2.4
Insurance companies	15.5	17.2	18.0
Sovereigns	0.9	1.2	1.5
Retail	36.2	32.9	33.0
Exchange traded funds	0.2	0.1	0.4
Banks	2.9	2.7	2.7
Unspecified	17.3	17.2	16.3

Source: IMF Survey on Global Asset Allocation.

Note: Figures are averages of 52 respondents.

Table 2.13. Asset Allocation by Asset Class

(In percent)

	Asset Managers			Pension Funds		
	2006	2008	2010	2006	2008	2010
Traditional asset classes						
Cash	6.9	8.9	6.5	1.7	2.1	2.4
Equities	39.7	31.2	34.5	51.4	40.3	44.9
Bonds	41.9	46.6	46.7	36.0	41.9	37.1
Subtotal	88.5	86.7	87.7	89.1	84.3	84.4
Alternative asset classes						
Real estate	4.4	5.2	4.7	5.2	6.7	5.6
Hedge funds	1.7	2.1	1.4	1.5	2.2	2.2
Private equity	0.5	0.6	0.6	2.7	4.5	4.6
Commodities	0.1	0.1	0.1	0.4	0.6	1.0
Others	4.8	5.4	5.5	1.0	1.7	2.1
Subtotal	11.5	13.3	12.3	10.9	15.7	15.6

Source: IMF Survey on Global Asset Allocation.

Note: Figures are averages for 55 asset manager respondents and 49 pension fund respondents.

Table 2.14. Regional Allocation
(In percent)

	Asset Managers				Pension Funds			
	Bonds		Equities		Bonds		Equities	
	2006	2010	2006	2010	2006	2010	2006	2010
Own country of domicile	61.0	60.1	47.5	44.8	78.1	75.7	55.5	50.3
East Asia/Pacific	3.4	3.6	8.5	9.0	1.8	2.4	8.6	10.1
Europe	27.2	27.1	28.2	27.1	11.7	11.4	22.1	21.4
Latin America	0.8	0.8	1.8	2.6	0.3	0.9	0.8	2.5
Middle East/North Africa	0.1	0.2	0.2	0.3	0.0	0.3	0.2	0.4
North America	7.1	7.7	11.7	13.0	7.9	8.9	11.6	13.1
South/Central Asia	0.2	0.2	0.8	2.1	0.1	0.4	1.1	2.0
Sub-Saharan Africa	0.0	0.0	0.1	0.2	0.0	0.1	0.1	0.3

Source: IMF Survey on Global Asset Allocation.

Note: For asset managers, figures are averages for 29 respondents for bonds and 32 respondents for equities. For pension funds, figures are averages for 28 respondents.

Table 2.15. Top 10 Investment Destinations
(Ranked by scores)

	Asset Managers		Pension Funds	
Rank	Country	Score	Country	Score
1	United States	225	United States	226
2	United Kingdom	115	United Kingdom	159
3	Germany	100	Japan	112
4	France	97	Germany	52
5	Japan	77	France	48
6	Italy	52	Canada	37
7	Canada	42	Switzerland	27
8	Switzerland	28	Australia	15
9	Australia	23	Sweden	14
10	Brazil	22	Denmark	10

Source: IMF Survey on Global Asset Allocation.

Note: Shown are the 10 countries cited most frequently by respondents, who were asked to report their top five countries. Score is calculated as (5 * rank-1 country) + (4 * rank-2 country) + (3 * rank-3 country) + (2 * rank-4 country) + (1 * rank-5 country). Results are for 64 asset manager respondents and 52 pension fund respondents.

Table 2.16. Top Five Factors Considered in Country Allocation
(Ranked by scores)

	Asset Managers		Pension Funds	
Rank	Factors	Score	Factors	Score
1	Economic growth prospects	190	Economic growth prospects	137
2	Sovereign debt issues	87	Liquidity of relevant markets	71
3	Inflation prospects	78	Inflation prospects	48
4	Interest rate differentials between countries	73	Sovereign debt issues	43
5	Industry- or sector-specific characteristics	62	Interest rate differentials between countries	34

Source: IMF Survey on Global Asset Allocation.

Note: Shown are the five factors cited most frequently by respondents, who were asked to report their top four factors. Score is calculated as (4 * rank-1 factor) + (3 * rank-2 factor) + (2 * rank-3 factor) + (1 * rank-4 factor). Results are for 62 asset manager respondents and 43 pension fund respondents.

Table 2.17. Top Five Factors Considered in Cross-Border Investment since End-2006

(Ranked by scores)

	Asset Managers		Pension Funds	
Rank	Factors	Score	Factors	Score
1	Diversification	115	Diversification	106
2	Longer-term growth prospects	113	Longer-term growth prospects	100
3	Search for yield	93	Search for yield	40
4	Sovereign or country risk	60	Range of investments available	33
5	Market liquidity	58	Volatility	32

Source: IMF Survey on Global Asset Allocation.

Note: Shown are the five factors cited most frequently by respondents, who were asked to report their top four factors. Score is calculated as (4 * rank-1 factor) + (3 * rank-2 factor) + (2 * rank-3 factor) + (1 * rank-4 factor). Results are for 61 asset manager respondents and 40 pension fund respondents.

Table 2.18. Experience and Expectations of Portfolio Risk Exposures and Returns

(In percent of respondents)

	Asset Managers		Pension Funds	
Changes in risk exposure and return	Since end-2006	In the next 3 years	Since end-2006	In the next 3 years
Higher risk exposure and…				
…higher return	6.3	9.5	16.3	16.3
…same return	4.8	3.2	12.2	2.0
…lower return	6.3	3.2	4.1	2.0
Same risk exposure and…				
…higher return	3.2	14.3	2.0	6.1
…same return	20.6	41.3	18.4	34.7
…lower return	27.0	7.9	18.4	10.2
Lower risk exposure and…				
…higher return	0.0	3.2	2.0	0.0
…same return	11.1	7.9	4.1	6.1
…lower return	20.6	9.5	22.4	22.4

Source: IMF Survey on Global Asset Allocation.

Note: The table summarizes the answers to two survey questions: (i) How has the risk exposure and return of your portfolio changed compared to end-2006? and (ii) Given your expectations for the risk/return landscape going forward, how do you think the risk exposure and expected return of your portfolio will change in the next three years, compared to today? Results are for 63 asset manager respondents and 49 pension fund respondents.

Table 2.19. Expected Period before Policy Rate Rise

(In percent of respondents)

	Asset Managers	Pension Funds
In 1 year	0.0	0.0
In 2 years	14.1	12.2
In 3 years	50.0	55.1
In 5 years	20.3	18.4
Beyond 5 years	15.6	14.3

Source: IMF Survey on Global Asset Allocation.

Note: Share of respondents expecting the policy rates in advanced economies to return to end-2007 levels in each time period. Results are for 64 asset manager respondents and 49 pension fund respondents.

Table 2.20. Use of Hedging Instruments
(In percent of respondents)

		Among Users, Change in Use since End-2006	
Instruments	Currently Using	Increased	Decreased
Asset Managers			
Currency forwards	88.9	73.2	7.1
Futures	88.9	67.9	12.5
Options/swaptions	76.2	56.3	20.8
Interest rate swaps	69.8	59.1	9.1
Credit default swaps	57.1	58.3	22.2
Currency swaps	47.6	50.0	26.7
Correlation hedging	42.9	63.0	3.7
Forward rate agreement	38.1	50.0	12.5
Cross-currency swaps	36.5	52.2	17.4
Short sales	27.0	47.1	5.9
Political risk insurance	6.3	0.0	25.0
Pension Funds			
Currency forwards	69.2	69.4	13.9
Futures	59.6	74.2	6.5
Interest rate swaps	51.9	70.4	18.5
Options/swaptions	46.2	79.2	8.3
Credit default swaps	38.5	70.0	10.0
Forward rate agreement	32.7	70.6	0.0
Currency swaps	32.7	64.7	5.9
Cross-currency swaps	19.2	90.0	0.0
Correlation hedging	17.3	55.6	11.1
Short sales	11.5	83.3	0.0
Political risk insurance	1.9	0.0	0.0

Source: IMF Survey on Global Asset Allocation.

Note: Results are for 63 asset manager respondents and 52 pension fund respondents.

Table 2.21. Use of Derivatives to Enhance Yields
(In percent of respondents)

	Asset Managers	Pension Funds
Not at time of survey		
Never	33.8	49.1
Not any more	1.5	0.0
Yes at time of survey and change since end-2006		
Less use	6.2	1.9
No change	16.9	9.4
More use	41.5	39.6

Source: IMF Survey on Global Asset Allocation.

Note: Results are for 65 asset manager respondents and 53 pension fund respondents.

Table 2.22. Survey Participants

Asset Managers	Pension Funds
Allianz Global Investors	Arizona State Retirement System
APG All Pensions Group	Barclays Plc.
Arca Sgr SpA	Canada Pension Plan Investment Board
Artio Global Management LLC	Colorado Public Employees' Retirement Association
Aviva Plc	Doctors Pension Funds Services
Banco Itau Unibanco	Emergency Services & State Super (ESSSuper)
Bank of Montreal Financial Group	Exxon Mobil Corporation
BayernInvest Kapitalanlagegesellschaft mbH	Första AP-Fonden
BNP Paribas	GE Asset Management
Caisse de dépôt et placement du Québec	Government Pension Investment Fund
Caixa Gestão de Activos	Healthcare of Ontario Pension Plan
Colonial First State Global Asset Management	International Business Machines (IBM)
Credit Suisse AG	Illinois Municipal Retirement Fund
Cutwater Asset Management	Illinois Teachers Retirement System
Danske Capital	National Grid Plc.
DekaBank	Novartis
Delaware Investments	Pension Fund Association for Local Government Officials
Deutsche Asset Management	Public Employees' Retirement System of Nevada
Edmond de Rothschild Asset Management	Retirement Systems of Alabama
F&C Investments	Retirement Systems of Georgia
Fiera Sceptre Inc.	South Carolina Retirement System Investment Commission
HarbourVest Partners	State of Wisconsin Investment Board
Helaba Invest Kapitalanlagegesellschaft mbH	Stichting Pensioenfonds Metaal en Techniek
HSBC Asset Management	Strathclyde Pension Fund
Investment Solutions Limited	Sunsuper
Legal & General Group Plc	Texas Municipal Retirement System
MEAG MUNICH ERGO Asset Management	The State Pension Fund
Mitsubishi UFJ Financial Group Inc.	United Parcel Service
Mondrian Investment Partners Limited	United Technologies Corporation
Nikko Asset Management	Versorgungsanstalt des Bundes und der Länder
Nordea Investment Management AB	Verizon Investment Management Corp.
Pioneer Investments	
PNC Financial Services Group Inc.	
Rabobank	
SEB Wealth Management	
Stone Harbor Investment Partners LP	
Sun Life Financial	
Swiss Life	
TD Asset Management Inc.	
Tokio Marine & Nichido Fire Insurance Co., Ltd.	
UBS Global Asset Management	
Union Asset Management Holding	
Union Bancaire Privée, UBP SA	
van Lanschot Bankiers	
William Blair & Company	

Source: IMF Survey on Global Asset Allocation.
Note: Among participants, 23 asset managers and 22 pension funds chose to remain anonymous.

Annex 2.3. Defining Foreign Exchange Reserves and Sovereign Wealth Funds[1]

Foreign Exchange Reserves

The IMF's primary definition of reserve assets is contained in its BoP/IIP manual (IMF, 2009, Chapter VI, paragraph 6.64) as follows:

> Reserve assets are those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, for intervention in exchange markets to affect the currency exchange rate, and for other related purposes (such as maintaining confidence in the currency and the economy, and serving as a basis for foreign borrowing).

The IMF further defines reserve assets by stating that they "must be both denominated and settled in foreign currency" (paragraph 6.71) and "must be denominated and settled in convertible foreign currencies" (paragraph 6.72); and that "reserve assets, other than gold bullion, must be claims on nonresidents" (paragraph 6.65). These definitions place few restrictions on the asset classes that can be used for reserve asset investments. The main constraints are that they must be liquid ("readily available") and that they must constitute claims on "nonresidents" in "convertible foreign currencies."

Sovereign Wealth Funds

The International Working Group of Sovereign Wealth Funds (2008) defines sovereign wealth funds (SWFs) as "special-purpose investment funds or arrangements that are owned by the general government" (p. 3). "Created by the general government for macroeconomic purposes, SWFs hold, manage, or administer assets to achieve financial objectives, and employ a set of investment strategies that include investing in foreign financial assets" (p. 3). In addition, SWFs "are commonly established out of balance of payments surpluses, official foreign currency operations, the proceeds of privatizations, fiscal surpluses, and/or receipts resulting from commodity exports" (p. 3, note 7). This definition excludes, among other things, "foreign currency reserve assets held by monetary authorities for the traditional balance of payments or monetary policy purposes, state-owned enterprises (SOEs) in the traditional sense, government-employee pension funds, or assets managed for the benefit of individuals" (p. 3, note 6).

The above definition of SWFs covers three key elements: ownership, type of investments, and purposes and objectives.

- Ownership: SWFs are owned by the general government, which includes both central government and subnational governments.[2]
- Investments: The investment strategies include investments in foreign financial assets, and excludes those funds that invest solely in domestic assets.
- Purposes and objectives (Table 2.23): SWFs are created to invest government funds to achieve financial objectives, and (may) have liabilities that are only broadly defined, thus allowing SWFs to employ a wide range of investment strategies with a medium- to long-term timescale. The objective of SWFs is different than that of, for example, reserve portfolios held only for traditional balance of payments purposes. Under the definition, SWFs may include reserve assets, but reserve assets are generally not intended to be a part of SWFs.[3]

Furthermore, the statement of the International Working Group of Sovereign Wealth Funds (2008) that SWFs are "commonly established out of balance of payments surpluses, official foreign currency operations, the proceeds of privatizations, fiscal surpluses, and/or receipts resulting from commodity exports" (p. 3) reflects both the traditional origin of SWFs—the revenues received from mineral wealth—and the more recent approach of transferring excess reserves.

[1]Prepared by Peter Lindner.

[2]Note that the use of the word *arrangements* as an alternative to *funds* allows for a flexible interpretation of the legal arrangement through which the assets can be invested. SWFs vary in their institutional arrangements, and the way they are recorded in the macroeconomic accounts may differ depending on their individual circumstances. See also IMF (2001b).

[3]Likewise, the intention is not to exclude all assets on the books of central banks: SWFs can be on the books of central banks if they are held for other than balance of payments purposes (for example, intergenerational wealth transfer).

Table 2.23. Sovereign Wealth Fund Classification

Source	Year Established	Country	Policy Purpose			
			Macro Stabilization	Saving	Pension Reserve	Reserve Investment
Oil/Natural gas	1953	Kuwait	Kuwait Investment Authority, General Reserve Fund	Kuwait Investment Authority, Future Generations Fund		
	1976	Canada		Alberta Heritage Savings Trust Fund		
	1976	United Arab Emirates		Abu Dhabi Investment Authority		
	1976	United States		Alaska Permanent Fund		
	1980	Oman		State General Reserve Fund		
	1983	Brunei Darussalam		Brunei Investment Agency		
	1996	Norway	Government Pension Fund, Global	Government Pension Fund, Global	Government Pension Fund, Global	
	1999	Azerbaijan	State Oil Fund	State Oil Fund		
	2000	Iran, Islamic Republic of	Oil Stabilization Fund			
	2000	Mexico	Oil Revenues Stabilization Fund			
	2000	Qatar		Qatar Investment Authority		
	2000	Trinidad and Tobago	Heritage and Stabilization Fund	Heritage and Stabilization Fund		
	2001	Kazakhstan	National Fund	National Fund		
	2002	Equatorial Guinea		Fund for Future Generations of Equatorial Guinea		
	2004	São Tomé and Príncipe		National Oil Account		
	2005	Timor Leste	Petroleum Fund	Petroleum Fund		
	2006	Bahrain	The Future Generations Reserve Fund	The Future Generations Reserve Fund		
	2006	Libya		Libyan Investment Authority		
	2008	Russian Federation	Reserve Fund		National Wealth Fund	
Other commodity	1956	Kiribati		Kiribati, Revenue Equalization Fund		
	1996	Botswana		Botswana, Pula Fund		
	2006	Chile			Pension Reserve Fund	
	2007	Chile	Economic and Social Stabilization Fund			
Fiscal surpluses	1974	Singapore		Singapore, Temasek		
	1981	Singapore				Government of Singapore Investment Corporation
	1993	Malaysia		Khazanah Nasional BHD		
	2000	Ireland			Ireland, National Pensions Reserve Fund	
	2001	New Zealand			New Zealand Superannuation Fund	
	2006	Australia			Australia, Future Fund	
	2005	Korea, Republic of				Korea Investment Corporation
Foreign exchange reserves	1981	Singapore				Government of Singapore Investment Corporation
	2005	Korea, Republic of				Korea Investment Corporation
	2007	China				China Investment Corporation

Source: Kunzel and others (2010); and national authorities.

Reserve assets and assets held by an SWF can overlap, in that reserve assets can be held within an SWF. However, such overlap can occur only when the SWF is "permitted to transact in such assets only on terms specified by the monetary authorities or only with their express approval" (IMF, 2009, Chapter VI, paragraph 6.67).

Annex 2.4. Theoretical Foundation of the Regression Specification and Detailed Regression Results[1]

In the generic mean-variance (or Markowitz) model, an investor will choose portfolio shares for assets that minimize the variance of the portfolio's value for a given portfolio return.[2] The solution to that problem yields optimal portfolio shares that minimize the variance across all possible combinations of returns. Each investor can then choose a variance-return combination that maximizes the investor's welfare (which will depend on the investor's risk aversion). Later versions of the mean-variance model have used various "utility" functions (that is, functions that conveniently summarize the investor's preferences) derived from microeconomic principles. We employ the widely used constant relative risk aversion (CRRA) utility function U, which is time separable, that is, where total welfare is a simple sum of welfare in each separate period. This can be represented by the following:

$$max E_t \sum_{i=0}^{\infty} \delta^i U(C_{t+i}) = \sum_{i=0}^{\infty} \delta^i \frac{C_{t+i}^{1-\gamma} - 1}{1-\gamma} \quad (1)$$

where C_{t+i} denotes consumption at time $t + i$; γ is the coefficient of relative risk aversion, which is assumed not to depend systematically on the investor's wealth; δ^i is a discount factor; and E_t is the expectations operator, taking into account all information up through period t. The intertemporal budget constraint of the investor is given by

$$W_{t+1} = (1 + R_{p,t+1})(W_t - C_t) \quad (2)$$

where $R_{p,t+1}$ is the portfolio return between period t and $t + 1$, and W_{t+1} is wealth in period $t + 1$. Suppose portfolio returns depend on N risky assets and one risk-free asset. $\mathbf{R}_{t+1}$ is a vector of risky returns with N elements. It has a mean vector $E_t\mathbf{R}_{t+1}$, and a variance-covariance matrix $\mathbf{\Sigma}_{t+1}$. $\boldsymbol{\alpha}_t$ is a vector of allocations to the risky asset. The riskless asset has return $r_{f,t+1}$ from time t to $t + 1$.[3] The portfolio manager optimally chooses $\boldsymbol{\alpha}_t$ to maximize utility subject to the budget constraint.

For this problem, no closed-form solution exists that will yield explicit portfolio weights based on the other variables. However, based on a linearized approximation to the intertemporal budget constraint (see Campbell and Viceira, 2002, for details) we can derive the following solution to the portfolio problem:

$$\boldsymbol{\alpha}_t = \frac{1}{\gamma}\mathbf{\Sigma}_t^{-1}(E_t\boldsymbol{r}_{t+1} - r_{f,t+1}\boldsymbol{\iota} + \sigma_t^2/2) + (1 - \frac{1}{\gamma})\mathbf{\Sigma}_t^{-1}\sigma_{ht} \quad (3)$$

where $\boldsymbol{\iota}$ is a unit vector, and $\boldsymbol{\sigma}_{ht}$ is the vector of covariances of each risky asset return with revisions in expected future portfolio returns:

$$\boldsymbol{\sigma}_{ht} = Cov_t(\boldsymbol{r}_{t+1,} - (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j r_{p,t+1+j}) \quad (4)$$

where ρ is a parameter for the linearization. When the consumption-to-wealth ratio is constant, the covariance, $\boldsymbol{\sigma}_{ht}$, can be interpreted as the ratio of reinvested wealth to total wealth. One transformation of equation (2) allows us to restate $\boldsymbol{\sigma}_{ht}$ as the covariance of the risky asset return with the value function, v_t: $\boldsymbol{\sigma}_{ht} = Cov_t(r_{t+1}, -v_{t+1})$. This shows that the intertemporal component of asset demand is determined by the covariance of the risky asset's return with the investor's utility per unit wealth, which varies over time with investment opportunities.

Equation (3) illustrates that the demand for a risky asset depends on the weighted average of the risk premium (relative to its variance) and the asset's covariance with the revisions in the expectations of future portfolio returns (again relative to its variance), that is, an intertemporal term. The weights on these terms are proportional to the investor's risk tolerance (1/). This result, which assumes independently and identically distributed returns, therefore predicts that an investor will choose to allocate more portfolio wealth in a given asset i when it:

- offers high expected returns, that is, $E_t r_{t+1} - r_{f,t+1}\boldsymbol{\iota} + \alpha_t^2/2$ is high;
- has low variance, that is, the ith diagonal term in $\mathbf{\Sigma}$ is low;
- has low covariance with other assets in the portfolio, that is, the applicable nondiagonal terms in $\mathbf{\Sigma}$ are low; and
- offers a hedge against future declines in portfolio returns, that is, $\boldsymbol{\sigma}_{ht}$ is high.

[1]Prepared by Ruchir Agarwal, Serkan Arslanalp, and Tao Sun.
[2]Markowitz (1952).
[3]Lowercase r refers to log returns: $r = \log(1 + R)$.

When risk aversion increases, investors will bias their portfolio toward the risk-free asset. Therefore, in periods of elevated risk aversion, funds should flow out of risky bonds and equities to "risk free" instruments (which, from the perspective of a long-term investor, is an asset that approximates a long-term inflation-indexed bond with low default risk).

The independent variables in the regression in the chapter proxy for the various determinants in equation (3) above, as shown in the table below.

Table 2.24 gives the detailed regression results.

Model determinant	Equities		Bonds	
	Empirical equivalent	Proxy in regressions	Empirical equivalent	Proxy in regressions
Expected returns	Capital gains Dividends Country risk	Real GDP growth Real GDP growth Country risk	Coupon payments Default/credit risk Country risk	3-month interest rate Real GDP growth Country risk
Variance	Stock market volatility	Real GDP volatility	Inflation risk	Inflation risk
Covariance (diversification effect)	Covariance with world returns	Covariance of country equity returns with world portfolio returns	Covariance with world returns	Covariance of country bonds returns with world portfolio returns
Intertemporal hedge	Covariance with change in world returns	Covariance of country equity returns with changes in world portfolio returns	Covariance with change in world returns	Covariance of country bond returns with changes in world portfolio returns

Table 2.24. Determinants of Equity and Bond Flows: Panel Regression Results

	World		Asia		Latin America		Europe, Middle East, and Africa		G-7 Countries		Non-G-7 Advanced Countries	
	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds
Policy rate differential (host–G-4 average)	-0.042 (-0.597)	-0.145 (-1.542)	-0.362** (-2.391)	-0.499 (-1.073)	-0.068 (-0.840)	-0.003 (-0.056)	0.081 (0.457)	-0.636*** (-3.246)	0.053 (0.152)	-0.519 (-1.120)	0.412*** (3.807)	0.410 (1.454)
GDP growth forecast	0.418*** (4.389)	0.775*** (5.557)	0.274** (2.426)	0.168 (0.790)	0.506** (2.509)	0.564*** (5.189)	0.483** (2.364)	1.265*** (5.479)	0.359** (2.054)	0.452*** (3.418)	0.256*** (3.376)	0.604*** (2.777)
Inflation volatility	-0.095 (-0.478)	-0.634** (-2.145)	-0.534** (-2.015)	-0.883** (-2.058)	0.293 (1.441)	0.147 (0.218)	0.654 (1.065)	-0.548* (-1.676)	-0.327* (-1.890)	-1.955** (-2.441)	-0.436** (-2.501)	-1.439** (-2.175)
GDP growth volatility	-1.908*** (-4.958)	-4.654*** (-8.389)	-2.835*** (-3.110)	-7.134*** (-8.558)	-2.997*** (-5.029)	-5.597*** (-7.783)	-2.423*** (-2.983)	-3.405*** (-3.356)	0.171 (0.419)	-3.410*** (-4.256)	-1.029*** (-3.287)	-3.463*** (-5.481)
Exchange rate volatility	-0.389*** (-3.630)	-0.835*** (-3.026)	-0.485** (-2.165)	-1.161*** (-4.641)	-0.268 (-0.677)	-0.080 (-0.135)	-0.556*** (-4.177)	-1.104*** (-3.864)	-0.361*** (-2.805)	-0.850** (-2.422)	-0.334*** (-5.757)	-1.063*** (-9.843)
Return covariance (cross-country)	-0.054 (-1.484)	-0.462*** (-6.532)	0.025 (0.721)	-0.656*** (-9.542)	0.235*** (4.034)	-0.422*** (-10.262)	-0.129*** (-3.506)	-0.275*** (-2.989)	0.002 (0.036)	-0.644*** (-5.005)	0.019 (0.599)	-0.574*** (-13.405)
Return covariance (intertemporal)	-0.002 (-0.028)	0.034 (0.784)	0.001 (0.037)	0.198*** (3.791)	-0.456*** (-6.069)	-0.289*** (-3.367)	0.120* (1.673)	0.049 (1.033)	-0.136* (-1.867)	0.077 (1.167)	-0.173*** (-6.011)	-0.030 (-0.690)
Country risk	-0.052* (-1.833)	-0.147*** (-2.996)	-0.157** (-2.296)	-0.351*** (-4.957)	-0.066 (-0.963)	-0.282 (-1.594)	-0.080 (-0.963)	-0.151*** (-2.981)	-0.019 (-0.304)	-0.058 (-0.796)	-0.023 (-0.836)	0.005 (0.051)
VIX index	-0.047*** (-8.368)	-0.071*** (-7.792)	-0.084*** (-10.264)	-0.073*** (-8.984)	-0.096*** (-6.437)	-0.079*** (-4.972)	-0.044*** (-3.892)	-0.117*** (-5.074)	-0.022*** (-9.109)	-0.047*** (-6.170)	-0.024*** (-6.977)	-0.051*** (-4.224)
Capital control index	-1.154 (-1.125)	-3.897*** (-2.625)	-7.776*** (-3.342)	-1.605 (-0.561)	0.364 (0.176)	5.839** (1.988)	0.981 (0.517)	-3.070 (-0.951)	-9.775* (-1.902)	-11.491*** (-2.915)	-0.902 (-1.113)	-8.481*** (-5.989)
Crisis dummy 1	-0.723*** (-7.155)	-2.388*** (-16.002)	-0.516** (-2.375)	-2.216*** (-8.895)	0.205 (0.927)	-2.758*** (-6.505)	-0.617*** (-3.102)	-2.536*** (-6.603)	-0.848*** (-4.152)	-1.602*** (-4.147)	-1.023*** (-13.087)	-2.309*** (-9.220)
Crisis dummy 2	-0.513* (-1.914)	-2.308*** (-6.899)	0.327 (0.843)	-3.597*** (-7.363)	1.033*** (5.464)	-4.119*** (-6.103)	-1.285 (-1.104)	-3.632*** (-5.847)	-0.823*** (-3.295)	-0.203 (-0.391)	-0.741*** (-8.102)	-0.906** (-2.079)

Table 2.24. ***(continued)***

	World		Asia		Latin America		Europe, Middle East, and Africa		G-7 Countries		Non-G-7 Advanced Countries	
	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds
Time trend	0.000	0.071***	-0.026***	0.105***	-0.034***	0.088***	0.033	0.099***	0.014**	0.033***	0.003	0.043***
	(0.052)	(10.724)	(-3.253)	(10.226)	(-4.048)	(6.367)	(1.575)	(9.091)	(2.361)	(3.651)	(1.227)	(5.639)
Constant	0.932	-7.071***	8.375***	-11.554***	4.979***	-12.243***	-4.228	-11.027***	-0.227	-2.464**	0.352	-3.551***
	(1.240)	(-6.913)	(4.193)	(-4.710)	(3.203)	(-9.145)	(-1.542)	(-5.524)	(-0.392)	(-1.990)	(1.385)	(-3.795)
Number of countries	50	50	9	9	6	6	13	13	7	7	15	15
Number of observations	2,966	2,845	504	504	395	397	527	461	490	485	1,050	998
R-squared (within)	0.160	0.472	0.271	0.510	0.147	0.490	0.214	0.615	0.295	0.526	0.400	0.475
R-squared (between)	0.047	0.003	0.493	0.288	0.068	0.003	0.370	0.173	0.073	0.351	0.121	0.210
R-squared (overall)	0.083	0.303	0.004	0.477	0.145	0.418	0.212	0.502	0.054	0.293	0.388	0.428

Source: IMF staff estimates.

Note: The table presents panel fixed-effects regressions on factors affecting equity and bond flows to advanced and emerging market economies between January 2005 and May 2011. The results are presented for the whole sample as well as for five separate regions. See notes to Table 2.4 for a definition of the regions. Dependent variables are monthly equity and bond flows as a proportion of assets dedicated to each country at the beginning of the month. The policy rate differential is the difference between the policy rate in the host country and the simple average policy rate for the G-4. GDP growth forecast is the one-year-forward GDP forecast for the host country, provided by Consensus Economics. Inflation volatility, GDP growth volatility, and exchange rate volatility are the standard deviation of inflation, GDP growth, and exchange rate forecasts over the past year. Country risk is a measure of country risk from International Country Risk Group (ICRG). The VIX index is used as a measure of global risk. Return covariance (cross-country) is a measure of the covariance of country returns with the world portfolio return (cross-country correlation factor). Return covariance (intertemporal) is a measure of the covariance of country returns with changes in the world portfolio return (intertemporal correlation factor). Capital control index is the 6-month lagged capital control index produced by the IMF's Monetary and Capital Markets Department. Crisis dummy 1 represents the period June 2007–August 2008 (global credit crunch). Crisis dummy 2 represents the period starting in September 2008 (Lehman Brothers bankruptcy). All independent variables, except for control variables (capital control index, crisis dummy 1, and crisis dummy 2), are in first-differences. A time trend is included. The values in parentheses are *t*-statistics. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels of confidence, respectively, based on robust standard errors.

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CHAPTER 3

Summary

Operationalizing macroprudential policies requires progress on a number of fronts: developing ways to monitor a risk buildup, choosing indicators to detect when risks are about to materialize, and designing and using macroprudential policy tools. Establishing these robust frameworks will be a lengthy process. Using a structural model and empirical evidence, the following analysis takes a solid step forward on each of the interrelated tasks.

Detecting both the slow buildup and the sudden materialization in systemic risk is the key to implementing good macroprudential policies. These two phases require two different sets of indicators. Slow-moving leading indicators signal risks are building up in the financial system and propagating to the real economy through financial intermediaries. High-frequency market-based indicators predict an imminent unwinding of systemic risk and potentially provide information on the extent of interconnectedness of financial institutions and its possible consequences.

This chapter uses a structural model with financial and real sector linkages to help policymakers understand the underpinnings of a systemic risk buildup. Empirical exercises further test the capabilities of indicators to predict financial crises and alert policymakers to the need for action. After identifying the buildup in systemic risk, policymakers will inevitably want to consider policies best suited to address the problem. The chapter illustrates how a countercyclical capital requirement would operate—with the accumulation of capital when risks are building and a drawdown of this capital buffer when high-frequency indicators are flashing an imminent crisis—as well as how it can be successful in cushioning the economy's real output during a crisis.

The chapter provides a few practical guidelines for operationalizing macroprudential policies.

- Movements in indicators for systemic risk buildup vary with the underlying root causes. Distinguishing "good" shocks (such as expected productivity gains) from "bad" shocks (asset price bubbles and lax lending standards) is important if policymakers are to avoid using macroprudential policies to squash healthy economic growth inappropriately.
- Credit growth and asset price growth together form powerful signals of systemic risk buildup as early as two to four years in advance of crises. Other variables can also help.
- Initial comparative analyses of high-frequency indicators suggest that those using a combination of the LIBOR-OIS spread and the yield curve could signal an imminent crisis and put policymakers on alert to execute contingency plans.
- Macroprudential policy tools can be used across countries with different economic characteristics as long as policymakers understand the source of shocks. However, tools need to be calibrated more conservatively for managed exchange rate regimes that feature widespread lending denominated in foreign currencies because these characteristics tend to amplify the transmission mechanism of any shock.
- Macroprudential and monetary policymakers need to coordinate in at least two areas: understanding the basic source of shocks and their policies in managed exchange rate regimes with widespread foreign currency lending.

Macroprudential policy uses primarily prudential tools to limit systemic risk.[1] Hence, successful macroprudential policy implementation is contingent on establishing robust methods for detecting systemic risk and a set of policy tools designed to mitigate it. Since the 2007–09 financial crisis, new tools for monitoring systemic risk have mushroomed in the academic literature and within policy-making circles.[2] The IMF has also enhanced its surveillance tools in the context of its early warning exercise, including the methods for monitoring risks associated with the financial sector (IMF, 2010b). Yet, even as various countries have recently set up macroprudential policy frameworks, there is still no robust set of indicators for detecting systemic risk (Box 3.1). Nor is there much guidance, from a conceptual perspective, on which macroprudential policy tools to apply under specific circumstances, although some types of tools have been used before.

It is widely agreed that risks can build up in the financial system over time and materialize precipitously during a crisis (Drehmann, Borio, and Tsatsaronis, forthcoming). This observation suggests that slow-moving financial balance sheet aggregates should be complemented by fast-moving market-based indicators. Credit growth, as a low-frequency indicator, has been used for detecting risk buildup for some time now, but the idea has resurfaced in the wake of the global financial crisis.[3] This is especially so due to its ability to propagate and amplify shocks from the financial intermediaries to the real sector and vice versa. However, a broader spectrum of slow-moving macroeconomic and financial variables may do even better to inform policymakers of the buildup of systemic risk.

While less apt to aid in detecting buildup, fast-moving financial indicators can help predict impending risks, alerting policymakers that a crisis may be imminent (IMF, 2009). Additionally, some of these indicators can provide information on the extent of interconnectedness of financial institutions, which is crucial for policymakers to understand the transmission and amplification mechanism of a shock and activate contingency plans.

This chapter finds that understanding the source of a shock and how it is transmitted to the economy is key to identifying leading and near-coincident indicators for monitoring systemic risk, as well as the tools to mitigate it. For example, a crisis may result from the bursting of a real estate bubble—a shock that is reflected in credit and funding aggregates. These aggregates may behave differently in the face of nonsystemic shocks, such as productivity improvements.

This chapter aims to contribute to operationalizing macroprudential policies along two dimensions.[4] *First*, it investigates the usefulness of various techniques to identify indicators for the buildup and materialization of systemic risk. It takes a two-pronged approach to do so (Figure 3.1): it uses a structural model of macroeconomic–financial linkages to identify a set of indicators that would help identify the source of systemic risk; and, informed by the model, it uses statistical techniques to choose a robust set of systemic risk indicators. *Second,* it sheds some light on how policy instruments can be applied to mitigate the buildup of systemic risk. Establishing comprehensive macroprudential policy frameworks will take time, and the chapter's analysis should be viewed as "work in progress" in the quest to move forward. In this regard, key questions and new analytical insights pursued in the chapter include:

- How can one use a model of macroeconomic–financial interactions to identify meaningful early warning indicators for systemic financial risk? The

Note: This chapter was written by Srobona Mitra (team leader), Jaromír Beneš, Silvia Iorgova, Kasper Lund-Jensen, Christian Schmieder, and Tiago Severo. Research support was provided by Ivailo Arsov and Oksana Khadarina.

[1]Systemic risk is the risk of disruptions to financial services that is caused by an impairment of all or parts of the financial system, and can have serious negative consequences for the real economy (IMF-BIS-FSB, 2009; IMF, 2011b). Systemic risk is driven by economic and financial cycles over time, as well as by the degree of interconnectedness of financial institutions and markets.

[2]See discussions in IMF (2009, 2011a and 2011b); Adrian and Brunnermeier (2010); Acharya and others (2010); Billio and others (2010); BCBS (2010); and Brownlees and Engle (2011).

[3]For the precrisis literature, see Enoch and Ötker-Robe (2007) and references therein. Some recent studies include Mendoza and Terrones (2008); Barajas, Dell'Ariccia, and Levchenko (forthcoming); De Nicoló and Lucchetta (2010); Claessens, Kose, and Terrones (2011a and 2011b); Kannan, Rabanal, and Scott (2009a and 2009b); Borio and Drehmann (2009); Drehmann, Borio, and Tsatsaronis (forthcoming).

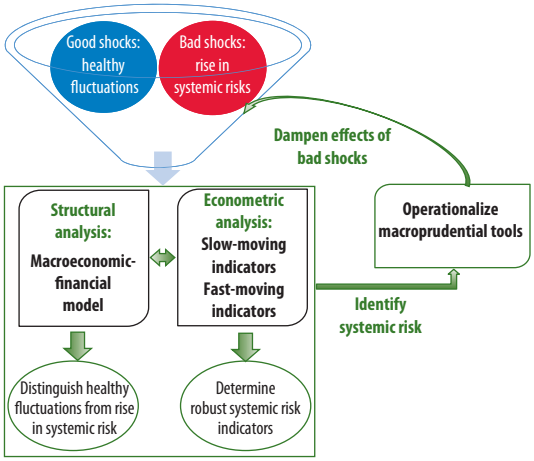
[4]The analysis builds on lessons from previous GFSR chapters (IMF, 2009 and 2011a) focusing on systemic risk issues.

chapter first lays out a structural model incorporating feedback between the banking sector and the real economy and shows how the interaction among several variables can allow policymakers to discern patterns of systemic risk buildup.

- How can empirical analysis help in identifying a set of robust indicators of systemic risk? The chapter evaluates both low- and high-frequency indicators based on their ability to make reasonably timely predictions about systemic stress. Such predictions allow policymakers to be adequately prepared to act.
- What are the considerations behind the design and effectiveness of macroprudential policy tools? The structural model introduced early in the chapter is used to examine how different sources of risk affect the use and effectiveness of countercyclical capital buffers, a key macroprudential policy tool. This discussion also sheds light on country practices.

Based on the above, in conclusion, the chapter proposes an initial, practical set of guidelines for monitoring systemic risk and operationalizing macroprudential policies.

Figure 3.1. Road Map of the Chapter



Box 3.1. Monitoring and Policy Tools at New U.S., U.K., and EU Macroprudential Authorities

The U.S. Financial Stability Oversight Council (FSOC)

- **Setup:** Established under the July 2010 Dodd-Frank Act, the FSOC is charged with identifying threats to financial stability, promoting market discipline, and responding to emerging risks to the stability of the U.S. financial system. It is chaired by the Treasury Secretary and brings together federal financial regulators, an insurance expert, and state regulators. By statute, the FSOC has a duty to facilitate the sharing of data and information among member agencies and to facilitate regulatory coordination. The FSOC will be based on a committee structure, with a Systemic Risk Committee; two subcommittees on institutions and markets, respectively; and several standing functional committees.
- **Monitoring:** The Systemic Risk Committee is responsible for identifying, analyzing, and monitoring risks to financial stability and for providing assessments of risks to the FSOC. The FSOC focuses on significant market developments, such as mortgage foreclosures in the United States and sovereign debt developments in Europe, as well as on structural issues, such as reform of the money market mutual fund industry. The FSOC is supported by the newly created Office of Financial Research (OFR), which is responsible for setting standards for data reporting and collecting while protecting confidential business data, and for analyzing risks to the financial system. The FSOC has the authority to direct the OFR to collect information from specific financial companies.
- **Policy Tools:** The FSOC has the authority to: (i) designate nonbank financial companies, regardless of their corporate form, for consolidated supervision; (ii) designate financial market utilities and payment, clearing, and settlement activities as systemic, requiring them to meet the risk management standards prescribed and be subject to heightened oversight by the Federal Reserve, the Securities and Exchange Commission, or the Commodity Futures Trading Commission; (iii) recommend stricter standards for the largest, most interconnected firms, including nonbanks, designated by the FSOC for Federal Reserve supervision; and for certain practices or

Note: Prepared by Ann-Margret Westin with contributions from Erlend Nier.

Box 3.1 *(continued)*

activities under the control of the primary financial regulatory agencies that are deemed to pose a threat to financial stability; (iv) recommend breaking up firms that pose a "grave threat" to financial stability; and (v) recommend that Congress close specific regulatory gaps.

- **Communication:** The FSOC meetings will be public whenever possible and held at least twice a year. The FSOC will report to Congress annually, and its chairperson will testify on its activities and on emerging threats to financial stability. The OFR will produce regular reports to Congress on significant market developments and potential emerging threats to financial stability.

The U.K. Financial Policy Committee (FPC)

- **Setup:** The FPC, which is expected to be established by end-2012, will be accountable to the governing body of the Bank of England (BoE). It will contribute to the BoE's financial stability objective by identifying, monitoring, and taking action to remove or reduce systemic risks.[1] Its focus will encompass structural aspects of the financial system and the distribution of risk within it, and cyclical threats from unsustainable levels of leverage, debt, or credit growth—with a view to protecting and enhancing the resilience of the U.K. financial system. The FPC must consider the potential for any adverse impact on medium- or long-term economic growth. An interim FPC was established in February 2011 and held its first official meeting in June. It will carry out preparatory work, including analysis of potential macroprudential tools, and monitor developments affecting financial stability in the United Kingdom and internationally. The interim FPC will advise the Financial Services Authority on emerging risks, including possible mitigating measures, and consider making recommendations to the Treasury about the regulatory perimeter.
- **Monitoring:** In monitoring financial stability, the FPC will identify emerging risks and vulnerabilities and cyclical imbalances using a broad range of indicators. The FPC will also monitor the activities of the prudential and other regulators, as well as the regulatory perimeter.
- **Policy Tools:** The FPC will be able to make recommendations on a "comply or explain" basis to the future Prudential Regulation Authority (PRA) and Financial Conduct Authority on their rules and policies. The FPC will also be able to direct the prudential regulators to take certain actions and must advise the government on changes in the perimeter of the PRA's prudential supervision. Instruments aimed at network issues could include recommendations or directions on disclosures regarding the issuance and structuring of securities; on the trading infrastructure of markets; on limits on large exposures among different kinds of firms; and on shadow banking rules. Cyclical instruments will include countercyclical capital buffers and might also include varying liquidity requirements, varying capital risk weights, and minimum haircuts for specific types of secured lending. Minimum margining requirements might also be applicable for key funding markets.
- **Communication:** The records of the interim FPC meetings are published, as will be those of the four regular meetings per year of the forthcoming FPC. A semiannual Financial Stability Report (FSR) will contain an assessment of risks to financial stability and action taken by the FPC and interim FPC. The publication of the FSR will coincide with an update by the Governor of the BoE to the Chancellor of the Exchequer.

The European Systemic Risk Board (ESRB)

- **Setup:** The ESRB, an independent EU body responsible for the macroprudential oversight of the financial system within the European Union, was established in December 2010, in line with the recommendations of the 2009 de Larosière Report. The ESRB contributes to the prevention or mitigation of systemic risks to financial stability in the EU. It also examines specific

[1]Until legislation establishing the FPC is passed, the BoE's Financial Stability Committee will continue with its statutory responsibilities in relation to the BoE's existing financial stability objective under the 2009 Banking Act.

Box 3.1 *(continued)*

issues at the invitation of the European Parliament, Council, or Commission. In pursuing its functions, the ESRB is required to coordinate closely with all the other parties in the European System of Financial Supervision as well as with the national macroprudential authorities across the EU. The ESRB held its inaugural meeting in January 2011 and its first of four regular annual meetings in March 2011. The president of the European Central Bank chairs the ESRB. Its General Board includes the governors of all EU central banks, the three new European regulatory authorities—the European Banking Authority, the European Securities and Markets Authority, and the European Insurance and Occupational Pensions Authority—and the European Commission; the national supervisory authorities are nonvoting members.

- **Monitoring:** In pursuing its function, the ESRB collects and analyzes all relevant and necessary information and identifies and prioritizes systemic risks. As appropriate, it provides the European Supervisory Authorities (ESAs) with the information on systemic risks required for the performance of their tasks. In particular, in collaboration with the ESAs, the ESRB will develop a common set of quantitative and qualitative indicators ("risk dashboard") to identify and measure systemic risk. The ESRB may also make specific requests for the ESAs to supply information on individual institutions.
- **Policy Tools:** The ESRB will not have direct control over policy instruments. Rather, it will issue warnings about significant systemic risks and, when appropriate, make those warnings public. It will also issue recommendations for remedial action in response to identified risks and, where appropriate, make those recommendations public. When the ESRB determines that an emergency situation may arise, it will issue a confidential warning to the European Council. The ESRB must monitor the response of agencies receiving its warnings and recommendations and ask those agencies for an accounting on an "act or explain" basis. Ensuring the effectiveness of the instruments will require the development of analytical tools and models that underpin the macroprudential policy process, including reliable systemic risk indicators that will support the issuance of warnings and inform its recommendations on the calibration of prudential measures.
- **Communication:** As noted above, the main instruments of the ESRB are warnings and recommendations that can be made public. Also, each ESRB meeting will be followed by a press release and/or press conference. Every year, the chair of the ESRB will be invited to a hearing in the European Parliament on the occasion of the ESRB's annual report to the Parliament and the Council.

Sources: www.bankofengland.co.uk/publications/news/2011/040.htm; www.bankofengland.co.uk/financialstability/fpc/termsofreference.pdf; www.ecb.europa.eu/press/key/date/2010/html/sp100929_1.en.html; www.esrb.europa.eu/home/html/index.en.html; www.hm-treasury.gov.uk/consult_financial_regulation.htm; www.hm-treasury.gov.uk/consult_finreg_strong.htm; www.treasury.gov/initiatives/Pages/FSOC-index.aspx; www.treasury.gov/initiatives/Pages/ofr.aspx; www.treasury.gov/press-center/press-releases/Pages/tg1139.aspx.

From Sources of Risk to Systemic Risk Indicators: Helpful Hints from a Structural Macro-Financial Model

Identifying leading indicators of crises requires a carefully specified structural model of the interactions between the financial sector and the real economy. Such a macro-financial model can show how changes in the sources of risk affect macroeconomic and financial variables. The model used here extends the traditional dynamic stochastic general equilibrium (DSGE) macroeconomic framework by taking into account the role of monetary and macroprudential policies, thus incorporating a more detailed interaction between the financial sector and the real economy (see Annex 3.1 for details).[5] Carefully specified structural models can provide useful insights by helping policymakers disentangle empirical relationships, think about various endogenous feedbacks between the real and the financial sectors, and impose a consistent structure on macroprudential policy.

The structural model could help predict movements of numerous macroeconomic and financial variables in response to alternative sources of shocks. For instance, rapid credit growth in a country is often associated with a higher probability of financial crisis.[6] But a boom in credit can also reflect a healthy response of markets to expected future productivity gains.[7] Indeed, many episodes of credit booms were not followed by a financial crisis or any other material instability. Policymakers should certainly use macroprudential instruments when credit booms threaten financial stability, but such instruments should not be used if they risk aborting a fundamentally solid expansion. To ensure that policies are appropriately designed and implemented, authorities need information that would allow them to distinguish between these different scenarios. The structural model should be able to inform policymakers of the variables that could be used for this purpose and how best to extract information on the sources of shocks.

Key features of the model used here are the inclusion of a realistic banking sector and a flexible set of parameters to mimic different types of economies (Beneš, Kumhof, and Vávra, 2010; and Annex 3.1). The innovative features of the banking part of the model are: (i) inclusion of the balance sheets of both banks and nonfinancial borrowers in the propagation of shocks; and (ii) a link between the diversifiable (or idiosyncratic) risk faced by banks in their lending activities and the nondiversifiable, aggregate macroeconomic risk arising from cyclical fluctuations.[8] The macroprudential concern stems from the presence of the aggregate risk. Examples of the flexible parameters are the extent of foreign-currency-denominated loans, the degree to which the central bank manages the nominal exchange rate, the sensitivities of both imports and exports to the exchange rate, and the ease with which banks can raise fresh equity capital in financial markets.

We use the model to address the following questions:

- Which variables are leading indicators of future financial instability?
- How do the leading indicators react to different types of shocks?
- Can the leading indicators differentiate healthy credit booms from unhealthy episodes of credit growth?

[5]The IMF and major central banks have developed one or more versions of these DSGE macroeconomic models to study the effectiveness and desirability of different macroeconomic policies (Roger and Vlćek, 2011 and forthcoming). More recently, DSGE models have also been used for forecasting purposes. For example, Smets and Wouters (2007) show an application of Bayesian techniques for the estimation of DSGE models that yields good forecasting properties.

[6]Bordo and others (2001), Reinhart and Rogoff (2009), and Mendoza and Terrones (2008) have compiled vast amounts of evidence about various drivers of boom-and-bust cycles across numerous countries over time. Moreover, Borio and Drehmann (2009), Drehmann, Borio, and Tsatsaronis (forthcoming), and Ng (2011) study the performance of alternative indicators of financial crisis; those studies show that some variables, including measures of excessive credit growth, could forecast crises occurring one to three years ahead. De Nicoló and Lucchetta (2010) explore the links between credit growth and GDP growth with a dynamic factor model using the concept of tail risk (the risk of negative shocks of low probability but high impact).

[7]Such gains could result from one or more developments, including new technologies, new resources, and institutional improvements.

[8]The model uses the concept of financial friction (see Bernanke, Gertler, and Gilchrist, 1999), in which limited enforcement of loan covenants gives the borrower an incentive to default and allows the lender to seize the collateral. The aggregate risk in the model arises from procyclicality in the system; the model does not take into account the systemic risk arising from interconnectedness in the financial system.

- Do the indicators vary according to characteristics of the economy, such as the degree of trade and financial openness or the nature of its exchange rate regime?

We consider three types of shocks, each of which can cause prolonged periods of rapid credit growth, persistent increases in the value of assets, and external imbalances.[9] The first two of the three shocks described below will likely increase systemic risk; the third represents a healthy change and does not expose the financial sector or the overall economy to substantial instabilities. In reality, all three shocks could (and often do) occur together. But the purpose of using the structural model is to be able to clearly distinguish between them so as to derive the implications for different indicators.

- The first shock is an *asset price bubble* (Bernanke and Gertler, 1999) that lasts for about 12 consecutive quarters.[10] The bubble is irrational because it is not underpinned by a change in fundamentals. It can be viewed as an exogenous persistent wedge between the price of certain assets and their fundamental level. While the bubble persists, credit risk builds up on the balance sheets of financial institutions—banks lend to households and businesses against financial wealth that is inflated by mispriced assets. When the bubble bursts, the credit risk materializes.
- The second shock is a *lowering of bank lending standards* for eight consecutive quarters. Banks seeking to increase their share in a highly competitive market may underestimate the true risk associated with lax lending standards.[11] Thus, the systemic risk in this scenario is generated from within the financial sector. It could reflect increased moral hazard (a stronger belief that the government will bail out banks), overoptimistic assumptions about credit risk, or greater financial integration.
- The third shock is *anticipated improvement in the economy's fundamentals*, such as a productivity gain expected from a future inflow of foreign direct investment. The anticipated improvement, if realized, will expand the economy's production frontier, export capacity, and real income. The actual improvement occurs after 12 consecutive quarters.[12] In this scenario, households and other nonfinancial agents start borrowing against their future income before the improvement materializes. Resulting increases in indebtedness and current account deficits may not lead to risks unless the expectations are overly optimistic; the risks fade away as the fundamental improvements materialize.

Is it possible to empirically distinguish between these three situations in which fast credit growth creates different levels or types of systemic risk? The dynamics of many macroeconomic and financial sector variables are qualitatively similar for the different sources of shocks (Figure 3.2).[13] The figure shows the paths of four variables when each of the three shocks hits the economy in quarter 1.[14] For example, the credit-to-GDP ratio increases initially as a response to any of the three shocks.

[9]No distinction is made between various types of assets—productive real capital, real estate, claims to investments, equity shares, and so on.

[10]The analysis assumes "irrational" bubbles—investors' and traders' sentiments and expectations are driven by extraneous or nonfundamental factors such as fads, fashions, rumors, and informational "noise," which can disrupt and destabilize asset markets and generate excessive volatility in asset prices (Kindleberger, 1989). A "rational" bubble, on the other hand, reflects the presence of self-fulfilling (rational) expectations about future increases in the asset price raising the possibility of deviation of the asset price from the fundamental value (Blanchard, 1979; Blanchard and Watson, 1982; Froot and Obstfeld, 1991; and Evans, 1991). In a rational bubble, stock price growth contains occasional corrections when investors realize the price is not increasing as expected, as opposed to diverging continually as in the "irrational" case.

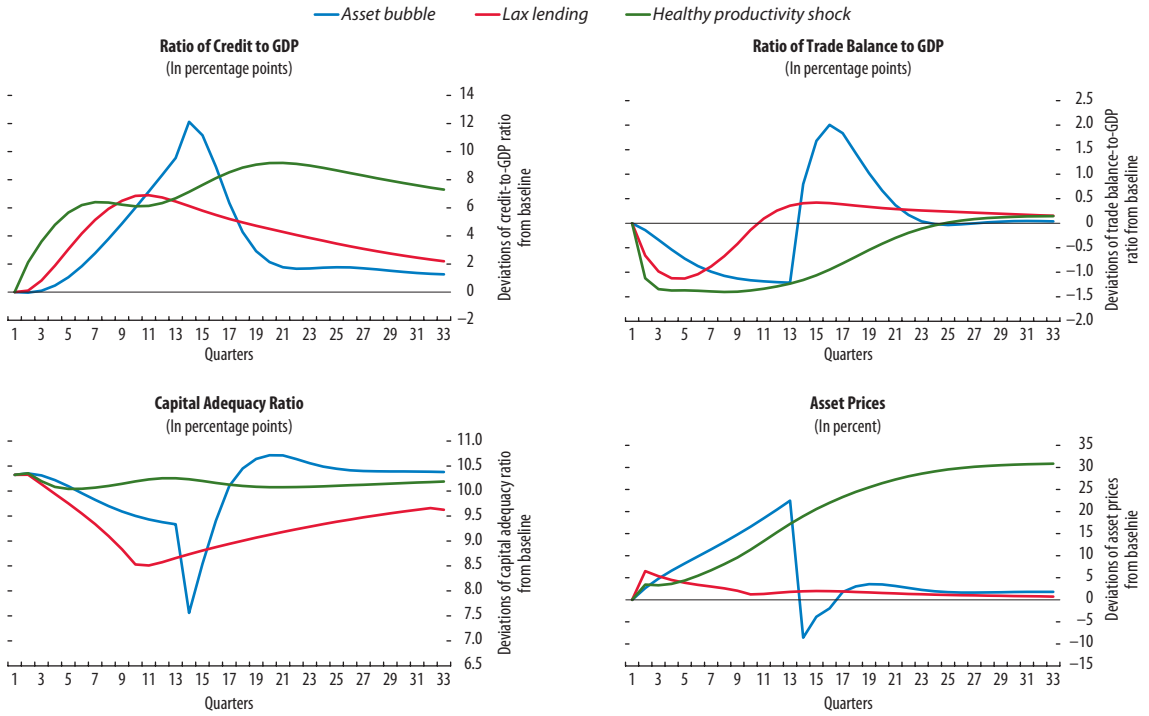
[11]Dell'Ariccia and Marquez (2006) show that, as more and more customers apply for bank loans, banks weaken their lending standards and collateral requirements to raise market share by undercutting their competitors.

[12]A bubble scenario could arise if the actual productivity gains are less than expected.

[13]Baseline parameterization drives the impulse responses that are used to construct Figure 3.2. Different parameterizations of the model are analyzed in Annex 3.1 and Beneš, Kumhof, and Vávra (2010). Impulse-response functions represent the deviations of macroeconomic variables from their regular path as a consequence of a disturbance, keeping all other elements constant. They compare the performance of the economy over time after a shock relative to a nonshock scenario. The length of the shocks is approximated using information about the time shocks tend to last in previous cases in a set of representative countries.

[14]Only four indicators have been shown in the figure for analytical purposes, but there are many other indicators that could be shown. Also see notes to Figure 3.2.

Figure 3.2. Behavior of Four Indicators under Three Shock Scenarios



Source: IMF staff estimates.

Note: For all three shock scenarios, the shock occurs in quarter 1. "Asset bubble" simulates a bubble in the price of productive capital (that is, the observed market price of capital differs systematically and persistently from the fundamental value) within the first 12 quarters and grows gradually to about 20 percent. After 12 quarters, the bubble bursts during the following three quarters. "Lax lending" simulates a loss-given-default that rises from an expected 20 percent to an actual 90 percent, and that returns only gradually to its original level. "Healthy productivity shock" is an expected improvement in productivity that actually materializes in two quarters.

This is indeed an important *first lesson* from the model:

- Increases in the credit-to-GDP ratio alone may signal undesirable speculative paths that risk derailing the financial sector and the economy, but they can also indicate a healthy cycle initiated by positive news about the future.

Despite the similarities among the variables, there are some important differences as well. Notably, the *second lesson* from the model is that even though the direction of change may be the same, the persistence (over several past quarters) and the degree of change in the key variables may not be. For example,

- The increase in the credit-to-GDP ratio from the baseline to the peak is about 12 percentage points in the case of an asset price bubble, whereas it is about half as much in the case of the productivity shock. When a shock arises from within the financial sector (lax lending standards), the credit-to-GDP ratio persistently increases until banks realize after some time that they were overestimating the credit quality of borrowers.
- The trade balance (in percent of GDP) immediately deteriorates under both lax lending standards and the productivity shock. The deterioration is sustainable only in the latter case as residents borrow against their (correctly anticipated) future productivity gains to purchase foreign goods and services. In contrast, under the lax lending standards scenario, the trade balance starts to improve when banks realize their mistake. In the case of the asset price bubble, the trade balance deteriorates much more gradually until it reverses sharply because of the asset price bust.
- The path of the bank capital adequacy ratio deteriorates substantially for the "perverse

shocks"—the asset price bubble and lax lending standards—but much less so upon positive news about productivity.
- The market price of capital (a measure of asset prices in the model) spikes quickly in response to the productivity shock and increases gradually afterward. In the case of the bubble, the increase is rapid before a sharp correction in response to the bust. Lax lending standards need not be accompanied by asset price increases although, in reality, they often are.
- Actual loan-to-value ratios (not shown in the figure) also behave differently.[15] It is almost unchanged in the initial stages of a bubble or following positive news about fundamentals. But it increases continuously when lending standards deteriorate, reverting slowly to its normal path as banks readjust their credit policies.[16]

Does the structure of the economy alter the second lesson? An important insight from the model is that the structural elements of the real economy, such as trade openness, do not make an appreciable difference in the relative movements in key variables following each shock. However, certain features of the *financial sector*—for instance, widespread foreign currency lending in a fixed or managed exchange rate regime—tend to magnify the effects of all shocks. This can be summarized as the *third lesson*:
- Sources of shocks matter more than some features of the real economy in driving movements in key indicators of systemic risk.
- Loans denominated in foreign currency, together with heavily managed exchange rates, tend to amplify the transmission mechanism of any shock.

In summary, the findings of this section are:
- All the responses to the shocks described above have distinctive patterns that are noticeable with enough lead time. For instance, increases in the credit-to-GDP ratio may signal the buildup of bubbles that wind up as future crises.
- Only when the ratio grows substantially and persistently should concerns be raised.
- The credit-to-GDP ratio alone may not be a sufficient indicator to distinguish risky episodes from welcome economic expansions resulting from improved fundamentals. But the combination of data on credit with information on asset prices, the cost of capital, bank capitalization, and realized ratios of credit to asset value may allow policymakers to better judge which force is prevailing.

In reality it is likely that all three shocks happen together, but after a few quarters the use of additional variables helps policymakers distinguish between the good and bad shocks. In other words, strong and persistent credit expansion that is accompanied by sharp asset price increases, a sustained worsening of the trade balance, and a marked deterioration in bank capitalization are suggestive of future problems for financial stability.

The Quest for Leading Indicators of Financial Sector Distress

The structural model in the previous section provides some helpful hints on the key indicators to signal rising systemic risk. Early recognition of the risk buildup phase is crucial to averting potential crises: it allows the financial sector time to accumulate capital and liquidity buffers and reduce risk taking. Many of these "leading" indicators are likely to come from relatively slow-moving, low-frequency, financial balance sheet aggregates.

Also required is the ability to predict with reasonable confidence the imminence of a period of high financial stress, so that policymakers are sufficiently prepared to manage an impending crisis, including by directing financial institutions to draw down their buffers to prevent financial disintermediation once the crisis sets in. Such short-range prediction must come from a second category of measures—"near-coincident" (high-frequency) indicators that, ideally, should provide enough lead time for policymakers to act. This set could also be used to trigger certain types of official sector responses, including, perhaps, some IMF lending

[15]This is not the loan-to-value (LTV) ratio imposed by banks, but literally the observed amount of credit for a given level of asset value.

[16]The ratio of credit to asset value actually declines slightly with the onset of an asset bubble because the bubble increases the value of assets that collateralize loans before lending increases enough to boost the ratio.

facilities. In short, two types of indicators are sought: leading, which signal well in advance that risks are building up; and near-coincident, which show that a crisis is about to materialize.

The empirical analysis in this section seeks to narrow down for policymakers a set of powerful and easily understood indicators for both the buildup and realization phases of systemic risk. By focusing on crisis episodes, the analysis ignores movements in credit associated with productivity gains—the type that is unlikely to lead to systemic stress. For the leading indicators, it uses information from the model described in the previous section to choose a set of variables that are associated with movements in credit aggregates. It is based on a broader sample (in terms of both countries and time periods) than previous studies, explicitly including the current crisis. And it uses a supplemental set of indicators (or "conditioning variables") that move together with credit aggregates: capital inflows, leverage indicators, asset prices, and real effective exchange rates.[17] For the near-coincident indicators, the analysis examines market-based indicators that have recently been proposed and ranks them using tests that distinguish their ability to signal stress in the financial system.

The analysis is guided by the following questions, which we address in turn below.

- What are the patterns followed by credit and other indicators in the lead-up to financial stress? Is there a specific credit measure that works best for this purpose?
- How can policymakers identify a buildup in risk without making costly mistakes? What are the thresholds beyond which the indicator signals financial crises at a reasonable forecasting horizon with a sufficiently high degree of certainty? (See also Box 3.2.)
- How much do credit aggregates and other indicators contribute to predicting a financial crisis?
- Among *near-coincident* indicators of financial stress, what is a robust set of high-frequency, market-based indicators that could be useful to put policymakers into alert mode? (See also Box 3.3.)

[17]Additional indicators are based on Shin (2010), Sun (2011), and IMF (2009). Ideally, also included would be the capital adequacy ratio, shown above to be informative; however, for the entire time period, it is available for only a few countries.

Event Study of Risk Buildup

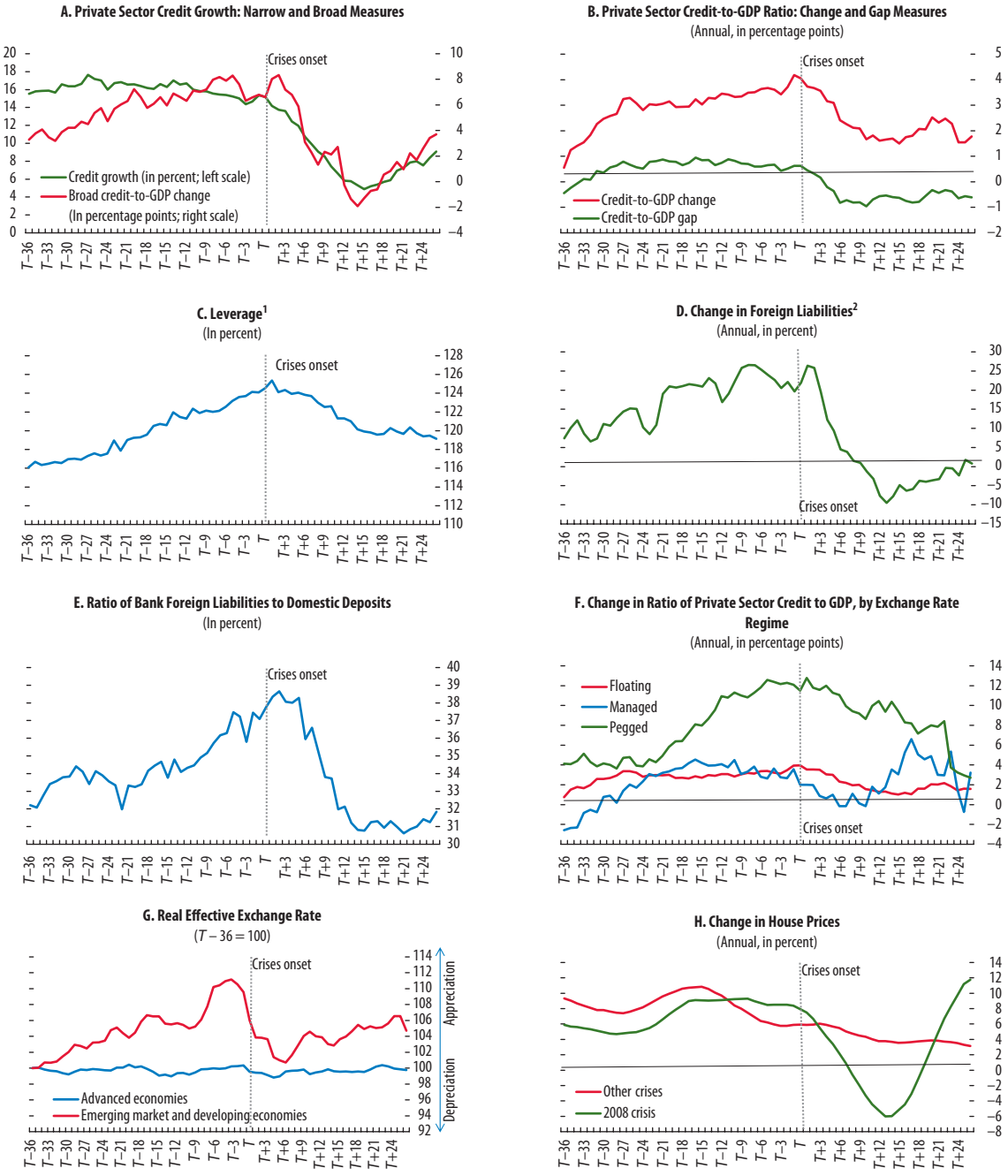
Various indicators move together with credit aggregates in the lead-up to severe financial stress episodes. An event study can help shed light on the levels and changes of these indicators one to three years before such episodes. The levels could give policymakers a broad sense of thresholds that can trigger concerns about risk buildup. The "event" in this case is severe financial stress identified—country by country—as extreme realizations of the Financial Stress Index (FSI) (IMF, 2008).[18] The month of the initial excess FSI realization is deemed to be the "signal" month for distress. Using this definition, 76 occurrences of financial distress across 40 countries have been identified in the monthly dataset. The main findings are as follows:

- Increases in the credit-to-GDP ratio above 3 percentage points, year-on-year, could serve as early warning signals one to two years before the financial crisis (Figure 3.3, panel B). Of all metrics of credit growth (Figure 3.3, panels A and B), changes in the credit-to-GDP ratio and changes in a broader measure of the credit-to-GDP ratio accelerate sharply before a crisis event occurs.[19] In

[18]The FSI is a monthly indicator of national financial system strain. See Cardarelli, Elekdag, and Lall (2011) for advanced economies; and Balakrishnan and others (2009) for emerging economies. This index—not to be confused with the Financial Soundness Indicators—relies on price movements relative to past levels or trends. For advanced economies, the index is the sum of seven variables, each of which is normalized to have a zero mean and a standard deviation of one: (i) the banking-sector beta (a measure of the correlation of bank equity returns with overall equity market returns); (ii) the TED spread (the difference between the three-month Treasury bill rate and the Eurodollar rate); (iii) term spreads (the difference between short- and long-term government bonds); (iv) stock market returns; (v) stock market volatility; (vi) sovereign debt spreads; and (vii) exchange market volatility. For emerging economies, the FSI comprises five variables (it excludes the TED and term spreads from the preceding list of seven and uses an index of exchange market pressure instead of exchange market volatility). See IMF (2008) for more details and Box 3.2 for details on the methodology. The average 5th percentile value of the FSI was 7.4 at the beginning of the 2007–09 financial crisis and 9.7 at its peak.

[19]The broader credit measure includes private-sector credit from banks (derived from monetary statistics) and cross-border loans to domestic nonbanks (derived from "other investment, liabilities" of international investment position statistics). The number of countries in the sample falls considerably when the broader measure is included.

Figure 3.3. Event Study Results: Aggregate Indicators Three Years before to Two Years after Crises



Sources: IMF, *International Financial Statistics*; OECD; Haver Analytics; Global Property Guide; and IMF staff estimates.
Note: *T* is month of crisis onset. For definition of broad credit, see text; for gap in credit-to-GDP ratio, see text and Box 3.2.
[1]Ratio of credit to deposits.
[2]Bank and private sector loans, deposits, and currencies.

Box 3.2. Extracting Information from Credit Aggregates to Forecast Financial Crisis

We examine three methods for analyzing credit aggregates to forecast a financial crisis: the event study, the noise-to-signal ratio, and the receiver operating characteristic.

Event Study

Severe financial stress is identified on a country-by-country basis at the 5th percentile upper tail of the Financial Stress Index (FSI) developed in IMF (2008).[1] Although tail occurrences tend to be clustered in successive months, identification is nontrivial, given that there may be temporary breaks in what, in principle, should be regarded as a single financial distress period. In this regard, we consider breaks of up to six months as being still within the same episode, with occurrences of financial distress immediately preceding and following a break forming one distinct episode. Once such distress episodes are fully identified, the month of the initial excess FSI realization is deemed to be the "signal" month for distress. In this fashion, 76 occurrences of financial distress across 40 countries are identified.

The analysis presented in Figure 3.3 uses windows of 36 months before and 24 months after a distress signal to examine the dynamics of a range of credit measures and financial balance sheet indicators, along with market-based indicators, for signs of a buildup of financial system instability. Credit measures are the annual change in nominal private sector credit, the annual change (in percentage points) in the private sector credit-to-GDP ratio, and the credit-to-GDP gap; the gap itself is measured as percentage point deviations from a recursive Hodrick-Prescott filter trend of the credit-to-GDP ratio, as in Drehmann, Borio, and Tsatsaronis (forthcoming). The analysis also considers measures of house prices, total and foreign-funded leverage (credit-to-deposit and foreign liability-to-deposit ratios), foreign liabilities, and exchange rate dynamics.

We use log-linear interpolation to create monthly frequencies for variables normally provided quarterly or annually—including GDP and capital flow measures.

Noise-to-Signal Ratio

A signaling exercise in the spirit of Drehmann, Borio, and Tsatsaronis (forthcoming) is conducted using noise-to-signal ratios (NSR) for a set of 169 countries (depending on the specification) that includes advanced, emerging, and low-income economies.[2] The NSR for different prediction horizons (lags) provides a summary picture of what thresholds routinely predict crises for different indicators and for different countries. Using annual data and the Laeven-Valencia crisis measure (LV) as an indicator for financial stress/crisis (Laeven and Valencia, 2010), the predictive capacities of three variables—change in the credit-to-GDP ratio, change in a broad measure of the credit-to-GDP ratio (which includes cross-border loans to the private sector), and the gap in the credit-to-GDP ratio—are analyzed at horizons ranging from one to five years before the crisis event. All results have been determined in-sample, drawing upon previous research indicating that the selected indicators also perform well out-of-sample (Borio and Drehmann, 2009).

The signaling methodology works as follows:

- For each signaling variable—changes in alternative measures of credit-to-GDP and the credit-to-GDP gap—a certain threshold is defined, based on the historical performance of

Noise-to-Signal Ratios: An Example

	Crisis occurs within a 3-year window starting *k* years after the signal	Crisis does not occur within a 3-year window starting *k* years after the signal
Indicator signaling *k* years ahead	A	B
Indicator not signaling *k* years ahead	C	D

Note: The indicator is lagged *k* years, for *k* = {1,2,3,4,5}.

Note: Prepared by Silvia Iorgova, Christian Schmieder, and Tiago Severo.

[1]The FSI is a monthly indicator of financial system strain. The index relies on price movements relative to past levels or trends. See the main text for details.

[2]The exact number of countries depends on the details of each exercise, since the availability of information varies as different crisis measures and macroeconomic variables are included in the computations.

Box 3.2 *(continued)*

the measure. Various thresholds are considered: annual increases above 3 percent, 4 percent, or 5 percent for changes in credit-to-GDP or observations above 1, 1.5, or 2 standard deviations beyond the sample mean for the gap.[3] A dummy variable is created, assuming the value of 1 if the signaling variable is above the threshold and zero otherwise. This dummy is the "crisis signal." The predictive value of the "crisis signal" is then assessed according to whether it predicts a crisis—determined by the LV variable—in at least one period in a window of three years. The crisis signal is lagged k years, where $k = \{1,2,3,4,5\}$. More specifically, the test is whether a value of 1 for a certain "crisis signal" at time t is followed by a value of 1 for the LV measure on at least one of the dates $t + k$, $t + k + 1$, and $t + k + 2$. If that is the case, the signal is correct. A failure to signal a crisis that actually happens produces a Type I error—C/(A + C) in the diagram above—whereas a false signal (a signal that is not followed by a crisis in the future) produces a Type II error—B/(B + D) in the diagram.

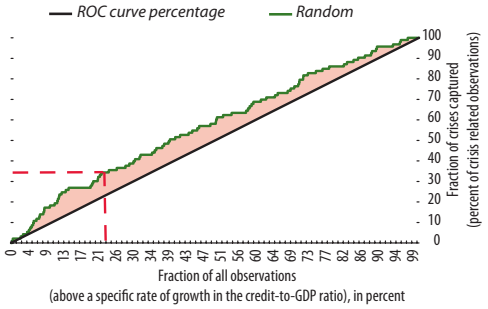
- The two types of errors are compared by means of the NSR, which is defined as the proportion of Type II errors divided by 1 minus the proportion of Type I errors. A "crisis signal" with a small NSR is able to forecast a large number of crises without sending an excessive number of false signals. A higher NSR, on the other hand, results from a combination of missing actual crises and producing too many false signals.

Receiver Operating Characteristic (ROC)

The receiver operating characteristic (ROC) is a graphical method for determining the discriminatory power of signaling variables. This analysis, which uses the same dataset as the NSR, first plots the share of (crisis- and noncrisis-related) observations based on a pre-specified order of the signaling variable along the x-axis. For example, suppose a change in the credit-to-GDP ratio of 3 percentage points or greater is 23 percent of all observations. Then the 23 percent value for the signaling variable on the x-axis would be associated with these levels of credit growth. To obtain a larger share of the observations moving to the right on the x-axis, lower thresholds are required. To obtain the corresponding y-axis value, one compares credit-to-GDP growth of 3 percentage points or greater with the number of crises in the sample. The proportion of crises at this level (34 percent) is plotted on the y-axis. In that sense, each point on the ROC curve corresponds to the percentage of predicted crises (and the corresponding number of all observations, which determines false signals) given a specific threshold, in this case, the greater than 3 percentage point change in the credit-to-GDP ratio.

The predictive power of the signaling variable (in this case credit-to-GDP change for emerging economies) is determined by the area between the ROC curve and the 45-degree line (the shaded area in the figure below). The 45-degree line in the figure corresponds to an area of 0.5 and is equal to random sampling of both the x- and y-axis variables, which means that a ROC curve lying on the 45-degree line does not indicate any predictive power. In the example shown below, the area is 0.57 (the area under the ROC for emerging economies in Table 3.2); that is, the shaded area is 0.07. As shown by the dashed lines

Example of an ROC Curve for Growth in the Ratio of Credit to GDP
(In percent)



Source: IMF staff estimates.
Note: Area under the receiver operating characteristic (ROC) curve is 0.57, which corresponds to the entry for emerging economies in Table 3.2. For data indicated by shaded area and dashed lines, see box text.

[3]Importantly, both the average gap and the standard deviation are country specific, to take into account the large variation in these measures across the countries considered.

Box 3.2 *(continued)*

in the figure, a threshold of 3 percentage points for growth of the credit-to-GDP ratio (which corresponds to an x-axis value of 23 percent), for example, captures about 34 percent of all crises (resulting in a Type I error of 0.66).

Depending on how many crises one seeks to identify on the one hand and how many false signals one tolerates on the other, one can calibrate a threshold accordingly. Generally, clustering of crisis observations within low percentiles (depending on the specific underlying order of the signaling variable) indicates higher discriminatory power for the signaling variable. Hence, while the total area under the curve provides a proxy for the predictive power in general, high levels of predictive power will be associated with the signaling variable performing well for the lowest percentiles of observations on the x-axis. Using a multivariate measure improves the predictive power, for example by using the outcome of the probit regression documented in Annex 3.2.

fact, the broader credit growth measure accelerates even more: its change averages 5 percentage points of GDP two years before the crisis and goes up to 7 percentage points of GDP one year before the crisis. In the aftermath of distress, this measure also drops the most.

- The nominal year-on-year rate of credit growth does not seem to accelerate ahead of a crisis (Figure 3.3, panel A). However, the "gap" measure of the credit-to-GDP ratio tends to be persistently positive before distress episodes (Figure 3.3, panel B).[20]
- Credit-to-deposit ratios higher than 120 percent are associated with crises within the next year (Figure 3.3, panel C).
- Foreign liabilities of the private sector typically accelerate rapidly before a crisis. External borrowing by banks and the nonbank private sector grows from around 10 percent to 25 percent in the run-up to financial stress (Figure 3.3, panel D). Following a stressful episode, these liabilities fall dramatically for the next 12 months.[21]
- Banks' foreign liabilities as a fraction of domestic deposits increase from about 32 percent to 38 percent two years before a crisis (Figure 3.3, panel E).[22]
- Countries with fixed exchange rates have much higher credit growth than average (Figure 3.3, panel F). This reinforces the findings from the structural model that any shock propagates more strongly in a fixed or managed exchange rate regime.
- Real effective exchange rates (REER) tend to appreciate rapidly in the run-up to the crisis in emerging economies (Figure 3.3, panel G). For example, the rapid credit expansion preceding the 2008 global crisis was associated with an increase in the REER (an appreciation) of around 4 percent for most of the precrisis years. As discussed in the previous section, the persistent deterioration in the trade balance resulting from an asset price bubble shock could be related to the rise in

[20]The credit-to-GDP gap (Borio and Drehmann, 2009; and Drehmann, Borio, and Tsatsaronis, forthcoming) and change in the credit-to-GDP ratio are prime candidates for comparison. The former is the deviation of the credit-to-GDP ratio from a recursive Hodrick-Prescott filter trend. The advantage of the gap measure is that it is cumulative and takes into account the country-specific trend. Its disadvantage is that a gap of zero could still reflect a very high rate of credit growth, which is the core concern for financial stability. In the same vein, the indicator is less convenient for policy purposes, and ultimately macroprudential policies will have to target credit growth as such (that is, the gap has to be translated back into credit growth). The advantage of the ratio measure is that it readily focuses on the pace of credit growth. Its main disadvantage is that it omits cumulative aspects.

[21]In this context, foreign liabilities refer only to loans and deposit liabilities of the private sector and are taken from balance of payments statistics (changes in the international investment position for banks and nonbanks under "other investment, liabilities"). Instead of focusing on the current account deficit, only the above set of capital inflows are emphasized here, since countries reliant on such flows have been more prone to the recent crisis, at least in emerging Europe (Cihak and Mitra, 2009).

[22]This measure could be interpreted as a measure of noncore/core liabilities, which tend to grow with assets. See Shin and Shin (2011).

the real exchange rate (Figure 3.2). The relentless increases in the price of nontradables that included housing services resulted in real appreciation of the currency before the recent crisis in some regions of the world.

- House prices, on average, tend to rise by 10 to 12 percent for two years before financial sector stress emerges.[23] This pattern is in line with previous studies showing that house prices are a strong leading indicator of potential financial distress (Kannan, Rabanal, and Scott, 2009b) or associated with rapid credit growth (Claessens, Kose, and Terrones, 2011a and 2011b) (Figure 3.3, panel H).

Echoing the implications of the structural model in the previous section, these results suggest that even though credit growth is potentially a good leading indicator, it may not be sufficient to determine the timing and extent of a risk buildup. Rather, other variables should be considered alongside it. The results above suggest that if asset prices are increasing, the real exchange rate is appreciating, bank and corporate cross-border funding are going up, and leverage is increasing, then there is a reasonable chance of facing an episode of financial stress within the next couple of years. The following subsections reinforce this point and derive meaningful thresholds of the leading indicators that would allow policymakers to issue signals of future financial stress.

Exploring the Costs and Benefits of Issuing Signals Based on Leading Indicators

Using early warning indicators to identify the buildup of financial risk entails two potential problems. There could be cases in which policymakers fail to predict a financial crisis that later occurs (called a Type I error) because thresholds were set too high. Alternatively, there could be instances in which early warning indicators exceed their thresholds but financial system stress does not materialize (called a Type II error). Ideally, the signaling power of indicators should minimize both types of errors. Naturally, there is a trade-off. For instance, minimizing Type I errors encourages setting thresholds low, creating frequent false signals (Type II error).

To observe the ability of different slow-moving variables to properly balance Type I and Type II errors, two statistical methods are used:

- Noise-to-signal ratio (NSR): The NSR is the ratio of false alarms to legitimate alarms, that is, a summary of Type I and Type II errors.[24] The lower the NSR, the better is the signaling power of a particular indicator (Box 3.2).
- Receiver operating characteristic (ROC): The ROC is a graphical tool that weighs the benefit of decreasing the thresholds of indicators (to lower the chance of missing a crisis) versus the cost of issuing a false signal (Box 3.2). It provides a summary measure of the signaling ability of an indicator. The more the measure exceeds 0.5, the better is the indicator's signaling ability.

Noise-to-Signal Ratio

The NSR is computed from annual data for 169 countries, with 109 crisis episodes identified by Laeven and Valencia (2010).[25] A three-year window is set, as it is in the event study, and the indicator variable was lagged two periods (Table 3.1). For example, if the credit-to-GDP ratio exceeds the threshold at year t and a crisis occurs at years $t + 2$, $t + 3$, or $t + 4$, then the signal is successful.[26] The findings suggest that:

[23]Equity prices are a part of the FSI indicator and hence tend to be contemporaneous with distress window peaks. For this reason, equity prices were not included in the event study.

[24]The noise-to-signal ratio is defined as the proportion of Type II errors (cases with indicator signaling a crisis as a fraction of cases in which crisis did not occur) divided by the proportion of legitimate signals (cases with indicator signaling a crisis as a fraction of cases in which crisis did occur). See Kaminsky, Lizondo, and Reinhart (1998); Berg and others (2000); and Box 3.2.

[25]The Laeven-Valencia index of episodes is a broad, coincident indicator for full-blown financial crises that uses government intervention in the financial sector to date the episodes. On the other hand, the FSI used in the previous section is an indicator of financial stress that might not materialize into a full-blown crisis. The advantage of the LV index is that it covers 169 countries rather than the 40 countries covered by the FSI, but a considerable drawback is its annual frequency and the scarcity of crisis occurrences—at most one crisis per country for most countries and 109 overall.

[26]The sample is reduced for different indicators based on data availability. Results are similar for a one-year lag.

Table 3.1. Noise-to-Signal Ratios for Different Credit Indicators
(In percent unless noted otherwise)

Crisis Measure	Warning Signal Issued When	Thresholds	Average NSR for Countries (at least one forecasted crisis)	Number of Countries	Average Type I Error	Average Type II Error	Fraction of Countries with 100% Type I Error
Laeven and Valencia (2010)	Credit-to-GDP gap is:	1 std > mean	0.07	82	65	8	61
		1.5 std > mean	0.05		84	3	80
		2 std > mean	0.04		95	1	94
	Percentage change in credit-to-GDP is larger than:	3	0.38	78	17	37	15
		5	0.33		22	31	21
		7	0.29		36	25	33
	Percentage change in broad measure of credit-to-GDP is larger than:	3	0.18	8	0	18	0
		5	0.11		0	11	0
		7	0.18		13	6	0

Source: IMF staff estimates.

Note: The numbers were computed for 2 lags of the signaling variable. The table reports the average NSR for all countries in a given group. Low values for the NSR indicate that a certain credit measure is able to accurately predict a large number of crises for many countries.

- The credit-to-GDP gap does not perform well as a signaling variable. It misses too many crises. Conditioning on extra variables only makes things worse. It is worth noting that if the sample is restricted to advanced countries, the performance improves.[27]
- The change in the credit-to-GDP ratio is more promising, as it misses only a moderate number of crises. Nonetheless, it induces frequent Type II errors. For instance, the average Type II error associated with the change in credit-to-GDP ratio is much higher (25 percent or higher) than for the credit-to-GDP gap (at most 8 percent). This problem may be mitigated with the inclusion of additional conditioning variables, such as asset price growth.
- The analysis based on the change in the broad measure of the credit-to-GDP ratio can be applied to only eight countries. The broad measure includes not only bank credit but also direct cross-border credit to the nonbank private sector.[28] The results improve substantially in this case. A 5 percentage point threshold captures all of the crises; that is, the average Type I error is zero (Table 3.1).

The findings from the NSR exercise and the event study suggest that the yearly change in the credit-to-GDP measure is best among credit aggregates in signaling a crisis. However, the analyses also indicate that a credit aggregate alone may not be a sufficiently good leading indicator, especially when considering a large sample of countries. As illustrated by the structural model, increases in credit aggregates may reflect benign responses of the economy to positive shocks to fundamentals, with muted effects on systemic risk. This implies that other conditioning variables that co-move with credit aggregates could complement the analysis, especially if these additional indicators allow policymakers to reduce Type II errors without increasing Type I errors too much.

Receiver Operating Characteristic (ROC)

The receiver operating characteristic (ROC) uses the annual data with Laeven-Valencia crisis dates to determine the predictive power of various slow-moving indicators (Box 3.2). The ROC summarizes the costs and benefits of choosing various thresholds of an indicator ranging from high to low—a richer set of possible choices. The higher its ROC above 0.5, the better is a variable's predictive power (Table 3.2).[29] Both the credit-to-GDP gap and the growth in the credit-to-GDP ratio are included in the analysis, along with asset prices, real exchange rate changes, and growth in banks' foreign liabilities. The analysis confirms that establishing clear thresholds for credit variables to identify crises is difficult and depends heavily on policymakers' preferences for implementation methods.

- If a policymaker's preference is to target "clear" cases, that is, to limit false signals, then thresholds should be set very high. Setting a threshold for the change in the credit-to-GDP ratio at the upper 20th–30th percentile in historical terms, for example, will help signal between 30 percent and 40 percent of the crises in both emerging markets and advanced countries.
- On the other hand, if the objective is to identify a larger number of crises, say 60 percent of them, then one has to accept a substantially higher number of false signals, as the threshold for credit-to-GDP change has to be set at the upper 45th–50th percentile in historical terms.
- A key finding for macroprudential policy is that asset price growth signals crises earlier than measures of credit growth, for both advanced and emerging economies. Credit growth peaks one to two years before crises, whereas both equity and house price growth are at their highest two to five years ahead of crises.
- The predictive power of other conditioning variables (exchange rates, foreign liabilities) peaks at about a year in advance. Table 3.2 confirms the

[27]Borio and Drehmann (2009), who advocate this measure, consider a small set of advanced economies only.

[28]The stock of cross-border loans is derived from other investment liabilities data from the balance of payments of the IMF's *International Financial Statistics* (IFS). The latter source of data was chosen to maintain consistency with data on credit, which comes from the monetary statistics of the IFS. However, the number of countries fall dramatically both because of data availability and coverage of the Laeven-Valencia index.

[29]If the predictive power of an indicator is very low, then it is hard to choose meaningful thresholds for it.

Table 3.2. Predictive Power of Various Indicators "X" Years before the Crisis

	All Crisis Observations	Only Crisis Observations X Years before Crises					All Crisis Observations		
		1 year	2 years	3 years	4 years	5 years	Advanced countries	Emerging markets	Low-income countries
Credit-to-GDP gap	0.54	0.60	0.56	0.57	0.49	0.49	0.59	0.53	0.53
Equity price gap	0.59	0.54	0.55	0.56	0.68	0.61	0.56	0.58	0.61
House price gap	0.58	0.55	0.59	0.54	0.60	0.63	0.65	0.51	0.62
Credit-to-GDP (year-on-year change)	0.54	0.61	0.55	0.54	0.54	0.49	0.62	0.57	0.48
Equity price (year-on-year change)	0.67	0.67	0.67	0.66	0.71	0.62	0.71	0.69	0.63
House price (year-on-year change)	0.57	0.52	0.59	0.58	0.55	0.60	0.65	0.57	0.52
Real effective exchange rate	0.56	0.61	0.58	0.53	0.53	0.56	0.59	0.52	0.59
Foreign liabilities (year-on-year change)	0.50	0.67	0.50	0.58	0.28	0.34	0.63	0.44	0.68

Source: IMF staff estimates.

Note: The crisis indicator is the Laeven-Valencia index. The table shows the area under the ROC curve (see Box 3.2). An area under the ROC curve of 0.5 indicates that there is no additional discriminatory power compared with random sampling. The higher the number (which is bounded at 1) above 0.5, the higher is the discriminatory power. Number of observations is low in some cases.

earlier result that the change in the real effective exchange rate can be a good conditioning variable.
- Indicators related to equity prices have the highest predictive power, followed by those related to house prices (Table 3.2). The structural model also identified these asset price indicators as having the potential to identify the type of shock hitting the economy, and could indicate excessive optimism by investors.

Panel Data Regressions

A more formal estimation of the relationship between slow-moving variables and the probability of financial crises confirms that both credit measures—the credit-to-GDP gap and the change in the credit-to-GDP ratio—have a statistically significant effect on crisis probabilities. As is common in many of these types of studies, however, the estimated probability of a systemic banking crisis is small (see Annex 3.2).[30]

- Generally, the relationship is strongest at a forecast horizon of one to two years. This confirms the observations based on the event study, the NSR, and the ROC.
- For a high-risk country, a 1 percentage point increase in the credit-to-GDP gap or an annual 1 percentage point increase in the credit-to-GDP growth will increase the probability of a systemic banking crisis by 0.2–0.3 percentage point in each of the following two years.[31]
- However, the probability of a crisis accelerates as credit growth (both the gap and change measures) increases from the median to the 90th percentile (in sample).
- When other indicator variables are interacted with credit aggregates, the probability of a systemic crisis increases.[32] This is evident with equity prices, confirming results from the NSR and ROC analyses. If growth of the credit-to-GDP ratio is at 5 percentage points, then an equity price increase of 10 percent increases the probability of a systemic financial crisis to more than 15 percent within the next two years (Figure 3.4).
- The model is able to forecast crises out-of-sample as well. Using just one country as an example, if the panel model is estimated up to 2000, credit aggregates help forecast the recent crisis in the United States well (Figure 3.5 and Annex 3.2).

Near-Coincident Indicators of Imminent Crisis

High-frequency indicators are best at informing policymakers of imminent severe financial stress. The credit aggregates and other low-frequency indicators cannot inform policymakers of imminent financial distress or the onset of a crisis. For instance, some balance sheet aggregates continue to increase well after a systemic stress is detected (see Figure 3.3). To signal imminent stress and crisis, near-coincident indicators are required. A version of conditional Value at Risk, or CoVaR (Adrian and Brunnermeier, 2010), that varies with the LIBOR-OIS spread and the yield curve, is a high-frequency, market-based measure that appears to be a good near-coincident indicator (Box 3.3).[33] Other high-frequency market-based indicators do well on other counts but not necessarily on average for all counts.

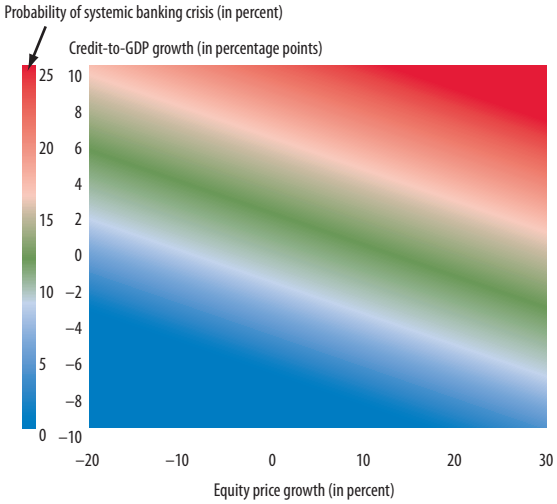
[30]A probit (unbalanced panel data) model with country fixed effects is estimated across 94 countries (with advanced, emerging, and low-income economies) over 1975–2010 using annual data. The fixed effects of a country denote the time-invariant characteristics that affect the crisis probability; a country with very high fixed effects (80th percentile) is termed "high risk." Using the Laeven and Valencia (2010) definition of crisis in the form of a crisis dummy (1 for crisis and 0 otherwise), the estimation evaluates the ability of the different indicators to explain the probability of crises at three different forecast horizons—one, two, and three years.

[31]See Annex 3.2 and Table 3.4 for medians based on data for 94 countries and methodological details.

[32]The estimation of the multivariate probit model is based on a smaller dataset because of data gaps for equity prices. The dataset shrunk further when other variables were included. Even so, indicators like the growth in foreign liabilities and the level of the loan-to-deposit ratio were tested and found to increase the marginal effect of credit aggregates on the probability of crisis.

[33]The CoVaR is the Value at Risk of the financial system conditional on institutions being under distress. An institution's contribution to systemic risk is the difference between the CoVaR for tail-risk episodes and the CoVaR at the median state. The time-varying CoVaR is estimated by quantile regressions of the returns of the financial system on the returns of an institution and other state variables. The latter includes the yield curve (the difference between interest rates on long-term Treasury bonds and short-term Treasury bills) and the spread between the London Interbank Offered Rate (LIBOR) and the overnight indexed swap (OIS).

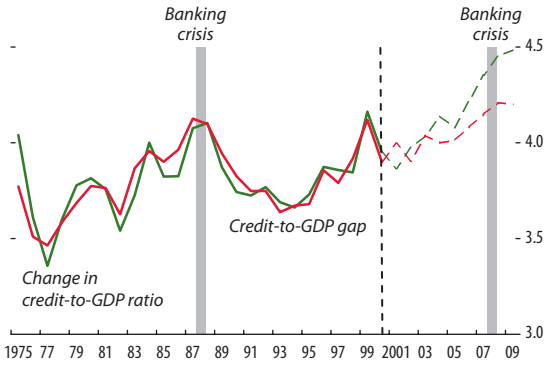
Figure 3.4. Probability of a Systemic Banking Crisis



Source: IMF staff estimates.

Note: The figure is based on a panel probit model with country fixed effects. See Annex 3.2 for estimation results. The data are from an unbalanced annual panel that lies within the period 1975–2010. The estimation with equity price growth is at a two-year forecast horizon and is based on 36 countries with 27 crises observations. The probabilities are evaluated at the 80th percentile fixed effect (high-risk country). The crisis probability ranges from 0 (blue) to 25 percent (red).

Figure 3.5. Estimated Probability of a Systemic Banking Crisis in the United States: Effect of Changes in Credit
(In percent)



Source: IMF staff estimates.

Note: The forecast of crisis probability for a given year is made in the preceding year. Probabilities are based on two panel probit models with fixed effects for 1975–2000, one with the change in the credit-to-GDP ratio and one with the credit-to-GDP gap; see text and Box 3.2. The dashed lines show the out-of-sample probabilities for 2001–09. See Annex 3.2 for details on calculation of probability.

However, the market-based indicators do not necessarily signal rising interconnectedness of the financial system well ahead of time. If policymakers could read market signals of interconnectedness—an institutions' rising contribution to systemic risk—early enough, then they could make these institutions pay (for example through capital or liquidity surcharges) for their risk taking.[34] The inability of the market to pick up interconnectedness could be due to the nontransparency of inter-institution exposures that do not enable market discipline early on.

The findings from this section can be summarized as follows:

- Among the credit aggregates, a threshold of 5 percentage points for annual change in the credit-to-GDP ratio works reasonably well in signaling crises: it reduces the chances of missing a crisis without a correspondingly high number of false signals. Thresholds for the credit-to-GDP gap are harder to determine, and those analyzed for advanced and emerging economies tend to miss most crisis episodes. Thresholds for a broader credit measure—that combines data on bank credit and cross-border credit—work well, but the analysis is hindered by data gaps.
- The panel regressions show that both credit growth measures are almost equally good in predicting crises at one- to two-year horizons, even though the predictive power for either measure is moderate. The gap performs better at a one-year horizon, whereas the growth rate is a better signal two years ahead.
- Other indicator variables need to be taken into account while applying thresholds for credit aggregates. Real exchange rate appreciation (especially for emerging economies) and growth in equity prices are prime candidates.
- Among high-frequency near-coincident indicators, the best performer is the time-varying CoVaR. Given that this indicator builds on the yield curve and LIBOR-OIS spread, among other data, some combination of the yield curve and LIBOR-OIS

[34]IMF (2010a) provides a method of calculating a systemic solvency surcharge based on interconnectedness; IMF (2011a) provides such a surcharge for systemic liquidity risk.

Box 3.3. Risk Materialization: The Search for Near-Coincident Indicators of Financial System Stress

High-frequency market-based indicators best inform policymakers that a systemic event or crisis is imminent ("near-coincident" indicators). Such signals can then be used by policymakers to request that accumulated capital or liquidity buffers be released; or the indicators can be built into macroprudential measures to effect the release automatically. Various econometric techniques are used to determine robustness in a group of near-coincident indicators of systemic financial stress. The findings suggest that an indicator combining information from the yield curve and the LIBOR-OIS spread works best for the United States. However, the tested indicators did not perform well in flagging the rising interconnectedness of Bear Stearns and Lehman Brothers before their respective failure.

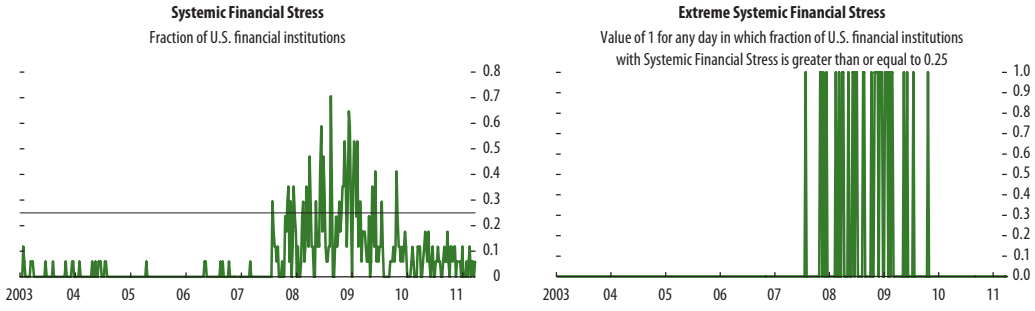
The current crisis is used as a testing ground for various high-frequency indicators, and two new indicators for ongoing stress specific to the financial sector are introduced (see Annex 3.3 for definition of the indicators and calculations). The first is "systemic financial stress," or SFS (first figure, left panel). An SFS of, say, 0.10 means that 10 percent of financial institutions in the system experienced large negative abnormal returns on a given day as well as negative abnormal returns for the two weeks following that day.[1] A second measure, a subset of SFS observations, is "extreme SFS," defined as an SFS equal to or larger than 0.25 (first figure, right panel). For the United States, the SFS helps predict changes in the real economy.[2] The set of high-frequency near-coincident indicators is then tested against both the SFS and its extreme form.

Note: Prepared by Srobona Mitra, drawing on Arsov and others (forthcoming).

[1]The SFS is calculated using equity returns of 17 domestic financial institutions from the United States for weekly data for the period 12/30/2002–4/11/2011. Abnormal returns are defined by banks' weekly equity returns *minus* overall market stock returns. For the United States, for instance, the return on the S&P 500 index is taken as the market return. The threshold for large negative abnormal returns is based on the 5 percent left tail of the joint distribution of abnormal returns for 17 domestic financial institutions for the United States. The Financial Stress Index (FSI) from IMF (2008), which is monthly, and the monthly version of the SFS seem to forecast (Granger-cause) each other. The SFS is a high-frequency measure of stress specific to a group of financial institutions, whereas the FSI is a broader measure of financial stress.

[2]The monthly version of the SFS for the United States helps forecast current-year's GDP growth (as shown by Granger Causality tests of the SFS and GDP growth forecasts from Consensus Economics) but not necessarily next years' GDP growth.

Systemic Financial Stress in the United States



Sources: Bloomberg; Datastream; and IMF staff estimates.

Box 3.3 *(continued)*

The performance of the 10 indicators in signaling the materialization of risk is judged by their scores on each of three tests:[3]

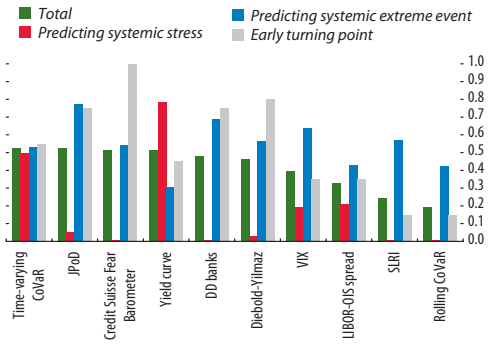
- Predicting SFS at a reasonable horizon.[4]
- Predicting extreme SFS with reasonable likelihood.[5]
- Providing an early turning point (early breakpoints in the level and persistence process of the variable).[6]

The 10 near-coincident indicators of systemic risk are then ranked by the average scores—from 0 (worst) to 1 (best)—on the three tests (see Annex 3.3 for details).

Based on the scores, the time-varying conditional Value at Risk or CoVaR—which takes into account two additional time-varying variables in the methodology: (i) a yield curve (the spread between the 10-year Treasury bond and the 3-month Treasury bill) and (ii) the LIBOR-OIS spread—is the best overall performing "near-coincident" indicator (second figure). The joint probability of distress (JPoD) is able to forecast extreme systemic stress events (or tail-risk scenarios) well but, like the distance to default (DD), does less well in forecasting stress in general. The yield curve by itself is best at signaling systemic stress events (the SFS), and the Credit Suisse Fear Barometer has the earliest turning point.

There are some indicators (out of the 10 studied here) that also have some component that measures interconnectedness in the financial system by calculating the contribution of an institution to systemic risk—the CoVaR, the Diebold-Yilmaz spillover index, and the JPoD are examples.[7] How well do these indicators signal a rise in interconnectedness of the system? Two institutions' contributions to systemic risk are tracked using the three indicators until the date the institutions were deemed to have failed.[8] As shown by the third figure, the time-varying CoVaR does not necessarily indicate rising interconnectedness before the other indicators. On the other hand, the Diebold-Yilmaz had indicated, as early as end-2006, that the contribution of Bear Stearns to systemic risk spillovers was 15 percent—larger than what could be inferred from its relative asset size among the group of financial institutions analyzed here. However, Diebold-Yilmaz does not signal the potentially high contribution of Lehman Brothers. The other two indicators do signal rising interconnections of the two failed institutions, but not far enough in advance for policymakers to take action before crisis has set in.[9]

Performance of Near-Coincident Indicators in Predicting Severe Stress Early Enough, by Indicator and Three Metrics
(Index: 0–1, higher the better)



Sources: Bloomberg; Datastream; and IMF staff estimates.
Note: See Annex 3.3 for an explanation of the indicators and for details on how the three metrics were estimated.

[3]See Rodríguez-Moreno and Peña (2011) for a related exercise, the conclusion of which is the "simpler the better."

[4]Given by Granger Causality tests at various horizons. Scores based on *p*-values.

[5]Logit tests are performed with extreme SFS as the dependent variable (0–1) and the lagged dependent and lagged indicator variable as explanatory variables. Scores are based on *p*-values of Wald tests and McFadden *R*-squares.

[6]Quandt-Andrews breakpoint test for unknown breakpoints for the level and persistence parameters of an AR(4) model of each indicator. Score based on the earliest breakpoint.

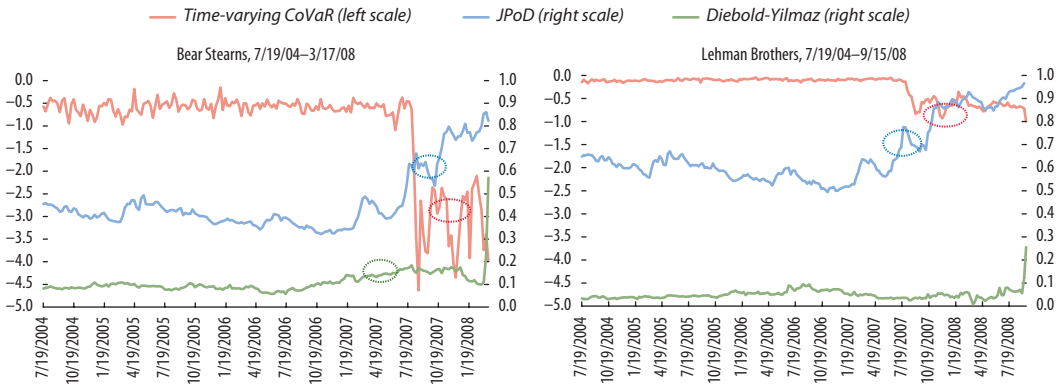
[7]See Schwaab, Koopman, and Lucas (2011) for a discussion of different purposes of high-frequency indicators.

[8]Bear Stearns was sold to JPMorgan Chase, and Lehman Brothers was placed into bankruptcy.

[9]The JPoD, for instance, shows a trend decline in interconnections before 2007 for the two failed institutions.

Box 3.3 *(continued)*

Interconnectedness: Contribution to Systemic Risk of Two Failed Institutions



Source: IMF staff estimates.

Note: See text for explanations of the indicators. The time-varying conditional Value at Risk (CoVaR) for each of the institutions denotes the VaR of the financial system conditional on the VaR of each of the institutions falling from its median to the lowest 5th percentile of returns (in percent). The joint probability of default (JPoD) for each institution denotes the probability (in percent) that at least one other institution defaults when the subject institution defaults. The Diebold-Yilmaz for each institution denotes the contribution of each institution's spillover risks to all other institutions as a fraction of all outward spillovers of all institutions. The circles denote the turning points in the levels of the indicators.

spread could be used effectively in a large set of countries.

- No market-based indicator tested here serves to alert policymakers to rising interconnectedness in the financial system, probably because the transparency and disclosure of information on interconnectedness is currently insufficient.

Macroprudential Indicators and Policies: Stitching Them Together

After identifying the buildup of systemic risk, authorities need policies well suited to deal with the problem. Ideally, the policies would reduce financial risk taking—so as to limit the buildup in the identified financial imbalances—and accumulate buffers to be drawn down during crisis. As the policy would aim at reducing the procyclicality of banks' risk taking, that is, reduce the financial sector's exposure to systemic risk, it would be implemented over and above microprudential requirements.[35]

Many countries, especially emerging economies, have experimented with various policy tools to manage systemic risk.[36] Some policies have indeed been effective in lowering the sensitivity of real GDP growth to financial aggregates, like credit growth and leverage. For instance, lending caps based on loan-to-value (LTV) ratios and the debt service-to-income ratio and direct limits on credit growth have worked to reduce procyclicality. Dynamic provisioning—setting aside loan-loss provisions at the beginning of the risk-taking cycle to be drawn when the cycle takes a downturn—has worked to reduce the procyclicality of both credit and leverage. In contrast, instruments like countercyclical capital requirements to build buffers are untested. Yet, capitalization was identified as an indicator that would persistently decline in response to the perverse shocks discussed previously and could be used as a buffer.

The structural model introduced above is invoked below, in two cases, to illustrate the effectiveness of

[35]See IMF (2011b).

[36]Box 3.4; Lim and others (forthcoming); Terrier and others (2011).

macroprudential policies using countercyclical capital buffers as an example. As will become clear in the discussion, proper application of macroprudential instruments could prevent crises and reduce the volatility of financial and real variables in the long run, a desirable outcome. The buffer-building stage could be informed by credit aggregates, possibly the broad credit-to-GDP ratio, and other indicators like asset price growth, leverage, and real exchange rate changes, as noted above. The drawdown stage could be informed by sudden changes in indicators that combine information on the yield curve and the LIBOR-OIS spread, for instance. However, the benefits have to be compared with the potential costs. For instance, macroprudential regulation could lower output and consumption growth and reduce financial intermediation in the medium term, considerably so if policymakers do not understand the source of the financial and real imbalances in the economy.

The objective of the macroprudential policy sought here is to reduce a severe disruption in financial services and output losses by containing the cycles in financial risk.[37] Instead of the traditional welfare analysis, in which welfare improves with consumer utility, the analysis here seeks to minimize the *cumulative* sum of squared deviations from the baseline in output, inflation, consumption, and credit following a crisis. As an illustration, the model assumes that the underlying movements in key variables are generated by an asset-price bubble, but it can also be used to combine two or more shocks to mimic real-world events.

Could this same macroprudential tool—countercyclical capital buffers—be effective for different types of economies? As an illustration, the exercise now considers two different economies: one with a fully flexible exchange rate and another with a managed exchange rate.

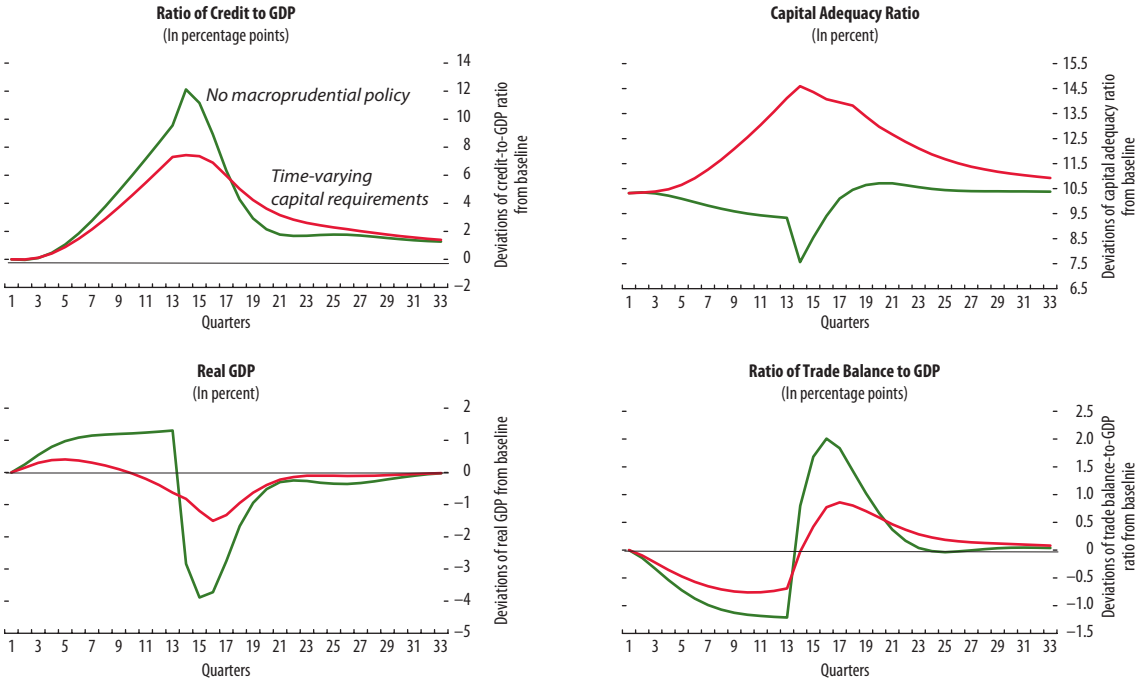
In the case of flexible exchange rates, the model shows that time-varying capital requirements are successful in dampening the credit cycle and in building buffers (Figure 3.6). For comparison, the time path of each variable is computed when capital requirements are fixed as well as when they are time varying. In either case, monetary policy operates in a flexible exchange rate regime. The fixed capital requirements and monetary policy are not enough to dampen the boom-bust asset-price cycle, mainly because these policies are not sufficient to prevent the procyclicality of capital and credit. The introduction of the countercyclical capital buffers dampens both the real and financial cycles and reduces the adverse impact of the crisis on the level of real GDP. In the model, raising capital is very costly for banks, so they pass on the higher cost of the macroprudential capital requirement by raising lending rates (by a "regulatory" spread). The dampening occurs both through reduced risk taking (the application of the regulatory lending spread) and the creation of a buffer for the crisis.[38] Furthermore, the long-run volatilities of consumption, output, inflation, and credit are reduced due to dynamic capital requirements (denoted by a proactive capital requirement and then by a more aggressive capital requirement, as illustrated in Table 3.3).

The model could also be used to illustrate the economic cost of not understanding the source of real and financial cycles. In general, the cost of misidentifying the shocks could be very high. For instance, the economy may be going through a healthy productivity rise; if policymakers mistake it for an asset-price boom and impose time-varying capital requirements, they could significantly dampen the level of output for a prolonged period (Figure 3.7). Hence, it would be useful to look at developments in productivity growth, in the tradables sector for instance, to judge whether the observed cycles in the real and financial sectors could be a macroprudential concern. This is an instance in which macroprudential

[37]See IMF (2011b). Monetary policy, with a separate objective and policy tool, is characterized by a simple inflation-targeting rule in a flexible exchange rate regime. Banks are subject to fixed microprudential capital requirements to address idiosyncratic credit risk. The macroprudential policy requirements are added due to concerns about banks' exposure to aggregate risk. Even though the risk could be addressed by containing the cycles of financial risk and addressing the interconnectedness of financial institutions, only the former is taken up in this section, as interconnectedness has not yet been introduced in the structural model.

[38]Banks do not expand credit as much during the boom phase because they fear they might not be able to satisfy the higher requirements when they are confronted with a future reversal. Hence, leverage is endogenously less procyclical in the model.

Figure 3.6. Effects of Macroprudential Policy: Time-Varying Capital Requirements for an Asset-Price Shock



Source: IMF staff estimates.

Note: Time-varying capital requirements are designed as a rule that depends upon the growth in the credit-to-GDP ratio. "No macroprudential policy" includes fixed microprudential capital requirements. The baseline assumes no shock and no macroprudential policy.

Table 3.3. Long-Run Steady-State Volatilities, by Type of Capital Requirement

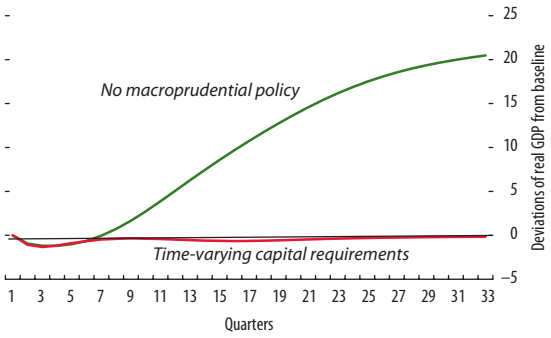
	Fixed (Microprudential)	Countercyclical (Mild)	Countercyclical (Aggressive)
Consumption	1.00	0.80	0.59
GDP	0.56	0.44	0.32
Inflation	0.25	0.20	0.16
Real credit	1.74	1.44	1.13

Source: IMF staff estimates.

Note: The long-run (asymptotic, steady-state) volatility implied by the occurrence of the asset price bubble shock is calculated above. The size of the shock is normalized so that the implied contribution to the standard deviations in real consumption is 1 percent. The table then shows the reductions in the implied standard deviations for four variables with different types of capital requirement policies.

Figure 3.7. Effects of Productivity Shock and Time-Varying Capital Requirements on Real GDP

(In percent)



Source: IMF staff estimates.

Note: See note to Figure 3.6.

and monetary policymakers could coordinate to form an informed view of the source of shocks.[39]

A parallel analysis of a fixed exchange rate economy shows that the qualitative impact of the macroprudential tool is virtually identical to that in the case of a flexible exchange rate economy. Hence, properly designed time-varying capital requirements for banks can help mitigate financial cycles for economies with different exchange rate regimes. Indeed, actual country practices show that the effectiveness of macroprudential tools in reducing procyclicality is not influenced by differences in economic structures—degree of economic development, the exchange rate regime, or the size of the financial sector (Box 3.4).

However, one of the lessons from the analysis based on the structural model was that the combination of fixed exchange rates and widespread foreign currency lending could amplify the boom-bust cycles created by the shocks. Fixed exchange rates tend to reduce the perception of exchange rate risks in the buildup stage, which encourages both banks and households (without a natural hedge against exchange rate risks) to accumulate loans in foreign currency. Overall credit growth increases rapidly until the possibility of a change in exchange rate regime amplifies the effect of any crisis. This observation could be a reason for more aggressive capital requirements (see Table 3.3) or a macroprudential rule based on growth in foreign currency lending, for instance, and provides an added reason in such economies for close coordination between macroprudential and exchange rate policies.

Key results:

- Combining empirical analysis with insights from a structural model can aid macroprudential policymakers in calibrating their macroprudential tools properly.
- Countercyclical capital buffers work to reduce risks of financial and economic disruptions.
- Knowledge of the type of shock is relevant to avoid the costly imposition of macroprudential tools when they are not warranted.
- The countercyclical capital buffer works across different exchange rate regimes.

Conclusions and Practical Guidelines

Operationalizing macroprudential policies is a multifaceted task, and the analysis here takes concrete steps along several paths to reach this goal. It uses a macroeconomic structural model with an explicitly embedded financial sector to explore how different indicators behave in response to various sources of shocks. Empirical exercises provide additional information on which variables are best for flagging the buildup of risk. Further, the analysis suggests a set of high-frequency indicators that could alert policymakers to imminent arrival of financial distress. The structural model also offers insights into how one popular macroprudential tool—countercyclical capital requirements—would work under different types of shocks and accounting for the financial linkages to the real side of the economy. The results yield the following set of practical guidelines.

Sources of shocks. Effective monitoring of systemic risk and effective policy responses depend critically on accurate identification of the sources of shocks. The chapter finds that the source of shocks drives movements in variables that are associated with systemic risk buildup. Differences in the financial structure of the economy change the magnitude of the effects of shocks but not their direction.

Credit and other aggregates. Among slow-moving indicators of the buildup of risk, credit aggregates are useful but need to be complemented by other indicators. Countries with a low level of credit might experience rapid credit growth and authorities may view it as a natural part of the development process, but credit growth that greatly exceeds economic growth would still be a signal of risk buildup particularly if some of the other indicators are signaling it as well.

[39]It can be argued that although the two policies, monetary and macroprudential, have different objectives and use different tools, their eventual impact on credit aggregates and on real economic cycles can be very similar, potentially reinforcing or offsetting each other. See Kannan, Rabanal, and Scott (2009a) on how welfare improves when a credit aggregate is included in the monetary policy rule; and Jácome and others (forthcoming) on institutional arrangements for macroprudential policies.

Box 3.4. An Empirical Analysis of the Effectiveness of Macroprudential Instruments

A number of countries employ macroprudential instruments to contain systemic risk. The effectiveness of 10 such instruments is examined here.

Through a panel regression analysis, we examine the effectiveness of 10 instruments on four types of risks considered systemic by country authorities.[1] These risks are associated with excessive: (i) credit growth, (ii) systemic liquidity, (iii) leverage, and (iv) size and volatility of capital flows.[2] The regression analysis examines whether the instruments limit the procyclicality of each of the risks—that is, the tendency of the risks to amplify the business cycle. The data for the regressions cover 49 countries, quarterly from 2000 to 2010, and were collected in the 2010 IMF survey on financial stability and macroprudential policy (IMF, 2011b).

Here are three key challenges in the data and the methods used to address them in the regressions:

- *Disentangling the effect of macroprudential instruments from those of other policies, especially monetary and fiscal policies.* Interest rates and real activity indicators (GDP growth) were used to control for the effects of macroeconomic policies.
- *Inferring the general effect of macroprudential instruments in the context of country-specific characteristics.* Dummy variables were used to control for the type of exchange rate regime, the size of the financial sector, and the degree of economic development. The fixed effect in the panel regression takes into account other unobserved country-specific characteristics.
- *Avoiding estimation biases to ensure a correct quantification of the effect of macroprudential instruments.* The regression employed system GMM (generalized method of moments), widely used for panel data with endogenous explanatory variables.

The regression results suggest that some macroprudential instruments reduce procyclicality, defined here as the correlation of systemic risk—credit growth, liquidity, leverage, and capital flows—with GDP growth. In particular, for credit and leverage growth, the results in the table show the following:

- Credit-related measures are generally effective in reducing procyclicality. Caps on the LTV ratio reduce the procyclicality of credit growth by 80 percent.[3] This is in line with findings of previous studies that associate higher LTV ratios with higher house price and credit growth over time.[4] Caps on the ratio of debt service to income (DTI) and limits on credit or credit growth have a similar effect. Caps on the DTI and credit growth also reduce the procyclicality of leverage.
- Liquidity-related measures also reduce procyclicality. Reserve requirements reduce the procyclicality of credit growth by close to 90 percent. The procyclicality of leverage is also reduced.
- Dynamic provisioning reduces the procyclicality of leverage and credit, but the effect of capital-related measures, i.e., countercyclical capital requirements and restrictions on profit distribution, is not obvious. The latter result may reflect the relatively limited use of those measures, and hence the limited number of observations for them, over the period.
- The estimated coefficients of the dummy variables representing the degree of economic development, the type of exchange regimes, and the size of the financial sector are all statistically insignificant.

Note: Prepared by Francesco Columba, Alejo Costa, and Cheng Hoon Lim, drawing on Lim and others (forthcoming).

[1]The 10 instruments are (i) maximum permissible loan-to-value ratio (LTV), (ii) a maximum permissible ratio of debt service to income (DTI), (iii) caps on foreign currency lending, (iv) ceilings on credit or credit growth, (v) limits on net open currency positions or on currency mismatch, (vi) limits on maturity mismatch, (vii) reserve requirements, (viii) countercyclical capital requirements, (ix) dynamic provisioning, and (x) restrictions on profit distribution.

[2]Credit is defined as the change in the inflation-adjusted claims on the private sector by banking and other financial institutions; liquidity is the ratio of liquid assets to short-term liabilities; leverage is assets as a fraction of equity for banking and other financial institutions; and size and volatility of capital flows are measured as the growth rates and volatility of the "other" category in the balance of payments statistics, which mainly captures bank flows.

[3]The coefficient of GDP growth is 0.079, and the coefficient of the cap on the LTV ratio is –0.063 (first column, upper half of table). For every 1 percent increase in GDP growth, credit growth increases by 0.08 percent, but it is offset by 0.06 percent when an LTV cap is introduced, leaving a net effect of 0.02 percent.

[4]See, for instance, IMF (2011c).

Box 3.4 *(continued)*

Overall, 5 of the 10 instruments reduce the correlation between credit growth and GDP growth, and 4 instruments reduce the correlation between leverage and GDP growth. The results were not affected by differences in the degree of economic development, the exchange rate regime or the size of the financial sector, suggesting that, while these factors may influence the choice of macroprudential instruments, the instruments can be effectively used by any country.

The results are promising, but longer time series and better data are needed to confirm them and to evaluate an instrument's effectiveness in specific countries. Indeed, reducing procyclicality does not ensure a directly proportional reduction in financial distress. Moreover, since regulatory and cross-border arbitrage can easily dilute the effectiveness of macroprudential policy, these factors should be taken into account in future analyses.

Effectiveness of Macroprudential Instruments in Reducing Procyclicality

Real Credit Gowth					
Independent Variables	Dependent Variable:[1] Quarterly Credit Growth Rate$_t$				
Quarterly credit growth rate$_{t-1}$	0.082	0.091	0.103	0.082	0.086
	(8.19)***	(15.16)***	(30.07)***	(33.60)***	(2.81)***
GDP growth$_t$	0.079	0.089	0.067	0.087	0.073
	(5.89)***	(10.44)***	(9.39)***	(6.17)***	(5.47)***
Interest rate$_t$	-0.078	-0.080	n.a.[2]	-0.084	-0.062
	(-11.35)***	(-10.48)***		(-19.74)***	(-10.07)***
Caps on loan-to-value ratio[3] × GDP growth$_t$	-0.063				
	(-3.01)**				
Caps on debt-to-income ratio[3] × GDP growth$_t$		-0.098			
		(-4.96)***			
Limits on credit growth[3] × GDP growth$_t$			-0.123		
			(-4.17)***		
Reserve requirements[3] × GDP growth$_t$				-0.080	
				(-4.27)***	
Dynamic provisioning[3] × GDP growth$_t$					-0.178
					(-2.12)**
Leverage Growth					
Independent Variables	Dependent Variable:[1] Quarterly Leverage Growth Rate$_t$				
Quarterly leverage growth rate$_{t-1}$	0.001	-0.012	-0.010	-0.017	-0.017
	(0.12)	(-2.88)***	(-1.62)	(-5.35)***	(-0.73)
GDP growth$_t$	0.035	0.042	0.039	0.088	0.032
	(2.58)**	(5.43)***	(7.15)***	(4.81)***	(4.36)***
Interest rate$_t$	0.059	0.112	0.143	0.136	0.096
	(0.94)	(3.22)***	(5.43)	(4.31)***	(3.09)**
Caps on loan-to-value ratio[3] × GDP growth$_t$	-0.012				
	(-0.44)				
Caps on debt-to-income ratio[3] × GDP growth$_t$		-0.041			
		(-3.35)***			
Limits on credit growth[3] × GDP growth$_t$			-0.032		
			(-1.82)*		
Reserve requirements[3] × GDP growth$_t$				-0.096	
				(-3.44)***	
Dynamic provisioning[3] × GDP growth$_t$					-0.274
					(-4.78)***

Sources: IMF, International Financial Statistics database; and staff estimates.

Note: ***, **, * indicate statistical significance at 1 percent, 5 percent, and 10 percent (two-tail) test levels, respectively.

[1]The dependent variable is (the log change in) real credit growth (top panel) or leverage growth (bottom panel). The interest rate is the nominal long-term interest rate on prime lending, from the IMF's *International Financial Statistics*. The regression includes dummy variables to control for different degrees of flexibility in the exchange rate regime, individual (country) effects, a time trend (year effect), and a dummy variable for the use of other macroprudential policy instruments. Instrumental variables for the policy instrument and the GMM Arellano-Bond estimator are used to address selection bias and endogeneity.

[2]Nonsignificant results when interest rate included.

[3]The coefficient corresponds to the interaction term between GDP growth and a dummy for the respective macroprudential instrument.

- The structural model suggests that even though credit increases in all three constructed scenarios—anticipation of productivity growth, lax lending standards, and asset-price bubbles—the amount of the increase and the persistence of the increase in credit and the decline in capital adequacy ratio are significantly higher in the case of asset price bubbles and lax lending standards.
- The empirical analyses suggest that credit growth, when accompanied by asset price growth, form powerful signals of a developing crisis within the following two years and are good leading indicators. Conditional on credit growing by more than 5 percentage points of GDP, an increase in equity prices of 15 percent or more is sufficient to push crisis probability to 20 percent within two years.
- Among credit aggregates, credit-to-GDP growth and the credit-to-GDP gap perform equally well in panel regressions to signal a risk buildup. The gap is better at predicting crises within one year, while the growth is better at a two-year horizon.

Thresholds. When considering thresholds for various credit aggregates and the timing of preventive policy actions, policymakers need to bear in mind the characteristics of their specific country. For instance:

- In the case of most countries, annual growth of credit-to-GDP is relatively easy to measure and track. For instance, a threshold of 5 percentage points for credit-to-GDP growth works reasonably well in signaling a crisis: it reduces the chances of missing a crisis while lowering the chances of issuing a false signal. For countries with low levels of the credit-to-GDP ratio, a slightly higher threshold might be applicable, although attention to country-specific circumstances would be important to consider.
- Setting a threshold of 5 percentage points of GDP on a broader measure of credit growth—that includes both bank and cross-border loans to the nonbank private sector—could signal a risk buildup even better. However, analysis of this indicator across countries is hampered by severe data constraints. This weakness points to the importance of collecting consistent cross-border credit information.
- Applying thresholds to the measure of credit-to-GDP gap is complicated and those countries and thresholds for which this measure was analyzed miss most crises.
- Interactions with other variables also matter. The probability of a crisis increases when other indicators—such as asset price growth, foreign liabilities of the economy, and real effective exchange rate—increase as well (as reported in the discussions of the structural model and empirical analyses). In the context of emerging economies, real exchange rate appreciation appears to be a particularly relevant factor.

Near-coincident indicators. Policymakers should also examine high-frequency indicators to prepare for the potential near-term materialization of a crisis and the possible release of built-up buffers.

- Among such indicators, this chapter finds that a time-varying version of the CoVaR using U.S. institutions performed best in predicting materialization of financial system stress in the United States during the last crisis. Since this indicator was constructed using the LIBOR-OIS spread and the yield curve, a combination of these two variables may be a good indicator of potential materialization of stress for countries for which they are available.
- Policymakers may have to rely on actual information on cross-institutional exposures to assess the potential for domino effects if a crisis were to materialize. The chapter is unable to find any market-based, high-frequency indicators that adequately signal a buildup of interconnectedness of the system. Enhancing transparency and disclosure requirements (for instance, by requiring OTC derivative trades to clear through central counterparties) could enhance market discipline and lower uncertainty about counterparty risks during a crisis, naturally mitigating domino effects.[40]

Universal use. Some elements of the structure of the real economy are less important than the source of shocks for choosing variables that signal crises and for determining the effectiveness of macroprudential policies. Thus, policymakers should devote resources and coordinate with each other to better understand the sources of shocks. The set of macroprudential tools can be relatively homogeneous across different economies, which should help to facilitate policy

[40]See IMF (2010c).

coordination at the international level. However, the *calibration* of policy instruments—especially those based on thresholds for different indicators—differ according to country-specific circumstances.

Managed exchange rate regimes. Even though the signaling variables and tools may be similar across most economies, certain exchange rate regimes together with some financial sector characteristics are shown to amplify the transmission mechanisms of all shocks. Managed exchange rates and the use of loans denominated in foreign currency are such specific characteristics. Thus, close coordination of exchange rate, monetary, and macroprudential policies is essential to achieve a more stable financial sector and real economy.

In conclusion, operationalizing macroprudential policies means progressing on a number of fronts: monitoring risk buildup, detecting when risks have materialized, and applying macroprudential policy tools to minimize the risks. The insights from the modeling and empirical work here advance our understanding of each of the interrelated tasks in the still-nascent area of macroprudential policymaking.

Annex 3.1. Description of the Structural Model[1]

The dynamic stochastic general equilibrium (DSGE) model used for the policy simulation experiments in the chapter is further described here. The behavior of individual agents in the model is derived from explicit optimizing problems, while the aggregate outcomes arise as a result of general equilibrium conditions assumed to prevail at all times.

The novel feature of the model is a fully endogenous feedback loop between a real economy and a financial (or more specifically, commercial banking) sector. The framework is designed to address the time dimension of systemic risk that is related to the exposure of all banks to the aggregate (credit) risk from procyclicality.

The feedback loop builds upon the following elements: (i) banks act as agents with their own net worth; (ii) bank loans are introduced whereby the loan value (credit risk) contains both idiosyncratic (diversifiable) and aggregate (nondiversifiable) components of risk, and loans cannot be renegotiated by the borrower after the shocks have occurred; (iii) aggregate risk associated with bank loans is derived from the value of underlying collateral assets; (iv) prudential capital regulation, at both the micro and macro levels, is introduced as an incentive-based mechanism; and (v) market rigidities that apply to equity (or bank capital) make *instantaneous* market recapitalization prohibitively expensive.

Real Sector

The real sector mimics a standard small open-economy DSGE model with sufficient short- and medium-term imperfections (rigidities, adjustment costs, etc.) to generate realistic business-cycle dynamics. Some of the most important characteristics of the real sector are listed below:

- One *production* function, but two separate markets: goods distributed locally and goods sold internationally. Local households and nonfinancial firms purchase locally produced final goods and directly imported final goods. Local goods are produced using three input factors: labor, capital, and intermediate imports.
- *Exports* are assembled by combining local value added with re-exports in fixed proportion. Export assembly has its own productivity process in addition to the overall total factor productivity introduced in the domestic production function. Adjustments to export production (in response, for instance, to terms-of-trade shocks) are costly and hence distributed over time. The terms of trade (the price of exports divided by the price of imports) are exogenous.
- The model structure is capable of encompassing a relatively large range of *different types of open economies*. For instance, the expenditure switching effects and the sensitivity of the real sector, including imports and exports, to exchange rate movements can be modified by changes in a number of structural parameters.
- *Households* play two roles. They act as consumers and investors and supply labor. Each investor makes two joint decisions: purchasing productive capital and acquiring bank loans. The investor uses his or her capital to collateralize the loan; the return on capital has an idiosyncratic component making the investors heterogeneous ex ante. The fact that the model considers only physical capital and no other types of assets (such as housing, stocks, etc.) is immaterial for the results: the main conclusions and policy implications would remain unaffected.

Banks

Banks make two types of decisions: asset related—providing loans to nonfinancial individuals—and liability related—choosing the optimal proportion of bank capital. To keep the problem tractable, the two decisions are made by two separate "branches" of the bank: a retail lending branch and a wholesale finance branch. Each branch takes the other's behavior as given; in other words, they do not internalize the other's reaction function.

Asset Decisions

Bank loans are noncontingent in that the lending rate is agreed upon at the beginning and cannot be subsequently adjusted in response to ex post shocks;

[1]Prepared by Jaromír Beneš.

noncontingent contracts are used, for instance, by Cúrdia (2007). Bank lending is subject to a financial friction (limited enforcement), which gives the borrower an incentive to default and let the lender seize the collateral.[2] The implications of this limited enforcement setup are very similar to those in the "costly state verification model" of Bernanke, Gertler, and Gilchrist (1999). Here, however, the assumptions are kept deliberately simpler to make the model and its parameterization more tractable in practical application.

As a result of the financial frictions, bank lending is risky, and the credit risk has both idiosyncratic (diversifiable) and aggregate (nondiversifiable) components. Each risk-neutral retail branch specifies a lending supply curve by equating the expected return on a loan with the marginal cost (or opportunity cost) of lending determined by the wholesale branch. The lending supply curve is characterized so that the amount loaned is positively related to the price of capital available to collateralize the loan.

Formally, the optimal contract between the bank and each individual household member maximizes the expected utility of the household as a whole subject to a participation constraint of the bank. Expressing only the relevant terms, an individual loan, L^i, the corresponding lending rate R^i_L, and the amount of productive capital, K^i, are chosen to maximize:[3]

$$\mathrm{E}_t\Big\{L^i_t - P_{K,t}K^i_t + \frac{\beta\Lambda_{t+1}}{\Lambda_t}\left[-R^i_{L,t}L^i_t + R^i_{K,t+1}P_{K,t}K^i_t\right] + \Phi^i_t\left[R^i_{L,t}L^i_t\left(1 - vF_i(\bar{R}^i_{K,t})\right) - \bar{R}_{A,t}L^i_t\right]\Big\}$$

where v is the loss given default, and F_i is the cumulative distribution function for the individual return on capital (see below). The price of capital, P_K, the shadow value of wealth of the household as a whole, Λ, and the opportunity cost, $\bar{R}_A$, are taken as given. Furthermore, the cutoff return on capital, $\bar{R}^i_K$, is given by

$$\bar{R}^i_{K,t} = \frac{R^i_{L,t}L^i_t}{P_{K,t}K^i_t} = R^i_{L,t}l^i_t$$

where l^i_t denotes the loan-to-value (LTV) ratio.

The retail branch extends loans to a large number of individuals to diversify away the idiosyncratic component of credit risk. The bank still remains exposed to the aggregate component of the risk. This makes the distribution of the return on an individual loan different from the distribution of the return on a whole portfolio of loans, and the actual ex post return on loans possibly different from its ex ante expectations. The distribution of the return on bank assets derives, in general, from the characteristics of the aggregate return on productive capital used as collateral.

Formally, the distribution of the individual return on capital is modeled as a multiplicative mean-preserving spread over the aggregate return on capital.

$$R^i_{K,t+1} = R_{K,t+1}\rho_{t+1}$$
$$R^i_{K,t+1} \sim F_i$$
$$R_{K,t+1} \sim F_R$$
$$\rho_{t+1} \sim F_\rho$$

where R^i_K is the individual return on capital with distribution F_i; R_K is the aggregate component of the return on capital with distribution F_R; and ρ is the idiosyncratic component with distribution F_ρ.

The idiosyncratic component is independent of the aggregate component and is centered around 1. The aggregate component is implied endogenously by the model. When choosing its debt liabilities (deposits and foreign borrowing) and equity liabilities (bank capital), the wholesale branch is constrained by capital regulation. As in Milne (2002), the capital regulation applies to the ex post values of bank assets and liabilities and specifies a penalty for banks whose capital adequacy ratio falls below a prescribed minimum:

$$NW_t < \tau_t AA_t \Rightarrow -vL_{t-1}$$
$$AA_t = R_{A,t}L_{t-1}$$
$$NW_t = R_{A,t}L_{t-1} - R_{F,t-1}F_{t-1}$$

where NW is the ex post net worth of the bank, AA is the ex post value of its assets, R_A is the actual

[2]In that case, the bank can pay a collection cost to make the defaulted borrower repay the loan in full; the probability that the bank succeeds is set to a number arbitrarily close to 1.

[3]The terms related to a situation in which the household member succeeds in walking away from the loan are dropped; the probability of such an outcome is set to a numerically negligible value.

return on bank assets, τ is the (possibly time-varying) regulatory capital minimum, and υ is the penalty as a percentage of the bank's assets.

Liability Decisions

Acquisition of bank capital is subject to two constraints. First, it is prohibitively costly for banks to issue new equity within the regulatory evaluation period after the true gains or losses are realized. Second, there are convex costs of acquiring new capital between every two periods, as in Estrella (2004)—the cost of capital becomes more than proportionately expensive in the second period. The high cost of capital makes retained earnings an important source of net worth. The costs are symmetric in that they also affect banks' dividend policies.

Putting the two above assumptions together, one can formally write the bank's optimal liability choice as follows. Choose the amount of loans, L, the amount of bank capital (or equity), E, and the amount of bank's funding liability (deposits, foreign funds), D, to maximize the expected payoff to the shareholders subject to the balance sheet identity that loans need to be equal to capital plus funding:

$$\max \left\{ \mathrm{E}_t \left[R_{A,t+1} L_t - R_{F,t} D_t - v L_t F_A(\tilde{R}_{A,t}) - \frac{\xi}{2} \mathrm{E}_t (\log E_t - \log \bar{E}_t)^2 \right] \right\}$$

subject to

$$L_t = E_t + D_t$$

where R_A is the return on bank assets and F_A is the distribution of this return on assets. The cutoff return on the bank's assets (that is, the portfolio of diversified loans), $\tilde{R}_A$, is given by

$$\tilde{R}_{A,t} = R_{F,t} \frac{1 - e_t}{1 - \tau_t}$$

where e_t represents the capital-to-loan ratio at time t

$$e_t = \frac{E_t}{L_t}$$

and the reference level of bank capital, $\bar{E}$, is set to retained earnings from the previous period, that is, the previous level of bank capital times the current gross return on equity:

$$\bar{E}_t = R_{E,t} E_{t-1}$$

In the simulations, the equity issuance parameter is set to infinity so that new capital can be acquired only through retained earnings.

Furthermore, the distribution of the portfolio of loans can be derived endogenously from the distribution of the aggregate return on capital (that is, on the collateralizing asset). For each cutoff return on assets there is a unique corresponding aggregate return on capital; the two are linked through the following relationship:

$$\tilde{R}_A = R_{L,t} \left[1 - v F_i \left(\frac{R_{L,t}}{\tilde{R}_{K,t}} l_t \right) \right]$$

Since each bank's return on its loan portfolio is uncertain, the optimal choice of capital gives rise to an endogenous and time-varying capital buffer in excess of the regulatory minimum. Also, the wholesale branch specifies a marginal cost of lending taken as given by the retail branch. The marginal cost is, in general, driven by the cost of bank liabilities, by the distance to regulatory minimum, and by the characteristics of the distribution of uncertainty associated with the bank's assets.

Monetary and Prudential Policies

In the simulations, monetary policy is characterized by a simple inflation-targeting rule and a flexible exchange rate. Some of the experiments also show the outcomes for economies with considerable financial dollarization. In those instances, the nominal exchange rate is included as a tool of defense against adverse balance sheet effects of the private sector that could, in turn, increase credit risk in banks.[4]

Bank capital is subject to fixed microprudential capital requirements. Furthermore, macroprudential capital requirements are also used in some of the experiments. The macroprudential requirements are

[4]Such a policy is not termed a managed exchange rate regime because it is typically implemented through sterilized interventions.

added as a surcharge on top of the microprudential ones and follow a time-varying rule based on changes in the credit-to-GDP ratio.

Parameterizing the Model

In the baseline calibration of the model, we considered several aspects and stylized facts of a number of small, open, emerging market economies in Europe, Latin America, and Asia. We arrived at four basic groups of parameters: steady-state, transitory, policy, and financial. The steady-state parameters were calibrated with various long-run structural indicators such as average export and import shares of GDP, the net investment position, the net foreign asset position of the banking sector alone, employment in the exporting industries, composition of tradables and nontradables in final prices, and so on. The transitory parameters were set to produce plausible dynamic responses, especially to match existing empirical evidence on the exchange rate pass-through into final prices and the cyclicality of demand components. The policy parameters were chosen to guarantee realistic policy trade-offs (measured by indicators such as sacrifice ratio or the costs of temporarily inactive policy).

The calibration of the financial sector, in particular the various aspects of the distribution of risks, was largely based on a heuristic method: finding sensible thresholds at which the built-in nonlinearities become influential in the interactions between real economic activity and the bank balance sheets. However, the techniques of empirical validation for such financial characteristics in models with macroeconomic-financial linkages are in their infancy. Therefore, the model simulations presented in the main text should be considered more as thinking devices rather than empirically accurate predictions.

Annex. 3.2. Predicting the Probability of a Banking Crisis[1]

The probability of a banking crisis, presented in the main text, was estimated with the following methodology (for details, see Lund-Jensen, forthcoming). In the empirical analysis, the probability of a banking crisis is a function of a vector of systemic risk indicators. The relationship can be approximated by a probit panel data model with country fixed effects:

$$Pr(y_{i,t}=1|\mathbf{x}_{i,t-h}) = \Phi(\alpha_i + \mathbf{x}_{i,t-h}\boldsymbol{\theta}) \quad (1)$$

where $y_{i,t}$ denotes a binary banking crisis variable; $\mathbf{x}_{i,t-h}$ is a row vector of indicator variables; α_i denotes the fixed effect for country i; Φ is the cumulative distribution function of a standard normal distribution; and $\boldsymbol{\theta}$ is a column vector of unknown parameters to be estimated. Note that all the indicator variables are known at time $t-h$. This analysis considers forecast horizons at one, two, and three years.

We adopt the Laeven and Valencia (2010) definition under which a banking crisis is systemic if two conditions are present: (i) significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and bank liquidations); and (ii) significant banking policy interventions in response to significant losses in the banking system. See Laeven and Valencia (2010) for more details.

The use of the probit framework implies that the marginal effect—the effect on the crisis probability due to an incremental increase in an indicator variable—is nonlinear and depends on the value of the fixed structure of the economy, α_i, and the level of the indicator variables. For example, the marginal effect of an incremental increase in $x_{ij,t-h}$ (an element of $\mathbf{x}_{i,t-h}$) can be described as:

$$\partial Pr(y_{i,t}=1|\mathbf{x}_{i,t-h})/\,\partial x_{ij,t-h} = \varphi(\alpha_i + \mathbf{x}_{i,t-h}\boldsymbol{\theta})\theta_j \quad (2)$$

where φ denotes the probability density function of a standard normal distribution. The marginal effect is allowed to vary by country via the fixed effect, the α_i. The fixed effects denote the time-invariant characteristics that affect crisis probability in a country. Countries with fixed effects higher (lower) than the 80th (20th) percentile of all fixed effects are termed *high risk (low risk)*.

The probabilities of a banking crisis based on the yearly change in the credit-to-GDP (CtG) ratio and the gap between the CtG ratio and its trend are estimated on a model specification with a single indicator variable using an unbalanced panel of 94 countries for the period 1975–2010 (Table 3.4). Both credit measures have a significant positive influence on the probability of a systemic banking crisis at a one- to two-year forecast horizon. For a high-risk country, evaluated at the median value of the indicator variable, a 1 percentage point increase in the CtG gap will increase the probability of a systemic banking crisis by 0.34 percentage point in the following year and by 0.24 percentage point the year after. Similarly, a 1 percentage point change in the year-on-year CtG growth will increase the probability of a systemic banking crisis by 0.23 percentage point in the following year and 0.24 percentage point the year after.

The marginal effect of the annual change in the CtG ratio at a two-year forecast horizon for different growth levels has been estimated (Figure 3.8) by implementing equation (2) using the estimate from Table 3.4 and $\theta = 1.69$. The marginal effects (ME) are calculated as follows:

$$ME_{high\ risk} = \varphi(\alpha_{high\ risk} + \Delta CtG_{t-2}*1.69)*1.69 \quad (3a)$$

$$ME_{low\ risk} = \varphi(\alpha_{low\ risk} + \Delta CtG_{t-2}*1.69)*1.69 \quad (3b)$$

where $\alpha_{high\ risk} = -1.44$ and $\alpha_{low\ risk} = -1.91$ are the 80th and 20th percentile country fixed effects, respectively. It is clear that the model structure implies that there is a positive relationship between the marginal effect and the level of CtG growth. For example, when the change in the CtG ratio is at its 95th percentile level, the marginal effect is 0.30 percentage point for a high-risk country rather than 0.24 percentage point at the 50th percentile.

Estimated model specifications were obtained for interactions of credit aggregates with other indicator variables, including for the change in the CtG ratio with the change in equity prices (Table 3.5).[2] That estimation is based on an unbalanced panel of 36

[1]Prepared by Kasper Lund-Jensen.

[2]This model specification corresponds to $\mathbf{x}_{i,t-h} = (\Delta CtG_{i,t-h}, \Delta \ln(\text{equity price})_{i,t-h})$ and $\boldsymbol{\theta} = (\theta_1, \theta_2)^T$ in equation (1).

Table 3.4. Determinants of Systemic Banking Crises: Single-Indicator Probit Model

Change in Credit-to-GDP Ratio
(In percentage points)

Lag length (in years)	Coefficient Estimate (θ)	*t*-Statistic	Marginal Effect (high risk)*	Marginal Effect (low risk)**	Median Credit-to-GDP Growth
1	1.42	2.29	0.23	0.09	0.62
2	1.69	2.14	0.24	0.11	0.61
3	1.04	1.37	0.18	0.07	0.56

Credit-to-GDP Gap
(In percentage points)

Lag length (in years)	Coefficient Estimate (θ)	*t*-Statistic	Marginal Effect (high risk)*	Marginal Effect (low risk)**	Median Credit-to-GDP Gap
1	2.01	2.36	0.34	0.13	0.33
2	1.27	1.48	0.24	0.08	0.24
3	0.09	0.11	0.02	0.01	0.16

Source: IMF staff estimates.

Note: The dependent variable is a binary systemic banking crises variable from Laeven and Valencia (2010). The data are from an unbalanced annual panel for the period 1975–2010. The model parameters are estimated using country fixed effects for 94 countries. Models with different lags are estimated using the same data sample. The marginal effects (ME) are evaluated at the median value of the explanatory variable in the last column. The change in the credit-to-GDP ratio is calculated as follows: $\Delta CtG_t = CtG_t - CtG_{t-1}$.The credit-to-GDP gap is estimated using a single-sided Hodrick-Prescott filter with a smoothing parameter of 100 and five initial observations. Model specification: $Prob(Banking\ Crisis_{i,t=1}|x_{i,t-h}) = \theta(\alpha_i + \theta^* x_{i,t-h})$.

* A high-risk country is defined as the 80th percentile country fixed effect.

** A low-risk country is defined as the 20th percentile country fixed effect.

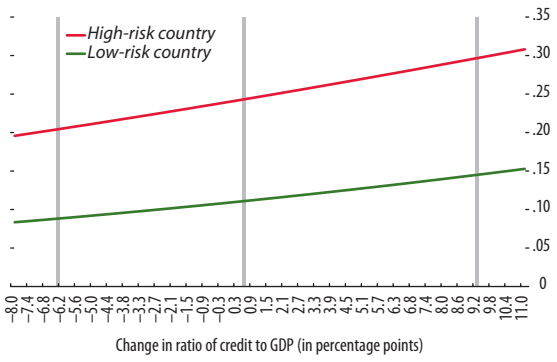
countries for the period 1975–2010. The change in the CtG ratio was found to have a significant positive impact on the crisis probability at all three forecast horizons. At a two-year horizon, the growth in equity prices also has a significant positive impact on the crisis probability. Based on this model specification, the crisis probability at a two-year horizon can be estimated as:

$$\Phi(\alpha_{high\ risk} + \Delta CtG_{t-2}*3.64 + \Delta \ln(\text{equity price})_{t-2}*0.67) \quad (4)$$

where $\alpha_{high\ risk} = -1.26$ denotes the 80th percentile country fixed effect. The predicted crisis probabilities for different values of change in equity prices and the CtG ratio are illustrated in Figure 3.4 in the main text.

The United States experienced two systemic banking crises during the 1975–2009 period according to Laeven and Valencia (2010): one beginning in 1988 and the other in 2007. Figure 3.5 in the main text depicts the out-of-sample

Figure 3.8. Marginal Effect on Probability of Crisis of Change in Ratio of Credit to GDP
(In percentage points)



Source: IMF staff estimates.

Note: Effect with a two-year lag. The parameters are estimated using a fixed-effect probit panel model with a single predictor (see Table 3.4 for details). The estimation is based on an unbalanced annual panel of 94 countries for the period 1975–2010. A high-risk country is defined as the 80th percentile country fixed effect; a low-risk country is defined as the 20th percentile country fixed effect. The vertical lines illustrate the 5th, 50th, and 95th percentiles of growth in the credit-to-GDP ratio in the sample.

forecast of the U.S. crisis probability for the period 2001–09. The forecasts were constructed by estimating a single indicator probit model with country fixed effects for 1975–2000 based on the CtG gap and the change in the CtG ratio.[3] The results were similar to the estimation based on the entire sample, 1975–2010, in Table 3.4. Both indicators were again found to have a positive significant impact on the crisis probability at a one-year forecast horizon. The out-of-sample forecasts were simply constructed as follows:

$$Pr(y_{US,t}=1|\mathbf{x}_{i,t-1}) = \Phi(\alpha_{US} + x_{US,t}*\theta_{2000}), \quad (5)$$
$$t = 2001, \ldots, 2009$$

where θ_{2000} denotes the parameter estimate based on the 1975–2000 sample.

[3]The change in the CtG ratio has a significant impact on the crisis probability at both a one- and two-year forecast horizon (Table 3.5). To incorporate information from both lags, the change in the CtG ratio was defined in the forecasting exercise as $\Delta CtG_t = (CtG_t - CtG_{t-2})/2$.

Table 3.5. Determinants of Systemic Banking Crises: Two-Indicator Probit Model

Change in Credit-to-GDP Ratio
(In percentage points)

Lag (length in years)	Coefficient Estimate (θ_1)	*t*-Statistic	Marginal Effect (high risk)*	Marginal Effect (low risk)**	Median Credit-to-GDP Growth
1	5.28	2.61	1.06	0.35	1.9
2	3.64	1.92	0.78	0.31	1.8
3	4.67	2.32	1.00	0.32	1.7

Equity Growth
(In percent)

Lag (length in years)	Coefficient Estimate (θ_2)	*t*-Statistic	Marginal Effect (high risk)*	Marginal Effect (low risk)**	Median Equity Price Growth
1	-0.01	-0.03	0.00	-0.00	12.8
2	0.67	2.35	0.14	0.06	10.6
3	-0.23	-0.80	-0.05	-0.02	12.8

Source: IMF staff estimates.

Note: The dependent variable is a binary systemic banking crises variable from Laeven and Valencia (2010). The data are from an unbalanced annual panel for the period 1975–2010. The model parameters are estimated using country fixed effects for 36 countries. Models with different lags are estimated using the same data sample. The marginal effects (ME) are evaluated at the median value of the explanatory variables in the last column. The change in the credit-to-GDP ratio is calculated as: $\Delta CtG_t = CtG_t - CtG_{t-1}$. Equity price growth is calculated as: $\Delta \ln(\text{Equity Price})_t = \ln(\text{Equity Price}_t) - \ln(\text{Equity Price}_{t-1})$.

Model specification: $\text{Prob}(\text{Banking Crisis}_{i,t=1}|x_{i,t-h}) = \Phi(\alpha_i + \theta_1{}^* \Delta CtG_{t-h} + \theta_2{}^* \Delta \ln(\text{Equity Price})_{t-h})$

* A high-risk country is defined as the 80th percentile country fixed effect.

* *A low-risk country is defined as the 20th percentile country fixed effect.

Annex. 3.3. Finding a Robust Set of Near-Coincident Indicators[1]

The methodologies for comparing high-frequency indicators presented in Box 3.3 are described here (see Arsov and others, forthcoming, for details). For the period from December 30, 2002, to April 11, 2011, daily data on (weekly) equity returns of 17 domestic financial institutions in the United States were used to create the abnormal returns. The data used to construct each of the indicators varied. All estimations were done on the weekly version of the dataset.

The ten indicators used for comparison were:

- **Yield curve:** The difference between the yield on 10-year Treasury bonds and 3-month Treasury bills.
- **Time-varying CoVaR:** Conditional Value at Risk or CoVaR (Adrian and Brunnermeier, 2010) is the Value at Risk of the financial system conditional on institutions being in distress. An institution's contribution to systemic risk is the difference between the CoVaR for tail-risk episodes and the CoVaR at the median state. The time-varying CoVaR is based on the returns of the market value of assets (Moody's KMV) and is estimated by quantile regressions of the returns of the financial system on the returns of an institution and other variables. For the exercise in this section, the yield curve and the LIBOR-OIS spread are used as these other variables.[2]
- **Rolling CoVaR:** CoVaR based on (200-week) rolling quantile regressions of weekly returns on the market value of assets. It does not take account of other variables.
- **Joint probability of distress (JPoD):** The joint probability of distress of all institutions included in a predefined financial system. It is based on a nonlinear, time-varying measure of "tail dependence" constructed with a multivariate distribution of individual institutions' probability distributions of their implied asset value movements (Segoviano and Goodhart, 2009).
- **Credit Suisse Fear Barometer:** An index of investor sentiment that prices zero-premium collars that expire in three months. The collar is implemented by the selling of a three-month, 10 percent out-of-the-money S&P 500 call option and using the proceeds to buy a three-month out-of-the-money S&P 500 put option of equal value.
- **Distance to default (DD) of banks:** The number of standard deviations by which the banking system is away from the default point—the point at which the liabilities of the banks are just equal to the market value of assets (De Nicolò and Kwast, 2002).
- **Diebold-Yilmaz:** A measure of spillovers based on the matrix of variance decompositions derived from 80-week rolling vector autoregressions of financial institutions' weekly credit default swaps spread returns (Diebold and Yilmaz, 2009).
- **VIX:** The Chicago Board Options Exchange Volatility Index calculated from S&P 500 option prices, measuring the market's expectation of future volatility over the next thirty-day period.
- **LIBOR-OIS spread:** A measure of the risk of default associated with lending to other banks in the LIBOR market.
- **Systemic Liquidity Risk Indicator (SLRI):** Measures the breakdown of arbitrage conditions in major markets, and is a global indicator of liquidity stress (Severo, forthcoming; IMF, 2011a).

The results were based on three types of tests on the systemic risk indicators. The dependent variables, that is, the event variables to test against, for the first two tests were Systemic Financial Stress (SFS) and the extreme SFS, respectively. The SFS is the fraction of banks experiencing large negative abnormal returns, with negative abnormal returns persisting for two weeks following the event (further details for the SFS are in Box 3.3). The extreme SFS is an SFS fraction greater than or equal to 0.25.

Forecasting Systemic Stress

The systemic risk indicator should be able to forecast the systemic stress given by the SFS. This attribute is tested using two scores (Table 3.6). The first score is based on a series of Granger Causality

[1]Prepared by Srobona Mitra.

[2]LIBOR is the London Interbank Offered Rate, and OIS is the overnight indexed swap rate.

(GC) tests on weekly data with lag lengths of 52 weeks, 26 weeks, 4 weeks, and 1 week. The score is constructed using *p*-values with significance levels less than 0.01—a larger weight on being significant at 52 weeks than at 1 week. The second score is based on running linear regressions with all four lags in the same regression: 52 weeks, 26 weeks, 4 weeks, and 1 week, and reporting the *p*-values of *t*-tests on each of the four lags in the same regression. The total score is a simple average of the first and the second scores.

Forecasting Systemic Extreme Stress

The systemic risk indicator should be able to forecast extreme events (an SFS greater than or equal to 0.25) with good precision. For this test, logit regressions are estimated with the binary dependent variable equaling 1 if SFS > 0.25 and 0 otherwise. The logistic distribution used in the logit model is skewed and is more appropriate in modeling extreme events, in contrast to the probit, which uses a normal distribution.

The scores are in two groups (Table 3.7): one based on (lower) *p*-values (<0.01) and the other based on McFadden *R*-squares for the logit regressions (the higher the better). The average of the two scores is reported in the last column.

Early Turning Points

Most systemic risk indicators barely showed movements before the crisis. However, nearer to systemic events, these indicators started moving, recording structural breaks in both the level and the persistence of their past relationships. For this exercise, autoregressive regressions with four lags (AR(4)) are estimated for each of the indicators. The Quandt-Andrews breakpoint (QABP) test (unknown breakpoint) is conducted for each of the regressions, testing for breaks both in the mean (the constant term) and persistence process (lagged coefficients in the AR(4) terms). The QABP gives us the possible breakpoint date for each of the indicators for each test (mean and persistence). Table 3.8 shows the dates of these turning points and ranks based on the dates.

Table 3.9 takes the average of the scores from the three tests.

Table 3.6. Granger Causality of Systemic Risk Measure to the Event Indicator

	p-Values for Granger Causality Tests with Various Lags[1]				Scores[2]					*p*-Values for *t*-Test at Each Lag[3]					
Indicators	52 weeks	26 weeks	4 weeks	1 week	52 weeks	26 weeks	4 weeks	1 week	*p*-Value score (1)	52 weeks	26 weeks	4 weeks	1 week	Lag-length score (2)	Average of (1) and (2)
Credit Suisse Fear Barometer	0.1219	0.7200	0.0719	**0.0066**	0	0	0	**1**	0.01	0.24	0.48	0.04	0.95	0.00	0.01
Time-varying CoVaR	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**52**	**26**	**4**	**1**	1.00	0.65	0.63	0.11	0.11	0.00	0.50
Rolling CoVaR	0.0105	0.0212	**0.2429**	**0.0011**	0	0	0	**1**	0.01	0.63	0.57	0.96	0.58	0.00	0.01
DD banks	0.4057	0.0816	0.0662	**0.0000**	0	0	0	**1**	0.01	0.02	0.42	0.26	1.00	0.00	0.01
Systemic liquidity risk index	0.4045	0.0667	0.6771	**0.0015**	0	0	0	**1**	0.01	0.86	0.09	0.17	0.17	0.00	0.01
Diebold-Yilmaz	0.0051	**0.0000**	**0.0000**	**0.0000**	0	0	**4**	**1**	0.06	0.01	0.22	0.64	0.06	0.00	0.03
JPoD	0.0130	**0.0000**	**0.0000**	**0.0000**	0	0	**4**	**1**	0.06	0.15	0.36	0.01	0.07	0.05	0.05
LIBOR-OIS spread	**0.0000**	**0.0000**	**0.0000**	**0.0000**	0	**26**	**4**	**1**	0.37	0.03	0.61	0.00	0.09	0.05	0.21
VIX	**0.0000**	**0.0000**	**0.0000**	**0.0000**	0	**26**	**4**	**1**	0.37	0.26	0.45	0.32	0.01	0.01	0.19
Yield curve	**0.0000**	**0.0000**	0.0967	0.0700	**52**	**26**	0	0	0.94	0.00	0.32	0.24	0.70	0.63	0.78

Source: IMF staff estimates.

Note: Black boldface values are significant at the 1 percent level. Red boldface values are those with no two-way causality (or the causality from the risk indicator to the event indicator is stronger) and are significant at 1 percent level.

[1]Granger Causality (GC) tests with lag-lengths specified in each column. The *p*-values for GC tests under each lag specification are reported here.

[2]Equal to the number of lags if *p*-value is less than 0.01; 0 otherwise.

[3]Based on ordinary-least-squares regression that regresses the Systemic Financial Stress (SFS) indicator on various lags of itself and each of the indicators; the *p*-values are for the *t*-tests for each of the lags in the same regression. The lag-length score is the weighted average of the *p*-values if the *p*-values are less than or equal to 0.01.

$$SFS_t = c + \sum_{s=1,4,26,52} \beta_S SFS_{t-s} + \sum_{s=1,4,26,52} \rho_S \chi_{t-s} + \varepsilon_t$$

Table 3.7. Forecastability of Extreme Events: Logit Regressions

	p-Values for Sum of Lags of Indicators Equal to 0					McFadden *R*-Squared			McFadden *R*-Squared Scores	
Indicators	6 weeks (weight = 6) A	4 weeks (weight = 4) B	1 week (weight = 1) C	Weighted Average *p*-Values D	Score 1 E = 1 – D	6 weeks (weight = 6) F	4 weeks (weight = 4) G	1 week (weight = 1) H	Score 2 I	Average of Score 1 and Score 2
Credit Suisse Fear Barometer	0.410	**0.000**	**0.000**	0.22	0.78	0.34	0.29	0.19	0.31	0.54
Time-varying CoVaR	0.594	**0.000**	**0.000**	0.32	0.68	0.41	0.35	0.36	0.38	0.53
Rolling CoVaR	0.651	0.093	**0.002**	0.39	0.61	0.27	0.21	0.13	0.24	0.42
DD banks	**0.008**	0.011	**0.000**	0.01	0.99	0.42	0.38	0.25	0.39	0.69
Systemic liquidity risk index	0.413	0.119	**0.004**	0.27	0.73	0.50	0.34	0.18	0.41	0.57
Diebold-Yilmaz	0.698	**0.001**	**0.000**	0.38	0.62	0.58	0.44	0.32	0.51	0.56
JPoD	0.028	0.030	0.023	0.03	0.97	0.66	0.53	0.21	0.57	0.77
LIBOR-OIS spread	0.921	**0.000**	**0.004**	0.50	0.50	0.40	0.34	0.26	0.37	0.43
VIX	0.069	**0.001**	**0.000**	0.04	0.96	0.34	0.29	0.23	0.31	0.64
Yield curve	0.805	0.528	0.158	0.65	0.35	0.30	0.24	0.12	0.26	0.31

Source: IMF staff estimates.

Note: Black boldface values are significant at the 1 percent level. A binary extreme event variable, *y*, takes the value of 1 if Systemic Financial Stress (SFS) is greater than or equal to 0.25. The two tests are based on three logit regressions with the binary variable as the dependent variable, with lagged dependent variables and lagged indicators, *x*. The lag lengths in each regression are 6, 4, and 1. Column E is based on the weighted average of the *p*-values, and column I is based on the weighted average of the McFadden *R*-squares. The total score is based on a simple average of the two subscores.

Table 3.8. Turning Points: Quandt-Andrews Breakpoint Test on Persistence and Level

	Persistence (ρ_s)		Level (c)		
Indicators	Break Date	Rank Score (higher the better)	Break Date	Rank Score (higher the better)	Average Score
Credit Suisse Fear Barometer	4/30/2007	1.0	4/30/2007	1.0	1.00
Time-varying CoVaR	8/6/2007	0.7	8/6/2007	0.4	0.55
Rolling CoVaR	9/15/2008	0.2	9/15/2008	0.1	0.15
DD banks	7/23/2007	0.8	7/9/2007	0.7	0.75
Systemic liquidity risk index	12/1/2008	0.1	6/16/2008	0.2	0.15
Diebold-Yilmaz	7/3/2007	0.9	7/9/2007	0.7	0.80
JPoD	8/13/2007	0.6	7/2/2007	0.9	0.75
LIBOR-OIS spread	4/7/2008	0.3	8/6/2007	0.4	0.35
VIX	10/29/2007	0.4	5/19/2008	0.3	0.35
Yield curve	8/27/2007	0.5	8/6/2007	0.4	0.45

Source: IMF staff estimates.

Note: Based on autoregressive regressions for each indicator: $\chi_t = c + \sum_{s=1}^{4} \rho_S \chi_{t-s} + \varepsilon_t$.

Table 3.9. Total Score

	Forecasting Stress (Granger Causality, Table 3.6)	Forecasting Extreme Event (logit regressions, Table 3.7)	Turning Point (breakpoint test, Table 3.8)	Average
Time-varying CoVaR	0.50	0.53	0.55	0.53
JPoD	0.05	0.77	0.75	0.53
Credit Suisse Fear Barometer	0.01	0.54	1.00	0.52
Yield curve	0.78	0.31	0.45	0.51
DD Banks	0.01	0.69	0.75	0.48
Diebold-Yilmaz	0.03	0.56	0.80	0.46
VIX	0.19	0.64	0.35	0.39
LIBOR-OIS spread	0.21	0.43	0.35	0.33
Systemic liquidity risk index	0.01	0.57	0.15	0.24
Rolling CoVaR	0.01	0.42	0.15	0.19

Source: IMF staff estimates.

Note: The time-varying CoVaR is derived by using two conditioning state variables: the yield curve and the LIBOR-OIS spread.

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GLOSSARY

Abnormal returns	The difference between the weekly returns of a financial institution's equity price and the S&P 500 index.
Alternative asset	A nontraditional component of investment portfolios that may include commodities, hedge funds, infrastructure, private equity, and real estate.
Asset-backed commercial paper (ABCP)	A form of commercial paper that is collateralized by other financial assets. Typically, ABCP is a short-term instrument that is issued by a bank or other type of financial institution and matures between 1 and 180 days from issuance.
Asset price bubble	A sharp rise in the price of an asset above its economically fundamental value over a specific period for reasons other than random shocks. In empirical work, the difficulty of classifying an asset price increase as a bubble is related to the complexity of determining what asset price levels are consistent with observable fundamentals.
Assets under management	Funds managed by a financial institution.
Autonomous pension fund	A separate institutional unit established by a private or public employer with the express purpose of providing retirement incomes for its employees.
Autoregressive model (AR)	A statistical time-series model in which the current value of a variable depends on its past values.
Basel I	A set of international banking regulations focused primarily on credit risk, introduced by the Basel Committee on Banking Supervision in 1988. Under Basel I, bank assets were classified into five categories in which the credit risk of the assets were weighted at zero, 10, 20, 50, and 100 percent, respectively. Internationally active banks were required to hold regulatory capital equal to at least 8 percent of the risk-weighted assets. See also *Basel III* and *Capital adequacy ratio.*
Basel III	A comprehensive set of reform measures introduced in the aftermath of the global financial crisis to improve the banking sector's ability to absorb financial and economic shocks; enhance banks' risk management and governance; and increase banks' transparency and disclosure. These measures revise the existing Basel capital adequacy standards and propose, for the first time, minimum liquidity adequacy standards for banks. See also *Basel I* and *Capital adequacy ratio.*
Basis spread	The difference in the yields of two financial instruments with similar risk characteristics and similar cash flows. The "basis" also refers to the difference between a futures contract price and the underlying cash instrument or commodity.
Black-Litterman approach	A mean-variance portfolio optimization approach, developed by Fisher Black and Robert Litterman (1992; cited in Chapter 2). It enhanced the original approach of Markowitz (1952; cited in Chapter 2) by (i) use of implied market equilibrium returns as the basis for the expected returns used in the optimization; (ii) potential introduction of assumptions about relative returns across assets into expected returns; and (iii) incorporation of uncertainty about the user's return assumptions. See also *Mean-variance approach for portfolio selection*.

Capital adequacy ratio (CAR)	The ratio of regulatory capital to risk-weighted assets of a financial institution. Regulatory capital is the sum of common equity and additional Tier 1 capital and Tier 2 capital. See also *Basel I* and *Basel III.*
Capital asset pricing model (CAPM)	A model that combines the Markowitz (1952; cited in Chapter 2) mean-variance approach with market-clearing in asset markets and the existence of a risk-free asset to model the pricing of an individual asset or a portfolio of assets. See also *Black-Litterman approach.*
Carry trade	A strategy whereby an investor sells an investment in a low-yielding currency (or borrows at low interest rates) and uses the proceeds to purchase an investment in a different currency with a higher yield.
Certificate of deposit (CD)	A deposit offered by banks, thrift institutions, and credit unions in the United States, generally at a fixed interest rate for a specified term to maturity.
Clearing	Transmitting, reconciling, and, in some cases, confirming payment orders or instructions for the transfer of financial instruments before settlement. Clearing includes netting orders and the establishment of final positions before settlement. For futures and options, clearing also entails daily balancing of profits and losses and daily calculation of collateral requirements.
Closed-end investment company	A managed investment company with an unlimited life that rarely issues new shares after its initial offering and does not redeem its own shares from its shareholders.
Collar	An option strategy established by holding shares of an underlying stock, purchasing a protective put and writing a covered call on that stock. The put and call contracts are both out-of-the-money, have the same expiration date, and are identical in number. See also *Credit Suisse Fear Barometer*.
Collateral	Assets pledged or posted to a counterparty to secure an outstanding exposure, derivative contract, or loan.
Commercial paper (CP)	An unsecured promissory note with a fixed maturity of 1 to 270 days.
Conditional Value at Risk (CoVaR)	The *Value at Risk (VaR)* in the financial system conditional on financial institutions being under stress. CoVaR is thus a measure of an institution's contribution to systemic risk. The contribution to systemic risk is the difference between CoVaR for tail-risk episodes and the CoVaR at the median state. See also *tail event*.
Constant relative risk aversion utility function	A class of utility functions that conveniently summarize an investor's risk preference. The functions assume that the investor's risk preference is independent of his or her wealth.
Contingent claims analysis (CCA)	A methodology that combines balance sheet data and market prices of traded securities to infer the implicit value of assets and contingent liabilities of a corporation. The method has been extended to study aggregate economic sectors and countries.
Countercyclical capital buffer (CCB)	A supplementary capital requirement for individual banks aimed at countering the procyclical depletion of capital. The buffer would be triggered by a signal of the buildup of systemwide risk, and would be drawn down when the risk materializes. The CCB would thus act as an automatic countercyclical stabilizer for a bank's risk. See also *Macroprudential capital requirements*.

Credit default swap (CDS)	A credit derivative whose payout is triggered by a "credit event," often a default. CDS settlements can either be "physical"—whereby the protection seller buys a defaulted reference asset from the protection buyer at its face value—or in "cash"—whereby the protection seller pays the protection buyer an amount equal to the difference between the reference asset face value and the price of the defaulted asset. A single-name CDS contract references a single firm or government agency, whereas CDS index contracts reference standardized indices based on baskets of single-name CDS contracts. See also *Credit derivative* and *Derivative.*
Credit derivative	A financial contract under which an agent buys or sells risk protection against the credit risk associated with a specific reference entity (or specified range of entities). For a periodic fee, the protection seller agrees to make a contingent payment to the buyer on the occurrence of a credit event (usually default in the case of a credit default swap). See also *Credit default swap* and *Derivative*.
Credit rating	A measure of the ability of a borrower to meet its financial commitments on a timely basis. Credit ratings are typically expressed as discrete letter grades. For example, Fitch Ratings and Standard & Poor's use a scale in which AAA represents the highest creditworthiness and D the lowest.
Credit Suisse Fear Barometer	An indicator of investor sentiment maintained by Credit Suisse. The value of the indicator (or the degree of fear) is based on the skew between the upside target and the downside protection embedded in zero-premium three-month collars. The *collar* is implemented by selling a three-month, 10 percent out-of-the-money S&P 500 call option and using the proceeds to buy a three-month, out-of-the-money S&P 500 put option of equal value.
Credit-to-GDP gap	The deviation of the credit-to-GDP ratio from a long-term trend. Under the modeling assumptions of this GFSR, the gap is estimated as a deviation from a recursive trend based on a *Hodrick-Prescott (HP) filter*.
Debt-service-to-income (DTI) ratio	The percentage of gross income applied to debt repayment. The debt portion of the ratio may also include taxes, fees, and insurance premiums associated with the debt.
Defined-benefit pension plan	A plan in which an employer pays its employees a predefined lifetime benefit at the time of retirement. The amount of the benefit is usually based on factors including age, earnings, and years of service. See also *Defined-contribution pension plan*.
Defined-contribution pension plan	A plan in which each participating employee typically has an account to which the employer makes a prespecified contribution. The employee's benefit is based on the amounts credited to the account (through employer contributions and, if applicable, employee contributions) and any investment earnings on the account. The level of future retirement benefits is not guaranteed. See also *Defined-benefit pension plan*.
Delinquency	A failure to make a contractual payment on a loan, usually defined as a certain number of days (or more) overdue (e.g., 30, 60, or 90 days).
Derivative	A financial instrument with a value dependent on the expected future price of its underlying asset, such as a stock or currency. Examples of derivatives include stock options, currency and interest rate swaps, and *credit default swaps*. See also *Credit derivative*.

Diebold-Yilmaz measure	A measure of spillovers across financial institutions developed by Diebold and Yilmaz (2009; cited in Chapter 3). It is based on the matrix of variance decompositions derived from rolling *vector autoregressions (VARs)* of financial institutions' weekly *credit default swap* returns.
Distance to default (DD)	A measure of credit risk, associated with the probability that the market value of a firm's assets will fall below the value of its debt. The equity of the firm is modeled as a call option on the value of its assets; the exercise price is equal to the value of the liabilities, since the firm defaults when its asset value falls below the face value of its debt. In the context of this GFSR, the DD represents the number of banking system standard deviations from default.
Dynamic stochastic general equilibrium (DSGE) models	A model that seeks to describe the behavior of the aggregate economy by analyzing the interaction of various microeconomic and financial decisions, including consumption, saving, and investment. Agents (or decision makers) in the model are varied and may include households, firms, banks, and governments. DSGE models are dynamic (accounting for various leads and lags in the evolution of the economy) and stochastic (accounting for the impact of random shocks—including technological or policy changes—on the economy).
Endogeneity	In an econometric modeling context, endogeneity is linked to the existence of correlation between a variable and the error term of an equation. In broad terms, a variable is endogenous if it is a function of other parameters or variables in the model.
European Financial Stability Facility (EFSF)	An institution set up by the current 16 euro area countries to preserve financial stability. The EFSF has the ability to issue bonds or other debt instruments in the market to raise the funds needed to provide temporary financial assistance to euro area member states in economic difficulty.
Euro interbank offered rate (Euribor)	A daily reference rate based on the averaged interest rates at which euro area banks offer to lend unsecured funds to other banks in the euro wholesale money market (or interbank market).
Event study	A statistical technique used to assess the short-term impact of an event—such as a crisis—on various macroeconomic or financial variables.
Exchange traded fund (ETF)	An investment fund traded on stock exchanges, most commonly tracking an index, such as the S&P 500. An ETF may be attractive to investors because of its low cost and tax efficiency.
Fat-tailed distribution	A probability distribution that exhibits higher kurtosis than the normal distribution, that is, more of the possible outcomes result from infrequent extreme deviations from the mean. See also *tail event*.
Federal Deposit Insurance Corporation (FDIC)	An independent U.S. government agency that provides insurance on deposits in member banks and thrift institutions, currently up to $250,000 per depositor per account ownership category per institution.
Flow of funds	An estimate of a country's financial flows, usually conducted by the country's monetary authority or central bank.

Foreclosure	The act by the lender of taking control of assets, such as real estate, that were pledged or mortgaged to secure a loan, usually with the intention of selling those assets to recover part or all of the amount due from the borrower.
Foreign exchange reserves	A stock of foreign currency denominated assets held and controlled by monetary authorities to meet balance of payments financing needs, intervene in currency markets to affect the country's exchange rate, and achieve other related purposes (such as to maintain confidence in the currency and the economy and to support foreign borrowing). Such reserves must be liquid and must constitute claims on nonresidents that are denominated and settled in a convertible foreign currency.
Financial Stability Board (FSB)	An international group of finance ministries, central banks, and international financial bodies that monitors and makes recommendations about the global financial system.
Funding	In this report, the process by which banks issue or assume liabilities associated with assets on their balance sheets.
Fixed-effects panel model	A panel model has cross-sectional and time dimensions. In a fixed-effects panel model, intercepts are allowed to vary along the cross-sectional dimension (for example, by country), or the time dimension, or both. A country fixed effects model summarizes structural characteristics that are fixed for a certain country over time. A time fixed effects model summarizes, for example, global shocks that affect all countries at a particular time.
Generalized autoregressive conditional heteroskedasticity (GARCH) model	A statistical model in which the variance of the error term is assumed to follow an autoregressive moving average (ARMA) process.
Granger Causality (GC) test	A statistical hypothesis test used to determine whether one time series may be useful in forecasting another, after taking into account various lags of the latter.
Group of Four (G-4)	The euro area, Japan, the United Kingdom, and the United States.
Group of Twenty (G-20)	The Group of Twenty Finance Ministers and Central Bank Governors established in 1999 as a forum for officials from systemically important advanced and emerging economies to discuss key issues related to the global economy. It consists of leaders from the European Union and the following 19 countries: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, Republic of Korea, Turkey, the United Kingdom, and the United States.
Haircut	A discount that a lender applies to the current market value of collateral received as security for a loan. The haircut reflects the risk that, at a later date, if the borrower defaults, the collateral may be worth less or be less easy to sell.
Hedge fund	An investment pool, typically organized as a private partnership, that faces few restrictions on its portfolio and transactions. Hence, compared with more regulated financial institutions, hedge funds use a wider variety of investment techniques—including short positions, derivatives transactions, and leverage—in their effort to boost returns and manage risk.
Hedging	Offsetting existing risk exposures by taking opposite positions in contracts with identical or similar risk—for example, in related derivatives contracts.

Hodrick-Prescott (HP) filter	A statistical data-smoothing technique for determining the long-term trend in the data by removing short-term fluctuations.
Interest-only mortgage	A mortgage in which the monthly payments cover only accrued interest; the principal balance is paid off when the loan matures.
Joint probability of distress (JPoD)	A measure of the joint probability of distress of all institutions in a financial system. The JPoD is constructed as a nonlinear, time-varying measure of "tail dependence" using a multivariate probability distribution of individual institutions' implied asset value movements.
Leading indicators	Indicators that signal well in advance the buildup of financial sector risks.
Leverage	The proportion of debt to equity (also assets to equity or, in banking, assets to capital). Leverage can be built up by borrowing (on-balance-sheet leverage, commonly measured by debt-to-equity ratios) or by using off-balance-sheet transactions.
Leveraged buyout (LBO)	The acquisition of a controlling interest in a company's equity with financing predominantly secured through leverage (borrowing).
London Interbank Offered Rate (LIBOR)	An index of the interest rates at which banks offer to lend unsecured funds to other banks in the London wholesale money market. See also *LIBOR-OIS spread* and *Overnight indexed swap*.
LIBOR-OIS spread	The difference between the three-month LIBOR rate and the overnight indexed swap rate. The spread is a measure of default risk associated with lending among banks in the LIBOR market. See also *London Interbank Offered Rate* and *Overnight indexed swap*.
Linear regression	A statistical model of linear relationships among variables, often under the assumption of normally distributed errors.
Loan-to-value (LTV) ratio	The outstanding balance on a loan as a proportion of the value of the asset (for instance, house) pledged as collateral against the loan.
Logit model	A statistical binary response model in which the response probability follows a logistic distribution and is evaluated as a function of the explanatory variables.
Macroprudential capital requirements	Capital requirements for banks aimed at curbing the probability of a systemic financial crisis. Unlike microprudential capital requirements, which are based on idiosyncratic risk, macroprudential requirements are set to mitigate the buildup of systemic risk (*countercyclical capital buffers* in the context of Chapter 3) and the interconnectedness of the financial system. See also *Macroprudential policy tools*.
Macroprudential policy tools	Tools used by country authorities to limit systemic financial risk and potential disruptions in key financial services that can have a sizable negative effect on the real economy. Such tools seek to (i) dampen the buildup of financial imbalances, (ii) build sufficient buffers to contain the speed and severity of potential downswings, and (iii) identify and address risk concentrations and financial interlinkages that may result in spillover risks and financial system disruptions. See also *Macroprudential capital requirements*.

Marginal tax rate	The tax rate on the last dollar of income earned. This is different from the average tax rate, which is the total tax paid as a percentage of the amount on which the tax is based. For instance, in a progressive tax system, any additional activity that pushes income above a certain threshold may be taxed at a significantly higher income tax rate than the amount of income below the threshold.
Mark-to-market accounting rules	The requirement to record the price or value of a security, portfolio, or account to reflect its current market value rather than its book or acquisition value.
Mark-to-market valuation	Recording the price or value of a security, portfolio, or account to reflect its current market value rather than its book value.
McFadden *R*-squared	A measure of goodness of fit in nonlinear estimation models, such as logit and probit, in which traditional *R*-squared measures can lie outside the [0,1] interval and are generally unsuitable. The McFadden *R*-squared compares the log likelihoods of a model including only a constant term with a full model with explanatory variables.
Mean-variance approach for portfolio selection	The first formal approach to solve an investor's portfolio allocation problem, developed by Markowitz (1952; cited in Chapter 2). Its name derives from the fact that the only inputs needed are the expected returns of the assets and their covariances.
Model calibration	The process of adjusting the values of model parameters to obtain a model representation that fits the observed data as closely as possible.
Money market mutual fund (MMMF)	An open-ended mutual fund that invests in short-term debt securities such as U.S. Treasury bills and commercial paper.
Moral hazard	A condition in which an entity tends to act less carefully than it otherwise would because the consequences of a bad outcome will be largely shifted to another party. For example, financial institutions have an incentive to take excessive risks if they believe that governments will step in and support them in the event of a crisis.
Mutual fund	A financial structure through which investors pool their funds to invest in a portfolio of securities, which may be broadly diversified or focused on particular market segments. The equity stakes of the investors consists of shares in the large pool of underlying assets. The selection of assets is made by professional fund managers.
Noise-to-signal ratio (NSR)	A measure that compares the level of good signals to the level of background noise. In the context of crisis modeling described in this GFSR, the NSR is the ratio of Type II errors (the proportion of times the indicator signaled a crisis and the crisis failed to occur) to legitimate signals (the share of indicator signals of a crisis for which the crisis did occur).
Nonperforming loans (NPL, NPL ratio)	Loans for which the contractual payments are *delinquent*, usually defined as a certain number of days (or more) overdue (e.g., 30, 60 or 90 days). The NPL ratio is the amount of nonperforming loans as a percent of gross loans.
Out-of-sample testing	Statistical testing in which a model created on the basis of historical data for a sample period of time ("in sample" period) is applied retroactively to a subsequent period of time ("out of sample" period) to determine the quantitative validity of the model and to derive simulated performance results.

Over-the-counter (OTC) derivative	A financial contract whose value derives from underlying securities prices, interest rates, foreign exchange rates, commodity prices, or market or other indices and that is negotiated and traded bilaterally rather than through an organized exchange.
Overnight indexed swap (OIS)	An interest rate swap in which the compounded overnight interest rate in the specified currency is exchanged for some fixed interest rate over a specified term. See also *London Interbank Offered Rate* and *LIBOR-OIS spread*.
P-value	The probability of observing a value for a test statistic equal to, or more extreme than, the one observed in reality, assuming that the statistic follows a distribution defined by a null hypothesis. The smaller the *p*-value, the more strongly the hypothesis is rejected. A *p*-value of less than a chosen significance level rejects the null hypothesis.
Peso problem	A situation in which a currency has a persistent positive differential with respect to the currency to which it is pegged. The differential exists because the market perceives a small probability of a large devaluation.
Probit model	A statistical binary response model in which the response probability follows a normal distribution and is evaluated as a function of the explanatory variables.
Procyclicality	The tendency of changes in asset prices and valuations to move in line with macroeconomic business cycles.
Put option	A financial instrument that allows, but does not require, its owner to sell ("put") an asset to the option seller at a certain price (the strike price) in the future. The option is of value to its owner if the market price of the asset drops below the strike price.
Quandt-Andrews breakpoint test (QABP)	A statistical test used to detect unknown structural breakpoints in a linear relationship by a change in the parameter estimates from a regression equation.
Receiver operating characteristic (ROC)	A graphical method for determining the discriminatory power of signaling variables. It summarizes the costs and benefits of choosing various *noise-to-signal ratio (NSR)* thresholds of an indicator ranging from high to low.
Repo (repurchase agreement)	The sale of securities together with an agreement for the seller to buy back the securities at an agreed price at a later date. The securities lender receives cash in return and pledges the legal title of a security as collateral.
Retained earnings	Earnings that have not been distributed to stockholders or transferred to a surplus account. Retained earnings are a part of a bank's capital.
Return on assets (or on equity)	The ratio of a bank's net income to the average value of its total assets (or equity capital) for a specified period.
Risk aversion	The degree to which an investor who, when faced with two investments with the same expected return but different risk, prefers the one with the lower risk. That is, it measures an investor's aversion to uncertain outcomes or payoffs.
Risk factor based asset allocation	An asset allocation framework that focuses on asset profiles of risk and return rather than on narrowly defined asset classes such as equities and bonds.
Search for yield	Investors' inclination to look for additional income or other return from their investments by moving into riskier asset classes such as those that are more illiquid, more complex, or contain more duration and credit risks.

Secondary mortgage market	The market for the sale of securities or bonds collateralized by the value of mortgage loans.
Securitization	The creation of securities from a portfolio of existing assets or future receivables that are placed under the legal ownership or control of investors through a special intermediary created for this purpose—a "*special purpose vehicle*" (SPV) or "special purpose entity" (SPE).
Seemingly unrelated regression method	A method of estimating the parameters of a system of equations that accounts for heteroskedasticity and contemporaneous correlation in the errors across equations. Also known as Zellner's method.
Settlement	The act that discharges the obligation to transfer funds or securities between two or more parties.
Skewness	A measure of the asymmetry of the probability distribution of a random variable.
Solvency II	A Directive of the European Union (Solvency II Directive 2009/138/EC) that codifies and harmonizes insurance regulations in the European Economic Area. Among other things, the directive determines the amount of capital that insurance companies must hold to reduce the risk of insolvency.
Sovereign wealth fund (SWF)	An investment fund created by a sovereign government for macroeconomic purposes. SWFs hold, manage, or administer assets to achieve financial objectives and employ a set of investment strategies that include investing in foreign financial assets. SWFs are commonly established variously from balance of payments surpluses, official foreign currency operations, the proceeds of privatizations, fiscal surpluses, and receipts resulting from commodity exports.
Special purpose vehicle (SPV)	Usually a subsidiary company with a balance sheet structure and legal status that makes its obligations secure even if the parent company goes bankrupt. See also *Securitization*.
Stationary data series	A data series with a distribution that does not change over time. Consequently, parameters such as the mean and variance also do not change over time. If a data series is not stationary, it should be transformed to a stationary form before some standard econometric techniques can be reliably applied.
Stress test	A process that evaluates the ability of an individual institution or the aggregate financial system to withstand adverse situations such as negative macroeconomic and financial shocks.
Structural break	A structural change in a time series that denotes a discontinuity in the relationship among variables. In regression modeling, the occurrence of a structural break is associated with a change in the best fitting coefficients for the periods before and after the break.
Sudden stop	A sudden slowdown in private capital inflows from abroad. When the inflows are large in relation to the domestic economy or financial system, as may be the case in emerging market economies, sudden stops are usually followed by a sharp decrease in output, private spending, and credit to the private sector and a real (inflation-adjusted) appreciation of the domestic currency.

Swap	An agreement between counterparties to exchange periodic payments based on different reference financial instruments or indices on a predetermined notional amount. See also *Swap spread*.
Swap spread	The differential between the government bond yield and the fixed rate on an interest-rate swap of the equivalent maturity. See also *Swap*.
Systemic financial stress (SFS) indicator	An indicator based on the fraction of financial institutions experiencing both large negative *abnormal returns* on any given day and negative returns for the two weeks following that day.
Systemic liquidity risk indicator (SLRI)	A global indicator of liquidity stress that measures the breakdown of arbitrage conditions in major markets.
Systemically important financial institutions (SIFIs)	Financial institutions deemed to be of systemic importance for the financial stability and health of the economy. Prevention of SIFIs' collapse is important to preserving systemwide financial stability. See also *Too important to fail*.
T-statistic	In regression estimation, the ratio of the estimated parameter coefficient to its standard error. The *t*-statistic can be tested against a *t* distribution to determine the probability that the true value of the coefficient is zero. See also *T-test*.
T-test	Any of various statistical tests based on the *t* distribution. Commonly used *t*-tests include tests for difference between two means; tests of whether a population mean is equal to a pre-specified value; and tests of whether the slope of a regression line differs significantly from a certain value (most commonly 0). See also *T-statistic*.
Tail event	An event with a small probability but with large (adverse) effects.
Tangible assets (TA)	Total assets less intangible assets (such as goodwill and deferred tax assets).
Tangible common equity (TCE)	Total balance sheet equity less preferred debt less intangible assets.
Tier 1 capital	A regulatory measure of capital supporting the lending activity of a bank. The capital that is most loss-absorbing, it consists primarily of common stock, retained earnings, and perpetual preferred stock. The greater the quantity of highly loss-absorbing capital held by the bank, the greater the protection of uninsured depositors and other bank creditors in an event of a bank failure.
Tier 2 capital	A regulatory measure of the supplementary capital supporting the lending activity of a bank. Less loss-absorbing than Tier 1 capital, it includes undisclosed reserves, general loss reserves, and subordinated term debt.
Too important to fail (TITF)	Institutions believed to be so large, interconnected, or critical to the workings of the wider financial system or economy that their disorderly failure would impose significant costs on third parties or the aggregate financial system. See also *Systemically important financial institutions*.

Tranche (of a security)	A slice of a security—typically an asset-backed security—associated with a specific order for payment and level of risk and that is sold to investors separately. Tranche holders are paid starting with the "senior" tranches (least risky) and then working down through one or more "mezzanine" levels to the "equity" tranche (most risky). If some of the expected cash flows are not received, and after any cash flow buffers are depleted, the payments to the equity tranche are reduced. If the equity tranche is depleted, then payments to the mezzanine tranche holders are reduced, and so on up to the senior tranches.
Treasury inflation-protected securities (TIPS)	Inflation-linked bonds issued by the U.S. Treasury that protect the holder from a decrease in purchasing power resulting from an increase in inflation.
Unit investment trust	An investment company that owns a fixed set of securities for the life of the company. That is, the investment company rarely alters the composition of its portfolio over the life of the company.
Unleveraged investment	An investment made without the use of borrowed money.
Value at Risk (VaR)	An estimate of the monetary loss over a given period that is unlikely to be exceeded statistically at a given probability level (typically the 95 percent confidence level). See also *CoVaR*.
Vector autoregression (VAR)	An econometric model used to capture the evolution of and interdependence among multiple time series, generalizing the univariate *autoregressive models*.
VIX	Chicago Board Options Exchange Volatility Index that measures market expectations of financial volatility over the next 30 days. The VIX is constructed from S&P 500 option prices.
Wholesale funding	Bank funding—in addition to customer deposits (retail funding)—in private markets to finance bank operations. Wholesale funding sources include debt issuance, short-term instruments such as certificates of deposit and commercial paper, repo transactions, and interbank borrowing.
Write down	To recognize in a set of accounts that an asset may be worth less than earlier supposed.
Yield curve	The relationship between the interest rate (or yield) and the time to maturity for debt securities of equivalent credit risk. In this GFSR, the interest (term) spread between the 10-year Treasury bonds and the 3-month Treasury bill.
Z-score	The number of standard deviations by which an observation is above or below the mean. It is a dimensionless quantity derived by subtracting the mean of the sample from the observation and then dividing the difference by the standard deviation.

ANNEX

SUMMING UP BY THE ACTING CHAIR

The Acting Chair made the following remarks at the conclusion of the Executive Board's discussion of the Global Financial Stability Report *on August 31, 2011.*

Executive Directors broadly agreed with the staff's analysis and expressed concern regarding the deterioration in global financial stability, following signs of an economic slowdown and renewed market anxieties about the euro area periphery and the U.S. fiscal and debt challenges. They noted that weaker growth could have a negative impact on both public and private sector balance sheets, with rising financing costs that could aggravate the fiscal position in many advanced economies. Directors observed that emerging market economies are generally in a stronger position, but also face difficult policy challenges, including those related to possible overheating. Directors underscored the importance of strong, coherent policy responses to address rising contagion risks and strengthen financial systems.

Directors noted that the financial crisis has entered a new difficult phase. In this context, they were concerned that political differences within the euro area may have delayed a lasting solution to the sovereign debt crisis. They also noted that difficulties in reaching a political consensus on medium-term fiscal adjustment in some other countries, including the United States, could undermine market confidence. Directors stressed, therefore, that a timely resolution of these difficulties would be critical to limiting risks to financial stability and addressing the fundamental challenges.

Directors observed that the adverse feedback loop between sovereign risk and bank balance sheets has intensified. They noted that risks of a funding disruption would rise if banks were unable to strengthen their balance sheets or sovereigns could not agree on credible medium-term fiscal plans in a timely manner. Directors concurred with the need to address vulnerabilities in the banking sector, including a further strengthening of bank capital buffers where necessary, to minimize risks to the real economy. Directors warned that lack of decisive action in this regard, as well as on the fiscal front, could trigger a negative spiral of rising funding costs and deteriorating debt dynamics.

Directors noted the staff's analysis of the potential impact of sovereign stress on bank balance sheets in Europe. A number of Directors welcomed this analysis as important to an understanding of contagion risks, but a number of others expressed concerns about the underlying methodological and data choices and the challenges in communicating it to the public. Many Directors saw scope for further work in this area.

Directors agreed that significant measures would be needed to restore the financial system to health. In the United States, policymakers still need to address the legacy of the financial crisis as it persists in household balance sheets. In the euro area, Directors called for swift implementation of the decisions taken at the Euro Area Summit in July 2011.

Directors noted that low policy interest rates, while necessary in many countries under current conditions, could pose long-term financial stability risks. The "search for yield" could push some market segments into excessive leverage, exposing them to higher risk. Directors concurred that a prompt completion of balance sheet repair in financial institutions could help contain these risks. A few Directors noted, however, that such risks could be overstated.

Directors shared the view that, while the recent surge of capital inflows to emerging markets has had beneficial effects, these inflows have fueled liquidity and credit expansion that could be destabilizing in case of a global growth slowdown, a rapid increase in funding costs, or a sudden reversal of the

flows. Directors agreed that a variety of measures, combining macroeconomic and macroprudential tools, could help limit the buildup of financial vulnerabilities, and stressed the importance of closely monitoring credit growth.

Overall, Directors agreed that the key near-term policy challenges should center around implementing coherent solutions to reduce sovereign risks, introducing credible efforts to rebuild the strength of the financial system in advanced economies, and controlling the risks of overheating and asset bubbles in emerging market economies. They also stressed that the international financial reform agenda needs to be completed as soon as possible. A few Directors were mindful of the possible adverse impact on bank lending and growth of an accelerated compliance with Basel III capital standards. A number of Directors noted that following up on the implementation of the previous advice and more specific policy recommendations by staff would help focus the discussion and more clearly define policy options.

Directors welcomed the analysis in Chapter 2 of the forces driving global asset allocation by long-term investors. They noted that public and private pension funds, insurance companies, and asset managers have altered their behavior since the crisis by focusing more on market, liquidity, and sovereign risks. They agreed that the generalized move to safer, more liquid securities may limit the stabilizing role that long-horizon investors can play in global markets.

Directors observed that the main factors underlying the long-term trend toward emerging market assets are strong domestic economic growth prospects and lower perceived country risk. They noted the risk of a reversal of these flows, especially in the current times of heightened global risk aversion, but agreed that the longer-term trend favoring emerging markets is likely to continue. To mitigate the chances of a sudden reversal, Directors called on policymakers in emerging markets to focus their attention on maintaining strong and stable growth, and financial system resiliency.

Directors welcomed the analysis in Chapter 3, which takes a step forward in the design and operation of macroprudential policy frameworks. In particular, they appreciated the discussion of the macro-financial linkages and concurred that understanding the sources of shocks would help the design of policy instruments. Directors concluded that establishing macroprudential frameworks would require careful consideration, taking into account country-specific circumstances.

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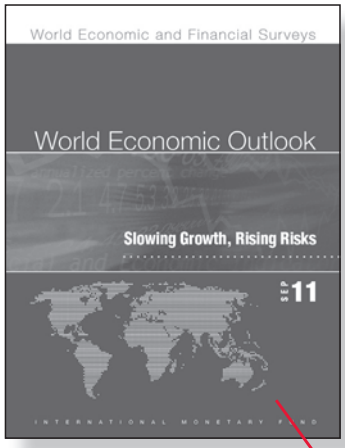

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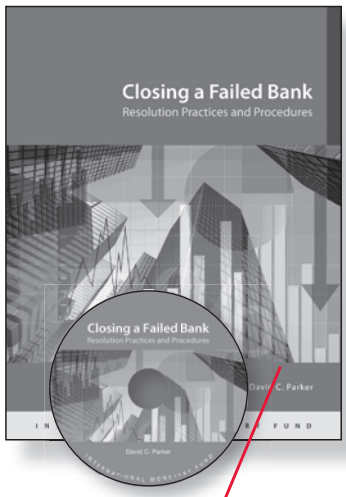

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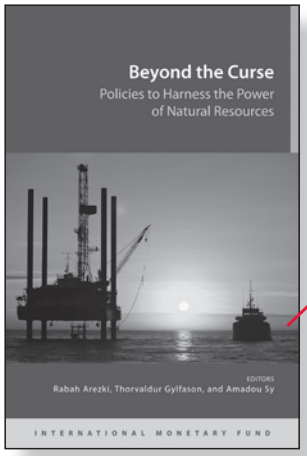

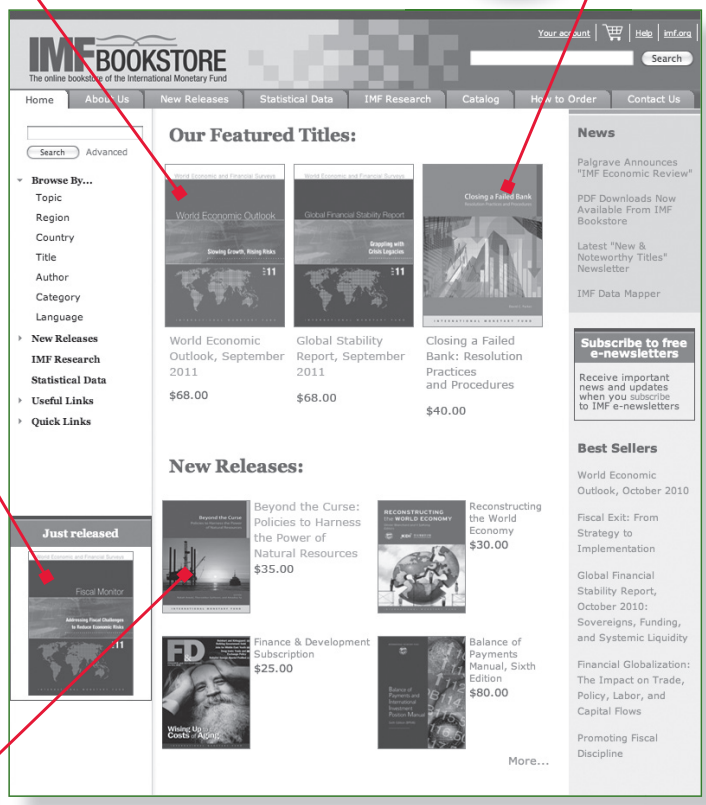

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