

**FOR
AGENDA**

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August 9, 2011

To: Members of the Executive Board

From: The Secretary

Subject: **September 2011 Global Financial Stability Report—Chapters 2, 3, and Statistical Appendix**

Attached for consideration by the Executive Directors is Part I (Chapters 2, 3, and Statistical Appendix) of the *September 2011 Global Financial Stability Report*, which is tentatively scheduled for discussion on **Wednesday, August 31, 2011**. Part II (Chapter 1) will follow as a separate document.

Questions may be referred to Mr. Brockmeijer (ext. 38551) and Ms. Kodres (ext. 36161) in MCM.

This report will be revised for publication in light of the Executive Board discussion. An edited version of Chapters 2 and 3 will be published on the IMF's external website, in preparation for the press conference scheduled for Tuesday, September 13, 2011 in Washington, D.C. If Executive Directors have additional comments, they may notify Ms. Kodres by **noon on Wednesday, September 7, 2011**.

This document will shortly be posted on the extranet, a secure website for Executive Directors and member country authorities.

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Global Financial Stability Report—Chapter 2, 3, and Statistical Appendix

Prepared by the Monetary and Capital Markets Department
(In consultation with other departments)

Approved by José Viñals

August 8, 2011

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LIST OF ACRONYMS

BoE	Bank of England
CalPERS	California Public Employees Retirement System
COFER	Currency Composition of Official Foreign Exchange Reserves
CoVaR	Conditional Value-at-Risk
CtG	Credit to GDP
DB	Defined Benefit
DSGE	Dynamic Stochastic General Equilibrium
DTI	Debt- service-to-income
EPFR	Emerging Portfolio Fund Research
ESA	European Supervisory Authorities
ESRB	European Systemic Risk Board
EU	European Union
FPC	Financial Policy Committee
FSI	Financial Stress Index
FSOC	Financial Stability Oversight Council
G-4	Group of 4
G-7	Group of 7
G-20	Group of 20
GDP	Gross Domestic Product
GFSR	Global Financial Stability Report
IFS	International Financial Statistics
JPoD	Joint Probability of Distress
LIBOR	London Inter-Bank Offered Rate
LTV	Loan-to-Value
LV	Laeven and Valencia crisis measure
NSR	Noise-to-Signal Ratio
OECD	Organization of Economic Cooperation and Development
OFR	Office of Financial Research

OIS	Overnight Indexed Swap
PRA	Prudential Regulatory Authority
ROC	Receiver Operating Characteristic
SFS	Systemic Financial Stress
SWFs	Sovereign Wealth Funds
VIX	Chicago Board Options Exchange Market Volatility Index

SUMMARY—CHAPTER 2. LONG-TERM INVESTORS AND THEIR ASSET ALLOCATION: WHERE ARE THEY NOW?

The asset allocation decisions of investors lie at the basis 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 pull-back 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, there may be a role for sovereign asset managers to take on some of the longer-term risks that private investors now avoid.

CHAPTER 2. Long-Term Investors and Their Asset Allocation: Where Are They Now?¹

I. INTRODUCTION

1. **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 countries 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.

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

- What are the trends in global asset allocation in the last 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 investment 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?

3. **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.² 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 sizeable sources of underlying capital flows.

4. **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

¹ This chapter was written by a team led by S. Erik Oppers and consisting of Ruchir Agarwal, Serkan Arslanalp, Ken Chikada, Pascal Farahmand, Gregorio Impavido, Peter Lindner, Yinqiu Lu, Tao Sun, and Han van der Hoorn. Excellent research support was provided by Yoon Sook Kim.

² See, for example, Forbes and Warnock, 2011; IMF, 2011b; and IMF, 2011c.

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.

5. **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.

6. **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 unexpected large losses for institutional investors (if pension funds and insurance companies take additional risk on their balance sheets), the risk of disruptions in financial markets (if the demand for assets suddenly changes, thereby affecting prices and market liquidity), or the risk of economic disruption (if there are large capital flows in or out of countries). These disruptions might 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.

7. **This chapter will look at these issues in detail, using available public and private data, the views of investors and other market participants, as well as the results of a recent survey conducted by the IMF (Annex 2.2).** Section II will use 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. Section III uses a detailed database of a subset of equity and bond funds to investigate the fundamental determinants of global asset allocation by private investors, such as economic growth, interest rates, and measures of risk. It will also look for 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. Section IV concludes with implications of our findings for investors and policymakers.

II. LONGER-TERM TRENDS IN GLOBAL ASSET ALLOCATION

A. Stylized Facts on Private Sector Institutional Investment

8. **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.**³ The OECD data cover assets under management by institutional investors domiciled in 17 OECD countries.⁴ 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 trillion at end-2008 before rebounding to \$60 trillion at end-2009 (compared with \$72 trillion in total bank assets).⁵ 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).

9. **Investors domiciled in the United States still account for almost half of all assets under management in the selected 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.

³ 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 section III below), but the series are of limited length, and their coverage may change over time as individual funds are added to the database.

⁴ See note to Table 2.1 for a list.

⁵ The OECD dataset does not indicate the effect of valuation changes, but national flow-of-funds data from the G-4 suggests that most of the decline in total assets under management during the crisis was due to valuation changes (especially in equities).

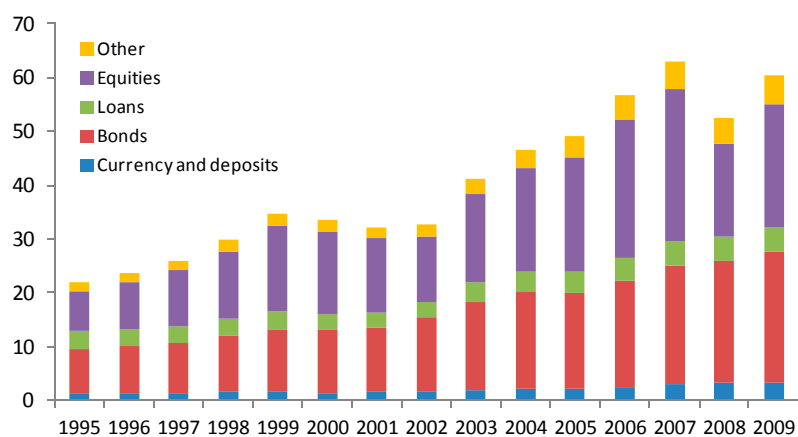
Table 2.1. Assets Under Management by Institutional Investors

	1995	2000	2005	2006	2007	2008	2009
<i>(In trillions of U.S. dollars)</i>							
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
<i>(In percent of GDP)</i>							
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.

Notes: 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 pensions funds and managed by investment companies.

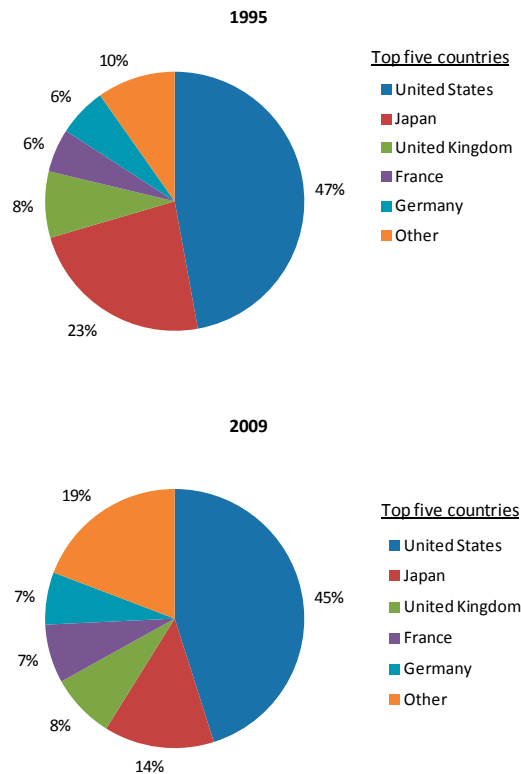
¹Investment funds include closed-end and managed investment companies, mutual funds, and unit investment trusts.

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. "Other" includes commercial loans and credits; financial derivatives; short-term investments; investments in hedge funds, private equities, and commodities; and miscellaneous assets. See Table 2.1 for the list of countries.

Figure 2.2. Assets of Institutional Investors by Country, 1995 and 2009
(In percent of total assets under management)



Sources: OECD; and IMF staff estimates.

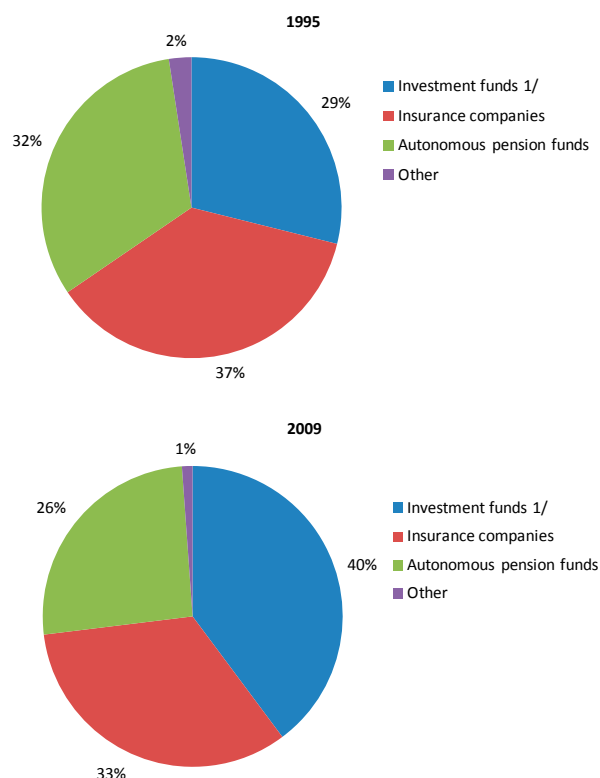
Note: Data based on the assets under management by institutional investors in 17 OECD countries.

See Table 2.1 for the list of countries.

10. **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.

11. **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 (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 over two-fifths, and the proportion of loans declined.

Figure 2.3. Assets Under Management by Type of Institutional Investors, 1995 and 2009
(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 the list of countries.

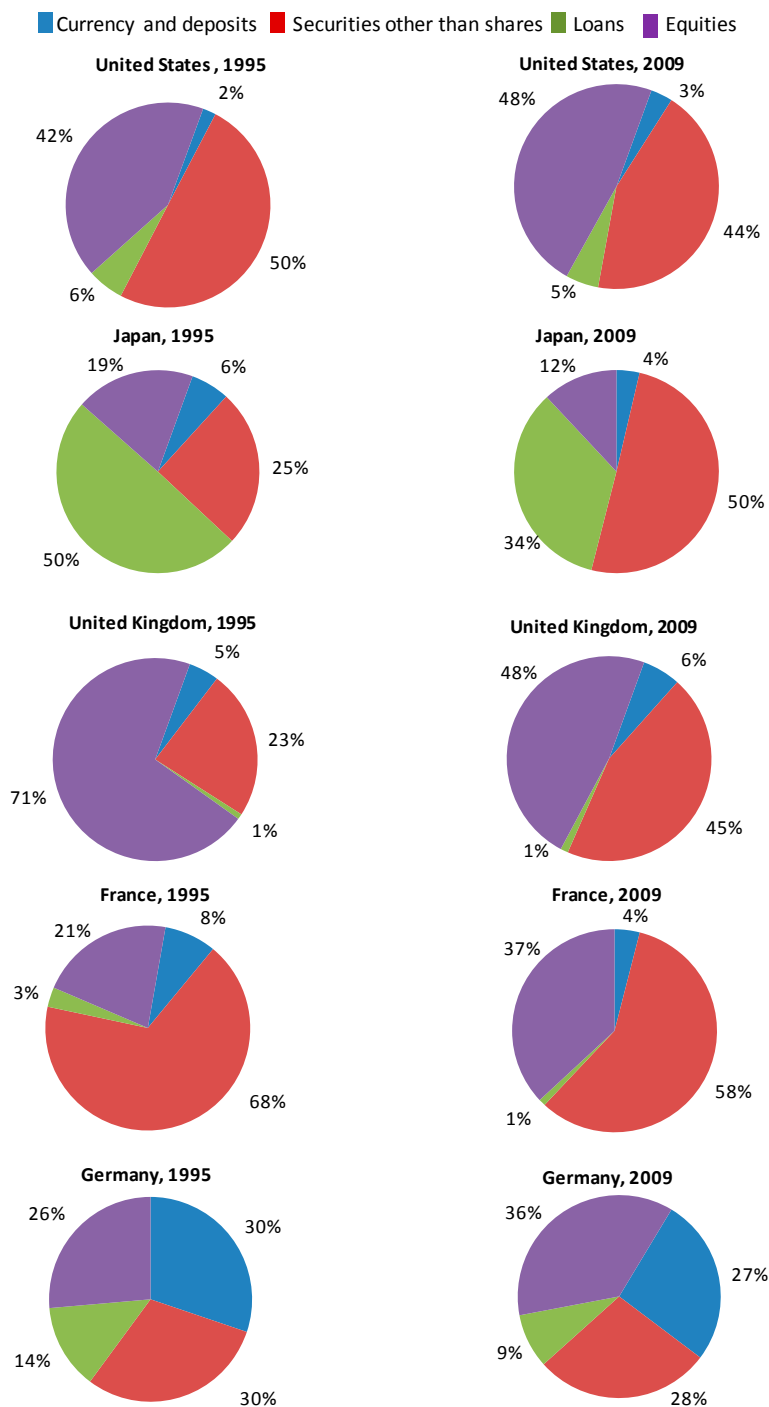
1/ Investment funds include closed-end and managed investment companies, mutual funds, and unit investment trusts.

12. **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 those in France hold a majority of assets in bonds 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.

13. **The diversity in asset allocation across countries reflect in part differing investment structures, and 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.

Figure 2.4. Global Asset Allocation of Institutional Investors by Selected Country, 1995 and 2009

(In percent)

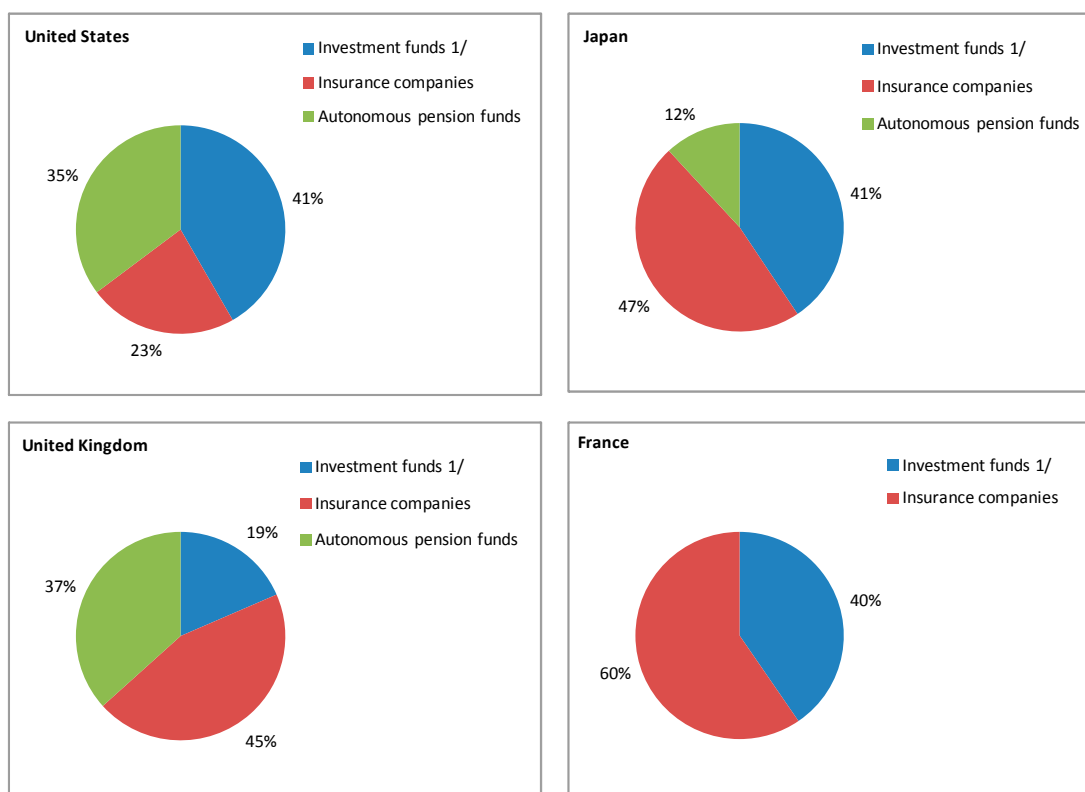


Sources: OECD; and IMF staff estimates.

Note: Data based on the assets under management by institutional investors in 17 OECD countries.

Data excludes assets classified in 'other' category. See Table 2.1 for the list of countries.

Figure 2.5. Assets under Management, by Type of Institutional Investor and Selected Countries, 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 the list of countries.

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

B. Stylized Facts on Official Sector Investment Vehicles

14. **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 trillion in assets (see Table 2.2 for a selection of SWFs), while international foreign exchange reserves amount to \$10 trillion (Figure 2.6).⁶ Taken together, the value of assets in SWFs and foreign exchange reserves are equal to about one-fourth of the assets under management of private institutional investors.

⁶ Using the IMF's definition of foreign exchange reserves and sovereign wealth funds; see Annex 2.3.

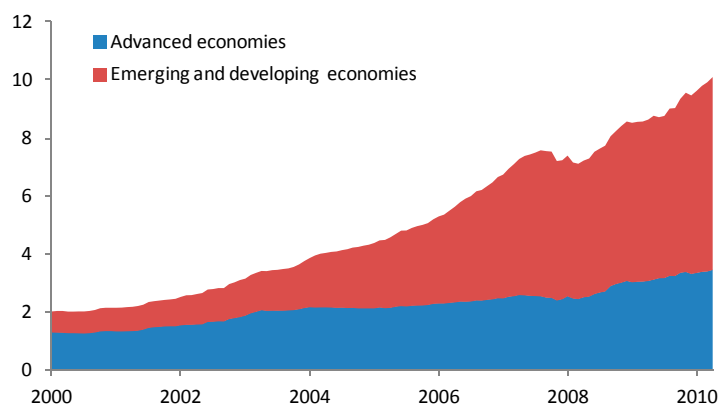
Table 2.2. Assets of Selected Sovereign Wealth Funds
(In billions of U.S. dollars)

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	332.4
Ireland	National Pensions Reserve Fund	31.1	32.6
Korea	Korea Investment Corporation	15.5	36.2
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 & Tobago	Heritage and Stabilization Fund	1.8	3.7
United States	Alaska Permanent Fund	39.8	38.8

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

Note: Australia (January 31, 2008, excluding Telstra); China (September 29, 2007 and end-2009); Singapore (March 31, 2008 and March 31, 2011); and Trinidad & Tobago (September 30, 2007).

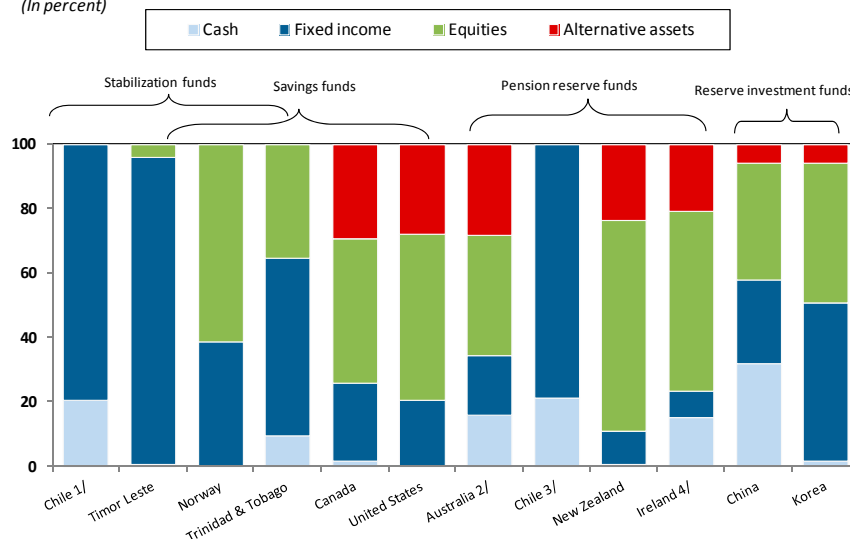
Figure 2.6. Foreign Exchange Reserves, Excluding Gold
(In trillions of U.S. dollars)



Source: IMF, International Financial Statistics.

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

Figure 2.7. 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.

1/Economic and Social Stabilization Fund

2/For Australia, excluding Telstra.

3/Pension Reserve Fund

4/ For Ireland, directed investments excluded.

16. 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.

Box 2.1. Asset Allocation of Reserve Managers¹

This box uses available data to investigate to what extent reserve managers respond to market-based incentives when deciding on the currency composition of international reserves.

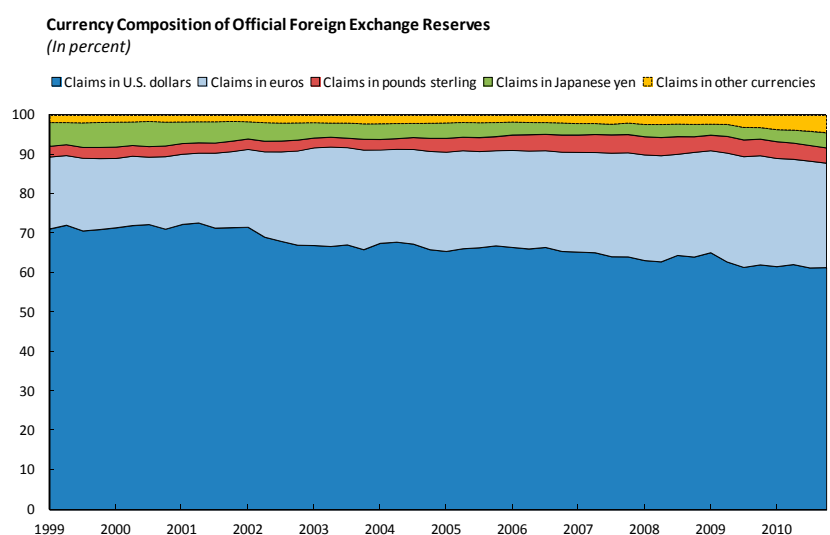
International reserves are explicitly held for balance of payments or monetary policy purposes, and as a result, the objectives of reserve managers are typically different from other investors. The asset allocation and management of reserves is traditionally driven by safety, liquidity, and return, in that order (IMF, 2001a). In addition, trade links and the composition of foreign debt may impart currency preferences on the stock of international reserves.

Despite these different asset allocation objectives of reserve managers, do they nevertheless respond to some of the incentives of private investors, such as investment returns and measures of risk? For instance, in principle, reserve managers have a choice in which currency to hold their reserves, as most reserve currencies have deep and liquid exchange markets and can quickly be converted into a different currency if needed. Given the dominance of short-term government bonds in their portfolios, short-term interest-rate differentials between major reserve currency countries may be expected to affect their asset allocation.

Considering that the currency composition of reserves is equivalent to the country destination of investment by

reserve managers, this question can be examined using the IMF's Currency Composition of Official Foreign Exchange Reserves (COFER) database. The database contains country-level currency composition data from the 1960s to the present. The data are submitted to the IMF by member countries on a confidential and voluntary basis; at present, it covers 56 percent of total world foreign reserves. Looking at the trends in the aggregate data, 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 below).

The investigation uses quarterly data from 1999 to 2010 for 102 countries that include a number of the variables used for the analysis of private mutual fund data in Section III below, in addition to variables to measure the conventional objectives of reserve managers, including debt-to-GDP ratios and export and import propensities. The four dependent variables used in this case are the shares of total reserves allocated to the four major currencies, the U.S. dollar, euros, pound Sterling, and Japanese yen, which constitute more than 90 percent of total reserve holdings for most of the countries in our sample.



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 key results of the analysis are as follows (see table below):

- Reserve managers appear to respond to U.S. interest rates: as shown in the first row of the table below, increases in the U.S. dollar interest-rate are associated with a rebalancing away from the euro and toward the U.S. dollar.
- An increase in the volatility of the euro/dollar exchange rate tends to favor the U.S. dollar as a reserve currency, also at the expense of the euro.
- The shares of the other two main reserve currencies, the pound and the yen, appear not to be affected by interest rates or exchange-rate volatility.
- Economic growth differentials (which are found below to be important for private asset allocation) appear not to matter for the currency composition of international reserves.
- At the start of the global financial crisis in the summer of 2007, there was a drop in the share of U.S. dollars in international reserves not related to the 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**

Source: IMF staff estimates.

Notes: 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 one. Data for the dependent variable is from the COFER statistical database, quarterly from Q1 1999 to Q4 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 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 Forecasts. Crisis dummy 1 represents the period between June 2007 and August 2008 (global credit crunch). Crisis dummy 2 represents the period after 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 level of confidence based on robust standard errors.

¹ This box was prepared by Ruchir Agarwal, with excellent research assistance from Michael Kamya.

17. **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 four-fold 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).

18. **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.⁷ Some central banks have facilitated this

⁷ This metric for reserve adequacy is developed in IMF (2011a); the suggested adequacy range is 100–150 percent of the metric, leading to the ranges given here.

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, however, added together these investment tranches remain small, and government bonds remain the dominant asset class in reserves.

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

III. DETERMINANTS OF PRIVATE ASSET ALLOCATION

A. The Role of Private Asset Managers

20. **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 those that manage 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.⁸

21. **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 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.

22. **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).

⁸ Hedge funds are not covered in our investigation directly as asset managers, although they are considered as an “investment class” for private asset managers.

Table 2.3. 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.

B. Factors Determining Private Asset Allocation

23. **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 the 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.

24. **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.⁹

⁹ The regressions are run on flow data, since the stock data are generally non-stationary. 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.

25. **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),¹⁰ (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.¹¹

26. **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 effect on flows into equity and bond funds.** These flows generally do not respond to policy rate differentials in a statistically significant way. 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 differentials relative to the G-4, and lagged policy rate differentials.¹² The implications of this finding are discussed further below.

¹⁰ 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 as reflected in this type of the regression; the lagged capital control variable addresses this concern of reverse causality.

¹¹ Two crisis dummies are included, one for the period between June 2007 and August 2008 (global credit crunch) and one for the period after September 2008 (Lehman Brothers bankruptcy).

¹² 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, as noted, 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.

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

	Hypothesized Signs		World		Asia		Latin America		Europe, Middle East and Africa		G-7 Countries		Non-G7 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-G4 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 level of confidence based on robust standard errors. Coefficients that are statistically significant and have signs different than expected are highlighted 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 host country and the simple average policy rate for G4. GDP growth forecast is the one-year-forward GDP forecast for host country, provided by Consensus Economics. Inflation volatility, GDP growth volatility, 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 inter temporal 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 between June 2007 and September 2008 (global credit crunch). Crisis dummy 2 represents the period after 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 based on the Morgan Stanley Capital International (MSCI) regional classification and are as follows:

- Asia-Pacific (excluding Australia, Japan, New Zealand): China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand (9)
- Eastern Europe Middle East and Africa (EMEA): Bulgaria, Croatia, Czech Republic, Egypt, Hungary, Nigeria, Poland, Romania, Russia, Saudi Arabia, Slovenia, South Africa, Turkey (13)
- Latin America: Argentina, Brazil, Chile, Colombia, Mexico, Venezuela (6)
- G7: Canada, France, Germany, Italy, Japan, United Kingdom, United States (7)
- Non-G7: Australia, Austria, Belgium, Denmark, Finland, Greece, Ireland, Israel, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland (15)

- **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 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.¹³ 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

¹³ For a detailed discussion see IMF (2010), Chapter IV "Global Liquidity Expansion: Effects on 'Receiving Economies' and Policy Response Options."

there was no effect on Asian equity investments). There is for now no firm evidence that these effects have faded.¹⁴

27. **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).¹⁵

28. **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).¹⁶ A few of the possible explanations are the following:¹⁷

- 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.
- 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

¹⁴ Specifically, the explanatory power of the crisis dummy variables does not improve significantly if it is terminated before the end of the sample, suggesting that the alteration during the crisis continues through the end of the sample.

¹⁵ 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.

¹⁶ 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.

¹⁷ 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 country 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.

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.

29. **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.¹⁸

C. The Risk of Sudden Reversals

30. **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.

31. **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.¹⁹ 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

¹⁸ Specifically, reducing their underweighting in international capital market indexes may lead to increased portfolio flows into emerging markets, with corresponding capital inflows.

¹⁹ To do so, we make the considerably simplifying assumption that the shocks have independent effects and are therefore additive.

standard deviations of the available time series covering 1996-2011, putting them among the 5 percent most severe during that period.²⁰

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

²⁰ 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, respectively.
- (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 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 <January 2008>	-4.0 <January 2008>	-4.4 <June 2006>
Largest net inflows	12.8 <October 2007>	5.5 <October 2010>	4.0 <January 2006>

Bond Funds

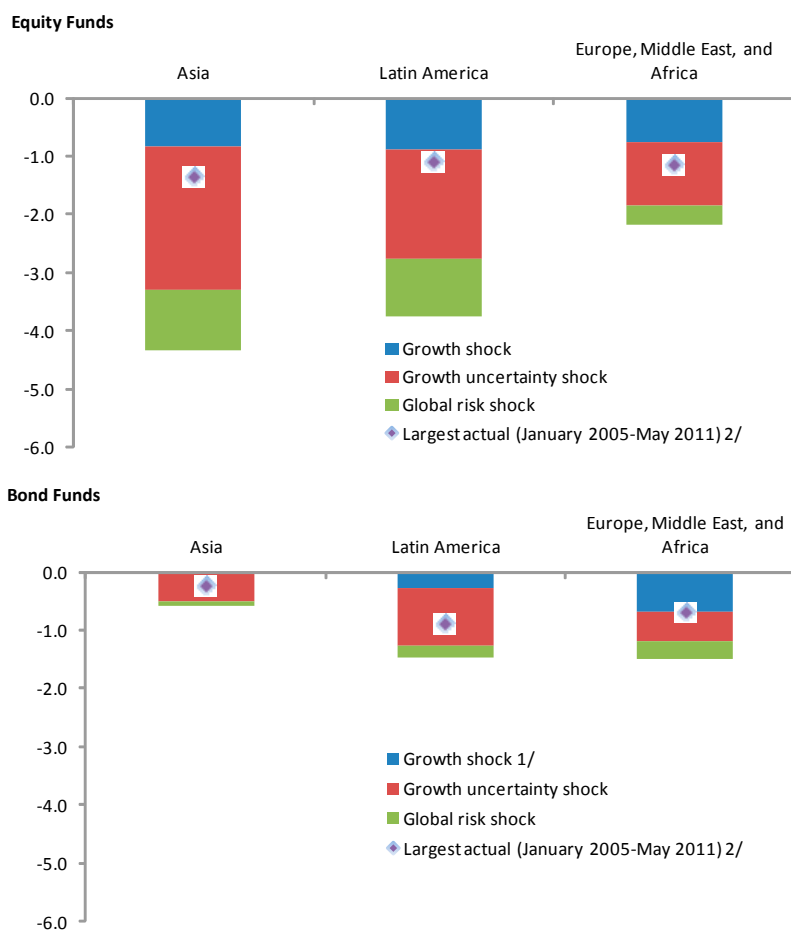
	Asia	Latin America	Europe, Middle East and Africa
	Simulated Effects		
Growth shock ¹	...	-1.0	-2.6
Growth uncertainty shock	-4.5	-3.6	-2.0
Global risk shock	-0.6	-0.8	-1.1
Sum of the above shocks	-5.1	-5.4	-5.6
	Largest Actual January 2005 – May 2011		
Largest net outflows	-1.9 <October 2008>	-3.3 <October 2008>	-2.6 <October 2008>
Largest net inflows	2.4 <April 2010>	2.7 <October 2010>	2.3 <October 2010>

Sources: IMF staff estimates; and EPFR.

Note: Simulated effects were calculated for respective regions by using the variables from the regressions in section IIIB and applying (i) a negative two standard deviation shock to 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).

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

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: Simulated effects were calculated for respective regions by using the variables from the regressions in section IIIB and applying (i) a negative two standard deviation shock to 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 deviation standard deviation shock to the VIX (an increase in global risk).

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

2/ For equity funds, the largest outflows were observed in January 2008, except for EMEA region (June 2006); for bond funds, the largest outflows were observed in October 2008.

D. Effects of the Crisis

33. **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.²¹ 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.

34. 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 exceeded 2, so that the outflows from bond funds during the crisis were among the 5 percent most severe compared to the pre-crisis period. For equities, there is a distinction between emerging markets and advanced markets. In emerging markets, even though 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 pre-crisis period). In addition, the coefficients on the second crisis dummy (after 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 pre-crisis period.

Table 2.6. Evaluating 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*** (-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)
Pre-crisis 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
Pre-crisis 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.

Notes: 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 pre-crisis 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 pre-crisis mean, divided by the pre-crisis 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 between June 2007 and August 2008, and crisis dummy 2 refers to the period after September 2008. "..." indicates that the original estimate is not statistically significant, so no Z-score is calculated.

35. 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

²¹ The Z-score is the size of the change implied by the dummy coefficient, minus the pre-crisis mean, divided by the pre-crisis standard deviation. Note that the Z-score is meaningless if the dummy is not statistically significant, as in such cases there was no statistically significant change at all in asset allocation at the time of the crisis.

Survey of Global Asset Allocation of 122 the largest asset management companies and pension funds and plan sponsors, which collectively had about \$20 trillion under management (Annex 2.2). The questions included 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.

36. **The traditional (so-called mean-variance) approach towards 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 directly on asset classes for asset allocation decisions (Box 2.2).

Box 2.2. A New Asset Allocation Framework—Risk-Factor Based Asset Allocations¹

This box describes a new method of evaluating asset allocation by institutional investors.

Risk-factor based asset allocation is gaining increased recognition among institutional investors. After the financial crisis, some institutional investors have started to group investments based on their risk and return profiles rather than on traditional asset classes such as equities, bonds, and alternative assets. By focusing on risk and return profiles of assets rather than on narrowly defined asset classes, asset managers are better able to understand risks they are taking, and therefore better to manage portfolio risks.

One case in point is the “new alternative asset classifications” of California Public Employees' Retirement System (CalPERS), which became effective in July 2011. Its new alternative asset classification defines five categories of assets— income, growth, real, inflation-linked, and liquidity (see table below). Compared with the traditional classification, this approach provides more information about the risk exposures of the pension fund. The new classification does not immediately change its overall asset allocation: CalPERS will roughly keep the same asset shares, except that real estate will be 3 percentage points higher, cash 2 percentage points higher, and fixed income 4 percentage points lower.

CalPERS: Alternative Asset Classification

Risk Class	Translating into Asset Classes	Purposes	Share, July 2011 (in percent)	Share, June 2009 (in percent)
Income	Global fixed income	Deliver stable income return	16	20
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	13	10
Inflation-linked	Commodities and inflation-linked bonds	Provide hedging against inflation	4	5
Liquidity	Cash and nominal government bonds	Supply liquidity when needed	4	2

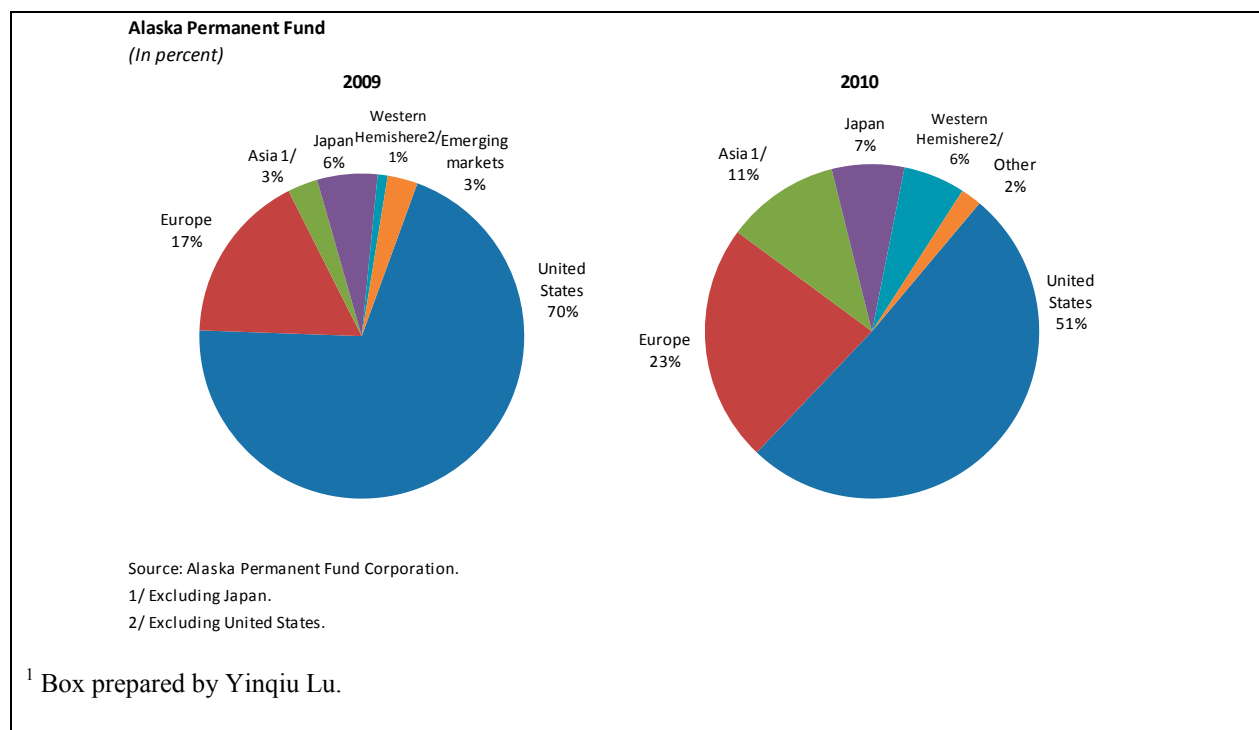
Source: CalPERS.

Another case of note is the Alaska Permanent Fund Corporation. In 2009, its Board adopted a new method of categorizing the fund's assets by regrouping investments by their risk and return profiles (see table below), rather than the traditional asset classes. It did not change the long-term target of achieving a 5 percent real rate of return, or the assets in which the fund invests; but it considered that the new classification could help the Fund better to understand the risk profile of its portfolio. For instance, corporate bonds and stocks are grouped together given that in adverse economic conditions, these may perform similarly. Within the stock portfolio, there has been a shift toward emerging Asia (see figure below). Cash was included in the 2010 asset allocation as a new asset class, with the purpose of avoiding fire sales of other assets to meet expected liquidity needs (i.e., primarily the annual dividend payment) during periods of market turmoil.

Alaska Permanent Fund Corporation: Asset Allocation

Risk Class	Translating into asset classes	Purposes	Share, FY2010 (in percent)
Cash	Short-term liquid investments	Meet expected liabilities and to manage liquidity needs	2
Interest rates	U.S. government bonds and international developed-country government bonds	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.



37. **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.

38. **The pre-crisis 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 few are willing to pay for it.

39. **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.

40. 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.

41. 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).

42. 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. 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 on higher-risk assets (see Box 2.3). Still, the IMF survey indicates that only about one-fifth of asset managers and pension funds surveyed expect higher risk exposure in their portfolios in the next three years (see Table 2.18, in Annex 2.2).²² In addition, survey respondents indicate that the “search for yield” is not the most important factor in cross-border investment decisions, coming in third after diversification and growth prospects (Table 2.8).

²² This may apply predominantly to pension and insurance companies, which are often required by regulation to follow conservative strategies (see also Section III.E below). See Chapter 1 for a summary of developments for other types of investors.

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: Numbers of respondents are 64 and 49 for asset managers and pension funds, respectively.

Share of respondents expecting the policy rates in advance economies to return to end-2007 levels in respective time horizon.

Table 2.8. Top 5 Factors Considered in Cross-border Investment since end-2006
(Ranked by scores)

Rank	Asset Managers		Pension Funds	
	Factors	Score ¹	Factors	Score ¹
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: Numbers of respondents are 61 and 40 for asset managers and pension funds, respectively.

¹ Each participant was asked to report top four factors. Score is calculated as 4*rank 1 factor + 3*rank 2 factor + 2*rank 3 factor + 1*rank 4 factor.

Box 2.3. The Low Interest Rate Environment and Pension Funds¹

This box explains how interest rates affect the funding status of defined benefit (DB) pension plans. It shows how a protracted low interest rate environment has significant negative effects on DB pension plan's funding status, which could ultimately burden plan sponsors and/or beneficiaries.

One measure of solvency or the funding status of a DB pension plan is defined as *the ratio of the current market value of plan assets to the plan's benefit obligations*, where the latter are its actuarial liabilities, representing the present discounted value of all future retirement benefits earned to date. If the ratio is less (greater) than one, the plan is underfunded (overfunded).²

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

- On the asset side, declines in interest rates generate capital gains in existing bond holdings and thus increase asset values.³
- On the liability side, declines in 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— increase the plan's liabilities.

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. This is in contrast to banks, which typically have longer maturities for assets than for liabilities.

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 (see table below): a mere 0.1 percentage point decline in the discount rate increases pension liabilities by 2 percent, while the effect on the asset side is negligible with this marginal change in the interest rate. Also, it is noteworthy (and highlighted in yellow in the table) that the impact of a 0.1 percent point decline in interest rates to the funding ratio would be roughly similar to a 5 percent decline in stock prices (starting from a base of 100 for both assets and liabilities).

Impact of changes in gilt yields on UK 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 - 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).

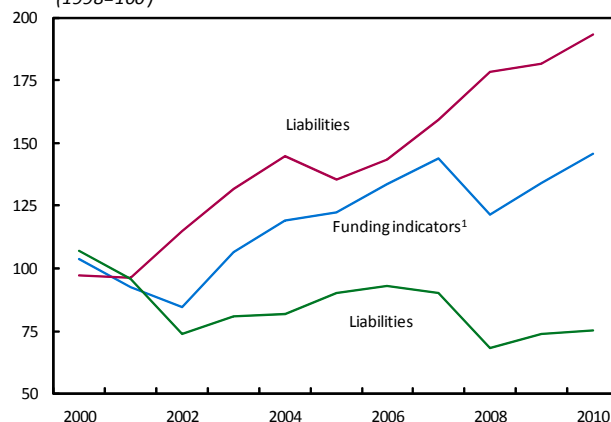
Notes: Sensitivity analysis based on dataset of 6,596 UK DB schemes on March 31 2010. Yellow cells indicate roughly similar order of impacts on the funding ratio stemming from changes in bond yields and equity prices respectively, assuming we start from a base of 100 for both the assets and liabilities.

Declines in interest rates also have an income effect: low interest rates further worsen the funding ratio over time, as higher-yielding bonds mature and are replaced with new lower-yielding ones.

Looking at developments in funding ratios of DB pension funds in major economies, the long-term decline in interest rates and improving life expectancy (the liability effect) have increased liabilities much faster than assets, and has put downward pressure on funding ratios. Short-term fluctuations correlate with equity price swings (the asset effect), as witnessed by the sharp drop in pension assets in 2008 and subsequent rebound in 2009 (see figure below).

Stringency of funding regulations on pension plans and hence how much time and flexibility are allowed to address plans' underfunding differ considerably among countries, partly reflecting how pension plans are linked financially to their sponsoring employers.⁴ Countries such as the Netherlands, where pension funds are more detached from sponsoring employers, generally require higher minimum funding ratios and quicker recovery plans in the event of underfunding. Countries where benefits are underwritten by sponsoring employers, such as the United States, Japan, and the United Kingdom, allow longer recovery plans, but unresolved underfunding would ultimately require increased contributions from employers.

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

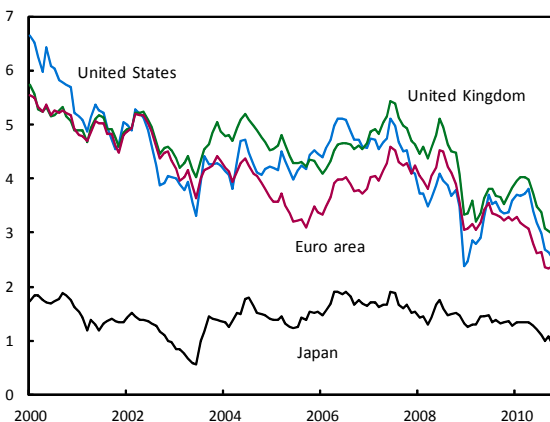


Sources: TheCityUK; and Towers Watson.

Note: Australia, Canada, France, Germany, Hong Kong SAR, Ireland, Japan, the Netherlands, Switzerland, the United Kingdom, and the United States.

¹Assets divided by liabilities.

Ten-Year Government Bond Yields (In percent)



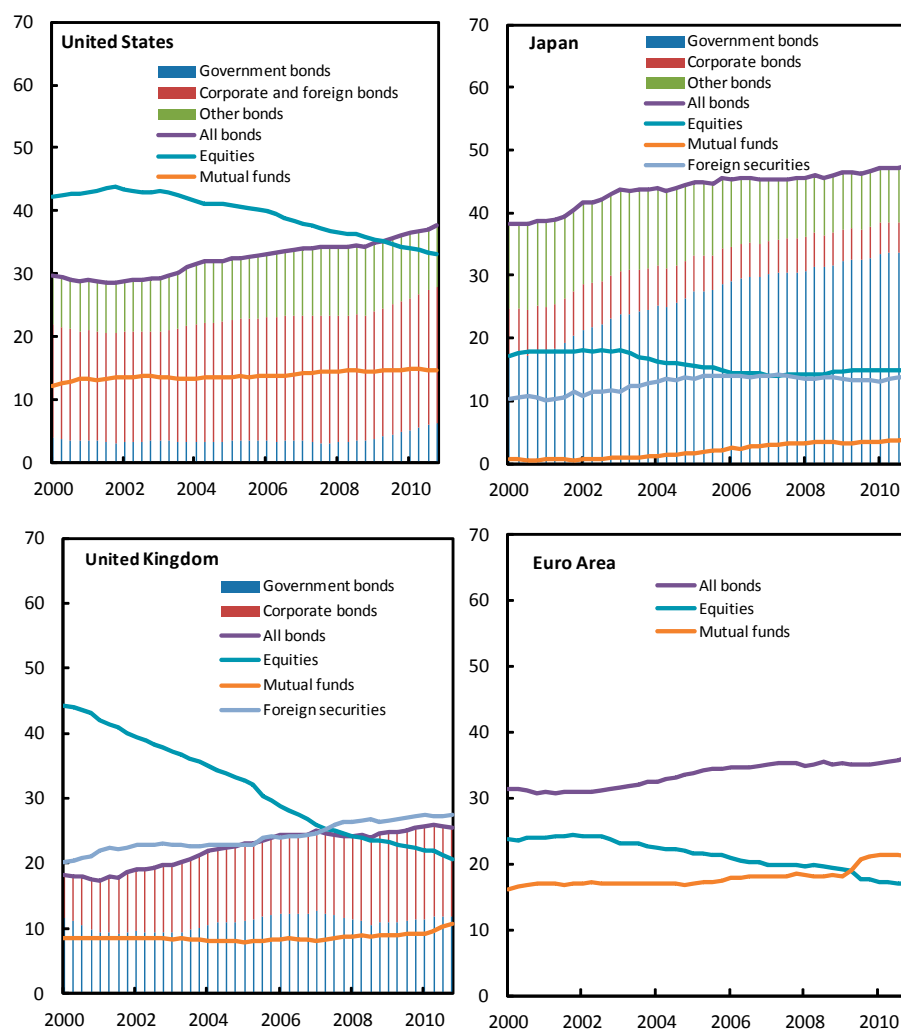
Source: Bloomberg L.P.

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 seek to shift their financial risks stemming from the provision of defined benefit pension plans to the beneficiaries by closing the plan to new employees and moving existing staff (if possible) to a new defined contribution pension scheme.

A common strategy taken to address a deterioration in funding status stemming from a protracted low interest rate environment is to 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. It should be noted, however, that this strategy is helpful to mitigate adverse effects of further declines in interest rates, but does not necessarily improve an already worsened funding status.

To address the worsened funding ratios, long term institutional investors may potentially be more inclined to “search for yield.” On this point, Flow of Funds Account data for pension funds and insurance companies in G-4 economies show a gradual but continuous increase in the bond holding ratio over the last decade after accounting for the effects of valuation changes (see figure below).⁵ In other words, rather than shifting the asset allocation to equities to try to enhance yields at the expense of having more volatility risk on the asset side, so far pension funds and insurance companies as a whole seem to have been putting more emphasis on duration matching to address effects on liability side stemming from low long term interest rates.⁶

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 consists of both domestic and foreign securities. Government bonds for the United States include Treasury bills.

¹ Box prepared by Ken Chikada.

² For more detailed and technical discussions on the funding status of defined benefit pension plan, see Impavido (2011).

³ 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.

⁴ Pugh and Yermo (2008), Yermo and Severinson (2010).

⁵ Utilizing both flow and stock data of the Flow of Funds Account, we can try to exclude effects of valuation changes. For example, the bond holdings of an investor at time t are calculated as follows:

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

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 $t=k$.

⁶ In fact, previous authors have suggested a possible shift in asset allocation to bonds from equity as a consequence of a shift toward fair value accounting of pension scheme and related changes in solvency regulations in advanced countries in the mid-2000s (OECD 2005, Boeri and others, 2006, Committee on the Global Financial System 2007 and Committee on the Global Financial System 2011).

43. 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.

Table 2.9. Regional Allocation
(In percent)

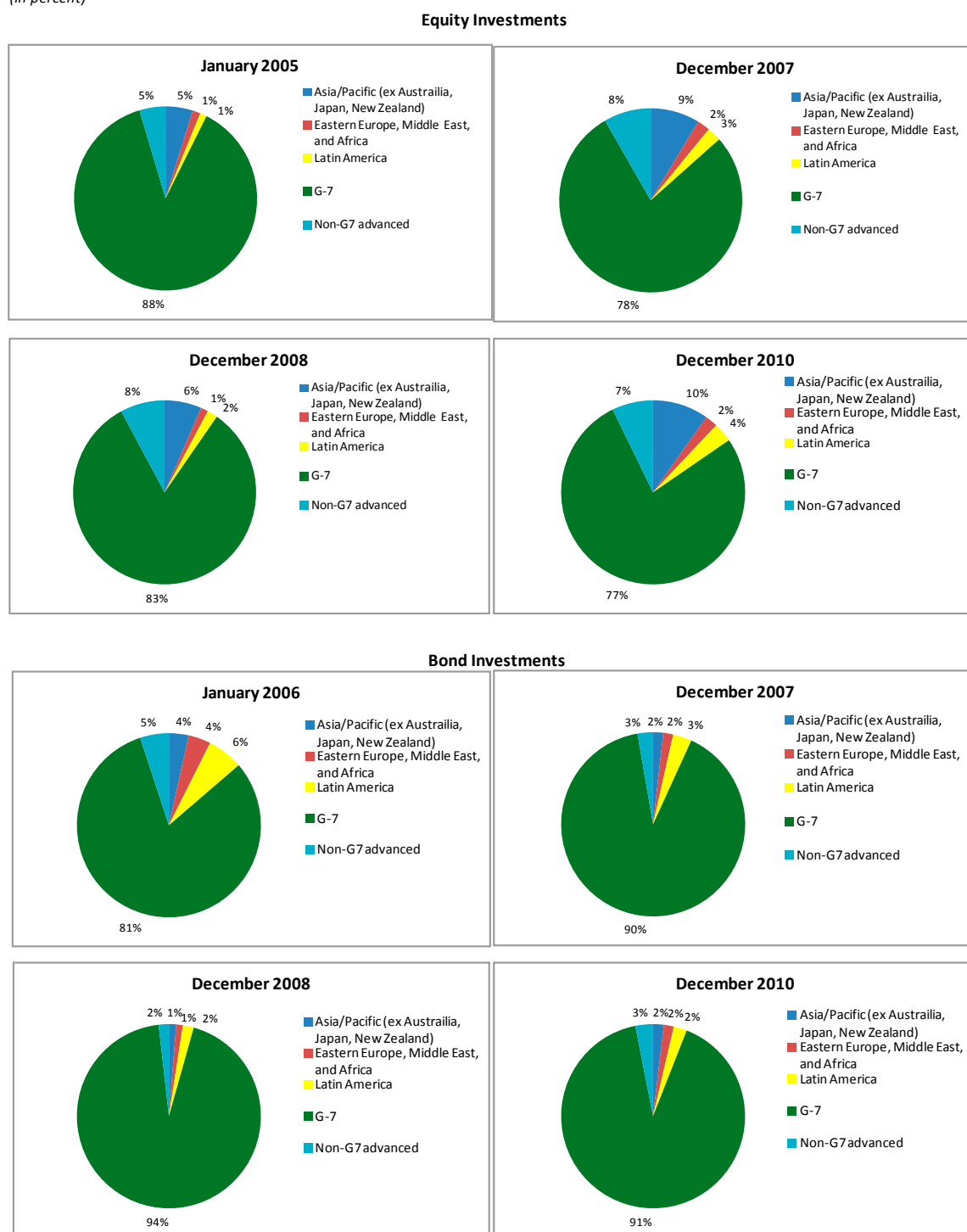
	Asset Managers				Pension Funds			
	Bonds		Equities		Bonds		Equities	
	2006	2010	2006	2010	2006	2010	2006	2010
Own country of domicile	61.0	60.1	47.5	44.8	78.1	75.7	55.5	50.3
East Asia/Pacific	3.4	3.6	8.5	9.0	1.8	2.4	8.6	10.1
Europe	27.2	27.1	28.2	27.1	11.7	11.4	22.1	21.4
Latin America	0.8	0.8	1.8	2.6	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: Figures are averages of 29 respondents' and 32 respondents' allocation shares for bonds and equities, respectively for asset managers; and 28 respondents' allocation shares for pension funds.

44. 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 significantly adding to their holdings in non-G-7 regions already 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 towards 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.

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



Sources: EPFR; and IMF staff calculations.

45. While 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 rather than in equities, although 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 homogenous asset class. Nonetheless, investors retain some home or regional bias.

46. **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.

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 of 55 respondents' and 49 respondents' allocation shares for asset managers and pension funds, respectively.

E. Effects of New Regulatory Initiatives

47. **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 countries in the mid-2000s (see OECD, 2005; Boeri and others, 2006; Committee on the Global Financial System 2007; and Committee on the Global Financial System, 2011). Recent other examples of such regulations are the Basel III proposals for banks of 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.

48. **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 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. While 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.

49. **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 completely be 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.²³ 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.²⁴ Their investment behavior regarding this risky part of their portfolio might well become more volatile,

²³ See Committee on the Global Financial System (2011) and World Economic Forum (2011).

²⁴ 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).

leading to a risk of sudden reversals in some less liquid markets, including in emerging economies.

IV. CONCLUSIONS AND POLICY IMPLICATIONS

50. **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 both flows into 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.

51. **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.²⁵

52. **While the trend of 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 has 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 reaction other types of investors (including those that are leveraged—see Chapter 1) would likely compound these investment outflows, or even initiate them.

²⁵ See Ostry and others, (2010).

53. **Policymakers should prepare for the possibility of a pullback from their markets 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.

54. **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 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 so far no evidence that this effect is fading. This may be evidence that risk aversion of institutional investors has fundamentally changed.²⁶

55. **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 their recent allocations indicate that investors have in general not yet moved into riskier assets to enhance yields.²⁷ 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.

²⁶ 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.

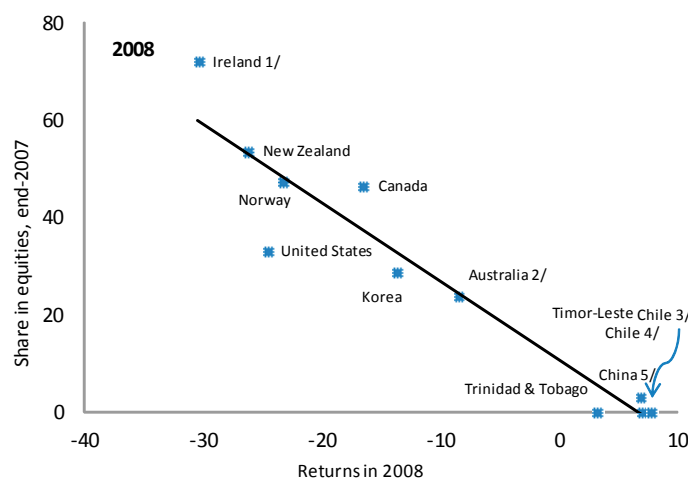
²⁷ See, for example, OECD (2011).

Box 2.4. Sovereign Asset Management and the Global Financial Crisis¹

This box describes how Sovereign Wealth Funds (SWFs) were affected by, and responded to, the global financial crisis.

The global financial crisis affected SWFs across the board. The sharp downturn in prices of risky assets, particularly equities, resulted in large losses for many funds. The extent of their losses—in some cases, in excess of 30 percent—reflected, naturally, their varying exposure to risky assets, in particular, equities (see figure below). Key to the subsequent recovery of those that had suffered large losses was their ability and willingness to stay invested in those assets and “ride out” the financial turmoil. As financial market conditions started to improve in early 2009, those longer-term approaches paid off.

Sovereign Wealth Funds: Shares in Equities and Returns, 2008 and 2009
(In percent)



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

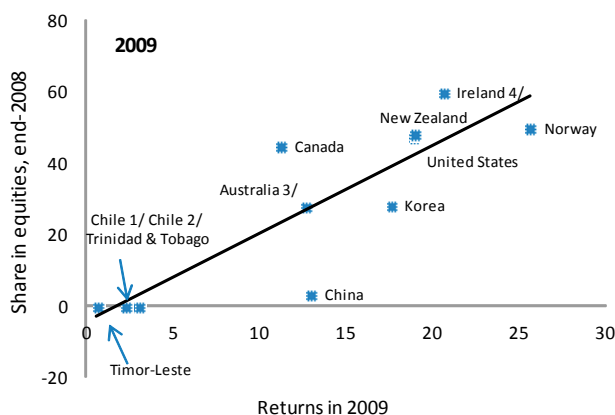
1/ Directed investments excluded.

2/ Excluding Telstra.

3/ Economic and Social Stabilization Fund

4/ Pension Reserve Fund

5/ For China, the share of equity as of end-2008.



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

1/ Pension Reserve Fund

2/ Economic and Social Stabilization Fund

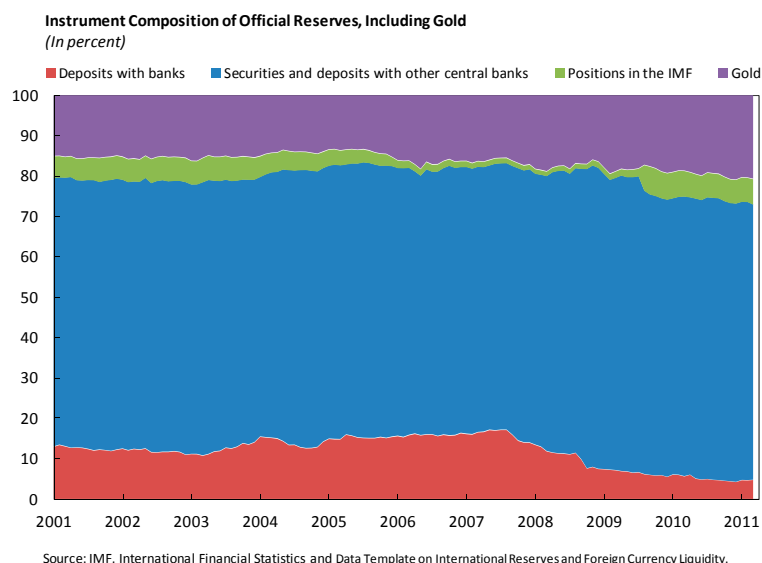
3/ Excluding Telstra

4/ Directed investments excluded.

Governments used SWF assets during the crisis to support economic, fiscal and financial stability objectives. Their new functions—some in line with their original mandate, others beyond—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 figure below). Several surveys, in particular those conducted annually by Central Banking Publications, and other studies (Pihlman and van der Hoorn, 2010) confirm that reserve managers' risk aversion increased and that reserve managers participated in the global flight to quality and liquidity. This was seen most clearly in the flight out of unsecured bank deposits: the proportion of reserves invested in this asset class (as a share of total including gold at market prices) dropped rapidly from its peak of 17.2 percent in July 2007 to less than 5 percent in June 2010. This raised concerns that reserve managers, by acting procyclically, 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 address this issue more formally, for example through an update of the IMF's Guidelines for Foreign Exchange Reserve Management.

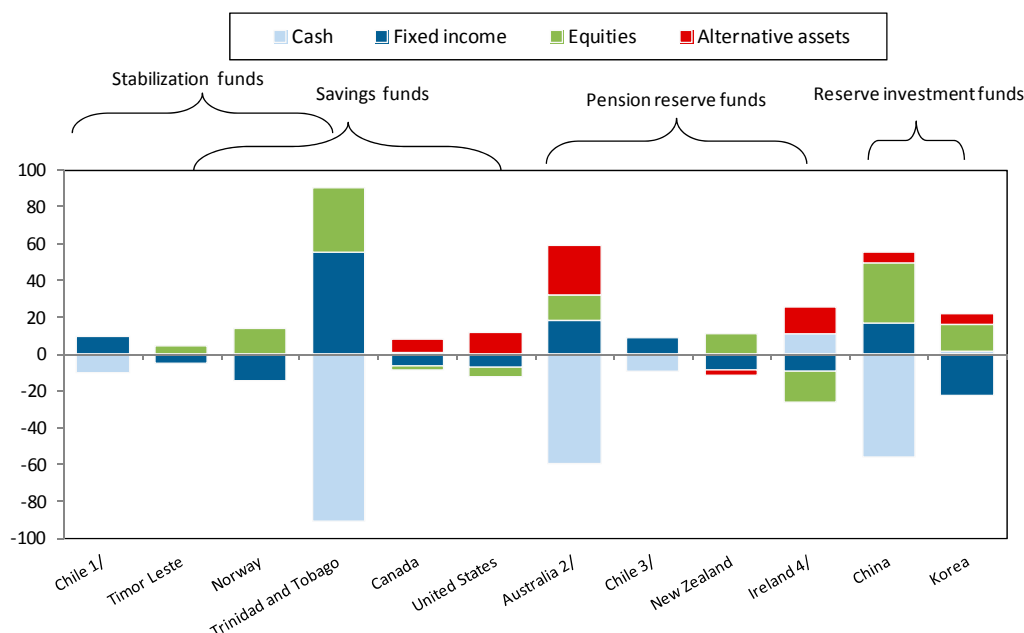


The asset allocation of SWFs in the aftermath of the crisis—and therefore the extent to which they may take on the risks that are now avoided by private institutional investors—is subject to several opposing factors. Like many private investors, SWFs suffered severe losses in the crisis and have likely become more sensitized to the various types of risk, and may have become more risk averse as a result. In addition,

changing mandates that could now include fiscal, economic and financial stabilization objectives may require assets to be safer or more liquid. On the other hand, however, the crisis and post-crisis 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 post-crisis 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 figure below). Like private asset managers, sovereign asset 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). Most of these new investments have been financed by cash, and to a lesser extent, fixed income holdings. Also, mirroring private trends, many have increased investments in emerging markets.²

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



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

Note: For Trinidad and Tobago, the change is between December 31, 2010 and September 30 2007; for Australia, the change is between December 31, 2010 and January 31, 2008; for China, the change is between December 31, 2009 and December 31, 2008.

1/Economic and Social Stabilization Fund

2/For Australia, excluding Telstra.

3/Pension Reserve Fund

4/For Ireland, directed investments excluded.

¹ Box prepared by Yinqiu Lu, drawing on Kunzel and others (2010).

² Examples of geographic diversification to emerging markets abound. For example, 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 exposure to emerging markets in Asia, Brazil, and the Russian Federation and reduce emphasis on OECD countries from one-third to one-fifth of its assets (see http://www.temasek.com.sg/media_centre_news_speeches_120509.htm). Norway has increased its presence in Asia by opening offices in Shanghai and Singapore (see <http://www.nbim.no/en/press-and-publications/News-List/2010/nbim-opens-new-office-in-singapore/>).

56. 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 will 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 will 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.

57. 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.

58. 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 lie at the basis of capital flows between institutions, markets, and countries. Direct monitoring of these changes 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 flows of funds) is 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.²⁸

²⁸ The IMF is contributing to this effort, including through the G-20 Data Gaps Initiative. See <http://www.imf.org/external/np/g20/pdf/102909.pdf>.

Annex 2.1. Asset Allocation: Theory and Practice²⁹

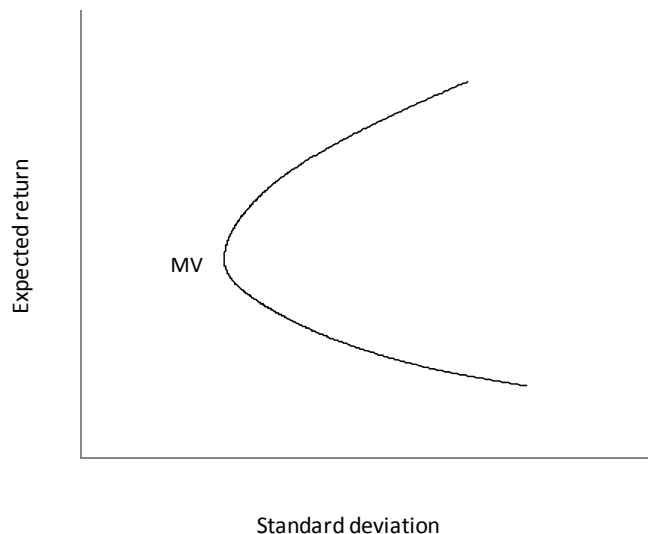
59. Markowitz (1952) changed the way both academics and practitioners would look at the portfolio selection problem. Modern portfolio theory, based on Markowitz' mean-variance approach, became the basis for the Capital-Asset-Pricing Model (CAPM), as well as for the application of continuous-time mathematics to the portfolio choice problem.

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

$$\begin{aligned} (1) \quad & w^{\min} = \min \{ w' \Sigma w \} \\ & \text{subject to} \\ (2) \quad & w' r = \hat{r} \end{aligned}$$

and other constraints, where w is a column vector of portfolio shares, r is a column vector of expected returns, and Σ is the covariance matrix of returns. w and r are of dimension $n \times 1$, Σ is of dimension $n \times n$. w^{\min} is the vector of portfolio shares, which 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, the *minimum-variance frontier* (see Figure 2.10). The upper part of the minimum-variance frontier, starting at the point of minimum variance MV, is called the *efficient frontier*, as these portfolios dominate those on the frontier below MV, which provide a lower return for the same risk.

Figure 2.10. Minimum Variance Frontier



²⁹ Annex prepared by Peter Lindner.

61. Starting in the 1970s, the mean-variance approach became the workhorse of most asset allocators. 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 the minimum, it provided a benchmark, against which other asset allocation models could be compared.

62. However, despite the large-scale integration of the mean-variance approach into strategic asset allocation, the approach suffered from a number of weaknesses.

63. First, expected returns and the covariance matrix of returns have to be estimated, or derived from analyst estimates. Investors typically have fairly firm ideas about the returns of only a subset of assets. For another set of assets, they might have an imprecise idea; for the remainder of assets, they might not have formed any expectation. The mean-variance approach needs point estimates for all asset returns, however. To avoid having to arrive at a full set of expected returns, many investors simply use historical returns when other estimates are not available. In the case of fixed income, yields are often used as expected return estimates. A significant problem is that historical estimates and yields have proved bad indicators of future returns. Similarly, although estimates of the matrix of return (co)variances (or volatilities) were initially deemed fairly stable, recent statistical advances have shown that they are time-varying.³⁰

64. A second, more fundamental, problem occurred in many applications. When correlations between assets were high, and they exhibited similar volatilities, small changes in expected returns among the highly correlated assets would lead to large changes in portfolio allocations, far greater than most users would expect and leading to potentially large transaction costs. Effectively, a mean-variance optimization algorithm has difficulty discriminating between the different assets in this case, and put a higher portfolio share on the one with only a slightly higher expected return.

65. Users dealt with these drawbacks mainly by imposing constraints, for example limiting certain assets to a much smaller share than the unconstrained 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.³¹

³⁰ Time-varying covariance matrices also presented a problem. Covariance matrices which utilize the Generalized Autoregressive Heteroscedasticity (GARCH) model can accommodate changing volatilities and correlations.

³¹ The purpose of this is to incorporate elements like trading and market impact costs, or the potential of market intervention by regulators, which are often hard to model.

66. The Black-Litterman (BL) approach sought to address these issues.³² It derives a vector of implied expected returns from the existing weights of the market portfolio. These returns are then used as a starting point for further analysis, to which the investor can add her own return forecasts, plus her confidence in those forecasts. In addition, return forecasts can be formulated on a relative basis (i.e., 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 BL-model applications, only the weights of those assets for which returns were modified would change appreciably upon recalculation.

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

- i. 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 the increasingly popular derivatives) made it progressively harder to justify allocation algorithms based on linear approximations.
- ii. A number of events occurred that focused attention on “tail risks,” which within the framework of a normal distribution had an extremely small probability of occurring (including the global financial crisis).³³ Also, besides many standard asset return distributions exhibiting fat-tailedness, many also display asymmetry, or ‘*skewness*’. These distributional observations made the assumption of normality hard to maintain, and models that incorporate this assumption lead to unexpectedly large losses.

68. Indeed, the global financial crisis weakened investors’ trust in the mean-variance model. Although advances have been made on the quantitative and statistical fronts and there has been more reliance on investment experience, no consensus approach has emerged that could take the place of the mean-variance model.

³² See Black and Litterman (1990 and 1992), and Idzorek (2005).

³³ Depending on the assets under consideration, the datasets used, and the data frequency covered, sometimes probabilities in the order of one in a trillion were found to pertain ex-ante to some of the observed returns.

Annex 2.2. Results of the IMF Survey on Global Asset Allocation³⁴

69. 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.³⁵ 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. The participants who agreed to be identified are listed at the end of this annex (Table 2.22).

A. Assets under Management and Allocation Trend³⁶

70. As of the end of 2010, the survey participants' assets under management (AUM) were \$16 trillion for asset managers and \$3 trillion for pension funds (Table 2.11). The latest available data put the end-2009 total for the global fund management industry at \$71 trillion.³⁷ Also, the participating asset managers cover a wide range of investor types (Table 2.12).³⁸

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

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.

³⁴ This annex was prepared by Ken Chikada.

³⁵ The potential participants were identified with data in Towers Watson (2010a, 2010b) and other relevant information.

³⁶ While the survey aimed to collect quantitative data since 2002, many participants had difficulty in providing consistent data for 2002. This annex focuses on the data since 2006.

³⁷ TheCityUK (2010).

³⁸ 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.

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 of 55 respondents' and 49 respondents' allocation shares for asset managers and pension funds, respectively.

B. Global Asset Allocation and Underlying Factors

72. As for the allocations 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.

73. 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, the desire for portfolio diversification played a key role (Table 2.17).

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: Figures are averages of 29 respondents' and 32 respondents' allocation shares for bonds and equities, respectively for asset managers; and 28 respondents' allocation shares for pension funds.

Table 2.15. Top Investment Destinations
(Ranked by scores)

Rank	Asset Managers		Pension Funds	
	Country	Score ¹	Country	Score ¹
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: Numbers of respondents are 64 and 52 for asset managers and pension funds, respectively.

¹ Each participant was asked to report 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.

Table 2.16. Top 5 Factors Considered in Country Allocation
(Ranked by scores)

Rank	Asset Managers		Pension Funds	
	Factors	Score ¹	Factors	Score ¹
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: Numbers of respondents are 62 and 43 for asset managers and pension funds, respectively.

¹ Each participant was asked to report top four factors. Score is calculated as 4*rank 1 factor + 3*rank 2 factor + 2*rank 3 factor + 1*rank 4 factor.

Table 2.17. Top 5 Factors Considered in Cross-border Investment since end-2006
(Ranked by scores)

Rank	Asset Managers		Pension Funds	
	Factors	Score ¹	Factors	Score ¹
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: Numbers of respondents are 61 and 40 for asset managers and pension funds, respectively.

¹ Each participant was asked to report top four factors. Score is calculated as 4*rank 1 factor + 3*rank 2 factor + 2*rank 3 factor + 1*rank 4 factor.

C. The Low Interest Rate Environment and Risk-Return Profiles

74. Since 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).

Table 2.18. Risk Exposure and Return of Portfolios
(In percent of respondents)

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

Source: IMF Survey on Global Asset Allocation.

Note: Numbers of respondents are 63 and 49 for asset managers and pension funds, respectively.

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 3 years, compared to today?

75. 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).

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: Numbers of respondents are 64 and 49 for asset managers and pension funds, respectively.

Share of respondents expecting the policy rates in advance economies to return to end-2007 levels in respective time horizon.

D. Usage of Derivatives

76. Both the asset managers and pension funds mostly used currency forwards and futures as hedging instruments, 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 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 2.20. Usage of Hedging Instruments
(In percent of respondents)

Asset Managers

Instruments	Usage ¹	Of which: usage has since end-2006	
		<i>increased</i>	<i>decreased</i>
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

Instruments	Usage ¹	Of which: usage has since end-2006	
		<i>increased</i>	<i>decreased</i>
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: Number of respondents are 63 and 52 for asset managers and pension funds, respectively.

¹Share of respondents who used respective hedging instruments at the time of the survey.

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

	Asset Managers	Pension Funds
No, not now and not in the past	33.8	49.1
No, not any more	1.5	0.0
Yes and their use has decreased since end-2006	6.2	1.9
Yes and their use has not changed since end-2006	16.9	9.4
Yes and their use has increased since end-2006	41.5	39.6

Source: IMF Survey on Global Asset Allocation.

Note: Number of respondents are 65 and 53 for asset managers and pension funds, respectively.

Share of respondents who used or did not use derivatives to enhance yields at the point of survey.

Table 2.22. Survey Participant List

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 Pensioenfond 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	Anonymous (22)
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	
Anonymous (23)	

Source: IMF Survey on Global Asset Allocation.

Note: This list contains only the names of institutions who agreed to be acknowledged for their participations in the survey.

Annex 2.3. Defining Foreign Exchange Reserves and Sovereign Wealth Funds³⁹

Foreign Exchange Reserves

77. The IMF's primary definition of reserves is contained in Chapter VI of its Balance of Payments and International Investment Position Manual, sixth edition (2009): "*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).*"

78. The IMF defines reserve assets further by stating that "reserve assets must be both denominated and settled in foreign currency" (paragraph 6.71); that "reserve assets 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). It should be noted that there are not many restrictions on the asset classes that can be used for reserve asset investments. The main constraints concern liquidity ("*readily available*") and they must constitute claims on "*nonresidents*" in "*convertible foreign currencies.*"

Sovereign Wealth Funds

79. SWFs are defined as follows: "*SWFs are defined as special purpose investment funds or arrangements, owned by the general government. 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, which include investing in foreign financial assets. The 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.*"⁴⁰

80. This definition excludes, inter alia, foreign currency reserve assets held by monetary authorities for the traditional balance of payments or monetary policy purposes, operations of state-owned enterprises in the traditional sense, government-employee pension funds, or assets managed for the benefit of individuals.

³⁹ Annex prepared by Peter Lindner.

⁴⁰ See International Working Group of Sovereign Wealth Funds (2008).

Three key elements define an SWF:

- Ownership: SWFs are *owned* by the *general government*, which includes both central government and sub-national governments.⁴¹
- Investments: The investment strategies include investments in *foreign financial assets*, so it excludes those funds that solely invest in domestic assets.
- Purposes and Objectives (Table 2.23): Established by the general government for macroeconomic purposes, 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. SWFs are created to serve a different objective than, for example, reserve portfolios held *only* for traditional balance of payments purposes. While SWFs may include reserve assets, the intention is not to regard all reserve assets as SWFs.⁴²

81. Furthermore, the reference in the definition 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” reflects both the traditional background to the creation of SWFs—the revenues received from mineral wealth—and the more recent approach of transferring “excess reserves.”

82. It should be noted that reserve assets and assets held by an SWF can overlap. Reserve assets can be held within an SWF. This can only occur, though, when the SWF is permitted to transact in such assets only on terms specified by the monetary authorities or only with their express approval.” (see Balance of Payments and International Investment Position Manual, sixth edition (2009), paragraph 6.67).

⁴¹ 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.

⁴² 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 also are held for purposes other than balance of payments purposes (e.g., as 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	Norway, Government Pension Fund	Norway, Government Pension Fund		
	1999	Azerbaijan	State Oil Fund	State Oil Fund		
	2000	Iran	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			
	2002	Equatorial Guinea		Fund for Future Generations of Equatorial Guinea		
	2004	Sao Tome & Principe		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	Russia	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	
	2004	Australia			Australia, Future Fund	
	2005	Korea				Korea Investment Corporation
Foreign exchange reserves	1981	Singapore				Government of Singapore Investment Corporation
	2005	Korea				Korea Investment Corporation
	2007	China				China Investment Corporation

Source: Kunzel, Lu, Petrova, and Pihlman (2010).

Annex 2.4. Theoretical Foundation of the Regression Specification and Detailed Regression Results⁴³

83. In the generic Mean-Variance (MV, 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.⁴⁴ Solving this problem, we can thus get optimal portfolio shares that minimize the variance for all possible returns. Each investor can then choose a variance-return combination of his choice that maximizes his welfare (which will depend on his risk aversion). Later versions of the MV model have used various "utility" functions (i.e., 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:

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

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 there are 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 Σ_{t+1} . α_t is a vector of allocations to the risky asset. The riskless asset has return $R_{f,t+1}$ from time t to $t+1$. The portfolio manager optimally chooses α_t to maximize his utility subject to the budget constraint.

84. No closed-form solution (yielding explicit portfolio weights based on the other variables) exists to this problem. 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:

$$\alpha_t = \frac{1}{\gamma} \Sigma_t^{-1} (E_t \mathbf{r}_{t+1} - r_{f,t+1} \mathbf{1} + \sigma_t^2 / 2) + \left(1 - \frac{1}{\gamma}\right) \Sigma_t^{-1} \sigma_{ht} \quad (3)$$

where σ_{ht} is the vector of covariances of each risky asset return with revisions in expected future portfolio returns:

⁴³ Annex prepared by Ruchir Agarwal, Serkan Arslanalp, and Tao Sun.

⁴⁴ Markowitz (1952).

$$\sigma_{ht} = Cov_t(\mathbf{r}_{t+1}, -(E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j r_{p,t+1+j}) \quad (4)$$

where ρ is a discount factor applied to future returns. One transformation of (2) allows us to restate the σ_{ht} term as the covariance of the risky asset return with the value function, v_t : $\sigma_{ht} = Cov_t(\mathbf{r}_{t+1}, -v_{t+1})$. This shows that the intertemporal component of asset demand is determined by the covariance of the risky asset return with the investor's utility per unit wealth, which varies over time with investment opportunities.

85. 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), i.e., an intertemporal term. The weights on these terms are proportional to the investor's risk tolerance ($1/\gamma$). This result, which assumes individually and identically distributed returns, therefore predicts that an investor will choose to allocate more of his portfolio wealth in a given asset i when

- it offers high expected returns, that is, $E_t \mathbf{r}_{t+1} - r_{f,t+1} + \sigma_t^2/2$ is high
- it has low variance, that is, the i^{th} diagonal term in Σ is low
- it has low covariance with other assets in the portfolio, that is, the applicable nondiagonal terms in Σ are low.
- it offers a hedge against future declines in portfolio returns, that is, σ_{ht} is high

When risk-aversion γ 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 other “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).

86. The independent variables proxy for the various determinants in equation (5) above, as follows:

Model determinant	Equities		Bonds	
	Empirical equivalent	Proxy in regressions	Empirical equivalent	Proxy in regressions
Expected returns	Capital gains	Real GDP growth	Coupon payments	3-month interest rate
	Dividends	Real GDP growth	Default/Credit risk	Real GDP growth
	Country risk	Country risk	Country risk	Country risk
Variance	Stock market volatility	Real GDP volatility	Inflation risk	Inflation volatility
Covariance (diversification effect)	Covariance with world returns	Covariance of country equity returns with	Covariance with world returns	Covariance of country bond returns with
		world portfolio returns		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 gives the detailed regression results.

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-G7 Advanced Countries	
	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds	Equities	Bonds
Policy rate differential (host-G4 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)
Time trend	0.000 (0.052)	0.071*** (10.724)	-0.026*** (-3.253)	0.105*** (10.226)	-0.034*** (-4.048)	0.088*** (6.367)	0.033 (1.575)	0.099*** (9.091)	0.014** (2.361)	0.033*** (3.651)	0.003 (1.227)	0.043*** (5.639)
Constant	0.932 (1.240)	-7.071*** (-6.913)	8.375*** (4.193)	-11.554*** (-4.710)	4.979*** (3.203)	-12.243*** (-9.145)	-4.228 (-1.542)	-11.027*** (-5.524)	-0.227 (-0.392)	-2.464** (-1.990)	0.352 (1.385)	-3.551*** (-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 host country and the simple average policy rate for G4. GDP growth forecast is the one-year-forward GDP forecast for host country, provided by Consensus Economics. Inflation volatility, GDP growth volatility, 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 Monetary and Capital Markets Department at the International Monetary Fund. Crisis dummy 1 represents the period between June 2007 and September 2008 (global credit crunch). Crisis dummy 2 represents the period after 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. T-statistics are in parentheses. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent level of confidence based on robust standard errors.

REFERENCES

- Black, Fischer, and Robert Litterman, 1990, "Asset Allocation: Combining Investors Views with Market Equilibrium." *Fixed Income Research*, Goldman, Sachs & Company.
- _____, 1992. "Global Portfolio Optimization." *Financial Analysts Journal*, September/October, pp. 28–43.
- Boeri, Tito, Lans Bovenberg, Benoît Coeuré and Andrew Roberts, 2006, "Dealing with the New Giants: Rethinking the Role of Pension Funds," Geneva Reports on the World Economy (Geneva: International Center for Monetary and Banking Studies).
- Borio, Claudio, Janneke Ebbesen, Gabriele Galati and Alexandra Heath, 2008, "FX Reserve Management: Elements of a Framework," BIS Papers, No 38 (Basel: Bank for International Settlements). Available via the Internet: www.bis.org/publ/bppdf/bispap38.pdf.
- Campbell, John and Luis Viceira, 2002, *Strategic Asset Allocation: Portfolio Choice for Long-term Investors*. (Oxford: Oxford University Press).
- Committee on the Global Financial System, 2007, "Institutional Investors, Global Savings and Asset Allocation," Working Group Report No. 27 (Basel: Bank for International Settlements). Available via the Internet: www.bis.org/publ/cgfs27.pdf.
- _____, 2011, "Fixed Income Strategies of Insurance Companies and Pension Funds," Working Group Report No. 44 (Basel: Bank for International Settlements). Available via the Internet: www.bis.org/publ/cgfs44.pdf.
- Financial Times*, 2011, "CIC seeks more funds out of China reserves," January 16. Available via the Internet: <http://www.ft.com/cms/s/0/a657ba86-219a-11e0-9e3b-00144feab49a.html#axzz1QV97Fico>.
- Forbes, Kristin and Francis E. Warnock, 2011, "Capital Flow Waves: Surges, Stops, Flight and Retrenchment," (Mimeo, May)
- Idzorek, Thomas M., 2005, "A Step-By-Step Guide to the Black-Litterman Model: Incorporating user-specified confidence levels." Ibbotson Associates.
- Impavido, Gregorio, 2011, "Stress tests for Defined Benefit Pension Plan - A Primer," IMF Working Paper 11/29 (Washington: International Monetary Fund).
- International Monetary Fund, 2001a, *Guidelines for Foreign Exchange Reserve Management* (Washington, September). Available via the Internet: www.imf.org/external/np/mae/ferm/eng/index.htm.

- _____, 2001b, *Government Financial Statistics Manual* (Washington, October). Available via the Internet: <http://www.imf.org/external/pubs/ft/gfs/manual/>.
- _____, 2007, *Global Financial Stability Report*, World Economic and Financial Surveys (Washington, April). Available via the Internet: <http://www.imf.org/External/Pubs/FT/GFSR/2007/01/index.htm>.
- _____, 2009, *Balance of Payments and International Investment Position Manual*, sixth edition (Washington). Available via the Internet: <http://www.imf.org/external/pubs/ft/bop/2007/bopman6.htm>.
- _____, 2010, *Global Financial Stability Report*, World Economic and Financial Surveys (Washington, April). Available via the Internet: <http://www.imf.org/external/pubs/ft/gfsr/2010/01/index.htm>.
- _____, 2011a, “Assessing Reserve Adequacy,” (Washington, February). Available via the Internet: www.imf.org/external/np/pp/eng/2011/021411b.pdf.
- _____, 2011b, *World Economic Outlook*, World Economic and Financial Surveys (Washington, April). Available via the Internet: <http://www.imf.org/external/pubs/ft/weo/2011/01/index.htm>.
- _____, 2011c, “Recent Experiences in Managing Capital Inflows—Cross-Cutting Themes and Possible Policy Framework” (Washington, February). Available via the Internet: <http://www.imf.org/external/np/pp/eng/2011/021411a.pdf>.
- International Working Group of Sovereign Wealth Funds, 2008, *Sovereign Wealth Funds: Generally Accepted Principles and Practices—“Santiago Principles”* (Washington). Available via the Internet: <http://www.iwgswf.org/pubs/eng/santiagoprinciples.pdf>.
- Kunzel, Peter, Yinqiu Lu, Iva Petrova, and Jukka Pihlman, 2010, “Investment Objectives of Sovereign Wealth Funds - A Shifting Paradigm,” in: *Economics of Sovereign Wealth Funds*, Das, Mazarei, and van der Hoorn (eds.), (Washington: International Monetary Fund). Available via the Internet: <http://www.imf.org/external/pubs/ft/wp/2011/wp1119.pdf>
- Markowitz, Harry, 1952, “Portfolio Selection,” *The Journal of Finance*, Vol. 7, No. 1, pp. 77–91.
- Mminele, Daniel, 2011, “Opening remarks at the World Bank Treasury’s RAMP-Africa Workshop in Cape Town,” 13 June.

- Niedermayer, Luděk, 2009, “When Liquidity and Reserve Management Collide,” in *RBS Reserve Management Trends 2009*, ed. by Robert Pringle and Nick Carver (London: Central Banking Publications).
- Norges Bank Investment Management, 2010, “NBIM opens new office in Singapore,” June 30. Available via the Internet: <http://www.nbim.no/en/press-and-publications/News-List/2010/nbim-opens-new-office-in-singapore/>.
- Organization for Economic Co-operation and Development, 2005, “Ageing and Pension System Reform: implication for Financial Markets and Economic Policies,” OECD Financial Market Trends, Volume 2005, Supplement 1 (Paris). Available via the Internet: www.oecd.org/dataoecd/1/35/35810991.pdf.
- _____, 2011, “Pension Markets in Focus,” Issue 8 (Paris, July). Available via the Internet: www.oecd.org/dataoecd/63/61/48438405.pdf.
- Ostry, Jonathan D., Atish R. Ghosh, Karl Habermeier, Marcos Chamon, Mahvash S. Qureshi, and Dennis B.S. Reinhardt, 2010, “Capital Inflows: The Role of Controls,” IMF Staff Position Note 10/04 (Washington: International Monetary Fund). Available via the Internet: <http://www.imf.org/external/pubs/ft/spn/2010/spn1004.pdf>.
- Pihlman, Jukka, and Han van der Hoorn, 2010, “Procyclicality in Central Bank Reserve Management: Evidence from the Crisis,” in: *Economics of Sovereign Wealth Funds*, Das, Mazarei, and van der Hoorn (eds.), (Washington: International Monetary Fund). Available via the Internet: <http://www.imf.org/external/pubs/ft/wp/2010/wp10150.pdf>.
- Pugh, Colin and Juan Yermo, 2008, “Funding Regulations and Risk Sharing,” OECD Working Papers on Finance Insurance and Private Pensions No. 17 (Paris: Organization for Economic Co-operation and Development).
- Temasek Holdings, 2009, Remarks by Ms Ho Ching, Executive Director and CEO, Temasek Holdings, “An Evening with the Junior Pyramid” May 12. Available via the Internet: http://www.temasek.com.sg/media_centre_news_speeches_120509.htm.
- TheCityUK, 2010 “Fund Management 2010.” Available via the Internet: <http://www.thecityuk.com/research/our-work/reports-list/fund-management-2010/>.
- Towers Watson, 2010a, “The World’s 500 Largest Asset Managers – Year End 2009.” Available via the Internet: <http://www.towerswatson.com/hong-kong/research/2942>.
- _____, 2010b, “P&I/TW 300 Analysis Year End 2009.” Available via the Internet: www.towerswatson.com/assets/pdf/2728/PI-TW-300-survey.pdf.

_____, 2011, “Towers Watson’s 2011 Insurer Investment Practices Survey.” Available via the Internet: <http://www.towerswatson.com/assets/pdf/mailings/2011-Insurer-Survey-Report-for-Survey-Participants-06-15-2011.pdf>.

World Economic Forum, 2011, “The Future of Long-Term Investing.” Available via the Internet: <http://www.weforum.org/reports/future-long-term-investing-1>.

Yermo, Juan and Clara Severinson, 2010, “The Impact of the Financial Crisis on Defined Benefit Plans and the need for Counter-Cyclical Funding Regulations,” OECD Working Papers on Finance Insurance and Private Pensions No. 3 (Paris: Organization for Economic Co-operation and Development).

SUMMARY—CHAPTER 3. TOWARDS OPERATIONALIZING MACROPRUDENTIAL POLICIES: WHEN TO ACT?

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 fallout.

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. And 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.

CHAPTER 3. TOWARDS OPERATIONALIZING MACROPRUDENTIAL POLICIES: WHEN TO ACT?⁴⁵

I. INTRODUCTION

87. **Macroprudential policy seeks to limit systemic risk that arises in or is transmitted and amplified by the financial sector.**⁴⁶ 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.⁴⁷ 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.

88. **It is widely agreed that risks can build up in the financial system over time and materialize precipitously during a crisis** (Drehmann and others, 2010). 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 build-up for some time now, but the idea has resurfaced in the wake of the global financial crisis.⁴⁸ 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.

89. **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).**

⁴⁵ The team includes Srobona Mitra (lead), Jaromir Benes, Silvia Iorgova, Kasper Lund-Jensen, Christian Schmieder, and Tiago Severo. Research support was provided by Ivailo Arsov and Oksana Khadarina.

⁴⁶ 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, and the degree of interconnectedness of financial institutions and markets.

⁴⁷ See discussions in IMF (2009, 2011a, and b), Adrian and Brunnermeier (2010), Acharya and others (2010), Billio and others (2010), Basel Committee on Banking Supervision (2010), and Brownlees and Engle (2010).

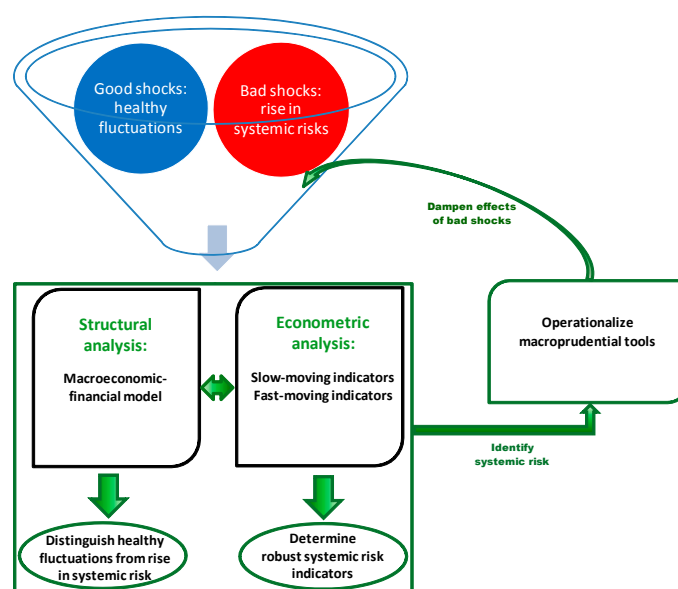
⁴⁸ For the pre-crisis literature, see Enoch and Otker-Robe (2007) and the references therein. Some recent studies include Mendoza and Terrones (2008); Barajas, Dell’Ariccia, and Levchenko (forthcoming); De Nicoló and Lucchetta (2010); Claessens, Kose, and Terrones (2011a and b); Kannan, Rabanal, and Scott (2009a and b); Borio and Drehmann (2009); Drehmann, Borio, and Tsatsaronis (forthcoming).

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.

90. **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.

91. **This chapter aims to contribute to operationalizing macroprudential policies along two dimensions.**⁴⁹ *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:

Figure 3.1. Road Map of the Chapter



- *How can one use a model of macroeconomic-financial interactions to identify meaningful early warning indicators for systemic financial risk?* Section II lays out a structural model incorporating feedbacks from the banking sector and the real economy. This section shows how the interaction among several variables can allow policymakers to discern patterns of systemic risk build up.

⁴⁹ The analysis builds on lessons from previous GFSR chapters (IMF 2009 and 2011a) focusing on systemic risk issues.

- *How can empirical analysis help in identifying a small set of robust indicators of systemic risk?* Section III evaluates both low-frequency 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 in Section II is used again in Section IV to examine how different sources of risk affect the use and effectiveness of countercyclical capital buffers, a key macroprudential policy tool. This section also sheds light on country practices.
- *Based on the above, the chapter proposes an initial, practical set of guidelines for monitoring systemic risk and operationalizing macroprudential policies.* Section V provides conclusions and a set of practical guidelines.

Box 3.1. Systemic Risk Monitoring and Policy Tools to be Used by Recently Established Key Macroprudential Authorities¹

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. By statute, the FSOC has a duty to facilitate the sharing of data and information among member agencies, and regulatory coordination. It is chaired by the Treasury Secretary that brings together federal financial regulators, an insurance expert, and state regulators. The FSOC will be based on a committee structure, with a Systemic Risk Committee; two Sub-committees on Institutions and Markets, respectively; and several Standing Functional Committees.
- **Monitoring:** The Systemic Risk Committee is accountable 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 financial system 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 reported and collected, while protecting confidential business data; and performing analysis on 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 Commodities 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 activities under the control of the primary financial regulatory agencies that are deemed to pose a threat to financial stability; (iv) determine whether action should be taken to break up firms that pose a “grave threat” to financial stability; and (v) recommend to Congress that it closes 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 the 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 contribute to the Bank of England's (BoE) financial stability objective by identifying, monitoring, and taking action to remove or reduce systemic risks—including structural aspects of the financial system or 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 will need to take into account the potential for any adverse impact on medium- or long-term economic growth and will be accountable to the governing body of the BoE. 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.
- **Monitoring:** The FPC will monitor the financial stability of the U.K.'s financial system, identifying emerging risks and vulnerabilities, and cyclical imbalances. In particular, the ratio of credit to GDP will be a trigger for the use of countercyclical capital buffers (CCBs). 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 kinds of action and will have a responsibility to advise the government on changes in the perimeter of the PRA's prudential supervision. As part of its mandate, the FPC will carry out preparatory work, including analysis of potential macroprudential tools. Instruments aimed at network issues could include recommendations or directions on disclosures regarding issuance and structuring of securities; on the trading infrastructure of markets; on limits on large exposures amongst different kinds of firms, and on shadow banking rules. Cyclical instruments will include the CCB and might also include varying liquidity requirements and capital risk weights, and/or minimum haircuts for specific types of secured lending. Minimum margining requirements might also be applicable for key funding markets.
- **Communication:** The minutes of the four regular meetings per year of the FPC will be published with the interim FPC minutes already available. A semi-annual Financial Stability Report (FSR) will contain an assessment of risks to financial stability and action taken by the FPC.² The publication of the FSR will coincide with an update by the Governor to the Chancellor.

The European Systemic Risk Board (ESRB)

- **Setup:** The ESRB, an independent EU body responsible for the macroprudential oversight of the financial system within the 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 Union. It shall also examine specific issues at the invitation of the European Parliament, Council, or Commission. In pursuing its functions, the ESRB needs to coordinate closely with all the other parties to 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 regular meeting (of four annually) in March 2011. The European Central Bank President chairs the ESRB. Its General Board includes the governors of all EU central banks, the three new European regulatory authorities and the European Commission, as well as the national supervisory authorities as nonvoting members.

- **Monitoring:** In pursuing its function, the ESRB should determine and/or collect and analyze all relevant and necessary information; and identify and prioritize systemic risks. As appropriate, it shall provide the European Supervisory Authorities (ESAs) with the information on systemic risks required for the performance of their tasks, and in particular, in collaboration with the ESAs, develop a common set of quantitative and qualitative indicators (risk dashboard) to identify and measure systemic risk. The ESRB may also request the ESAs to supply information on individual institutions on the basis of a reasoned request.
- **Policy Tools:** The ESRB will not have direct control over policy instruments. Rather, it shall issue warnings when systemic risks are deemed to be significant, and, where appropriate, make those warnings public. It shall also issue recommendations for remedial action in response to risks identified and, where appropriate, make those recommendations public. When the ESRB determines that an emergency situation may arise, it shall issue a confidential warning addressed to the European Council. The ESRB needs to monitor the follow-up to warnings and recommendations on the basis of an “act or explain” mechanism. 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 support the issuance of warnings and 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. At least annually, the Chair of the ESRB will be invited to a hearing in the European Parliament, marking the publication of the ESRB’s annual report to the Parliament and the Council.

¹This Box was prepared by Ann-Margret Westin with contributions from Erlend Nier.

²The Financial Stability Committee will continue with its statutory responsibilities in relation to the BoE’s existing financial stability objective under the 2009 Banking Act until new legislation is passed.

Sources: www.bankofengland.co.uk/publications/news/2011/040.htm;
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

II. FROM SOURCES OF RISK TO SYSTEMIC RISK INDICATORS: HELPFUL HINTS FROM A STRUCTURAL MACRO-FINANCIAL MODEL

92. **Identifying leading indicators of crises requires a carefully specified structural model of the interactions between the financial sector and the real economy.** Such a 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).⁵⁰ Carefully specified structural models can provide useful insights by helping policymakers disentangle empirical relationships, think of various endogenous feedbacks between the real and the financial sectors, and impose a consistent structure on macroprudential policy.

93. **The structural model could help predict movements of numerous macroeconomic and financial variables in response to alternative sources of shock.** For instance, rapid credit growth in a country is often associated with a higher probability of financial crisis.⁵¹ But a boom in credit can also reflect a healthy response of markets to expected future productivity gains.⁵² 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.

94. **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 (Benes, Kumhof and**

⁵⁰ The IMF as well as major central banks have developed one or more versions of these dynamic stochastic general equilibrium (DSGE) macroeconomic models to study the effectiveness and desirability of different macroeconomic policies (Roger and Vlcek, 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.

⁵¹ 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 and others (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).

⁵² Such gains could result from one or more developments, including new technologies, new resources, and institutional improvements.

Vavra, 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.⁵³ 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.

95. 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?
- 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?

96. 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.⁵⁴

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.⁵⁵ The bubble is irrational because it is not underpinned

⁵³ 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.

⁵⁴ No distinction is made between various types of assets—productive real capital, real estate, claims to investments, equity shares, and so on.

⁵⁵ 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

(continued)

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.⁵⁶ 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.⁵⁷ 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.

97. **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).⁵⁸ The figure shows the paths of four variables when each of the three

“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 in the “irrational” case.

⁵⁶ 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.

⁵⁷ A bubble scenario could arise if the actual productivity gains are less than expected.

⁵⁸ 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 Benes, Kumhof, and Vavra (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.

shocks hit the economy in quarter 1.⁵⁹ For example, the credit-to-GDP ratio increases initially as a response to any of the three shocks. 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.

98. **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.

⁵⁹ 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.

- Actual *loan-to-value ratios* (not shown in the figure) also behave differently.⁶⁰ 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, slowly reverting to its normal path as banks re-adjust their credit policies.⁶¹

99. **Does the structure of the economy alter the second lesson?** An important insight from the model is that the structure of the real economy, such as in terms of trade openness, does 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.

100. **In summary, the findings of this section are:**

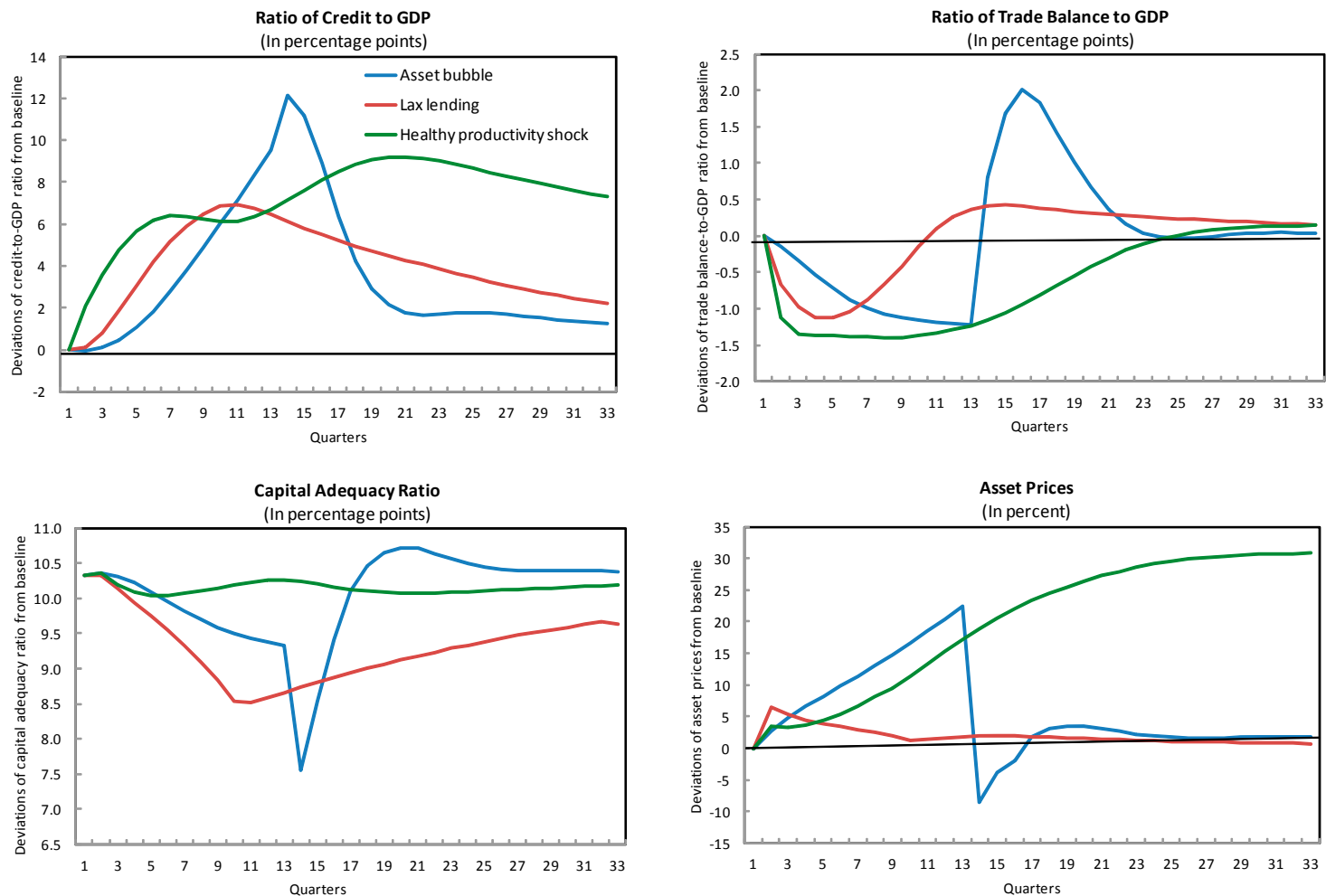
- All the responses to the shocks described above have distinctive patterns that are noticeable with enough lead time. For instance, increases in the credit-to-GDP ratio may signal the buildup of bubbles that wind up as future crises.
- Only when the ratio grows substantially and persistently should 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 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.

⁶⁰ 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.

⁶¹ The ratio of credit to asset value actually declines slightly with the onset of a price bubble because the bubble increases the value of assets that collateralize loans before lending increases enough to boost the ratio.

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 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 after two quarters.

III. THE QUEST FOR LEADING INDICATORS OF FINANCIAL SECTOR DISTRESS

101. **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.

102. **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 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.

103. **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 in Section II 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.⁶² 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.

104. **The analysis is guided by the following questions:**

- 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? (Subsection A).
- How can policymakers identify a buildup in risk without making costly mistakes?

⁶² Additional indicators are based on Shin (2010), Sun (2011), and IMF (2009). Ideally, also included would be the capital adequacy ratio, found to be informative in Section II; but for the entire time period, it is available for only a few countries.

What are the thresholds beyond which the indicator signals financial crises at a reasonable forecasting horizon with a sufficiently high degree of certainty? (Subsection B and Box 3.2).

- How much do credit aggregates and other indicators contribute to predicting a financial crisis? (Subsection C).
- 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? (Subsection D and Box 3.3).

A. Event Study of Risk Buildup

105. 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).⁶³ 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 data set. The main findings are:

- 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, changes in the credit-to-GDP ratio and changes in a broader measure of the credit-to-GDP ratio (Figure 3.3, panel A) accelerate sharply before a crisis event occurs.⁶⁴ In fact, the broader credit growth

⁶³ The Financial Stress Index (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 is not to be confused with the Financial Soundness Indicators. The FSI 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 treasuries); (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.

⁶⁴ 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 balance of payments statistics). The number of countries in the sample falls considerably when the broader measure is included.

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).⁶⁵
- Credit-to-deposit ratios higher than 120 percent are associated with crises within the next two years (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.⁶⁶
- 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).⁶⁷
- Countries with fixed exchange rates have much higher credit growth than average (Figure 3.3, panel F). This reinforces the findings (from Section II) that any shock propagates more strongly in a fixed or managed exchange rate regime.
- Real effective exchange rates (REER) tend to rise 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

⁶⁵ 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 five-year recursive 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.

⁶⁶ 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).

⁶⁷ This measure could be interpreted as a measure of noncore/core liabilities, which tend to grow with assets. See Shin and Shin (2011).

appreciation) of around 4 percent for most of the pre-crisis 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 the real exchange rate (Section II, 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 10–12 percent for two years before financial sector stress emerges.⁶⁸ 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 b) (Figure 3.3, panel H).

106. **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 deteriorating, bank and corporate cross-border funding going up, and leverage 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.

B. Exploring the Costs and Benefits of Issuing Signals Based on Leading Indicators

107. **Identification of financial risk buildup based on early warning indicators 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).

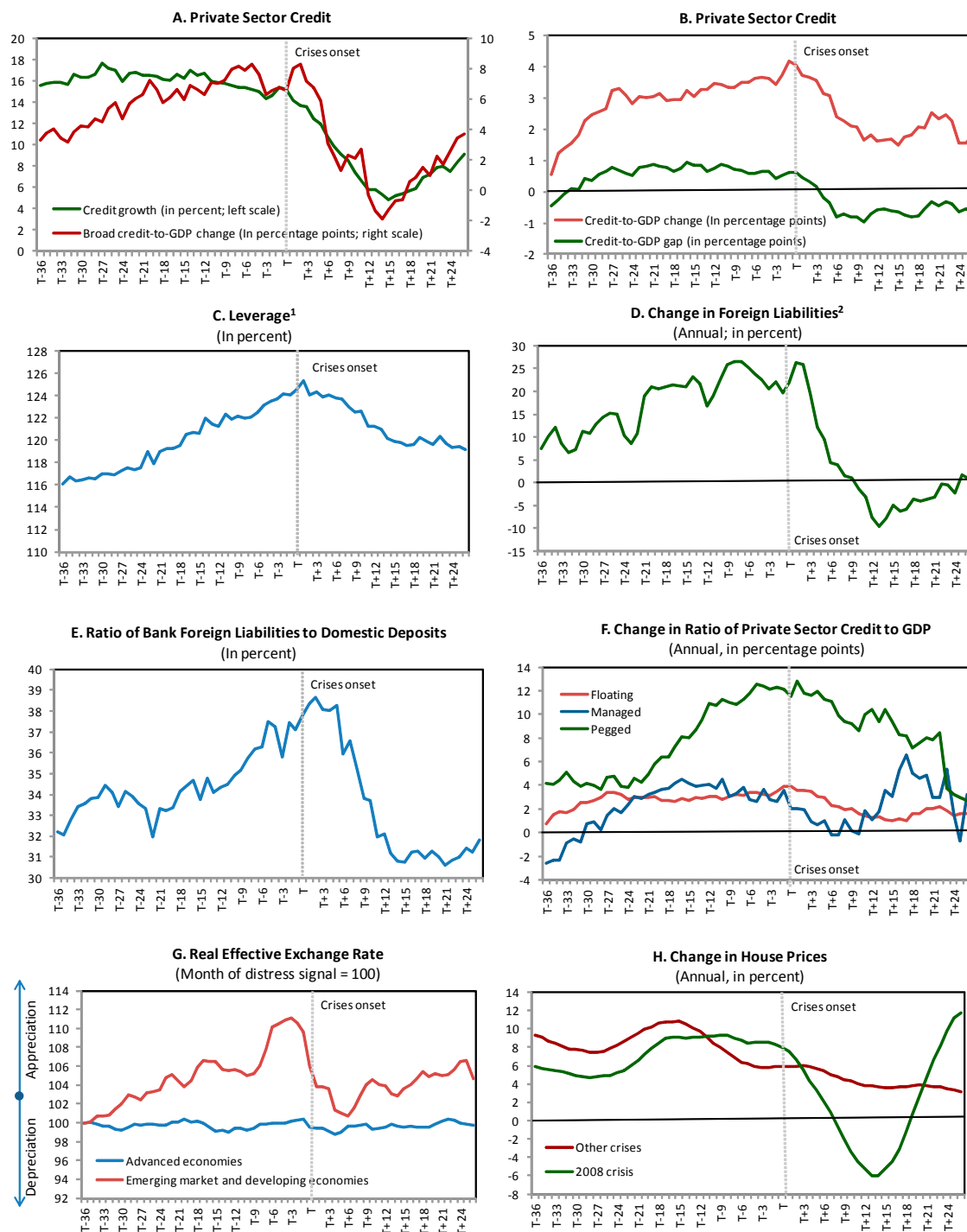
108. **To observe the ability of different slow-moving variables to properly balance Type I and Type II errors, two statistical methods are used:**

⁶⁸ 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.

- *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.⁶⁹ 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.

⁶⁹ 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.

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.

¹Ratio of credit to deposits.

²Bank and private sector loans, deposits, and currencies.

Box 3.2. Extracting Information from Credit Aggregates to Forecast Financial Crisis¹

Event study

Severe financial stress is identified on a country-by-country basis, at the 5 percentile upper tail of the Financial Stress Index (FSI) developed in IMF (2008).² While 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 single financial distress periods. In this regard, we consider breaks of up to six months as nonmaterial, 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 uniform windows of 36 months before and 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 build-up 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 HP-filter trend of the credit-to-GDP ratio, as in Drehmann, Borio, and Tsatsaronis, forthcoming). The analysis also looks at measures of asset prices (including equity and housing prices), total and foreign-funded leverage (credit-to-deposit and foreign liability-to-deposit ratios), and exchange rate dynamics.

We interpolate variables normally provided on a quarterly or annual basis—including GDP and capital flow measures—to a monthly frequency using log-linear interpolation.

Noise-to-signal

A signaling exercise in the spirit of Drehmann and others (forthcoming) is conducted using noise-to-signal ratios (NSR) including up to 169 countries (depending on the specification), which contains developed, emerging, and low-income economies.³ The NSR for different prediction-horizons (lags) provides a summary picture of what thresholds routinely predict crisis for different indicators and for different countries. Using annual data and the Laeven-Valencia crisis measure (LV) as an indicator for financial stress/crisis, 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 three years before the crisis event. All results have been determined in-sample, drawing upon previous research that suggests that the selected indicators also perform well out-of-sample (Borio and Drehmann, 2009).

Noise-to-signal Ratios: An Example

	Crisis occurs within a 3-year window starting k periods after the signal	Crisis does not occur within a 3-year window starting k periods 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 $k=\{1,2,3,4,5\}$.

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 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.⁴ A dummy variable is created, assuming the value of one 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 based on whether it predicts the occurrence of 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 one for a certain “crisis signal” at time t is followed by a value of one for the LV measure on at least one of the dates $t+k$, $t+k+1$, and $t+k+2$. If this 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 table 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 table above).
- The two types of errors are compared by means of the noise-to-signal ratio (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 excessive false signals. A higher NSR, on the other hand, results from a combination of missing actual crisis and producing too many false signals.

Receiver operating characteristic (ROC)

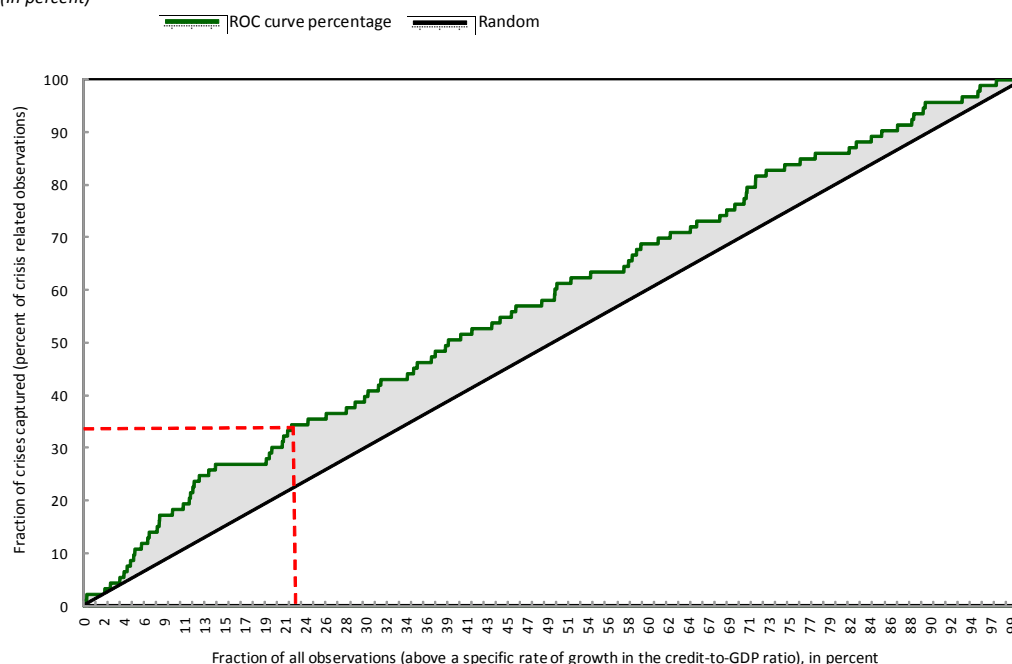
The ROC is a graphical method for determining the discriminatory power of signaling variables. For the purpose of this analysis, which uses the same dataset as the NSR, it plots the share of observations based on a pre-specified order of the signaling variable along the x-axis. For credit growth, for example, observations are ordered from the largest to the smallest value as higher credit growth is expected to be linked to crises. For example, suppose credit growth of 25 percent or greater is 1 percent of all observations. Then the 1 percent value for x would be associated with these levels of credit growth. To obtain the corresponding y-axis value, one compares the 25 percent or greater credit with the number of crises in the sample. The proportion of crises at this level (say, 3 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 credit growth threshold.

The predictive power of the signaling variable (in this case credit-to-GDP change for emerging markets) is determined by the area under the ROC curve (i.e., the shaded area between the upper and 45 degree lines in the figure below). The 45 degrees line in the figure corresponds to an area under the ROC curve of 0.5 and is equal to random sampling of both x and y axis variables, that is, does not indicate any specific predictive power. In the example shown below, the area is 0.57 (the area under the ROC for emerging markets in Table 3.2); that is, the shaded area is 0.07. If one uses a threshold of 3 percentage points for growth of the credit-to-GDP ratio (which corresponds to an x of 23 percent), for example, then one captures about 34 percent of all crises (resulting in a Type I error of 0.34).

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 allows improving the predictive power, for example by using the outcome of the probit regression documented in Annex 3.2.

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.

¹ This box was prepared by Silvia Iorgova, Christian Schmieder, and Tiago Severo.

² The Financial Stress Index (FSI) is a monthly indicator of financial system strain. The index relies on price movements relative to past levels or trends. See the text for details behind this indicator.

³ 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.

⁴ 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.

Noise-to-signal ratio

109. **The NSR is computed from annual data for 169 countries, with 109 crisis episodes identified by Laeven and Valencia (2010).**⁷⁰ 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.⁷¹ The findings suggest that:

- 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 only, the performance improves.
- 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 nonbank private sector.⁷² 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).

⁷⁰ The Laeven-Valencia index of episodes is a broad, coincident indicator for full-blown financial crises, using 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.

⁷¹ The sample is reduced for different indicators based on data availability. Results are similar for a one-year lag.

⁷² 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.

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
Laven 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.

110. **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.⁷³ As illustrated by the structural model in Section II, 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)

111. **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 low to high—a richer set of possible choices. The higher its ROC above 0.5, the better is a variable's predictive power (Table 3.2).⁷⁴ 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 on implementation methods.

⁷³ Borio and Drehmann (2009), who advocate this measure, consider a small set of advanced economies only.

⁷⁴ If the predictive power of an indicator is very low, then it is hard to choose meaningful thresholds for it.

- 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 20–30th 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 45–50th percentile in historical terms.
- A key finding for macroprudential policy is that asset prices peak earlier than credit aggregates, both for advanced and for emerging economies. Credit aggregates peak one to two years before crises whereas both equity and house price growth is at its 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 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 (Section II) also identified these asset price indicators as having the potential to identify the type of shock hitting the economy, and could indicate excessive optimism in the economy.

Table 3.2. Predictive Power of Various Indicators "X" Years before the Crisis

	All Crises Observations	Only Crises Observations X Years before Crises					All Crises 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: Dependent variable is the crisis indicator by Laeven and Valencia. Number of observations are low in some cases. An area under the ROC curve of 0.5 indicates that there is no additional discriminatory power compared to random sampling. The higher the number (which is bound at 1) the higher is the discriminatory power.

C. Panel Data Regressions

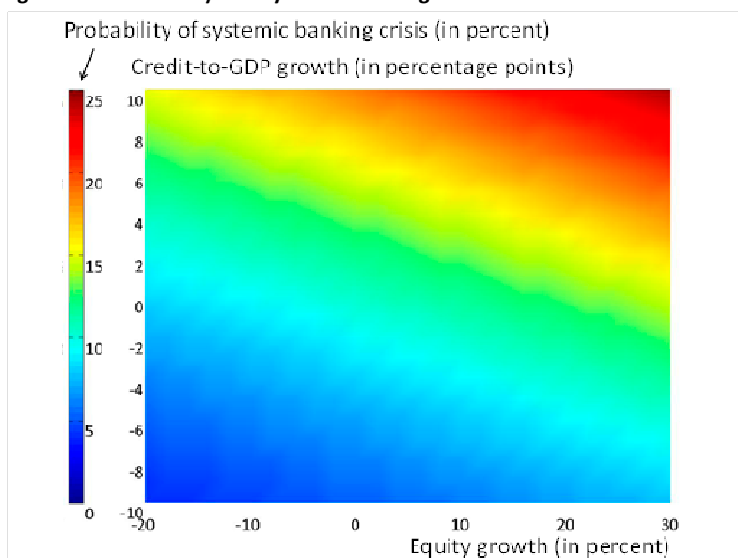
112. **A more formal estimation of the relationship between slow-moving variables and the probability of financial crises confirms that both credit measures—the credit-to-GDP gap and the change in the credit-to-GDP ratio—have a statistically significant effect on crisis probabilities. As is common of many of these types of studies, however, the estimated probability of a systemic banking crisis is small (see Annex 3.2).⁷⁵**

- 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 1.0 percentage point increase in the credit-to-GDP gap or an annual 1 percentage point increase in the credit-to-GDP ratio will increase the probability of a systemic banking crisis by 0.2–0.3 percentage point in each of the following two years.⁷⁶
- However, the probability of a crisis accelerates as credit growth (both the gap and change measures) increases from the median to 90th percentile (in sample).
- When other indicator variables are interacted with credit aggregates, the probability of a systemic crisis increases.⁷⁷ This is evident with equity price growth, confirming results from the NSR and ROC analyses. If growth of the credit-to-GDP ratio is at 5 percentage points, then equity price growth 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. For instance, if the model is estimated up to 2000, credit aggregates help forecast the recent crisis well in the United States (Figure 3.5 and Annex 3.2).

⁷⁵ A probit (unbalanced panel data) model with country fixed effects is jointly 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 unconditional probability of a crisis; 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.

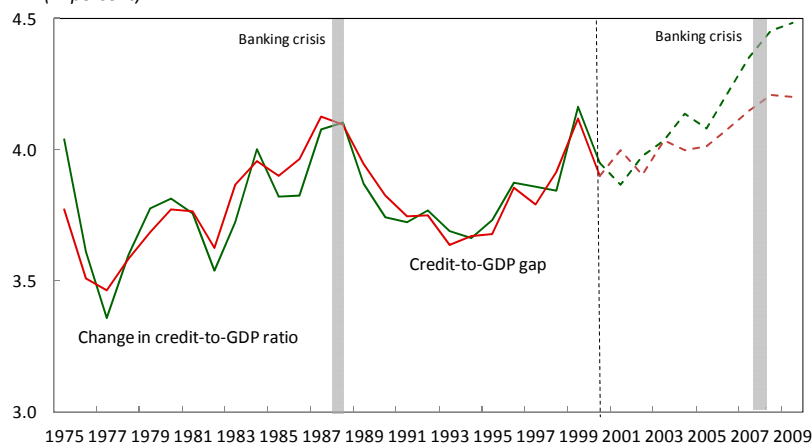
⁷⁶ See Annex 3.2 and Table 3.4, for medians based on data for 94 countries and methodological details.

⁷⁷ The estimation of the multivariate probit model is based on a smaller dataset because of data gaps for equity prices. Other variables, like the change in the real effective exchange rate, house price growth, growth in foreign liabilities, and the level of the loan-to-deposit ratio were tested but were not found to be robustly increasing the marginal effect of credit aggregates on the probability of crisis. The dataset also shrunk substantially when some of these variables were included.

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 is an unbalanced annual panel that lies within the period 1975–2010. The estimation with equity 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. Effect on Estimated Probability of a Systemic Banking Crisis in the United States from 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.

D. Near-Coincident Indicators of Imminent Crisis

113. 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 of 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).⁷⁸ Other high-frequency market-based indicators do well on other counts but not necessarily on average for all counts.

114. However, the market-based indicators do not necessarily signal rising interconnectedness of the financial system well ahead of time. If policy makers 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.⁷⁹ 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.

⁷⁸ 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 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 LIBOR-OIS spread.

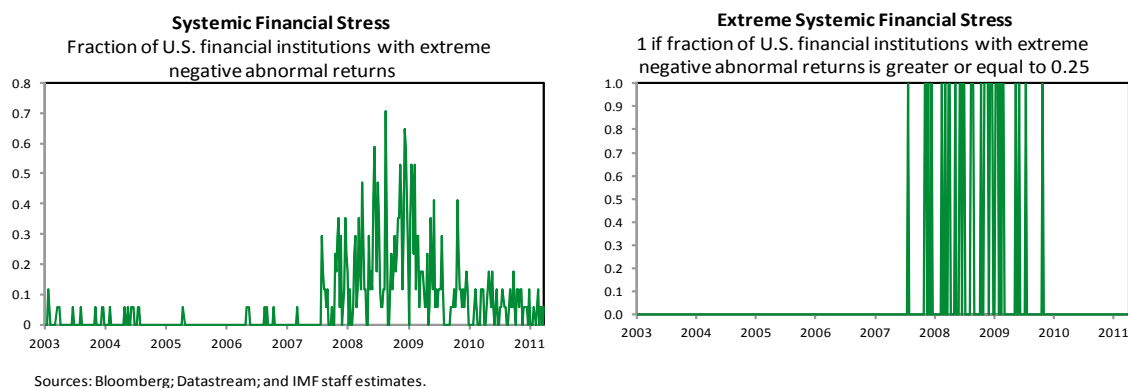
⁷⁹ IMF (2010a) provides a method of calculating a systemic solvency surcharge based on interconnectedness; IMF (2011a) provides such a surcharge for systemic liquidity risk.

Box 3.3. Risk-Materialization: Robust Set of Near-Coincident Indicators of Financial System Stress¹

High-frequency market-based indicators would best inform policymakers that a systemic event or crisis is imminent (“near-coincident” indicators). Such signals can then be used by policymakers to prepare for releasing their capital or liquidity buffers or be built into macroprudential measures to do so automatically. Various econometric techniques are used to determine robustness in a group of near-coincident indicators. The findings suggest that an indicator that combines information from the yield curve and the LIBOR-OIS spread worked best for the United States. However, these indicators are not good at flagging rising interconnectedness of two failed banks.

The current crisis is used as a testing ground for various high frequency indicators and a new indicator for ongoing stress specific to the financial sector, is introduced. The “systemic financial stress” (SFS) is the fraction of financial institutions in the system experiencing extremely negative abnormal returns (with negative returns persisting for two weeks following the day on which extreme negative abnormal returns was recorded).² A second measure, a subset of observations on the SFS, serves to distinguish *extreme* stress from ongoing stress. This subset is defined by days on which 25 percent or more financial institutions are experiencing stress (SFS larger than 0.25) (Figure below, right panel). For the United States, the SFS helps predict extreme changes in the real economy.³ The set of high-frequency near-coincident indicators are then tested against both the SFS and its extreme form, calculated using equity returns of 17 domestic financial institutions from the United States for weekly data 12/30/2002–4/11/2011.

Systemic Financial Stress in the United States



The performance of the indicators to signal risk-materialization stem from three characteristics, each of which are given scores (ranging 0–1):⁴

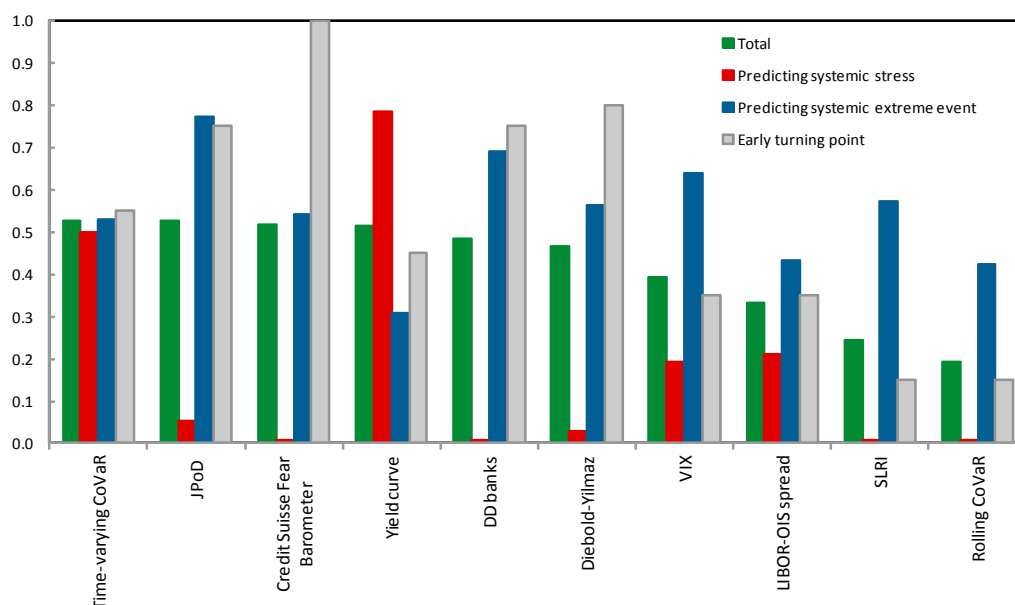
- The indicator should be able to predict SFS on an ongoing basis at a reasonable horizon.⁵
- The indicator should be able to predict extreme SFS with reasonable likelihood.⁶
- The indicator should have an early turning point (the break point detected in the level and persistence process of the variable should be early).⁷

The ten near-coincident indicators of systemic risk are then ranked by their total scores based on the criteria above, with scores running from 0 (worst) to 1 (best). See Annex 3.3 for details.

Based on the scores, the time-varying Conditional Value-at-Risk or CoVaR (that takes into account the yield curve between 10-year Treasury bonds and the 3-month Treasury bills and the LIBOR-OIS spread as time-varying

additional variables in the methodology) is the best overall performing “near-coincident” indicator (Figure below). The appeal of the Joint Probability of Distress (JPod) comes from its specific ability to forecast extreme systemic stress events (or tail-risk scenarios), but is not a good measure, like the Distance-to-Default (DD), in forecasting stress in general. The yield curve by itself is best at signaling systemic stress events. The Credit Suisse Fear Barometer has the earliest turning point.⁸

Performance of Near-Coincident Indicators in Predicting Severe Stress Early Enough, by Indicator and Three Metrics
(Index: 0-1, higher the better)

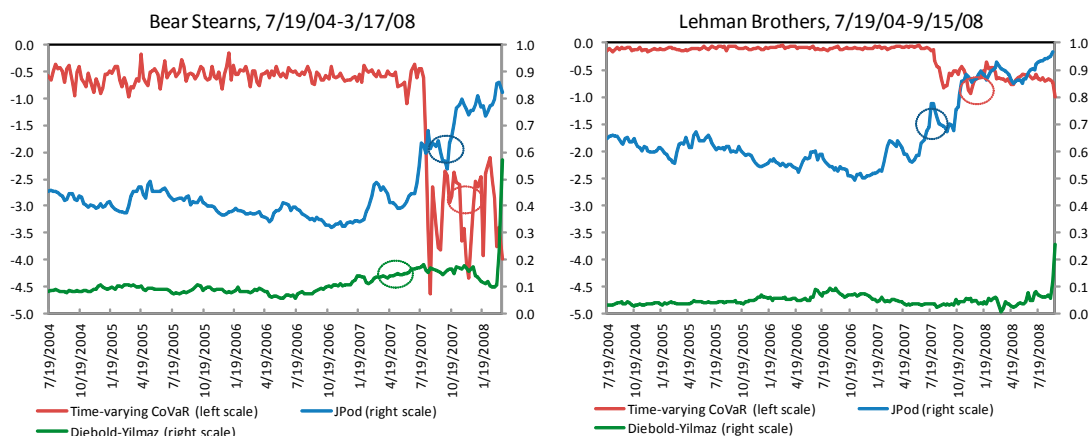


Sources: Bloomberg; Datastream; and IMF staff estimates.

Note: See Annex 3.3 for an explanation of the indicators and for details on how the three metrics were estimated.

There are some indicators (out of the ten studied here) that also have some component that measures interconnectedness of the financial system by calculating the contribution of an institution to systemic risk—the CoVaR, Diebold-Yilmaz spillover index, and the JPod are examples.⁹ 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 they were deemed to have “failed” (Figure below).¹⁰ The figures show that 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 20 percent—larger than what could be inferred from its relative size among the group of financial institutions analyzed here. However, Diebold-Yilmaz does not signal the potentially high contribution of Lehman Brothers. The other indicators are also not robustly flagging rising interconnectedness well in advance of the event.

Interconnectedness: Contribution to Systemic Risk of Two Failed Institutions



¹ This box was prepared by Srobona Mitra, and is based on Arsov, Canetti, Kodres and Mitra (forthcoming). Also see Annex 3.3 for definition of the indicators and calculations.

² 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&P500 index is taken as the market return. The threshold for extremely 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.

³ 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 Forecasts) but not necessarily next years' GDP growth.

⁴ See Rodriguez-Moreno, Maria, and Juan Ignacio Pena (2011) for a related exercise that concludes "simpler the better."

⁵ Given by Granger-Causality tests at various horizons. Scores based on p-values.

⁶ Logit-tests with Extreme SFS as dependent variable (0–1) and lagged dependent and lagged indicator variable as explanatory variables are performed. Scores are based on p-values of Wald-tests and McFadden R-squares.

⁷ Quandt-Andrews break point test for unknown break-points for the level and persistence parameters of an AR(4) model of each indicator. Score based on the earliest break-point.

⁸ 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 denotes stress specific to the financial system, whereas the FSI is an overall stress indicator.

⁹ See Schwaab, Koopman and Lucas (2011) for a discussion of different purposes of high frequency indicators.

¹⁰ Bear Stearns was sold to JP Morgan Chase and Lehman Brothers was placed into bankruptcy.

115. **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 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.

IV. MACROPRUDENTIAL INDICATORS AND POLICIES: STITCHING THEM TOGETHER

116. **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.⁸⁰

117. **Many countries, especially emerging economies, have experimented with various policy tools to manage systemic risk.**⁸¹ Some policies have indeed been effective in

⁸⁰ See IMF (2011b) and IMF (2011d, forthcoming).

⁸¹ Box 3.4; IMF (2011d, forthcoming); Terrier and others (2011).

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 ratio of debt service to income 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 in Section II, and could be used as a buffer.

118. The structural model introduced in Section II is invoked below in two cases—to illustrate the effectiveness of macroprudential policies using countercyclical capital buffers as an example. As will become clear in the discussion below, 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 run, considerably so if policymakers do not understand the source of the financial and real imbalances in the economy.

119. 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.⁸² Instead of the traditional welfare analysis, in which welfare improves with a reduction in the *volatility* of output and inflation, the analysis here seeks to minimize the *cumulative reduction* 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.

120. Could this same macroprudential tool—countercyclical capital buffers—be effective for different types of economies? As an illustration, the exercise now considers

⁸² 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.

two different economies: one with a fully flexible exchange rate and another with a managed exchange rate.

121. 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.⁸³ Furthermore, the long-run volatility of credit, output, consumption and inflation 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).

122. 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 not being able to identify 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 tradable 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 and monetary policymakers could coordinate to form an informed view of the source of shocks.⁸⁴

123. 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

⁸³ 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.

⁸⁴ 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 IMF (2011e, forthcoming) on institutional arrangements for macroprudential policies.

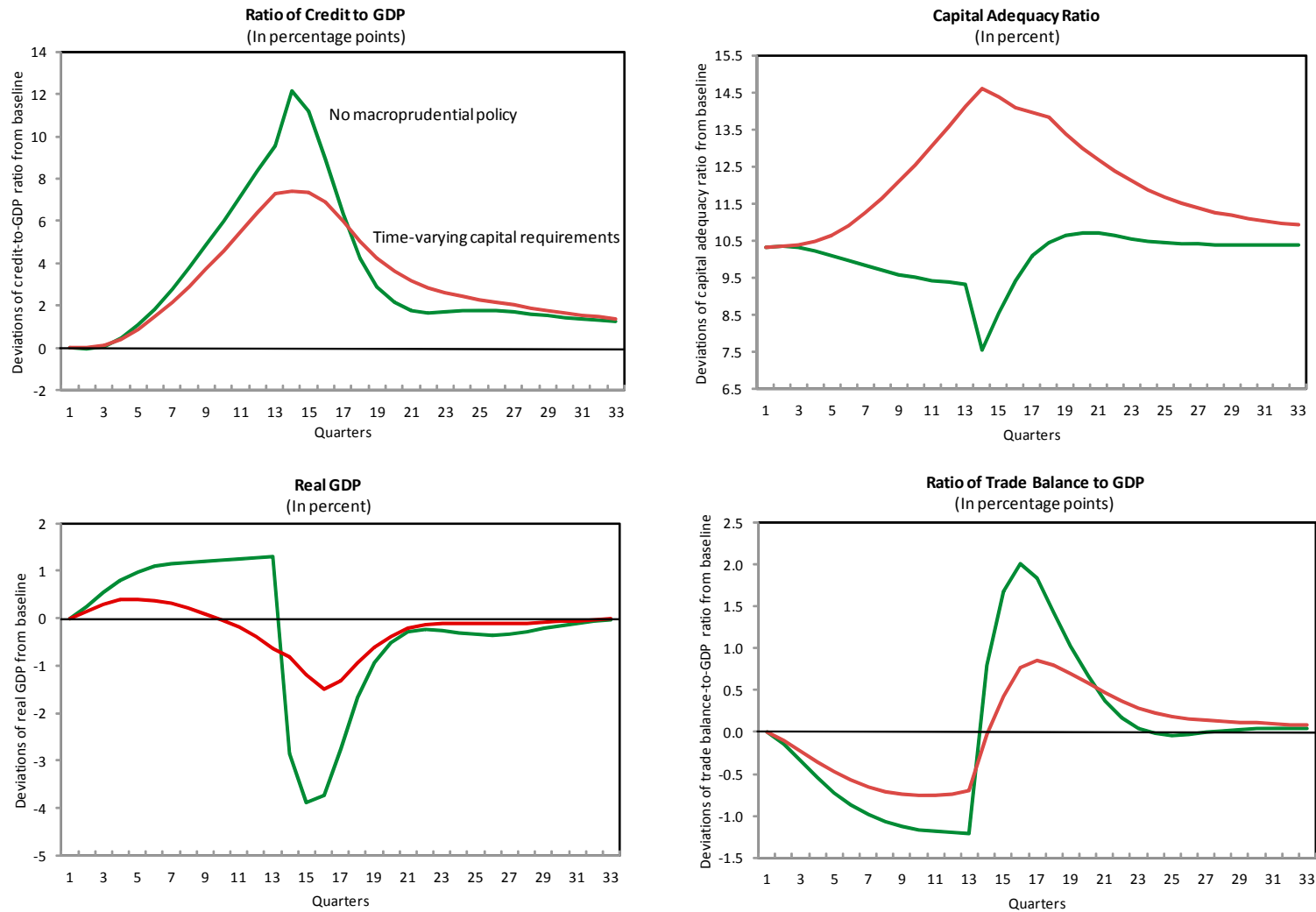
banks can help mitigate financial cycles for economies with different exchange rate regimes. Indeed, actual country practices show that the effectiveness of macroprudential tools in reducing procyclicality is not influenced by differences in economic structures—degree of economic development, the exchange rate regime, or the size of the financial sector (Box 3.4).

124. **However, one of the lessons from the analysis in Section II 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 for close coordination between macroprudential and exchange rate policies.

125. **Key results:**

- Combining empirical analysis with insights from a structural model can aid macroprudential policymakers calibrate 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.

Figure 3.6. Effects of Macroprudential Policy: Time-Varying Capital Requirements for an Asset-Price Shock



Source: IMF staff estimates.

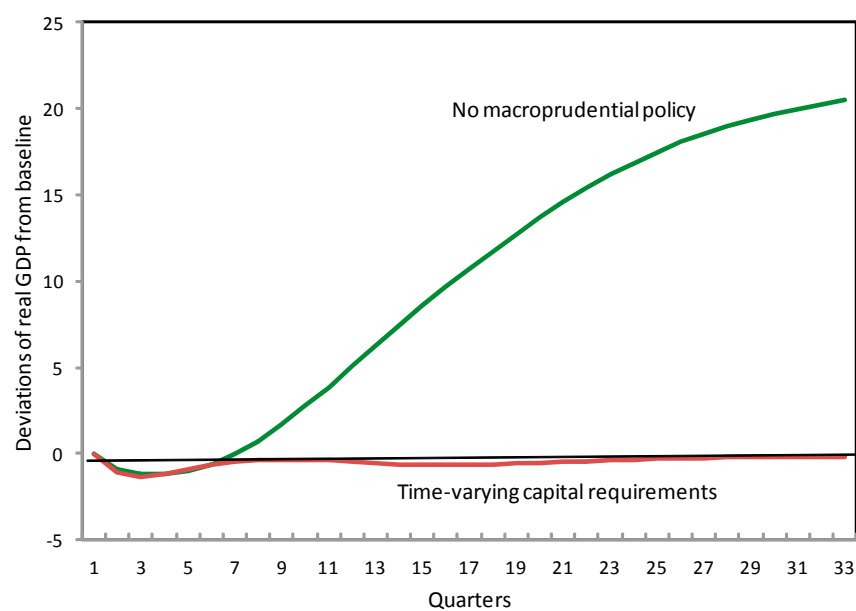
Note: Time-varying capital requirements are designed as a rule that depends upon the growth in the credit-to-GDP ratio. "No macroprudential policy" includes fixed macroprudential capital requirements. The baseline assumes no shock and no macroprudential policy.

Table 3.3. Long-run Steady-state Volatilities

	Fixed (Microprudential capital requirements)	Countercyclical Capital Requirements	Aggressive Capital Requirements
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.

Box 3.4. An Empirical Analysis of the Effectiveness of Macroprudential Instruments¹

This box aims to assess the effectiveness of actual macro-prudential instruments currently in use to contain systemic risk. Using panel regression analysis, the effectiveness of 10 instruments on four types of risks that are considered systemic by country authorities was examined.² These risks are associated with excessive: (i) credit growth; (ii) systemic liquidity; (iii) leverage; and (iv) large and volatile capital flows.³ In particular, the regression analysis examines if the instruments limit the procyclicality of each of the risks—their tendency to amplify the business cycle. The panel regression uses data from 49 countries during a 10-year period from 2000 to 2010 collected in the 2010 IMF survey on financial stability and macroprudential policy (IMF, 2011b).

The specification of the panel regression addresses several challenging issues, including:

- *How to disentangle the effect of macroprudential instruments from those of other policies, especially monetary and fiscal policies.* This is addressed by introducing interest rates and real activity indicators (GDP growth) to control for the effects of macroeconomic policies.
- *How to infer the general effect of macroprudential instruments in the context of country-specific characteristics.* This is addressed by introducing dummy variables to control for the type of exchange rate regime, the size of the financial sector, and the degree of economic development. The panel regression's fixed effect takes into account other unobserved country-specific characteristics.
- *How to avoid estimation biases to ensure a correct quantification of the effect of macroprudential instruments.* This is addressed by using the System Generalized Method of Moments, widely used to deal with panel data with endogenous explanatory variables.

The results suggest that some macroprudential instruments reduce the procyclicality in the financial system. In this analysis, procyclicality is defined as the respective correlation of the risk variables—credit growth, liquidity, leverage and capital flows—with GDP growth. According to the empirical result, five of the 10 instruments reduce the correlation between credit growth and GDP growth, and four instruments reduce the correlation between leverage and GDP growth. The result is not affected by differences in the degree of economic development, the exchange rate regime or the size of the financial sector. A few points from the result are worth noting:

- Credit-related measures are generally effective in reducing procyclicality. Caps on the LTV reduce the procyclicality of credit growth by 80 percent.⁴ This is in line with findings of previous studies that associate higher LTV ratios with higher house price and credit growth over time.⁵ Caps on the 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 are also effective. 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 other capital-related measures, i.e., countercyclical capital requirements and restrictions on profit distribution, is not obvious. This probably reflects the fact that only a few countries have implemented these instruments in the last two years, limiting the number of observations available for the estimates.
- 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. This may be an indication that, while these factors may influence the choice of macroprudential instruments, the instruments can be effectively used by any country.

While the panel regression yields promising results, more work is needed to confirm its findings. The use of macroprudential instruments is still relatively new, especially for advanced economies. The short experience with macroprudential policy limits the number of observations available for a more comprehensive evaluation of its effectiveness. Further research with longer time series and better quality data is therefore necessary to corroborate the initial assessment and to evaluate an instrument's effectiveness in country-specific contexts. Since regulatory and cross-border arbitrage can easily circumscribe the effectiveness of macroprudential policy, these factors should be taken into account in future analyses.

Effectiveness of Macroprudential Instruments in Reducing Pro-cyclicality

Independent Variables	Dependent Variable ¹ : Quarterly Credit Growth Rate _t				
Quarterly credit growth rate _{t-1}	0.0819 (8.19)***	0.0909 (15.16)***	0.1034 (30.07)***	0.0817 (33.60)***	0.0855 (2.81)***
GDP growth _t	0.0791 (5.89)***	0.0889 (10.44)***	0.0667 (9.39)***	0.0869 (6.17)***	0.0729 (5.47)***
Interest rate _t	-0.0777 (-11.35)***	-0.0804 (-10.48)***	n.a. ²	-0.0839 (-19.74)***	-0.0618 (-10.07)***
Caps on loan-to-value ³ × GDP growth _t	-0.0634 (-3.01)**				
Caps on debt-to-income ³ × GDP growth _t		-0.0976 (-4.96)***			
Limits on credit growth ³ × GDP growth _t			-0.1227 (-4.17)***		
Reserve requirements ³ × GDP growth _t				-0.0800 (-4.27)***	
Dynamic provisioning ³ × GDP growth _t					-0.1776 (-2.12)**
Independent Variables	Dependent Variable ¹ : Quarterly Leverage Growth Rate _t				
Quarterly leverage growth rate _{t-1}	0.0012 (0.12)	-0.0116 (-2.88)***	-0.0095 (-1.62)	-0.0170 (-5.35)***	-0.0167 (-0.73)
GDP growth _t	0.0346 (2.58)**	0.0418 (5.43)***	0.0394 (7.15)***	0.0880 (4.81)***	0.0323 (4.36)***
Interest rate _t	0.0591 (0.94)	0.1121 (3.22)***	0.1429 (5.43)	0.1362 (4.31)***	0.0956 (3.09)**
Caps on loan-to-value ³ × GDP growth _t	-0.0121 (-0.44)				
Caps on debt-to-income ³ × GDP growth _t		-0.0406 (-3.35)***			
Limits on credit growth ³ × GDP growth _t			-0.0317 (-1.82)*		
Reserve requirements ³ × GDP growth _t				-0.0959 (-3.44)***	
Dynamic provisioning ³ × GDP growth _t					-0.2744 (-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 credit growth (top) or leverage growth (bottom), the log change in the real level of credit or leverage. Credit is measured as claims on private sector from both bank and non-bank financial institutions and leverage is measured as assets over capital. The interest rate is the nominal long-term interest rate on prime lending, from the IMF's International Financial Statistics. The estimation period is 2000–2010. The sample is composed of 48 countries. The regression includes dummy variables to correct 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 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.

¹ This box was prepared by Francesco Columba, Alejo Costa and Cheng Hoon Lim, drawing from IMF (2011d, forthcoming).

² The maximum Loan-to-Value ratio (LTV), the maximum Debt service to income ratio (DTI), caps on foreign currency lending, ceilings on credit or credit growth, limits on net open currency positions/currency mismatch, limits on maturity mismatch, reserve requirements, countercyclical capital requirements, dynamic provisioning, and restrictions on profit distribution.

³ Credit is defined as the change in the inflation-adjusted claims on the private sector by banking and other financial institutions; liquidity risk is the ratio of liquid assets to short-term liabilities; leverage is assets as a fraction of equity, also for banking and other financial institutions; and capital flows are measured in growth rates and volatility of the “other” category in the balance of payments statistics, which mainly captures bank flows.

⁴ The coefficient of GDP growth is 0.0512 and the coefficient of LTV caps is -0.0351 (first column, upper half of Table). For every 1 percent increase in GDP growth, credit growth increases by 0.05 percent, but it is offset by 0.03 percent when LTV caps are introduced, leaving an overall net effect of 0.02 percent.

⁵ See, for instance, IMF (2011c).

V. CONCLUSIONS AND PRACTICAL GUIDELINES

126. 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 insight 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.

127. 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 merely change the magnitude of the effects of shocks but not their direction.

128. Among slow-moving indicators on the build-up 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.

- The structural model in Section II 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 in Section III 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, in signaling a risk build-up (Section III). The gap is better at predicting crises within 1 year, while the growth is better at a 2-year horizon.

129. 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 percent 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 nonbank private sector—could signal a risk build-up 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 (see Sections II and III). In the context of emerging economies, real exchange rate appreciation appears to be a particularly relevant factor.

130. 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 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 in which it is available.

131. **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 (CCPs) could enhance market discipline and lower uncertainty about counterparty risks during a crisis, providing a natural mitigate for domino effects.⁸⁵

132. **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 homogenous across different economies, which should help to facilitate policy 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.

133. **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.

134. **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.

⁸⁵ See Chapter III of IMF (2010c).

Annex 3.1. Description of the Structural Model⁸⁶

135. This annex fleshes out the Dynamic Stochastic General Equilibrium (DSGE) model used for the policy simulation experiments in Sections II and IV. 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.

136. 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.

137. 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-level, is introduced as an incentive-based mechanism, not as a hard-wired restriction; and (v) equity (or bank capital) have market rigidities making *instantaneous* market re-capitalization prohibitively expensive.

Real sector

138. 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.

⁸⁶ This annex was prepared by Jaromir Benes.

- 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: purchases productive capital and acquires 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 only considers 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

139. Banks make two types of decisions: manage their assets by providing loans to nonfinancial individuals, and manage their liabilities by 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.

140. The asset management is described first. Bank loans are noncontingent in that the lending rate is agreed upon at the beginning and cannot be adjusted in response to ex-post shocks; 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 without repaying the loan, letting the lender seize the collateral (in the present model, the bank can pay a collection cost to make the defaulted borrower repay the loan in full in such a case; the probability that the bank succeeds is set to a number arbitrarily close to one). The implications of this limited enforcement set-up are very similar to Bernanke, Gertler and Gilchrist’s (1999) “costly state verification model;” here 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 therefore 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 such that the amount loaned is positively related to the price of capital available to collateralize the loan.

141. 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_L^i , and the amount of productive capital, K^i , are chosen to maximize.⁸⁷

$$E_t \left\{ L_t^i - P_{K,t} K_t^i + \frac{\beta \Lambda_{t+1}}{\Lambda_t} [-R_{L,t}^i L_t^i + R_{K,t+1}^i P_{K,t} K_t^i] + \Phi_t^i [R_{L,t}^i L_t^i (1 - \nu F_i(\bar{R}_{K,t}^i)) - \bar{R}_{A,t} L_t^i] \right\}$$

where ν is the loss-given-default, and F_i is the cumulative distribution function for the individual return on capital (see below). Furthermore, the price of capital, P_K , the shadow value of wealth of the household as whole, Λ , and the opportunity cost, \bar{R}_A are taken as given. Furthermore, the cut-off return on capital, \bar{R}_K^i is given by

$$\bar{R}_{K,t}^i = \frac{R_{L,t}^i L_t^i}{P_{K,t} K_t^i} = R_{L,t}^i l_t^i$$

where l_t^i denotes the loan-to-value (LTV) ratio.

142. The retail branch extends loans to a large number of individuals diversifying 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.

$$R_{K,t+1}^i = R_{K,t+1} \rho_{t+1}$$

$$R_{K,t+1}^i \sim F_i$$

$$R_{K,t+1} \sim F_R$$

$$\rho_{t+1} \sim F_\rho$$

where R_K^i 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 .

⁸⁷ Note that the terms related to a situation in which the household member succeeds in running away from the loan are dropped; the probability of such an outcome is set to a numerically negligible number.

143. The idiosyncratic component is independent of the aggregate one, and is centered around one. The aggregate component is implied endogenously by the model. When choosing its debt liabilities (deposits and/or 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, τ is the (possibly time-varying) regulatory capital minimum, and v is the penalty as a percentage of the bank's assets.

144. 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.

145. 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), F , to maximize the expected pay-off to the shareholders subject to the balance-sheet identity that loans/assets need to be equal to capital plus funding:

$$\max \left\{ E_t \left\{ R_{A,t+1}L_t - R_{F,t}F_t - vL_tF_t(\tilde{R}_{A,t}) - \frac{\xi}{2}E_t(\log E_t - \log \bar{E}_t)^2 \right\} \right\}$$

subject to

$$L_t = E_t + F_t$$

where R_A is the return on bank assets and F_A is the distribution of this return on assets. The cut-off return on the bank's assets (i.e., 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, i.e. 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.

Note furthermore, that the distribution of the portfolio of loans can be derived endogenously from the distribution of the aggregate return on capital (i.e., on the collateralizing asset). For each cut-off return on assets there is a unique corresponding aggregate return on capital; the two are linked through the following relationship:

$$\tilde{R}_{A,t} = R_{L,t} \left[1 - v F_i \left(\frac{R_{L,t}}{\tilde{R}_{K,t}} l_t \right) \right]$$

146. 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

147. 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 these 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.⁸⁸

148. 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 added as a surcharge on top of the microprudential ones, and follow a time-varying rule based on changes in credit-to-GDP ratio.

⁸⁸ Such a policy is not termed as a managed exchange rate regime because it is typically implemented through sterilized interventions.

Parameterizing the model

149. In the baseline calibration of the model, we considered several aspects and stylized facts of a number of small open emerging market economies. We can think of four basic groups of parameters: steady-state parameters, transitory parameters, policy parameters, and financial parameters. The steady-state parameters were calibrated using 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 cyclicalities 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).

150. The calibration of the financial sector, in particular the various aspects of the distribution of risks, was largely based on a heuristic method of finding sensible thresholds at which the built-in nonlinearities become influential in the interactions between real economic activity and the bank balance sheets. Note, however, that the empirical validation of such financial characteristics in models with macro-financial linkages is just at its very beginning. From this point of view, the model simulations presented in Sections II and IV should be considered more as thinking devices rather than empirically accurate predictions.

Annex. 3.2. Predicting Probability of a Banking Crisis⁸⁹

151. This annex describes the methodology for the estimation of the probability of a banking crisis, presented in Section III. The empirical analysis is based on the assumption that the banking crisis probability is a function of a vector of systemic risk indicators. More specifically, it is assumed that the relationship can be approximated by a probit panel data model with country fixed effects:

$$(1) \quad \Pr(y_{i,t}=1|\mathbf{x}_{i,t-h}) = \Phi(\alpha_i + \mathbf{x}_{i,t-h}\boldsymbol{\theta})$$

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 three different forecast horizons—1, 2 and 3 years.

152. We adopt Laeven and Valencia's (2010) definition of a systemic banking crisis. They define a banking crisis to be systemic if two conditions are satisfied: (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 the original paper for more details.

153. 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:

$$(2) \quad \text{Marginal Effect: } \partial \Pr(y_{i,t}=1|\mathbf{x}_{i,t-h}) / \partial x_{ij,t-h} = \phi(\alpha_i + \mathbf{x}_{i,t-h}\boldsymbol{\theta})\theta_j$$

where ϕ denotes the probability density function of a standard normal distribution. Note that the marginal effect is allowed to vary across the countries via the fixed effects, the α_i 's. The fixed effects denote the unconditional probability of a crisis in a country. Countries with fixed effects higher (lower) than the 80th (20th) percentile of all fixed effects are termed *high-risk* (*low-risk*).

154. Table 3.4 presents the empirical results for the yearly credit-to-GDP (CtG) gap and credit-to-GDP (CtG) change based on a model specification with a single indicator variable. The estimation is based on an unbalanced panel of 94 countries for the period 1975–2010. Both credit measures have a significant positive influence on the probability of a systemic

⁸⁹ This annex was prepared by Kasper Lund-Jensen. For details, see Lund-Jensen, forthcoming.

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 one percentage point increase in the CtG Gap will increase the probability of a systemic banking crisis by 0.34 percent next year and 0.24 percent the year after. Similarly, a one percent point change in the year-on-year CtG growth will increase the probability of a systemic banking crises occurring next year by 0.23 percent and 0.24 percent the year after.

Table 3.4. Determinants of Systemic Banking Crises: Single Indicator Probit Model

Credit-to-GDP Growth (In percentage points)					
Lag (Length in years)	Coefficient estimate (θ)	t-stat	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-stat	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: Dependent variable is a binary systemic banking crises variable from Laeven and Valencia (2010). The data is an unbalanced annual panel for the period 1975-2010. The model parameters are estimated using country fixed effects based on 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. Credit-to-GDP growth is calculated as follows: $\Delta CtG_t = CtG_t - CtG_{t-1}$. The credit-to-GDP gap is estimated using a single sided HP-filter with a smoothing parameter of 100 and 5 initial observations.

Model Specification: $\text{Prob}(\text{Banking Crisis}_{i,t=1} | x_{i,t-h}) = \Phi(\alpha_i + \theta * x_{i,t-h})$

* 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.

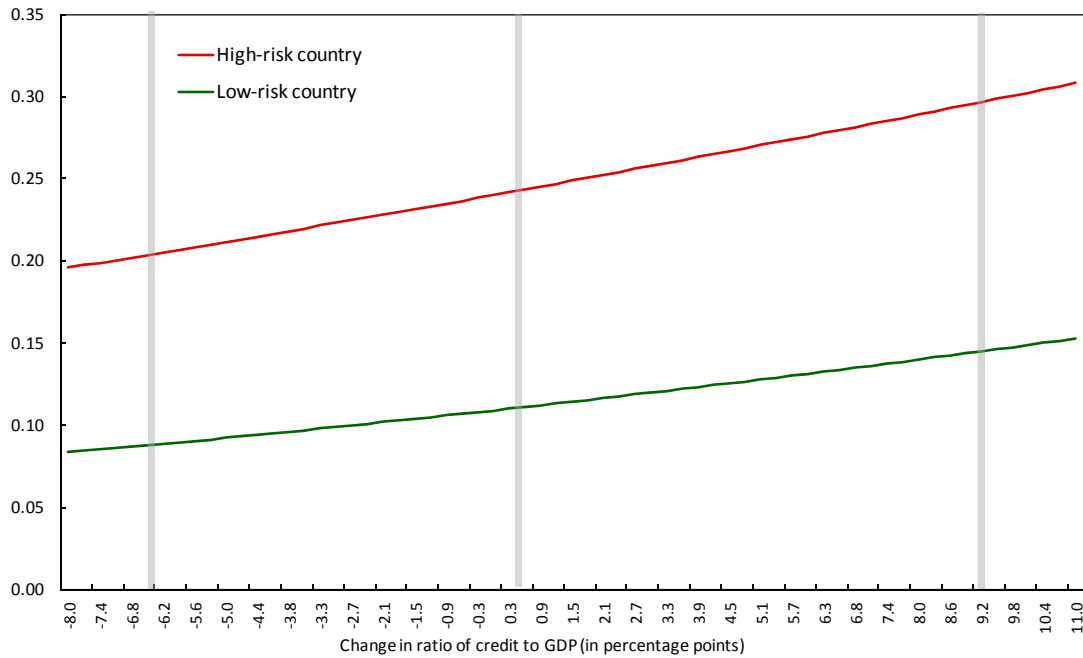
155. Figure 3.8 depicts the marginal effect of the annual change in credit-to-GDP ratio, at a two year forecast horizon, for different growth levels by implementing equation (2) using the estimate from table 3.4 and $\theta=1.69$. The marginal effects are simply calculated as

(3a) Marginal Effect: $ME_{HighRisk} = \phi(\alpha_{HighRisk} + \Delta CtG_{t-2} * 1.69) * 1.69$

(3b) Marginal Effect: $ME_{LowRisk} = \phi(\alpha_{LowRisk} + \Delta CtG_{t-2} * 1.69) * 1.69$

where $\alpha_{HighRisk} = -1.44$ and $\alpha_{LowRisk} = -1.91$ are the 80th and 20th percentile country fixed effects, respectively. It is clear that the model structure implies that there is positive relationship between the marginal effect and the level of credit-to-GDP growth. For example, when credit-to-GDP growth is at its 95th percentile level the marginal effect is 0.30 percent for a high risk country rather than 0.24 percent.

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.

156. Other model specifications where other indicator variables were made to interact with credit aggregates were also estimated. Table 3.5 contains the empirical results for a model specification with both credit-to-GDP change and equity price growth.⁹⁰ The estimation is based on an unbalanced panel of 36 countries for the period 1975–2010. The credit-to-GDP growth is found to have a significant positive impact on the crisis probability at all three forecast horizons. At a two year forecast horizon, equity growth also has a significant

⁹⁰ 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).

positive impact on the crisis probability. Based on this model specification, at a two year forecast horizon, the crisis probability can be estimated as:

$$(4) \text{ Crisis Probability} = \Phi(\alpha_{\text{High Risk}} + \Delta \text{CtG}_{t-2} * 3.64 + \Delta \ln(\text{Equity Price})_{t-2} * 0.67)$$

where $\alpha_{\text{High Risk}} = -1.26$ denote the 80th percentile country fixed effect. The predicted crisis probabilities, for different values of equity and CtG growth, are illustrated in Figure 3.4 in the main text.

Table 3.5. Determinants of Systemic Banking Crises: Two Indicator Probit Model

Credit-to-GDP Growth (In percentage points)					
Lag (Length in years)	Coefficient estimate (θ_1)	t-stat	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-stat	Marginal effect (High risk)*	Marginal effect (Low risk)**	Median Equity 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: Dependent variable is a binary systemic banking crises variable from Laeven and Valencia (2010). The data is an unbalanced annual panel for the period 1975–2010. The model parameters are estimated using country fixed effects based on 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. Credit-to-GDP growth is calculated as: $\Delta \text{CtG}_t = \text{CtG}_t - \text{CtG}_{t-1}$. Equity Growth is calculated as: $\Delta \ln(\text{Equity_Price})_t = \ln(\text{Equity_Price}_t) - \ln(\text{Equity_Price}_{t-1})$.

Model Specification: $\text{Prob}(\text{Banking Crisis}_{i,t=1} | \mathbf{x}_{i,t-h}) = \Phi(\alpha_i + \theta_1 * \Delta \text{CtG}_{t-h} + \theta_2 * \Delta \ln(\text{Equity Price})_{t-h})$

* 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.

157. Other variables, like real effective exchange rate change, house price growth, growth in foreign liabilities and level of loans-to-deposits ratio were tested but were not found to have a significant impact on the crisis probability. The dataset also shrunk substantially when some of these variables were included.

158. Figure 3.5 in the main text depicts the out-of-sample forecast of the U.S. crises probability for the period 2001–09. There were two systemic banking crises in the U.S. during 1975–2009, according to Laeven and Valencia (2010): beginning in 1988 and 2007, respectively. The forecasts were constructed by estimating a single indicator probit model,

with country fixed effects, for the period 1975–2000 based on the credit-to-GDP gap and the credit-to-GDP growth.⁹¹ 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

$$(5) \quad \Pr(y_{US,t}=1|\mathbf{x}_{i,t-1}) = \Phi(\alpha_{US} + \mathbf{x}_{US,t} * \theta_{2000}), \quad t=2001, \dots, 2009$$

where θ_{2000} denotes the parameter estimate based on the 1975–2000 sample.

⁹¹ The credit-to-GDP growth has a significant impact on the crisis probability at both a one and two year forecast horizon, see Table 3.4. In order to incorporate information from both lags the credit-to-GDP growth was defined as $\Delta CtG_t = (CtG_t - CtG_{t-2})/2$ in the forecasting exercise.

Annex. 3.3. Finding a Robust Set of Near-Coincident Indicators⁹²

159. This annex describes the methodologies for comparing high-frequency indicators presented in Box 3.3. Daily (5-week) data on equity returns of 17 domestic financial institutions in the United States, and S&P 500 over 12/30/2002–4/11/2011 was used for the exercise to create the abnormal returns. The data used to construct each of the indicators varied. All estimations are done on the weekly version of the dataset.

160. The ten indicators considered for comparison are:

- The **Yield curve** is 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 under distress. An institution's contribution to systemic risk is the difference between 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.
- **Rolling CoVaR** is the same as CoVaR, but is based on (200-week) rolling quantile regressions of weekly returns on market value of assets and does not take account of other variables.
- **JPoD** is the Joint Probability of Distress (Segoviano and Goodhart, 2009), which measures the joint probability of distress of all institutions included in a pre-defined financial system, by constructing a nonlinear, time-varying measure of “tail dependence” using a multivariate distribution of individual institution's probability distributions of their implied asset value movements.
- The **Credit Suisse Fear Barometer** is an indicator specifically designed to measure investor sentiment, and the number represented by the index 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.

⁹² This annex was prepared by Srobona Mitra. See Arsov and others (forthcoming) for details.

- **DD Banks** refers to Distance to Default (De Nicolo and Kwast, 2002) or the number of standard deviations the banking system is away from the default point—at which the liabilities of the banks are just equal to the market value of assets.
- The **Diebold-Yilmaz** refers to a measure of spillovers (Diebold and Yilmaz, 2009) based on the matrix of variance decompositions derived from 80-week rolling vector autoregressions of financial institutions' weekly CDS returns.
- **VIX** refers to Chicago Board Options Exchange Volatility Index calculated from S&P 500 option prices, measuring the market's expectation of future volatility over the next 30-day period.
- The **LIBOR-OIS spread** is a measure of the risk of default associated with lending to other banks in the LIBOR market.⁹³
- **SLRI** refers to the Systemic Liquidity Risk Indicator (Severo, forthcoming, IMF, 2011a) that measures the breakdown of arbitrage conditions in major markets, and is a global indicator of liquidity stress.

Methodology

161. The results are based on three types of tests on the systemic risk indicators. The dependent variable (the event variable to test against), “systemic stress,” is the fraction of banks experiencing extremely negative abnormal returns (with negative returns persisting for two weeks following the event). This is the systemic financial stress (SFS) indicator for the United States.

A. Forecasting Systemic Stress

162. The systemic risk indicator should be able to forecast 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 (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.

⁹³ LIBOR refers to London Inter Bank Offer Rate and the OIS refers to the Overnight Indexed Swap rate.

B. Forecasting Systemic Extreme Events

163. The systemic risk indicator should be able to forecast extreme events (more than 25 percent of banks experiencing extreme negative abnormal returns) 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 amenable in modeling extreme events compared to the probit, which uses a normal distribution.

164. There are two sets of scores (Table 3.7): one based on (lower) p-values (< 0.01) and the other based on McFadden R-squares for the logit regressions (higher the better). The average of the two scores is reported in the last column.

C. Early Turning Points

165. 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 4 lags (AR(4)) are estimated for each of the indicators and the Quandt-Andrews break point (QABP) test (unknown break point) 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.

166. Table 3.9 takes the average of the scores from subsections A-C.

Table 3.6. Granger Causality of Systemic Risk Measure to the Event Indicator

Indicators	P-values for Granger-Causality Tests with Various Lags ¹				Scores ²				P-value score (1)	P-values for t-test at each Lag ³				Lag- length score (2)	Average Score (1,2)
	52 weeks	26 weeks	4 weeks	1 week	52 weeks	26 weeks	4 weeks	1 week		52 weeks	26 weeks	4 weeks	1 week		
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.

¹Granger-Causality (GC) tests with lag-lengths specified in each column. The p-values for GC tests under each lag-specification reported here.

Red bold values are those with no two-way causality (or the causality from the risk indicator to the event indicator is stronger) and significant at 1 percent level.

²Equal to the number of lags if p-value is less than 0.01 or 0 otherwise.

³Based on OLS 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 weighted average of the p-values if the p-values are less than or equal to 0.01.

$$SFS_t = c + \sum_{s=1,4,26,52} \beta_s SFS_{t-s} + \sum_{s=1,4,26,52} \rho_s x_{t-s} + \varepsilon_t$$

Table 3.7. Forecastability of Extreme Events: Logit Regressions¹

Indicators	P-values for H0: Sum of Lags of Indicators is equal to 0			Weighted Average p- values	Score 1	McFadden R-squares			McFadden R-square scores	Average Score (1, 2)
	6 weeks (wht:6)	4 weeks (wht:4)	1 week (wht: 1)			6 weeks (wht:6)	4 weeks (wht:4)	1 week (wht: 1)	Score 2	
	A	B	C			F	G	H	I	
Credit Suisse Fear Barometer	0.4100	0.0000	0.0000	0.22	0.78	0.34	0.29	0.19	0.31	0.54
Time-varying CoVaR	0.5938	0.0000	0.0000	0.32	0.68	0.41	0.35	0.36	0.38	0.53
Rolling CoVaR	0.6507	0.0928	0.0016	0.39	0.61	0.27	0.21	0.13	0.24	0.42
DD banks	0.0081	0.0111	0.0002	0.01	0.99	0.42	0.38	0.25	0.39	0.69
Systemic liquidity risk index	0.4126	0.1192	0.0040	0.27	0.73	0.50	0.34	0.18	0.41	0.57
Diebold_Yilmaz	0.6983	0.0006	0.0000	0.38	0.62	0.58	0.44	0.32	0.51	0.56
JPoD	0.0278	0.0295	0.0228	0.03	0.97	0.66	0.53	0.21	0.57	0.77
LIBOR-OIS spread	0.9210	0.0001	0.0038	0.50	0.50	0.4	0.34	0.26	0.37	0.43
VIX	0.0685	0.0007	0.0000	0.04	0.96	0.34	0.29	0.23	0.31	0.64
Yield curve	0.8051	0.5276	0.1581	0.65	0.35	0.3	0.24	0.12	0.26	0.31

Source: IMF staff estimates.

¹Based on Logit regressions. A binary extreme event variable, y , takes the value of 1 if the Systemic Financial Stress (SFS) indicator (the fraction of banks undergoing extremely negative abnormal returns) is greater 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 Mc-Fadden R-squares. The total score is based on a simple average of the two sub-scores.

Table 3.8. Turning Points: Quandt-Andrews Break-point Test on Level and Persistence¹

Indicators	Persistence (ρ_s)		Level (c)		Average score
	Break date	Rank score (higher the better)	Break date	Rank score (higher the better)	
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	0.8
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.

¹Based on autoregressive regressions for each indicator $x_t = c + \sum_{s=1}^4 \rho_s x_{t-s} + \varepsilon_t$ **Table 3.9. Total Score**

	Forecasting			
	Forecasting Stress	Extreme Event	Turning Point	Total
	GC (A)	Logit (B)	QABP (C)	
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.

References

- Acharya, Viral V., Lasse H. Pederson, Thomas Philippon, and Matthew Richardson, 2010, "Measuring Systemic Risk," Working Paper, NYU Stern School of Business.
- Adrian, Tobias and Markus Brunnermeier, 2010, "CoVaR," Federal Reserve Bank of New York Staff Reports.
- Arsov, Ivailo, Elie Canetti, Laura Kodres, and Srobona Mitra, forthcoming, "Tail Risk Measures—Do they Flag Systemic Risks well in advance?" IMF Working Paper (Washington: International Monetary Fund).
- Balakrishnan, Ravi, Stephan Danninger, Selim Elekdag, and Irina Tytell, 2009, "The Transmission of Financial Stress from Advanced to Emerging Economies" IMF Working Paper No. 09/133 (Washington: International Monetary Fund).
- Barajas, Adolfo, Giovanni Dell'Ariccia and Andrei Levchenko, forthcoming, "Credit Booms: the Good, the Bad, and the Ugly," IMF Working Paper (Washington: International Monetary Fund).
- Basel Committee on Banking Supervision (BCBS), 2010, "Guidance for National Authorities Operating the Countercyclical Capital Buffer" (Basel: Bank for International Settlement, December)
- Benes, Jaromir, Michael Kumhof, and David Vavra, 2010, "Monetary policy and financial stability in emerging-market economies: An operational framework," Central Bank Macroeconomic Modeling Workshop, Manila.
- Berg, Andrew, Eduardo Borensztein, Gian Maria Milesi-Ferretti, and Catherine Pattillo, 2000, "Anticipating Balance of Payments Crises: The Role of Early Warning Systems," IMF Occasional Paper No. 186 (Washington: International Monetary Fund).
- Bernanke, Ben S., and Mark Gertler, 1999, "Monetary Policy and Asset Price Volatility," in Federal Reserve Bank of Kansas City, *New Challenges for Monetary Policy*, pp. 77–128.
- Bernanke, Ben S., Mark Gertler, and Simon Gilchrist, 1999. "The Financial Accelerator in a Quantitative Business Cycle Framework," Handbook of Macroeconomics, in: J. B. Taylor & M. Woodford (ed.), *Handbook of Macroeconomics*, edition 1, Vol. 1, Chapter 21, pp. 1341–93 Elsevier.

- Billio, Monica, Mila Getmansky, Andrew W. Lo, and Lorian Pelizzon, 2010, “Econometric Measures of Systemic Risk in the Finance and Insurance Sectors,” NBER Working Paper No. 16223 (Cambridge, Massachusetts: National Bureau of Economic Research).
- Blanchard, Olivier, 1979, “Speculative Bubbles, Crashes, and Rational Expectations,” *Economics Letters*, 3, pp 387-389.
- Blanchard, Olivier and Mark Watson, 1982, “Bubbles, Rational Expectations, and Financial Markets,” in P. Wachtel (ed.) *Crisis in the Economic and Financial Structure*, Lexington Books, Lexington, Mass. 1982.
- Bordo, Michael, Barry Eichengreen, Daniela Klingebiel and Maria Soledad Martinez-Peria, 2001, “Financial Crises: Lessons from the Past 120 years,” *Economic Policy*, April.
- Borio, Claudio and Mathias Drehmann, 2009, “Assessing the risk of banking crises—revisited,” *BIS Quarterly Review*, pp. 29–44 (Basel: Bank for International Settlements, March).
- Brownlees, Christian T., and Robert Engle, 2010, “Volatility, Correlation and Tails for Systemic Risk Management,” Working Paper, (New York: NYU Stern School of Business).
- Cardarelli, Roberto, Selim Elekdag, and Subir Lall, 2011, “Financial Stress and Economic Contractions,” *Journal of Financial Stability*, Vol.7, No.2 (June), pp. 78–97.
- Cihak, Martin, and Srobona Mitra, 2009, “The Financial Crisis and European Emerging Economies,” *Czech Journal of Economics and Finance*, 59, No. 6, pp 541–53.
- Claessens, Stijn, Ayhan Kose, and Marco E. Terrones, 2011a, “How Do Business and Financial Cycles Interact?” IMF Working Paper 11/88 (Washington: International Monetary Fund).
- _____, 2011b, “Financial Cycles: What? How? When?” IMF Working Paper 11/76, also a chapter in Richard Clarida and Francesco Giavazzi, eds., *NBER International Seminar in Macroeconomics 2010*.
- Cúrdia, Vasco, 2007. “Monetary Policy Under Sudden Stops,” Staff Reports 278, Federal Reserve Bank of New York.
- De Nicolò, Gianni and Myron Kwast, 2002, “Financial Risk and Consolidation: Are They Related?” *Journal of Banking and Finance*, Vol. 26, no. 5, pp. 861–80.
- De Nicolò, Gianni, and Marcella Lucchetta, 2010, “Systemic Risk and the Macroeconomy,” IMF Working Paper 10/29, (Washington: International Monetary Fund).

- Dell’Ariccia, Giovanni and Robert Marquez, 2006, “Lending Booms and Lending Standards,” *Journal of Finance*, 2006, October, Vol.61, pp 2511–46.
- Diebold, Francis X. and Kamil Yilmaz, 2009, "Measuring Financial Asset Return and Volatility Spillovers, With Application to Global Equity Markets," *Economic Journal*, Vol.119, 15–71.
- Drehmann, Mathias, Claudio Borio and Kostas Tsatsaronis, forthcoming, “Anchoring Countercyclical Capital Buffers: the Role of Credit Aggregates,” manuscript, BIS and *Journal of Central Banking*.
- Enoch, Charles and Inci Ötker-Robe, 2007, “Rapid Credit growth in Central and Eastern Europe: Endless Boom or Early Warning?” Palgrave MacMillan (March 2007).
- Estrella, A, 2004, “The Cyclical Behavior of Optimal Bank Capital,” *Journal of Banking and Finance* 28, pp 1469–98.
- Evans, George, 1991, “Pitfalls in Testing for Explosive Bubbles in Asset Prices,” *American Economic Review*, 81, 922–30.
- Froot, Kenneth and Maurice Obstfeld, 1991, “Intrinsic Bubbles: The Case of Stock Prices,” *American Economic Review*, 81, 1189–214.
- International Monetary Fund (IMF), 2008, “Financial Stress and Economic Downturns,” Chapter 4 in *World Economic Outlook*, World Economic and Financial Surveys (Washington: October).
- _____, 2009, “Detecting Systemic Risk,” Chapter 3 in *Global Financial Stability Report*, World Economic and Financial Surveys (Washington: April).
- _____, 2010a, “Systemic Risk and the Redesign of Financial Regulation” Chapter 3 in *Global Financial Stability Report*, World Economic and Financial Surveys (Washington: April).
- _____, 2010b, “The IMF-FSB Early Warning Exercise: Design and Methodological Toolkit,” available at <http://www.imf.org/external/np/exr/facts/ewe.htm>.
- _____, 2010c, “Making Over-the-Counter Derivatives Safer: The Role of Central Counterparties,” Chapter 3 in *Global Financial Stability Report*, World Economic and Financial Surveys, (Washington: April).
- _____, 2011a, “How to Address the Systemic Part of Liquidity Risk,” Chapter 2 of the Global Financial Stability Report, April 2011.

- _____, 2011b, “Macroprudential Policy: An Organizing Framework,” IMF Report.
- _____, 2011c, “Housing Finance and Financial Stability—Back to Basics?” Chapter 3 of the Global Financial Stability Report, April 2011.
- _____, 2011d (forthcoming), “Macroprudential Policy Objectives and Tools: Lessons from Country Experiences,” Informal Board Paper, [September 2011].
- _____, 2011e (forthcoming), “Institutional Arrangements for Macroprudential Policies in Advanced and Emerging Market Countries,” Staff Discussion Note (Washington: International Monetary Fund).
- _____, Bank of International Settlements, Financial Stability Board (IMF-BIS-FSB), 2009, “Guidance to Assess the Systemic Importance of Financial Institutions, Instruments, and Markets: Initial Considerations,” Report to the G-20 Finance Ministers and Governors (October).
- Kaminsky, Graciela, Saul Lizondo, and Carmen Reinhart, 1998, “Leading Indicators of Currency Crisis,” IMF Staff Papers, Vol. 45 (March), pp. 1–48.
- Kannan, Prakash, Pau Rabanal, and Alasdair Scott, 2009a, “Monetary and Macroprudential Policy Rules in a Model with House Price Booms,” IMF Working Paper 09/251 (Washington: International Monetary Fund).
- _____, 2009b, “Macroeconomic Patterns and Monetary Policy in the Run-Up to Asset Price Busts,” IMF Working Paper 09/252 (Washington: International Monetary Fund).
- Kindleberger, Charles, 1989, *Manias, Panics and Crashes: A History of Financial Crisis*, (revised edition), New York, Basic Books.
- Laeven, Luc and Fabian Valencia, 2010, “Resolution of Banking Crises: The Good, the Bad, and the Ugly” IMF Working Paper 10/146 (Washington: International Monetary Fund).
- Lund-Jensen, Kasper, forthcoming, “The Role of Credit and Leverage Measures as Leading Indicators of Systemic Risk,” IMF Working Paper (Washington: International Monetary Fund).
- Mendoza, Enrique G. and Marco E. Terrones, 2008, “An Anatomy of Credit Booms: Evidence from Macro Aggregates and Micro Data,” IMF Working Paper No. 08/226 (Washington: International Monetary Fund).

- Milne, Alistair, 2002, "Bank Capital Regulation as an Incentive Mechanism: Implications for Portfolio Choice," *Journal of Banking & Finance*, Volume 26, Issue 1, January 2002, pp. 1–23.
- Ng, Tim, 2011, "The Predictive Content of Financial Cycle Measures for Output Fluctuations," *BIS Quarterly Review*, pp 53–65 (Basel: Bank for International Settlements, June).
- Reinhart, Carmen, and Kenneth Rogoff, 2009, "This Time is Different: Eight Centuries of Financial Folly," *Princeton University Press*.
- Rodriguez-Moreno, Maria, and Juan Ignacio Pena, 2011, "Systemic Risk Measures: The Simpler the Better?" available at SSRN: <http://ssrn.com/abstract=1681087>, February.
- Roger, Scott, and Jan Vlček, 2011, "Macroeconomic Costs of Higher Bank Capital and Liquidity Requirements," IMF Working Paper 11/103 (Washington: International Monetary Fund).
- _____, forthcoming, "Macro-Financial Modeling at Central Banks: Recent Developments and Future Directions," IMF Working Paper (Washington: International Monetary Fund).
- Schwaab, Bernd, Siem Jan Koopman and André Lucas, 2011, "Systemic Risk Diagnostics: Coincident Indicators and Early Warning Signals," ECB Working Paper No. 1327, April (Frankfurt: European Central Bank).
- Segoviano, Miguel and Charles Goodhart, 2009, "Banking Stability Measures," IMF Working Paper No. 09/04 (Washington: International Monetary Fund).
- Shin, Hyun Song, 2010, "Macroprudential Policies Beyond Basel III," Policy Memo, Princeton University, available at www.princeton.edu/~hsshin/www/MacroprudentialMemo.pdf
- Shin, Hyun Song and Kwanho Shin, 2011 "Procyclicality and Monetary Aggregates," NBER Working Papers, No 16836 (Cambridge, Massachusetts: National Bureau of Economic Research).
- Severo, Tiago, forthcoming, "Using Violations of Arbitrage to Measure Systemic Liquidity Risk and the Cost of Liquidity Insurance," IMF Working Paper (Washington: International Monetary Fund)

Sun, Tao, 2011, “Identifying Vulnerabilities in Systemically-Important Financial Institutions in a Macro-financial Linkages Framework,” IMF Working Paper No. 11/111 (Washington: International Monetary Fund).

Terrier, Gilbert, Rodrigo Valdés, Camilo E Tovar, Jorge Chan Lau, Carlos Fernandez Valdovinos, Mercedes Garcia-Escribano, Carlos Medeiros, Man-Keung Tang, Mercedes Vera-Martin, and W. Christopher Walker, 2011, “Policy Instruments To Lean Against The Wind In Latin America,” IMF Working Paper No. 11/159 (Washington: International Monetary Fund).

GLOBAL FINANCIAL STABILITY REPORT

STATISTICAL APPENDIX, SEPTEMBER 2011

This presentation complements the main text of the *Global Financial Stability Report* (GFSR) with data on financial developments in regions and countries as well as in selected sectors.

Unless otherwise noted, the data reflect information available up to July 15, 2011. The data come for the most part from sources outside the IMF. Although the IMF endeavors to use the highest quality data available, it cannot be responsible for the accuracy of information obtained from independent sources.

Please note that effective since April 2011 issue, the IMF's Statistics Department has assumed responsibility for compiling the Financial Soundness Indicators tables and they are no longer part of this appendix. However, these tables will continue to be linked to the GFSR Statistical Appendix on the IMF's public website.

The following symbols have been used throughout this appendix:

. . . 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 and 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 $\frac{1}{4}$ 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.

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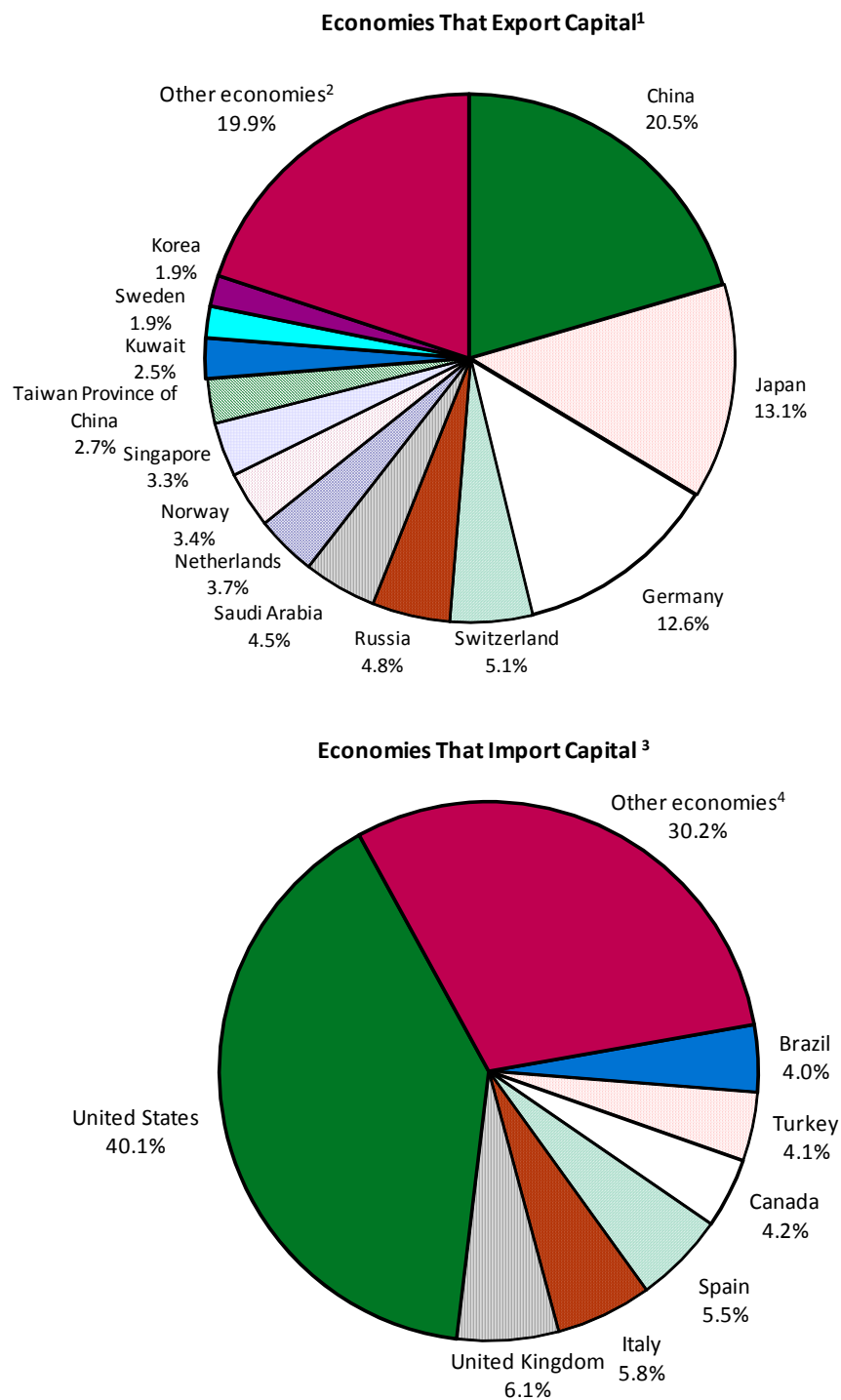
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Figure 1. Major Net Exporters and Importers of Capital in 2010

Source: IMF, *World Economic Outlook database* as of August 5, 2011.

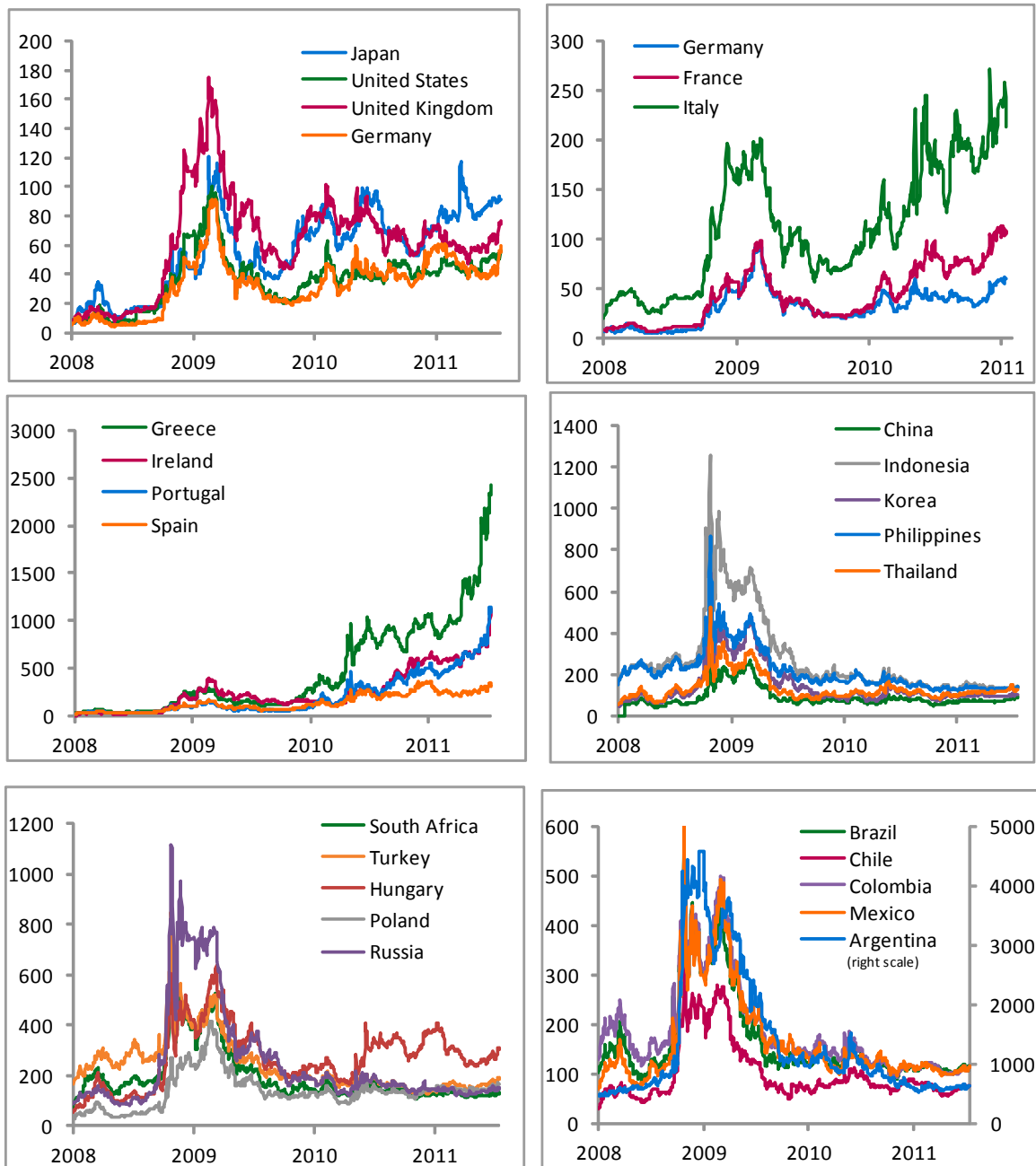
¹As measured by economies' current account surplus (assuming errors and omissions are part of the capital and financial accounts).

²Other economies include all economies with shares of total surplus less than 1.9 percent.

³As measured by economies' current account deficit (assuming errors and omissions are part of the capital and financial accounts).

⁴Other economies include all economies with shares of total deficit less than 4.0 percent.

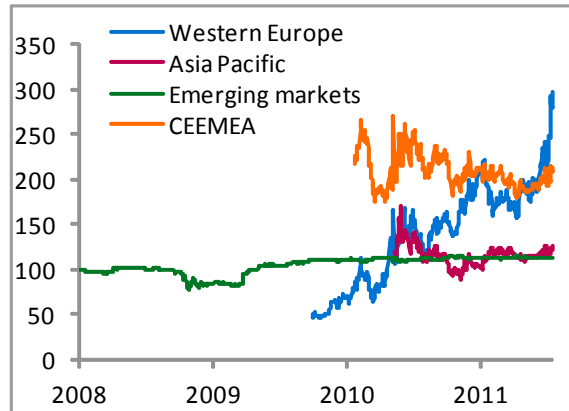
Figure 2. Sovereign Credit Default Swap Spreads
(5-year tenors, in basis points)



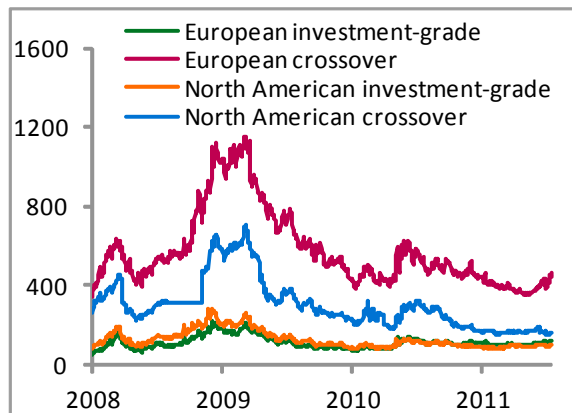
Source: Bloomberg L.P.

Figure 3. Selected Credit Default Swap Spreads
(5-year tenors, in basis points)

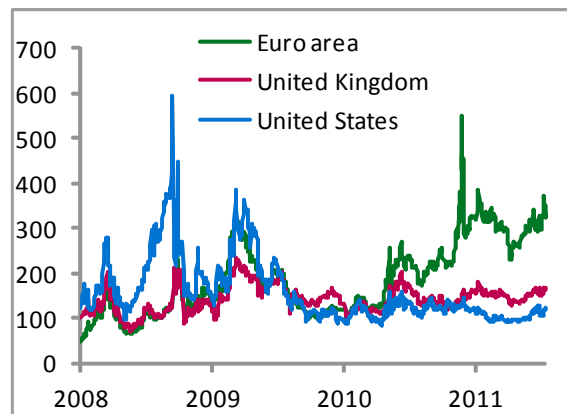
Sovereigns by Region



Corporates by Credit Quality



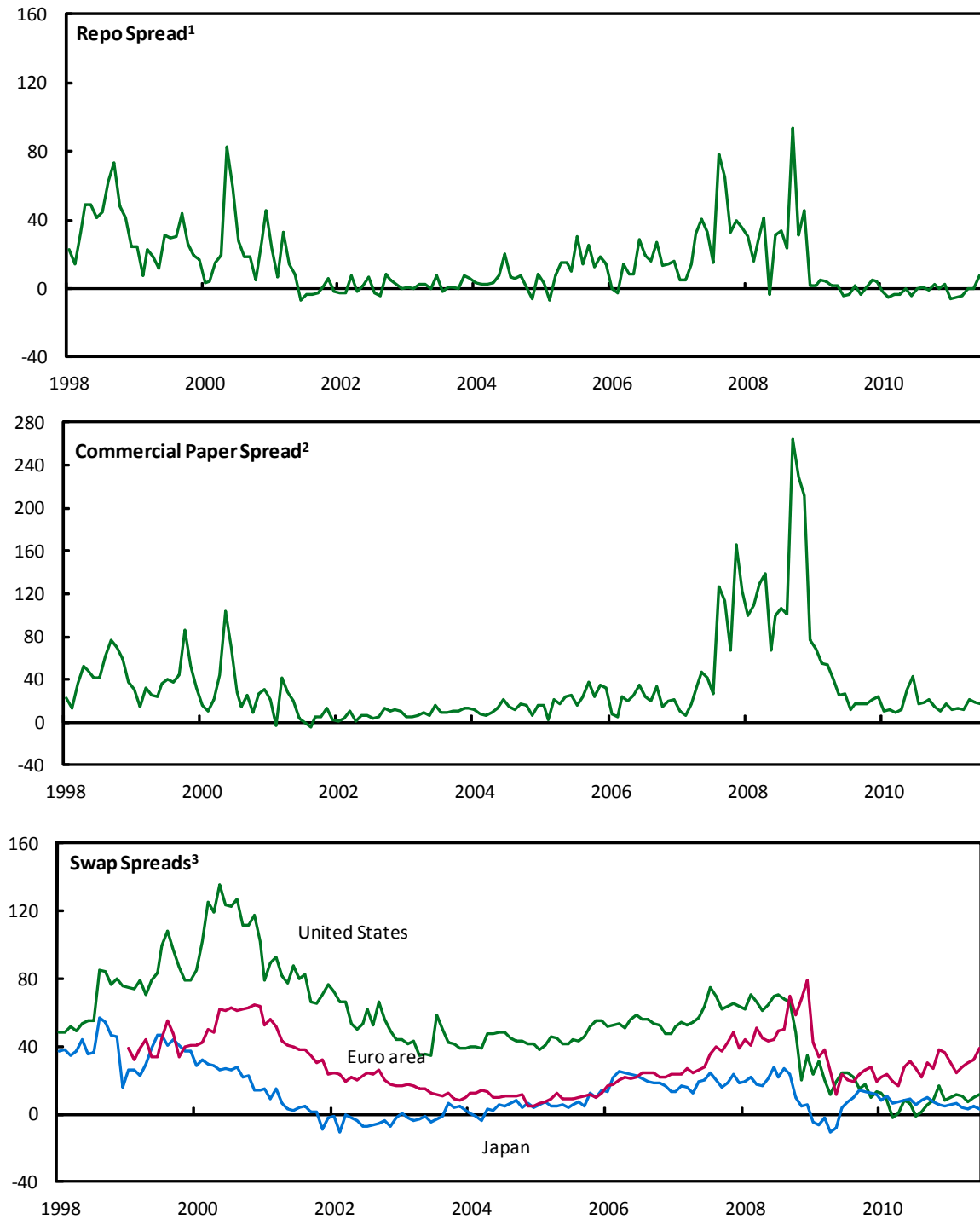
Banks by Region



Sources: Bloomberg L.P.; and Datastream.

CEEMEA = Central and Eastern Europe, Middle East, and Africa.

Figure 4. Selected Spreads
(In basis points; monthly data)

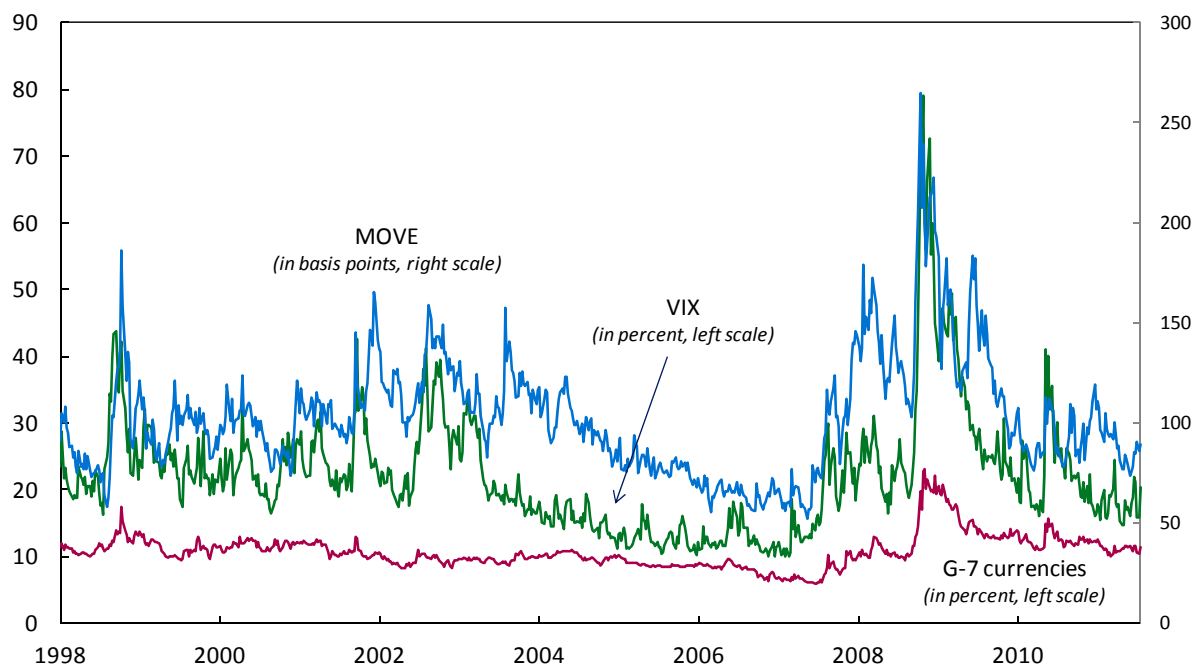


Sources: Bloomberg L.P.; and Merrill Lynch.

¹Spread between yields on three-month U.S. treasury repo and on three-month U.S. treasury bill.

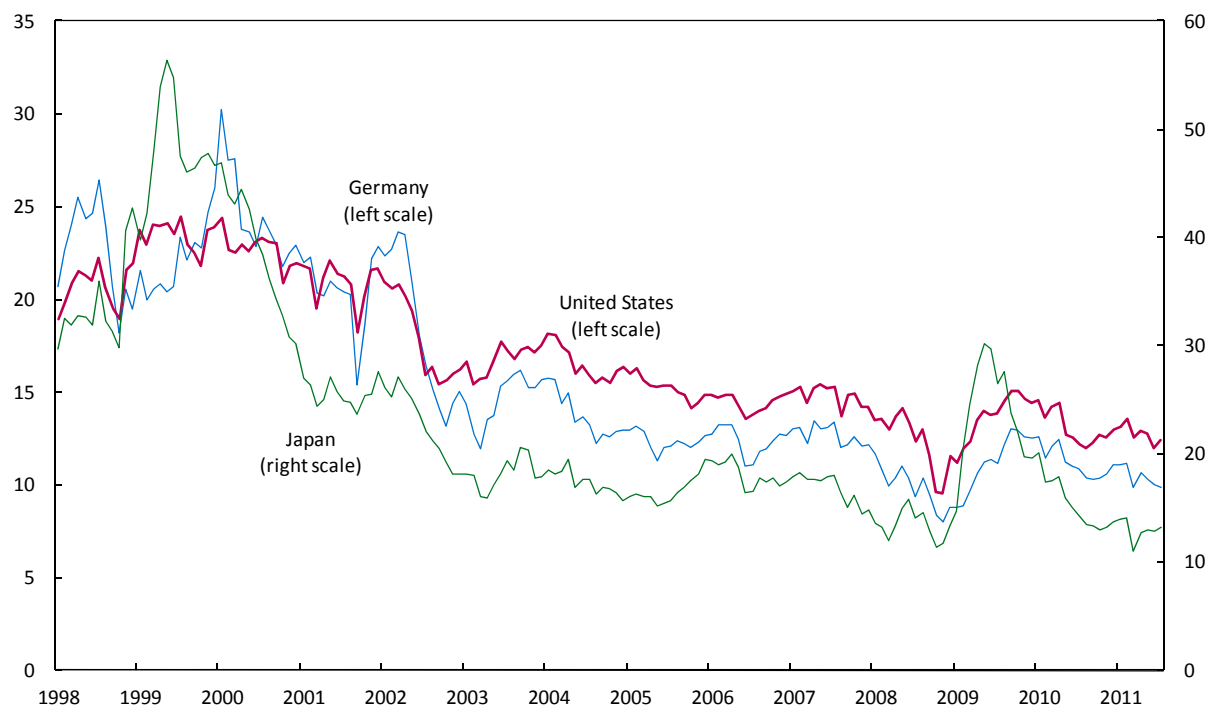
²Spread between yields on 90-day investment grade commercial paper and on three-month U.S. treasury bill.

³Spread over 10-year government bond.

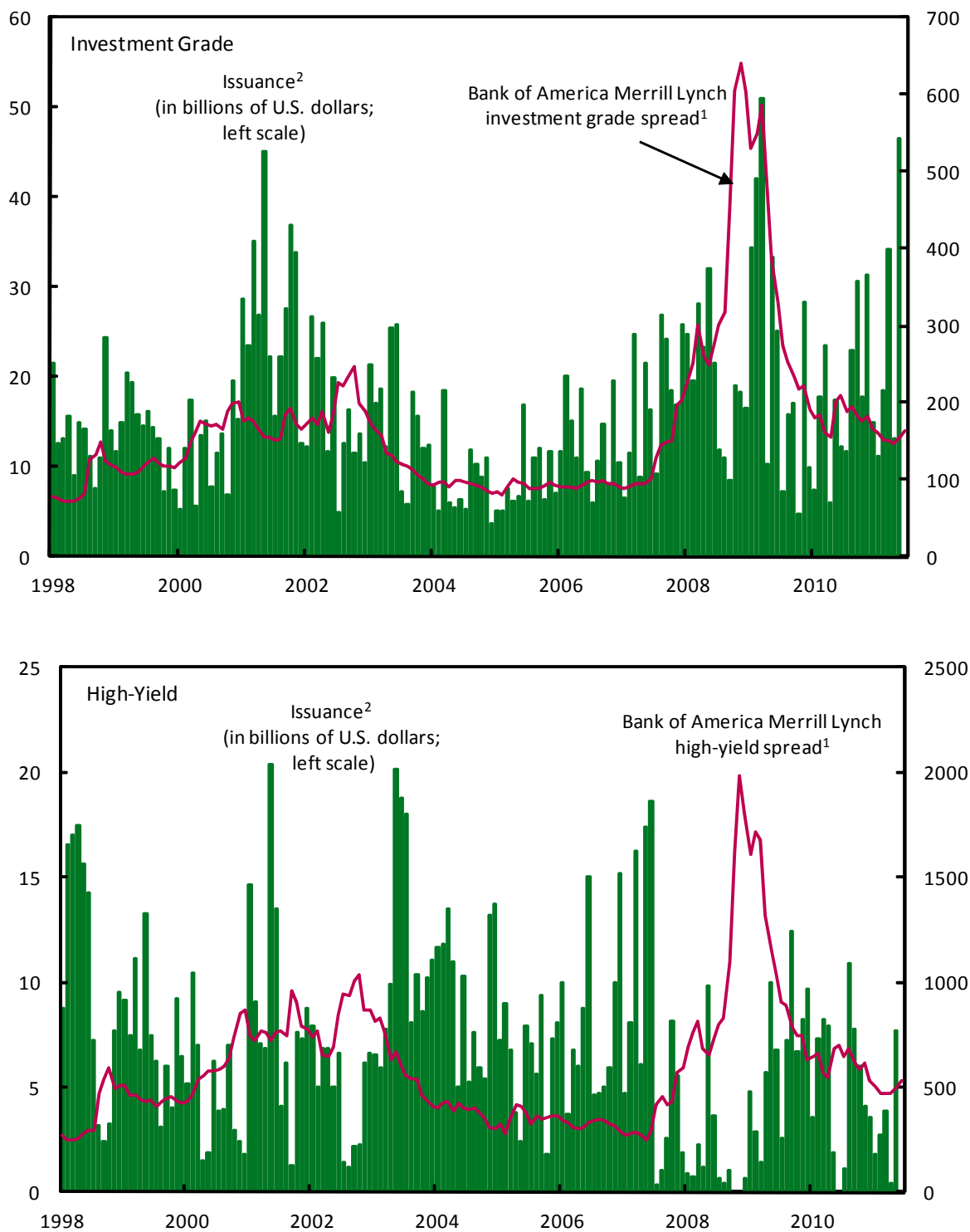
Figure 5. Implied Volatility Indices

Source: Bloomberg L.P.

Note: VIX = Chicago Board Options Exchange volatility index on the Standard & Poor's 500 and denotes equity volatility. MOVE = Bank of America Merrill Lynch Option Volatility Estimate index and denotes 1-month Treasury options volatility. G-7 currencies = VXY index from JPMorgan Chase & Co. and denotes G-7 foreign exchange volatility.

Figure 6. Twelve-Month Forward Price/Earnings Ratios

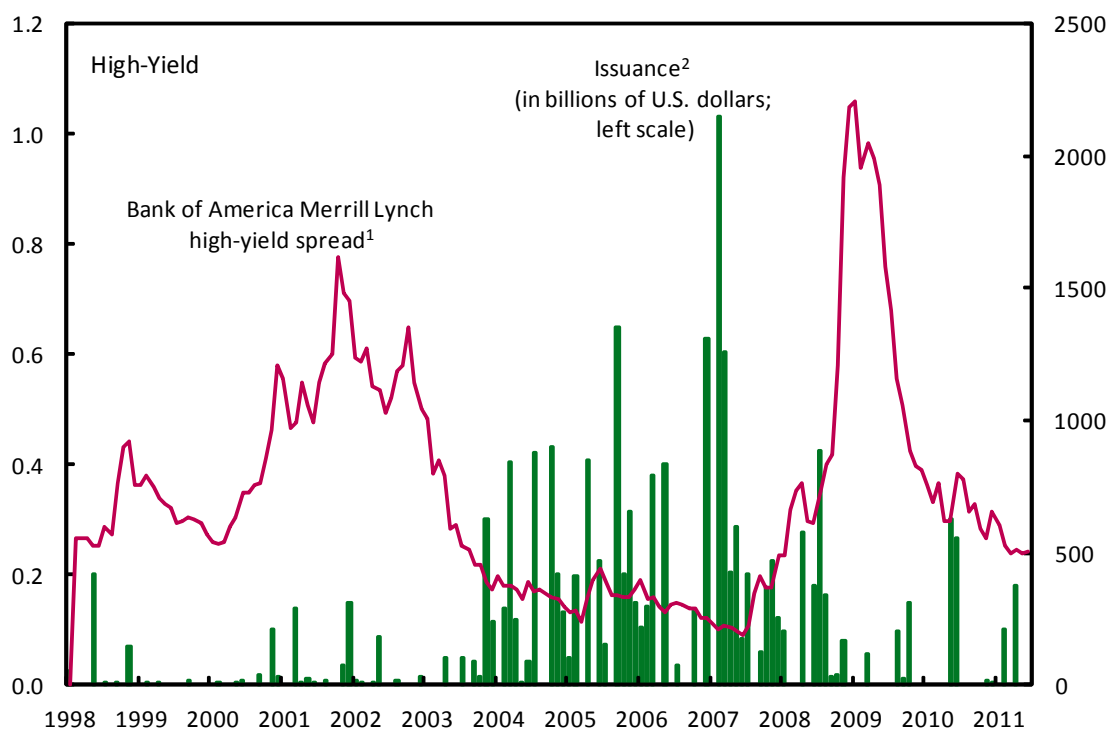
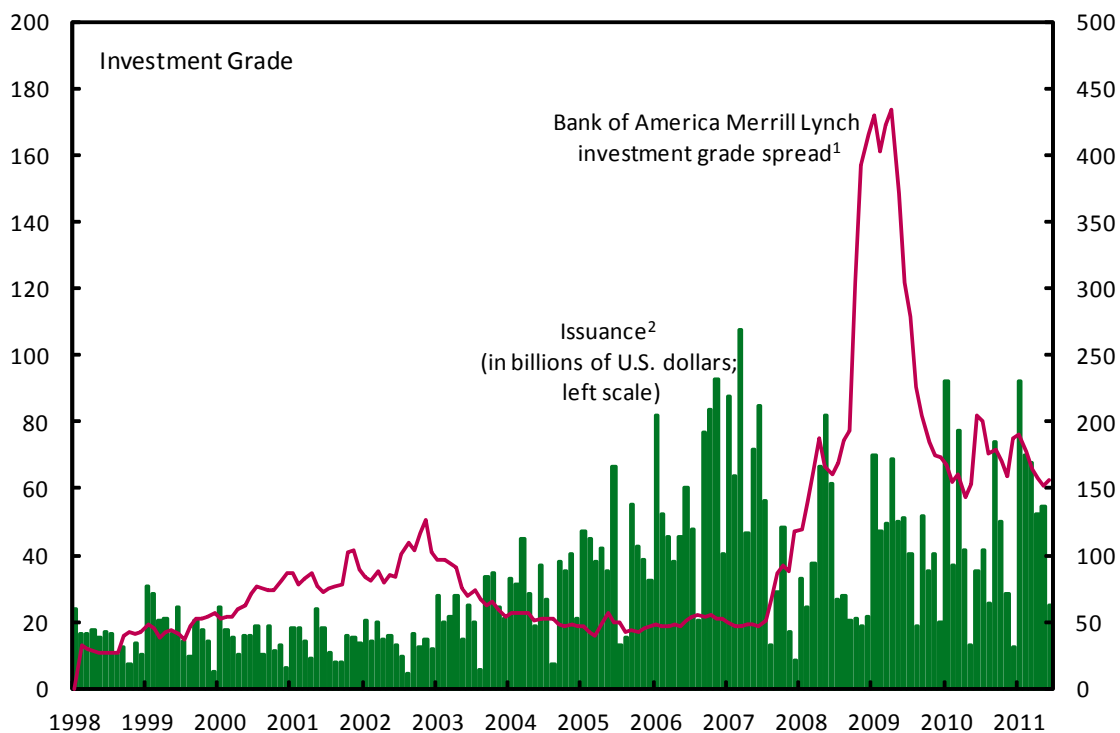
Source: I/B/E/S.

Figure 7. United States: Corporate Bond Market

Sources: Board of Governors of the Federal Reserve System; and Bank of America Merrill Lynch.

¹Option-adjusted spread; in basis points; right scale.

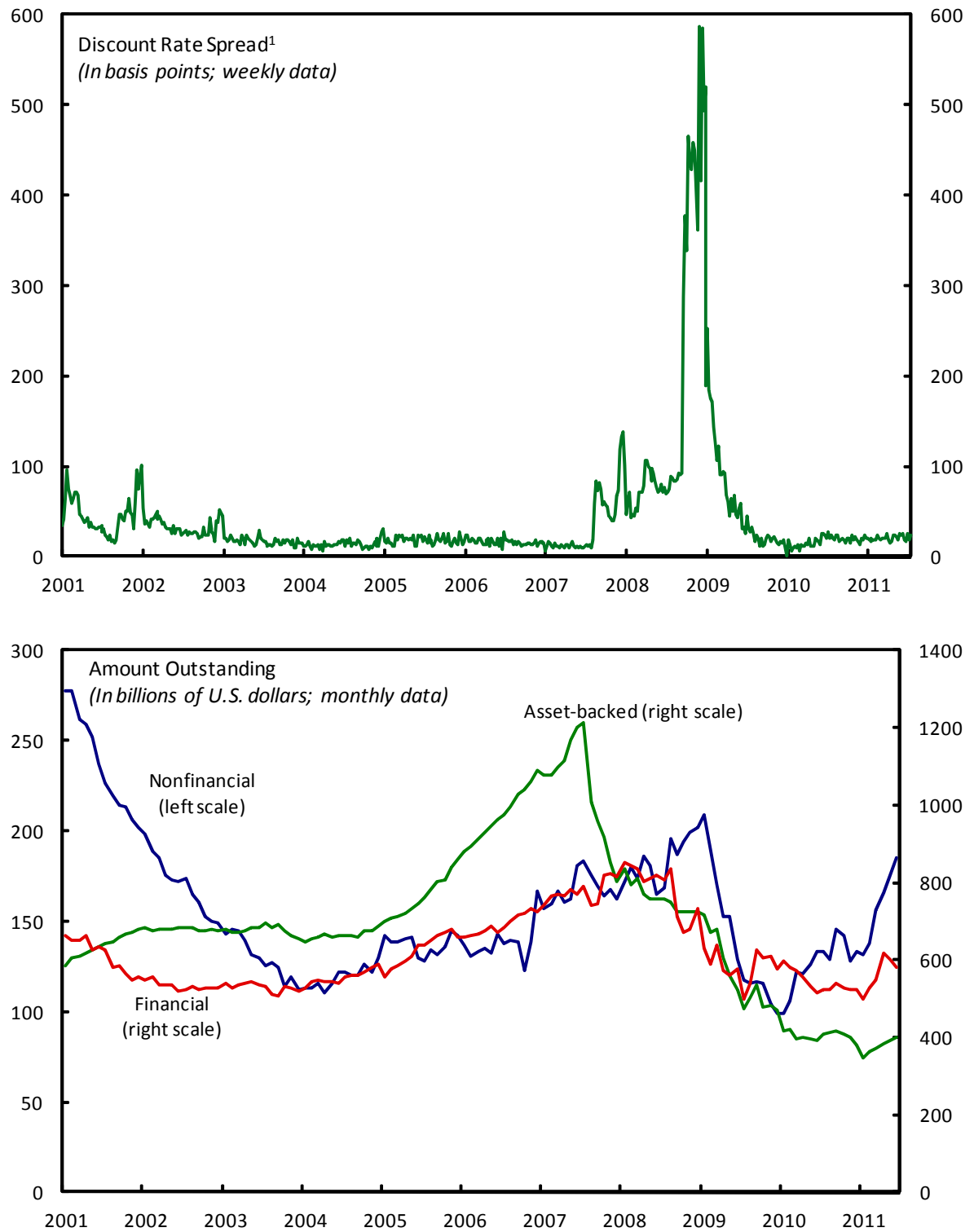
²Gross issuance.

Figure 8. Euro Area: Corporate Bond Market

Sources: DCM Analytics; and Bank of America Merrill Lynch.

¹Option-adjusted spread; in basis points; right scale.

²Gross issuance.

Figure 9. United States: Commercial Paper Market

Source: Board of Governors of the Federal Reserve System.

¹Difference between 30-day A2/P2 and AA nonfinancial commercial paper.

Table 1. Selected Indicators on the Size of the Capital Markets, 2010*(In billions of U.S. dollars unless noted otherwise)*

	Total Reserves		Stock Market Capitalization	Debt Securities ³			Bank Assets ⁴	Bonds, Equities, and Bank Assets ⁵	Bonds, Equities, and Bank Assets ⁵ (In percent of GDP)
	GDP	Minus Gold ²		Public	Private	Total			
World	62,909.3	9,639.3	55,102.1	41,377.0	53,465.1	94,842.2	98,227.8	248,172.1	394.5
European Union ¹	15,203.1	431.5	10,689.9	10,426.9	20,806.4	31,233.2	40,541.4	82,464.6	542.4
Euro area	12,189.0	300.2	6,236.1	8,716.4	16,096.6	24,812.9	26,613.8	57,662.9	473.1
North America	16,234.5	178.4	19,453.9	12,302.1	22,344.7	34,646.8	17,398.4	71,499.2	440.4
Canada	1,574.1	57.0	2,170.4	1,139.1	973.2	2,112.3	3,062.3	7,345.1	466.6
United States	14,660.4	121.4	17,283.5	11,163.0	21,371.5	32,534.5	14,336.1	64,154.1	437.6
Japan	5,458.9	1,061.5	4,099.6	11,635.5	2,518.0	14,153.5	11,280.9	29,533.9	541.0
Memorandum items:									
EU countries									
Austria	376.8	9.6	126.0	239.1	461.0	700.1	660.4	1,486.6	394.5
Belgium	465.7	16.5	269.3	437.3	719.3	1,156.6	1,448.8	2,874.7	617.3
Denmark	310.8	73.5	244.2	118.4	698.0	816.4	1,139.8	2,200.4	708.1
Finland	239.2	7.3	213.2	100.3	131.9	232.1	487.9	933.2	390.1
France	2,582.5	55.8	1,758.7	1,762.7	3,404.8	5,167.6	7,841.1	14,767.4	571.8
Germany	3,315.6	62.3	1,429.7	2,025.6	3,336.9	5,362.5	4,984.6	11,776.8	355.2
Greece	305.4	1.3	67.6	382.5	302.9	685.4	587.1	1,340.0	438.8
Ireland	204.3	1.8	60.4	127.1	711.3	838.4	992.1	1,890.9	925.7
Italy	2,055.1	47.7	598.4	2,186.8	2,172.2	4,359.0	3,072.5	8,029.9	390.7
Luxembourg	54.9	0.7	101.1	6.9	89.9	96.8	534.4	732.3	1,332.7
Netherlands	783.3	18.5	327.2	408.8	1,911.7	2,320.5	2,269.1	4,916.8	627.7
Portugal	229.3	3.7	87.8	178.1	367.9	546.0	717.9	1,351.7	589.4
Spain	1,409.9	19.1	1,171.6	795.5	2,462.9	3,258.4	2,830.1	7,260.1	514.9
Sweden	455.8	42.6	596.6	170.9	650.7	821.5	680.0	2,098.1	460.3
United Kingdom	2,247.5	68.3	3,613.1	1,421.2	3,361.2	4,782.3	12,107.8	20,503.2	912.3
Newly industrialized Asian economies ⁶	1,885.4	1,167.8	5,059.4	774.1	1,085.3	1,859.4	3,906.9	10,825.7	574.2
Emerging market economies ⁷	21,378.2	6,294.6	12,535.8	5,537.3	3,341.6	8,878.9	19,213.2	40,628.0	190.0
Of which:									
Asia	9,426.1	3,647.2	6,680.9	2,824.4	1,893.6	4,718.0	12,028.6	23,427.5	248.5
Latin America and the Caribbean	4,832.3	632.8	2,669.5	1,562.2	992.8	2,555.0	3,517.1	8,741.6	180.9
Middle East and North Africa	2,355.5	1,013.2	848.6	205.3	126.6	331.9	1,398.7	2,579.2	109.5
Sub-Saharan Africa	1,056.0	157.2	727.1	155.2	100.4	255.5	550.3	1,532.9	145.2
Europe	3,708.4	844.1	1,609.8	790.3	228.1	1,018.4	1,718.5	4,346.7	117.2

Sources: World Federation of Exchanges; Bank for International Settlements (BIS); IMF, International Financial Statistics (IFS) and World Economic Outlook databases as of June 21, 2011; ©2003 Bureau van Dijk Electronic Publishing-Bankscope; Board of Governors of the Federal Reserve System, *Flow of Funds*; and Bloomberg L.P.

¹This aggregate includes euro area countries, Denmark, Sweden, and the United Kingdom.

²Data are from IFS. For euro area, the data also include the total reserves minus gold holdings of European Central Bank.

³Data are from BIS. The data include international and domestic debt securities. For data definition and coverage, refer to the BIS Guide to the International Financial Statistics.

⁴Total assets of commercial banks, including subsidiaries. For Ireland, the data are from Central Bank of Ireland. For Portugal, the data are from Bank of Portugal.

⁵Sum of the stock market capitalization, debt securities, and bank assets.

⁶Hong Kong SAR, Korea, Singapore, and Taiwan Province of China.

⁷This aggregate comprises the group of emerging and developing economies defined in the *World Economic Outlook*.

Table 2. MSCI Equity Market Indices

	2010		2011		End of Period			
	Q3	Q4	Q1	Q2	2007	2008	2009	2010
Global	13.2	8.6	4.3	-0.3	-71.1	-40.9	26.2	
Emerging Markets Index¹	17.2	7.1	1.7	-2.1	36.5	-54.5	74.5	16.4
Latin America	20.4	5.3	0.4	-3.6	46.9	-52.8	98.1	12.1
Argentina	40.8	25.6	-12.0	0.1	-5.4	-55.3	61.1	70.1
Brazil	21.0	2.6	2.0	-5.3	75.3	-57.6	121.3	3.8
Chile	32.4	5.5	-8.3	7.2	20.8	-37.3	81.4	41.8
Colombia	31.7	-5.6	0.0	5.2	12.6	-27.7	76.5	40.8
Mexico	11.2	16.3	0.5	-1.3	9.3	-44.0	53.1	26.0
Peru	24.4	16.6	-14.0	-16.4	86.0	-42.4	69.3	49.2
Asia	14.7	6.9	1.3	-0.9	38.3	-54.1	70.3	16.6
China	10.1	0.7	2.9	-3.6	63.1	-51.9	58.8	2.3
India	15.0	2.0	-5.2	-4.2	71.2	-65.1	100.5	19.4
Indonesia	16.7	-1.1	4.7	6.5	50.8	-57.6	120.8	31.2
Korea	17.0	12.8	6.5	0.8	30.0	-55.9	69.4	25.3
Malaysia	17.6	4.4	3.6	2.8	41.5	-43.4	47.8	32.5
Pakistan	0.1	20.7	-0.6	0.4	32.5	-75.4	78.1	19.5
Philippines	28.1	-3.8	-4.4	2.7	38.0	-53.8	60.2	30.3
Taiwan Province of China	15.7	17.4	-4.2	1.0	5.4	-48.7	75.1	18.3
Thailand	30.9	5.7	3.5	-3.1	40.9	-50.3	70.0	50.8
Europe, Middle East, & Africa	21.1	10.0	4.7	-4.0	25.8	-56.7	63.5	20.9
Czech Republic ¹	15.3	-3.5	16.3	1.4	51.7	-45.1	19.6	-7.4
Egypt	10.0	4.9	-23.7	-3.2	54.8	-53.9	32.8	9.5
Hungary	27.0	-9.4	20.2	0.1	13.4	-62.4	73.9	-10.7
Israel	10.7	4.1	-2.9	-6.1	35.8	-30.9	51.3	2.2
Jordan	-2.4	2.0	-9.7	-4.2	20.9	-35.8	-7.7	-12.0
Morocco	7.9	4.0	5.5	-5.3	44.0	-13.0	-8.3	10.8
Poland	34.8	3.8	6.9	2.8	22.7	-56.2	37.3	12.6
Russia	13.1	16.5	16.3	-7.1	22.9	-74.2	100.3	17.2
South Africa	24.2	12.6	-2.8	-2.5	14.7	-40.0	53.4	30.7
Turkey	31.9	-7.9	-5.5	-6.0	70.0	-63.4	92.0	18.4
Sectors								
Energy	12.4	10.2	11.6	-8.5	51.9	-62.1	82.1	7.5
Materials	14.6	8.4	1.2	-5.9	48.8	-52.2	74.8	14.7
Industrials	24.9	7.1	-3.3	0.3	66.6	-62.8	56.3	27.1
Consumer discretionary	24.7	6.0	1.4	7.8	16.2	-53.2	113.0	29.5
Consumer staple	19.9	4.4	-2.0	6.1	24.1	-36.5	66.7	27.6
Health care	17.5	4.8	-5.1	2.1	28.8	-18.2	40.1	25.7
Financials	18.7	3.7	0.3	-2.9	28.9	-54.2	76.6	14.5
Information technology	11.8	13.6	-2.0	-3.8	-0.1	-51.9	104.7	13.9
Telecommunications	11.9	2.3	1.0	0.6	50.4	-44.9	21.8	10.9
Utilities	9.2	0.2	2.0	0.5	34.4	-43.4	51.2	4.9

Table 2 (concluded)

	Period on Period Percent Change							
	2010		2011		End of Period			
	Q3	Q4	Q1	Q2	2007	2008	2009	2010
World Index	13.2	8.6	4.3	-0.3	7.1	-42.1	27.0	13.9
Australia	22.0	8.9	3.2	-1.4	25.0	-52.3	68.8	13.5
Austria	27.8	11.7	6.0	-0.5	0.7	-69.0	38.4	13.8
Belgium	19.5	-3.7	5.5	0.6	-5.3	-67.5	54.3	3.1
Canada	12.7	11.6	7.2	-5.2	27.6	-46.6	52.7	26.7
Denmark	17.7	7.0	8.8	-6.7	24.2	-48.2	35.2	41.2
Finland	26.5	5.8	1.2	-10.3	45.0	-56.4	7.2	8.3
France	20.6	1.3	10.5	2.2	10.9	-44.9	27.6	3.1
Germany	16.6	9.5	7.2	4.0	32.5	-47.2	21.3	13.6
Greece	18.0	-10.8	15.2	-17.9	29.2	-67.1	22.6	-38.2
Hong Kong SAR	21.1	4.3	-0.8	-2.0	37.5	-52.9	55.2	18.7
Ireland	-4.1	6.4	7.6	7.4	-21.9	-72.7	9.9	-13.6
Italy	19.2	-2.8	13.8	-4.8	2.7	-52.1	22.6	-6.3
Japan	5.0	12.0	-5.9	0.1	-5.4	-30.5	4.4	6.7
Netherlands	15.7	1.7	10.3	-6.0	17.5	-50.1	37.9	9.6
New Zealand	11.4	10.6	2.6	10.9	4.0	-56.2	43.0	5.8
Norway	29.1	11.6	6.6	-4.3	28.4	-65.2	82.5	14.5
Portugal	20.5	-0.8	8.7	-2.5	21.0	-53.6	35.4	-7.2
Singapore	14.7	6.2	-0.7	0.5	23.9	-49.5	67.3	17.6
Spain	26.5	-10.1	12.9	-0.2	20.7	-43.0	36.5	-15.8
Sweden	24.7	7.4	4.8	-1.7	-1.4	-51.4	60.2	37.6
Switzerland	13.3	7.5	0.7	5.2	3.9	-31.6	22.9	10.6
United Kingdom	18.8	5.5	2.8	0.7	4.7	-50.6	37.3	8.1
United States	11.0	10.5	5.5	-0.3	4.1	-38.6	24.2	19.4

Source: Morgan Stanley Capital International.

Note: Price indices in U.S. dollar terms.

¹ The country and regional classifications used in this table follow the conventions of MSCI, and do not necessarily conform to IMF country classifications or regional groupings.

Table 3. Emerging Market Bond Index: EMBI Global Yield Spreads
(In basis points)

	2010		2011		End of period				
	Q3	Q4	Q1	Q2	2006	2007	2008	2009	2010
EMBI Global	305	289	299	288	171	255	724	294	289
Latin America									
Argentina	689	507	539	568	216	410	1,704	660	507
Brazil	203	189	174	150	190	220	429	189	189
Chile	136	115	117	131	84	151	343	95	115
Colombia	169	172	153	121	161	195	498	198	172
Dominican Republic	333	322	393	393	196	281	1,605	405	322
Ecuador	1,226	913	780	783	920	614	4,731	769	913
El Salvador	361	302	330	321	159	199	854	326	302
Mexico	191	173	160	148	115	172	434	192	173
Panama	174	162	150	127	146	184	539	166	162
Peru	174	165	173	169	118	178	509	165	165
Uruguay	214	188	176	151	185	243	685	238	188
Venezuela	1,162	1,114	1,137	1,117	183	523	1,864	1,041	1,114
Asia									
China	81	126	151	155	51	120	228	64	126
Indonesia	192	183	204	178	153	275	762	230	183
Malaysia	137	117	109	131	66	119	370	136	117
Pakistan	695	654	774	857	154	535	2,112	688	654
Philippines	184	163	174	160	155	207	546	206	163
Vietnam	305	323	295	329	95	203	747	314	323
Europe, Middle East, & Africa									
Bulgaria	256	195	185	198	66	153	674	179	195
Egypt	246	221	322	289	52	178	385	-3	221
Hungary	300	345	276	268	58	84	504	186	345
Iraq	468	314	298	348	526	569	1,282	447	314
Lebanon	348	270	308	323	395	493	794	287	270
Poland	161	151	156	152	47	67	314	124	151
Russia	249	224	188	204	99	157	805	203	224
Serbia	493	418	366	407	186	304	1,224	333	418
South Africa	158	145	163	159	84	164	562	149	145
Tunisia	102	111	223	223	83	140	464	189	111
Turkey	220	177	204	201	207	239	534	197	177
Ukraine	559	461	419	468	172	303	2,771	989	461
Latin America	363	357	373	355	180	275	746	355	357
Non-Latin America	244	220	225	225	159	227	699	224	220

Table 3. (concluded)

	Period on Period Change								
	2010		2011		End of period				
	Q3	Q4	Q1	Q2	2006	2007	2008	2009	2010
EMBI Global	-54	-16	10	-10	-66	84	470	-430	-6
Latin America									
Argentina	-156	-182	32	29	-288	194	1294	-1044	-153
Brazil	-44	-14	-15	-24	-118	30	209	-240	0
Chile	-10	-21	2	14	4	67	192	-248	20
Colombia	-60	3	-19	-32	-83	34	303	-300	-26
Ecuador	213	-313	-133	3	259	-306	4117	-3962	144
El Salvador	8	-59	28	-9	-80	40	655	-528	-24
Mexico	-21	-18	-13	-12	-28	57	262	-242	-19
Panama	-46	-12	-12	-23	-93	38	355	-373	-4
Peru	-41	-9	8	-4	-139	60	331	-344	0
Uruguay	-46	-26	-12	-25	-113	58	442	-447	-50
Venezuela	-85	-48	23	-20	-130	340	1341	-823	73
Asia									
China	-5	45	25	4	-17	69	108	-164	62
Indonesia	-82	-9	21	-26	-116	122	487	-532	-47
Malaysia	-34	-20	-8	22	-16	53	251	-234	-19
Pakistan	92	-41	120	83	-44	381	1577	-1424	-34
Philippines	-82	-21	11	-14	-147	52	339	-340	-43
Vietnam	-33	18	-28	34	-95	108	544	-433	9
Europe, Middle East, & Africa									
Bulgaria	-78	-61	-10	13	-24	87	521	-495	16
Egypt	-57	-25	101	-33	-6	126	207	-388	224
Hungary	-63	45	-69	-8	-16	26	420	-318	159
Iraq	5	-154	-16	50	...	43	713	-835	-133
Lebanon	1	-78	38	15	149	98	301	-507	-17
Poland	-56	-10	5	-4	-15	20	247	-190	27
Russia	-46	-25	-36	16	-19	58	648	-602	21
Serbia	18	-75	-52	41	-52	118	920	-891	85
South Africa	-52	-13	18	-4	-3	80	398	-413	-4
Turkey	-64	-43	27	-3	-16	32	295	-337	-20
Ukraine	-69	-98	-42	49	-12	131	2468	-1782	-528
Latin America	-52	-6	16	-18	-92	95	471	-391	2
Non-Latin America	-57	-24	-220	0	-20	68	472	-475	-4

Source: JPMorgan Chase & Co.

Note: The country and regional classifications used in this table follow the conventions of JPMorgan, and do not necessarily conform to IMF country classifications or regional groupings.

¹From initiation of the index.

Table 4. Emerging Market External Financing: Total Bonds, Equities, and Loans*(In millions of U.S. dollars)*

	2006	2007	2008	2009	2010	2010		2011	
						Q3	Q4	Q1	Q2
Total	414,795.7	576,435.0	324,255.5	426,386.9	583,281.9	168,368.0	164,107.8	149,566.7	139,597.6
Sub-Saharan Africa	15,800.2	28,085.3	5,424.4	15,146.7	16,316.3	2,817.2	4,616.1	6,685.8	2,914.9
Angola	91.9	74.6	15.0	1,813.8	3,767.8	-	2,632.0	-	346.4
Botswana	-	-	-	825.0	1.9	-	-	-	-
Burkina Faso	-	14.5	-	-	-	-	-	-	-
Cameroon	-	-	-	-	-	-	-	-	-
Cape Verde	-	-	-	-	-	-	-	-	-
Central African Republic	-	305.5	-	-	-	-	-	-	-
Côte d'Ivoire	-	-	45.0	150.7	2,332.1	-	-	-	-
Ethiopia	-	-	100.2	46.8	693.9	-	646.1	-	114.8
Gabon	34.4	1,000.0	600.0	-	119.0	-	-	-	-
Ghana	860.0	1,464.3	1,000.0	1,331.5	45.5	-	45.5	-	-
Kenya	330.1	10.0	277.0	125.7	-	-	-	-	-
Lesotho	-	19.7	-	-	-	-	-	-	-
Madagascar	-	-	-	-	78.8	-	78.8	-	-
Mali	-	180.9	110.4	-	-	-	-	-	-
Mauritius	180.0	110.0	29.0	-	-	-	-	-	-
Mozambique	38.8	-	808.5	55.0	-	-	-	-	-
Namibia	100.0	-	97.6	-	-	-	-	-	-
Nigeria	640.0	4,841.4	472.5	2,414.7	1,638.7	-	519.0	1,485.4	-
Rwanda	-	-	-	-	-	-	-	29.2	-
Senegal	31.6	-	-	200.0	118.9	118.9	-	-	500.0
Seychelles	200.0	30.0	-	168.9	-	-	-	-	-
Sierra Leone	-	-	-	-	-	-	-	116.5	-
South Africa	12,700.8	19,779.5	1,366.1	7,544.7	7,459.7	2,698.3	694.7	5,054.6	1,953.7
Tanzania	-	-	358.1	-	60.0	-	-	-	-
Togo	-	-	125.0	-	-	-	-	-	-
Uganda	12.6	-	-	300.0	-	-	-	-	-
Zambia	505.0	255.0	20.0	90.0	-	-	-	-	-
Zimbabwe	75.1	-	-	80.0	-	-	-	-	-
Central and Eastern Europe	50,213.6	54,108.1	39,751.2	36,152.2	52,119.1	13,146.7	8,752.9	17,767.4	21,318.4
Albania	34.0	-	78.1	-	407.3	-	407.3	-	-
Bulgaria	1,000.4	1,095.5	1,415.0	540.5	46.0	-	46.0	-	-
Croatia	1,896.7	2,786.5	870.6	3,718.0	1,950.2	1,337.0	219.4	1,968.4	1,073.3
Hungary	7,328.7	5,330.8	7,865.6	5,980.3	3,832.5	309.0	-	3,750.0	3,177.3
Latvia	1,457.4	1,614.7	1,892.0	278.2	26.7	-	-	-	500.0
Lithuania	1,292.0	1,645.3	263.3	2,415.2	2,785.9	750.0	-	750.0	-
Macedonia, FYR	-	14.4	-	452.8	-	-	-	-	-
Montenegro	0.8	21.4	6.4	6.3	254.0	254.0	-	-	253.8
Poland	8,014.6	7,343.0	8,106.3	11,717.4	18,305.5	3,370.4	4,350.5	2,477.6	5,548.5
Romania	848.4	1,070.4	1,890.0	161.3	1,456.7	-	27.6	172.3	4,264.7
Serbia	60.2	1,376.0	235.3	886.8	-	-	-	-	-
Turkey	28,280.3	31,810.1	17,128.6	9,995.4	23,054.3	7,126.3	3,702.1	8,649.0	6,500.8
Commonwealth of Independent States	80,156.6	114,344.3	70,987.6	58,895.2	59,687.5	19,267.0	19,740.5	20,071.3	19,998.8
Armenia	30.0	19.1	11.0	2.4	-	-	-	-	11.6
Azerbaijan	183.8	315.7	126.6	539.8	2,555.0	2,250.0	305.0	125.0	-
Belarus	338.6	302.8	327.0	53.5	1,736.7	1,000.0	576.7	800.0	58.5
Georgia ¹	166.8	341.6	984.8	55.5	250.0	250.0	-	-	500.0
Kazakhstan	14,727.1	17,712.3	10,542.1	1,053.7	3,793.2	23.2	3,209.2	1,175.4	300.0
Kyrgyz Republic	-	-	7.4	46.2	-	-	-	-	-
Moldova	-	-	171.3	28.4	-	-	-	-	-
Mongolia ¹	6.0	85.0	6.8	1.0	894.5	36.0	858.5	-	-
Russia	59,246.3	86,892.8	54,247.8	53,389.9	45,589.1	13,467.1	12,952.8	15,870.9	16,611.7
Tajikistan	-	2.0	16.7	3.2	-	-	-	-	-
Ukraine	5,453.1	8,672.9	4,529.8	3,716.7	4,869.0	2,240.6	1,838.3	2,100.0	2,517.1
Uzbekistan	4.9	-	16.4	5.0	-	-	-	-	-

Table 4. (concluded)

	2006	2007	2008	2009	2010	2010		2011	
						Q3	Q4	Q1	Q2
Developing Asia	113,784.7	169,443.6	92,860.5	168,830.5	261,266.7	77,545.2	85,804.7	66,023.8	56,372.3
Bangladesh	356.5	57.5	65.4	56.4	-	-	-	86.0	-
Bhutan	-	-	-	-	92.2	-	92.2	-	-
Cambodia	96.3	220.0	-	-	-	-	-	-	-
China	52,957.2	75,074.8	28,469.7	68,501.0	80,044.2	30,880.8	29,250.6	19,154.4	20,910.2
Fiji	150.0	-	-	-	-	-	-	250.0	-
India	29,668.6	60,647.7	37,361.7	56,890.8	115,757.7	28,269.7	35,765.5	32,272.4	17,035.9
Indonesia	8,267.4	8,680.7	13,542.5	13,151.9	20,052.9	3,568.3	6,975.4	3,137.2	8,075.4
Lao P.D.R.	-	160.0	592.0	213.7	3,000.0	2,888.7	111.2	-	-
Malaysia	6,446.1	7,068.2	3,927.7	7,122.7	17,199.7	5,545.8	5,699.8	2,385.5	6,730.3
Marshall Islands	170.0	1,069.3	204.0	-	660.0	660.0	-	427.2	880.0
Nepal	-	-	15.0	-	-	-	-	-	-
Pakistan	3,260.0	1,999.3	837.8	534.3	596.1	92.9	300.8	389.6	-
Papua New Guinea	-	1,024.3	-	11,428.5	-	-	-	240.0	-
Philippines	7,041.8	6,602.3	2,590.2	7,358.7	10,508.3	2,030.9	2,648.4	4,314.7	1,045.9
Sri Lanka	129.8	755.0	538.7	560.0	1,205.6	1,170.6	-	-	-
Thailand	4,783.6	2,527.8	3,056.3	1,573.2	8,038.5	1,543.6	4,022.8	3,306.8	1,404.5
Vietnam	457.4	3,556.8	1,659.5	1,439.2	4,111.6	894.0	938.1	60.0	290.0
Middle East and North Africa	85,926.1	76,994.0	56,471.7	52,386.9	60,171.0	17,062.7	15,720.5	9,553.8	6,056.5
Algeria	2.0	411.0	1,738.0	-	1.9	-	-	-	-
Bahrain	3,785.7	6,170.1	1,245.0	2,159.5	2,874.9	-	859.9	698.0	-
Egypt	4,379.6	5,471.7	6,128.5	1,757.0	5,482.6	1,515.0	438.3	754.7	829.7
Iran, I.R. of	142.5	-	-	-	-	-	-	-	-
Iraq	2,877.0	-	-	-	-	-	-	-	-
Jordan	-	-	-	-	750.0	-	750.0	-	-
Kuwait	5,346.6	2,379.9	3,146.8	1,463.3	3,671.6	1,300.0	302.0	1,496.6	254.2
Lebanon	6,040.0	2,420.0	3,203.2	2,945.6	2,143.5	-	765.0	-	1,000.0
Libya	-	38.0	-	-	-	-	-	-	-
Morocco	158.7	1,721.0	346.6	-	1,346.9	1,346.9	-	-	13.0
Oman	3,430.2	2,873.3	950.6	565.8	2,418.9	835.7	488.3	296.0	250.0
Qatar	11,191.9	12,672.2	9,782.4	14,663.8	6,217.5	4,250.0	1,830.1	-	43.6
Saudi Arabia	14,955.5	8,720.8	5,532.7	2,282.9	16,129.9	2,497.1	3,281.1	377.6	-
Syrian Arab Republic	-	-	80.0	-	-	-	-	-	-
Tunisia	24.7	403.4	403.5	1.4	-	-	-	-	-
United Arab Emirates	33,591.6	33,712.6	21,492.1	26,500.0	19,083.0	5,318.1	6,955.6	5,931.0	3,666.0
West Bank and Gaza	-	-	-	-	50.3	-	50.3	-	-
Yemen Arab Republic	-	-	2,422.2	47.6	-	-	-	-	-
Latin America and the Caribbean	68,914.5	133,459.7	58,760.1	94,975.5	133,721.4	38,529.2	29,473.1	29,464.6	32,936.7
Argentina	3,343.6	10,472.2	1,651.4	209.3	4,799.1	1,923.0	1,669.1	2,472.3	2,819.1
Bolivia	-	-	100.0	-	253.0	-	253.0	-	-
Brazil	29,517.8	74,225.0	28,060.4	39,616.7	67,565.1	20,792.6	12,667.4	10,688.6	17,982.3
Chile	6,009.1	3,673.2	4,570.4	4,060.1	8,526.8	4,144.5	2,365.5	3,257.0	3,480.6
Colombia	5,036.1	7,879.4	1,991.7	6,018.7	4,201.2	1,525.0	64.8	1,656.9	3,050.4
Costa Rica	1.7	31.1	85.0	-	5.8	-	5.8	-	175.0
Dominican Republic	779.8	657.9	479.6	15.0	2,024.7	56.8	108.3	323.8	-
Ecuador	19.1	104.0	-	-	-	-	-	36.0	-
El Salvador	1,326.6	-	-	855.0	200.0	-	-	653.5	-
Guatemala	-	15.0	5.0	-	-	-	-	-	-
Haiti	134.0	-	-	-	-	-	-	-	-
Honduras	-	-	113.6	-	-	-	-	-	-
Jamaica	1,076.1	1,275.0	450.0	1,085.0	1,825.2	-	497.0	598.4	-
Mexico	14,321.9	17,803.9	10,432.3	24,957.9	28,733.5	5,544.8	5,707.9	4,839.6	4,934.7
Panama	74.8	1,056.1	4,389.3	2,201.4	477.3	-	-	588.5	-
Paraguay	-	-	98.8	-	-	-	-	-	-
Peru	1,489.9	5,624.4	2,330.0	3,606.4	7,595.9	1,542.5	3,134.4	935.0	-
St. Lucia	-	-	-	-	-	-	-	175.0	-
Trinidad and Tobago	2,708.0	955.4	-	850.0	13.8	-	-	-	-
Uruguay	2,700.0	918.3	2.6	500.0	-	-	-	-	494.8
Venezuela	376.1	8,769.0	4,000.0	11,000.0	7,500.0	3,000.0	3,000.0	3,240.0	-

Source: Data provided by the Bond, Equity and Loan database of the International Monetary Fund sourced from Dealogic.

Note: Deal inclusion conforms to the vendor's criteria for external publicly-syndicated gross issuance, generally excluding bilateral deals.

¹Georgia and Mongolia, which are not members of the Commonwealth of Independent States, are included in this group for reasons of geography and similarities in economic structure.

Table 5. Emerging Market External Financing: Bonds*(In millions of U.S. dollars)*

	2006	2007	2008	2009	2010	2010		2011	
						Q3	Q4	Q1	Q2
Total	130,816.9	144,534.2	65,371.7	133,574.3	207,503.2	64,110.5	49,825.5	64,402.4	64,132.9
Sub-Saharan Africa	4,898.9	12,318.6	83.1	2,368.9	6,032.1	1,700.0	-	4,968.2	1,150.0
Cote d'Ivoire					2,332.1				
Gabon		1,000.0							
Ghana		950.0							
Nigeria		525.0						500.0	
Senegal				200.0					500.0
Seychelles	200.0	30.0		168.9					
South Africa	4,698.9	9,813.6	83.1	2,000.0	3,700.0	1,700.0		4,468.2	650.0
Central and Eastern Europe	22,917.8	17,727.1	14,941.4	21,173.5	29,964.5	8,149.4	3,377.7	12,012.5	11,965.8
Albania					407.3		407.3		
Bulgaria	220.8								
Croatia	384.9	746.4		3,148.0	1,250.0	1,250.0		1,700.8	1,073.3
Hungary	6,900.9	4,088.2	5,281.3	3,045.3	3,523.5			3,750.0	2,650.8
Latvia	266.1		607.6						500.0
Lithuania	1,241.6	1,484.2	104.9	2,388.1	2,750.0	750.0		750.0	
Macedonia, FYR				243.9					
Montenegro					254.0	254.0			253.8
Poland	4,693.5	4,111.0	3,785.1	8,598.3	10,445.7	2,933.0	1,068.7	1,879.8	2,423.2
Romania			1,162.5		1,429.1				4,264.7
Serbia		165.2							
Turkey	9,209.9	7,132.2	4,000.0	3,750.0	9,904.8	2,962.3	1,901.6	3,931.9	800.0
Commonwealth of Independent States	30,981.3	43,428.2	20,073.9	14,005.3	36,559.1	9,751.1	12,639.2	9,716.2	10,021.6
Azerbaijan	5.0	100.0	49.6		130.0		130.0	125.0	
Belarus	2.5	19.4	3.0		1,325.2	1,000.0	325.2	800.0	
Georgia ¹		200.0	500.0		250.0	250.0			500.0
Kazakhstan	7,055.8	8,808.6	3,040.0	671.2	3,560.8		3,000.0	947.4	300.0
Mongolia ¹		75.0			175.0		175.0		
Russia	20,804.6	30,190.3	15,881.3	10,109.1	26,900.1	6,301.1	7,491.0	5,743.7	6,981.6
Ukraine	3,113.5	4,035.0	600.0	3,225.1	4,218.0	2,200.0	1,518.0	2,100.0	2,240.0
Developing Asia	14,708.7	15,377.6	7,726.4	15,166.4	26,233.4	6,607.8	6,367.4	13,187.1	18,385.6
China	1,110.0	2,144.2	2,055.3	2,242.8	10,619.7	2,741.7	4,115.9	7,149.7	9,817.1
Fiji	150.0							250.0	
India	2,644.2	7,549.4	157.5	1,750.0	1,050.0			1,656.4	497.8
Indonesia	2,000.0	1,750.0	4,200.0	5,223.6	3,423.9		643.9	180.0	4,115.0
Malaysia	2,076.2	918.6	439.7		2,338.6	1,088.6		300.0	3,590.7
Pakistan	1,050.0	750.0							
Philippines	4,623.2	1,000.0	350.0	5,350.0	6,451.2	1,777.5	1,457.6	3,651.0	275.0
Sri Lanka		500.0		500.0	1,000.0	1,000.0			
Thailand	1,055.0	765.4	523.8		350.0		150.0		
Vietnam				100.0	1,000.0				90.0
Middle East and North Africa	26,595.3	17,143.3	5,756.8	29,237.0	27,051.2	9,226.0	10,180.4	4,934.4	4,100.0
Bahrain	1,120.0	1,767.7	350.0	750.0	2,500.0		500.0		
Egypt		1,803.5		300.0	2,100.0	600.0			
Iraq	2,700.0								
Jordan					750.0		750.0		
Kuwait	1,137.0	575.0	305.7	500.0	900.0	900.0		196.6	
Lebanon	5,741.6	2,300.0	3,138.2	2,865.6	1,965.0		765.0		1,000.0
Morocco		671.3			1,346.9	1,346.9			
Oman	25.0								
Qatar	3,040.0			13,830.0	6,035.1	4,250.0	1,785.1		
Saudi Arabia	2,913.8			140.0	650.0				
Tunisia		253.4							
United Arab Emirates	9,917.9	9,772.4	1,962.9	10,851.4	10,804.2	2,129.1	6,380.3	4,737.8	3,100.0
Latin America and the Caribbean	30,714.8	38,539.5	16,790.2	51,623.2	81,662.8	28,676.2	17,260.9	19,584.0	18,510.0
Argentina	1,745.5	3,400.9	65.0	145.0	4,013.0	1,650.0	1,346.0	1,332.2	629.7
Brazil	12,303.9	9,916.9	6,484.7	9,796.7	32,605.3	13,458.0	5,320.1	5,278.0	10,940.5
Chile	1,100.0	250.0	99.8	2,651.4	5,608.1	3,028.1	1,700.0	1,839.7	300.0
Colombia	3,177.6	3,133.7	1,039.7	5,503.0	1,912.8	1,116.4		1,197.1	1,600.0
Dominican Republic	550.0	430.0			750.0				
Ecuador									
El Salvador	625.0			800.0				653.5	
Guatemala			5.0						
Jamaica	880.0	625.0	350.0	1,085.0	1,075.0		300.0	400.0	
Mexico	6,207.2	6,341.4	4,361.0	15,340.9	23,792.9	5,081.1	2,968.2	4,422.7	4,545.0
Panama			235.0	1,323.0				500.8	
Peru	445.0	4,449.0	150.0	2,628.2	5,905.7	1,342.5	2,626.6	785.0	
St. Lucia								175.0	
Trinidad and Tobago	980.7	900.0		850.0					
Uruguay	2,700.0	342.6		500.0					494.8
Venezuela		8,750.0	4,000.0	11,000.0	6,000.0	3,000.0	3,000.0	3,000.0	

Source: Data provided by the Bond, Equity and Loan database of the International Monetary Fund sourced from Dealogic.

Note: Deal inclusion conforms to the vendor's criteria for external publicly-syndicated gross issuance, generally excluding bilateral deals.

¹Georgia and Mongolia, which are not members of the Commonwealth of Independent States, are included in this group for reasons of geography and similarities in economic structure.

Table 6. Emerging Market External Financing: Equities
(In millions of U.S. dollars)

	2006	2007	2008	2009	2010	2010		2011	
						Q3	Q4	Q1	Q2
Total	99,436.2	181,940.1	44,067.2	83,783.5	133,469.4	32,574.1	49,941.0	19,725.8	30,632.9
Sub-Saharan Africa	3,875.3	8,037.2	884.1	1,236.6	2,841.1	998.3	551.0	242.2	245.9
Botswana					1.9				
Central African Republic		305.5							
Ghana		9.8			45.5		45.5		
Kenya			252.0						
Madagascar					78.8		78.8		
Namibia			87.6						
Nigeria		692.8							
Rwanda								29.2	
South Africa	3,800.2	7,029.1	544.5	1,236.6	2,715.0	998.3	426.7	213.0	245.9
Zimbabwe	75.1								
Central and Eastern Europe	3,231.0	4,702.4	1,104.5	3,835.6	7,484.1	296.4	3,153.9	597.8	3,125.3
Bulgaria	85.7				46.0		46.0		
Croatia	220.0	1,377.6							
Hungary		191.8		1,201.7					
Lithuania			15.0		35.9				
Poland	1,588.5	498.2	1,089.5	2,634.0	7,402.2	296.4	3,107.9	597.8	3,125.3
Romania	172.5	58.2							
Turkey	1,164.3	2,576.6							
Commonwealth of Independent States	17,654.1	35,960.1	4,087.2	1,257.8	7,021.3	63.9	3,714.3	4,053.9	5,266.6
Armenia				2.4					11.6
Georgia ¹	159.8		100.0						
Kazakhstan	4,303.6	5,030.4	219.9	195.1	232.4	23.2	209.2		
Mongolia ¹					683.5		683.5		
Russia	13,165.4	29,596.8	2,850.3	955.6	5,454.4		2,501.2	4,053.9	4,978.0
Ukraine	25.3	1,332.9	917.0	104.7	651.0	40.6	320.3		277.1
Developing Asia	57,124.5	79,821.0	21,440.6	61,312.8	87,289.0	25,906.2	35,415.4	9,287.6	11,130.2
Bangladesh	23.0	39.9						86.0	
Cambodia	96.3	220.0							
China	40,517.1	47,805.1	11,973.8	40,088.6	45,326.3	21,260.4	16,813.2	4,784.5	7,328.3
India	11,009.0	21,588.6	6,008.4	16,223.1	26,150.6	3,129.2	7,919.8	1,862.4	2,006.2
Indonesia	675.9	3,009.0	2,212.9	1,285.5	6,832.7	1,143.9	3,356.5	1,085.0	945.0
Lao P.D.R.					111.2		111.2		
Malaysia	559.4	1,790.9	660.0	3,603.9	5,817.6	180.2	4,837.6	529.5	358.6
Pakistan	922.2	793.4	109.3		92.9	92.9			
Papua New Guinea		1,024.3							
Philippines	1,515.7	2,226.8	125.2	0.4	959.6		689.7		425.0
Sri Lanka			3.7		5.6	5.6			
Thailand	1,805.8	819.9	257.4	111.2	1,990.5	94.0	1,685.4	880.2	67.0
Vietnam		503.0	90.0		2.1		2.1	60.0	
Middle East and North Africa	2,499.3	6,414.3	3,831.9	916.5	1,695.3	173.3	728.4	-	13.0
Algeria	2.0								
Bahrain	420.5	266.4			80.0		80.0		
Egypt	483.7	592.1	483.6	114.2	142.0				
Kuwait			1,642.0						
Lebanon	248.4								
Morocco	133.3	1,049.7	346.6						13.0
Oman			34.6		474.8		474.8		
Qatar	234.8	171.4	900.0		137.5				
Saudi Arabia		41.8		639.9	687.4	173.3			
United Arab Emirates	976.6	4,293.0	425.0	162.4	123.3		123.3		
West Bank and Gaza					50.3		50.3		
Latin America and the Caribbean	15,052.0	47,005.2	12,719.0	15,224.2	27,138.6	5,136.0	6,378.0	5,544.3	10,852.0
Argentina	987.1	1,845.3			73.1		73.1	1,140.1	1,457.6
Brazil	11,177.1	38,722.9	10,435.4	12,963.4	24,633.3	4,516.9	5,490.2	2,985.0	5,546.5
Chile	742.9	317.7		31.8	1,214.3	173.6	465.5	1,217.3	2,110.4
Colombia	54.2	3,365.7		427.7	295.5	230.6	64.8		1,450.4
Mexico	1,513.8	2,111.1	2,127.2	1,567.3	661.7	214.9	126.7	201.9	287.2
Panama			156.4		103.0				
Peru	576.9	642.6		234.1	157.7		157.7		

Source: Data provided by the Bond, Equity and Loan database of the International Monetary Fund sourced from Dealogic.

Note: Deal inclusion conforms to the vendor's criteria for external publicly-syndicated gross issuance, generally excluding bilateral deals.

¹Georgia and Mongolia, which are not members of the Commonwealth of Independent States, are included in this group for reasons of geography and similarities in economic structure.

Table 7. Emerging Market External Financing: Loans*(In millions of U.S. dollars)*

	2006	2007	2008	2009	2010	2010		2011	
						Q3	Q4	Q1	Q2
Total	184,542.6	249,960.7	214,816.5	209,029.1	242,309.3	71,683.4	64,341.2	65,438.5	44,831.8
Sub-Saharan Africa	7,026.0	7,729.6	4,457.2	11,541.2	7,443.0	118.9	4,065.1	1,475.4	1,519.0
Angola	91.9	74.6	15.0	1,813.8	3,767.8		2,632.0		346.4
Botswana				825.0					
Burkina Faso		14.5							
Cameroon									
Cape Verde									
Côte d'Ivoire			45.0	150.7					
Ethiopia			100.2	46.8	693.9		646.1		114.8
Gabon	34.4		600.0		119.0				
Ghana	860.0	504.5	1,000.0	1,331.5					
Kenya	330.1	10.0	25.0	125.7					
Lesotho		19.7							
Mali		180.9	110.4						
Mauritius	180.0	110.0	29.0						
Mozambique	38.8		808.5	55.0					
Namibia	100.0		10.0						
Nigeria	640.0	3,623.6	472.5	2,414.7	1,638.7		519.0	985.4	
Senegal	31.6				118.9	118.9			
Sierra Leone								116.5	
South Africa	4,201.7	2,936.8	738.5	4,308.1	1,044.8		268.0	373.5	1,057.8
Tanzania			358.1		60.0				
Togo			125.0						
Uganda	12.6			300.0					
Zambia	505.0	255.0	20.0	90.0					
Zimbabwe			80.0						
Central and Eastern Europe	24,064.8	31,678.7	23,705.3	11,143.0	14,670.5	4,701.0	2,221.4	5,157.1	6,227.4
Albania	34.0		78.1						
Bulgaria	693.9	1,095.5	1,415.0	540.5					
Croatia	1,291.9	662.6	870.6	570.0	700.2	87.0	219.4	267.6	
Hungary	427.8	1,050.9	2,584.3	1,733.3	309.0	309.0			526.6
Latvia	1,191.3	1,614.7	1,284.3	278.2	26.7				
Lithuania	50.4	161.2	143.5	27.2					
Macedonia, FYR		14.4		209.0					
Montenegro	0.8	21.4	6.4	6.3					
Poland	1,732.6	2,733.8	3,231.7	485.2	457.6	141.0	173.9		
Romania	675.9	1,012.2	727.5	161.3	27.6		27.6	172.3	
Serbia	60.2	1,210.8	235.3	886.8					
Turkey	17,906.2	22,101.3	13,128.6	6,245.4	13,149.4	4,164.0	1,800.5	4,717.1	5,700.8
Commonwealth of Independent States	31,521.1	34,956.0	46,826.5	43,632.1	16,107.1	9,452.0	3,387.0	6,301.3	4,710.6
Armenia	30.0	19.1	11.0						
Azerbaijan	178.8	215.7	77.0	539.8	2,425.0	2,250.0	175.0		
Belarus	336.1	283.5	324.0	53.5	411.5		251.5		58.5
Georgia ¹	7.0	141.6	384.8	55.5					
Kazakhstan	3,367.7	3,873.4	7,282.2	187.4				228.0	
Kyrgyz Republic			7.4	46.2					
Moldova			171.3	28.4					
Mongolia ¹	6.0	10.0	6.8	1.0	36.0	36.0			
Russia	25,276.4	27,105.7	35,516.2	42,325.2	13,234.6	7,166.0	2,960.5	6,073.3	4,652.1
Tajikistan		2.0	16.7	3.2					
Ukraine	2,314.3	3,305.0	3,012.8	386.9					
Uzbekistan	4.9		16.4	5.0					

Table 7. (concluded)

	2,006.0	2,007.0	2,008.0	2,009.0	2,010.0	2010		2011	
						Q3	Q4	Q1	Q2
Developing Asia	41,951.6	74,244.9	63,693.5	92,351.2	147,744.2	45,031.1	44,021.8	43,549.0	26,856.6
Bangladesh	333.6	17.6	65.4	56.4					
Bhutan					92.2		92.2		
China	11,330.1	25,125.4	14,440.6	26,169.6	24,098.2	6,878.6	8,321.4	7,220.1	3,764.8
India	16,015.4	31,509.7	31,195.8	38,917.7	88,557.1	25,140.5	27,845.7	28,753.6	14,531.9
Indonesia	5,591.5	3,921.7	7,129.6	6,642.7	9,796.3	2,424.4	2,975.1	1,872.2	3,015.4
Lao P.D.R.		160.0	592.0	213.7	2,888.7	2,888.7			
Malaysia	3,810.5	4,358.8	2,828.0	3,518.8	9,043.4	4,276.9	862.2	1,556.0	2,781.0
Marshall Islands	170.0	1,069.3	204.0		660.0	660.0		427.2	880.0
Nepal			15.0						
Pakistan	1,287.8	455.9	728.5	534.3	503.2		300.8	389.6	
Papua New Guinea				11,428.5				240.0	
Philippines	902.9	3,375.4	2,115.0	2,008.3	3,097.5	253.4	501.1	663.6	346.0
Sri Lanka	129.8	255.0	535.0	60.0	200.0	165.0			
Thailand	1,922.8	942.4	2,275.1	1,462.0	5,698.0	1,449.6	2,187.3	2,426.5	1,337.5
Vietnam	457.4	3,053.8	1,569.5	1,339.2	3,109.5	894.0	936.0		200.0
Middle East and North Africa	56,831.4	53,436.5	46,883.0	22,233.4	31,424.5	7,663.4	4,811.7	4,619.4	1,943.5
Algeria		411.0	1,738.0		1.9				
Bahrain	2,245.2	4,136.0	895.0	1,409.5	294.9		279.9	698.0	
Egypt	3,895.9	3,076.1	5,644.8	1,342.8	3,240.6	915.0	438.3	754.7	829.7
Iran, I.R. of	142.5								
Iraq	177.0								
Jordan									
Kuwait	4,209.6	1,804.9	1,199.1	963.3	2,771.6	400.0	302.0	1,300.0	254.2
Lebanon	50.0	120.0	65.0	80.0	178.5				
Libya		38.0							
Morocco	25.4								
Oman	3,405.2	2,873.3	916.0	565.8	1,944.2	835.7	13.5	296.0	250.0
Qatar	7,917.1	12,500.8	8,882.5	833.8	45.0		45.0		43.6
Saudi Arabia	12,041.7	8,679.0	5,532.7	1,503.0	14,792.4	2,323.8	3,281.1	377.6	
Syrian Arab Republic			80.0						
Tunisia	24.7	150.0	403.5	1.4					
United Arab Emirates	22,697.1	19,647.3	19,104.3	15,486.2	8,155.5	3,189.0	452.0	1,193.2	566.0
Yemen Arab Republic			2,422.2	47.6					
Latin America and the Caribbean	23,147.7	47,915.1	29,250.9	28,128.1	24,919.9	4,717.0	5,834.1	4,336.3	3,574.8
Argentina	611.0	5,226.0	1,586.4	64.3	713.0	273.0	250.0		731.8
Bolivia			100.0		253.0		253.0		
Brazil	6,036.7	25,585.1	11,140.3	16,856.6	10,326.5	2,817.6	1,857.0	2,425.7	1,495.3
Chile	4,166.2	3,105.5	4,470.7	1,377.0	1,704.4	942.9	200.0	200.0	1,070.2
Colombia	1,804.4	1,380.0	952.0	88.0	1,993.0	178.0		459.8	
Costa Rica	1.7	31.1	85.0		5.8		5.8		175.0
Dominican Republic	229.8	227.9	479.6	15.0	1,274.7	56.8	108.3	323.8	
Ecuador	19.1	104.0						36.0	
El Salvador	701.6			55.0	200.0				
Guatemala		15.0							
Haiti	134.0								
Honduras			113.6						
Jamaica	196.1	650.0	100.0		750.2		197.0	198.4	
Mexico	6,600.9	9,351.4	3,944.1	8,049.7	4,278.8	248.7	2,613.0	215.0	102.5
Panama	74.8	1,056.1	3,997.9	878.4	374.3			87.7	
Paraguay			98.8						
Peru	468.0	532.9	2,180.0	744.1	1,532.4	200.0	350.0	150.0	
Trinidad and Tobago	1,727.3	55.4			13.8				
Uruguay		575.7	2.6						
Venezuela	376.1	19.0			1,500.0			240.0	

Source: Data provided by the Bond, Equity and Loan database of the International Monetary Fund sourced from Dealogic.

Note: Deal inclusion conforms to the vendor's criteria for external publicly-syndicated gross issuance, generally excluding bilateral deals. Date reflect commitments rather than actual disbursements.

¹Georgia and Mongolia, which are not members of the Commonwealth of Independent States, are included in this group for reasons of geography and similarities in economic structure.

Table 8. Equity Valuation Measures: Dividend-Yield Ratios

	2006	2007	2008	2009	2010	2010		10-year
						Q3	Q4	average
Emerging Markets	2.2	1.9	4.1	2.0	2.1	2.2	2.4	2.5
Asia	2.1	1.8	4.2	1.7	2.0	2.0	2.2	2.3
Europe/Middle East/Africa	2.0	2.0	4.3	2.2	2.1	2.3	2.6	2.6
Latin America	2.4	2.1	4.0	2.7	2.3	2.4	2.8	2.9
Argentina	0.8	1.6	2.7	1.1	1.9	2.2	4.2	2.2
Brazil	3.1	2.2	4.6	2.9	2.7	2.8	3.3	3.8
Chile	1.9	1.7	2.6	1.6	1.4	1.4	1.6	2.2
China	1.5	1.2	3.1	1.9	2.2	2.2	2.5	2.3
Colombia	2.5	2.3	2.4	2.8	2.1	2.1	2.5	3.2
Egypt	2.3	1.8	6.3	4.8	3.5	5.0	4.6	4.1
Hungary	2.5	2.3	4.6	1.3	1.6	1.5	1.7	2.0
India	1.0	0.7	1.8	0.9	0.9	1.0	1.2	1.4
Indonesia	2.3	1.5	5.4	1.9	2.2	2.1	2.3	3.1
Jordan	3.4	1.8	3.4	3.1	2.5	2.7	3.0	2.7
Malaysia	2.6	2.0	4.1	2.4	2.3	2.6	2.8	2.5
Mexico	1.2	1.6	2.8	2.4	1.6	1.7	1.7	2.0
Morocco	3.5	2.7	3.2	4.9	4.3	4.3	4.8	3.8
Pakistan	5.8	4.1	12.5	6.4	5.6	6.6	6.6	7.5
Philippines	2.3	2.2	4.4	2.2	2.4	2.8	2.6	2.2
Poland	4.2	3.6	5.9	3.0	2.5	2.5	2.8	2.9
Russia	1.0	1.2	3.5	1.4	1.5	1.4	1.9	1.8
South Africa	2.4	2.7	4.5	2.7	2.3	2.8	2.9	3.1
Sri Lanka	1.4	1.9	9.8	1.6	1.2	1.2	1.5	3.0
Thailand	3.9	2.9	6.5	2.9	2.5	2.8	3.0	3.3
Turkey	2.9	2.3	5.8	2.1	2.2	2.5	2.7	2.6

Source: Morgan Stanley Capital International.

Note: The country and regional classifications used in this table follow the conventions of MSCI, and do not necessarily conform to IMF country classifications or regional groupings.

Table 9. Equity Valuation Measures: Price/Earnings Ratios

	2006	2007	2008	2009	2010	2010		10-year average
						Q3	Q4	
Emerging Markets	15.7	17.1	8.5	20.6	14.6	14.1	12.8	14.4
Asia	15.8	19.0	9.4	24.3	15.2	14.9	13.8	15.6
Europe/Middle East/Africa	15.7	14.6	6.7	16.2	12.1	11.8	10.8	13.2
Latin America	14.7	16.0	9.0	18.3	15.9	14.4	12.3	13.7
Argentina	16.7	13.1	3.7	8.0	8.8	7.3	8.0	22.5
Brazil	12.8	15.5	7.9	17.0	13.8	12.7	10.5	11.6
Chile	23.6	22.1	13.3	18.7	21.4	18.6	18.5	22.3
China	21.0	27.0	10.3	21.1	14.6	14.9	12.8	16.2
Colombia	20.1	27.0	13.4	25.1	23.5	24.5	19.6	56.2
Egypt	19.1	21.5	7.1	13.9	17.4	13.3	16.0	14.3
Hungary	11.3	12.8	3.7	14.2	12.2	13.2	12.1	12.2
India	22.9	32.8	10.5	21.8	22.4	19.9	17.8	17.8
Indonesia	19.5	21.5	8.7	16.4	19.0	19.0	17.2	16.0
Jordan	15.3	21.3	14.4	15.9	21.3	24.6	20.3	23.1
Malaysia	18.4	16.9	10.2	20.3	18.1	18.2	17.2	17.3
Mexico	17.3	16.4	12.3	22.7	23.9	22.1	20.7	15.9
Morocco	22.8	27.2	26.0	14.3	17.5	17.4	15.1	19.8
Pakistan	10.0	13.4	3.8	10.1	9.1	9.0	8.0	9.4
Philippines	17.7	16.5	11.7	19.1	17.5	16.5	16.2	21.5
Poland	13.2	15.2	7.3	19.3	14.1	13.3	11.9	16.4
Russia	15.8	14.1	3.4	15.6	8.3	8.8	7.5	10.4
South Africa	16.5	14.9	10.7	16.6	18.9	17.3	17.1	14.0
Sri Lanka	21.5	14.7	7.1	77.7	20.5	19.9	16.3	17.6
Thailand	9.1	14.8	7.1	19.3	14.8	14.3	12.2	20.7
Turkey	12.4	10.9	5.3	12.6	10.8	10.4	10.9	16.0

Source: Morgan Stanley Capital International.

Note: The country and regional classifications used in this table follow the conventions of MSCI, and do not necessarily conform to IMF country classifications or regional groupings.

Table 10. Emerging Markets: Mutual Funds*(In millions of U.S. dollars)*

Net Flows						2010		2011	
	2006	2007	2008	2009	2010	Q3	Q4	Q1	Q2
Bonds	6,233.1	4,294.9	-14,717.6	8,275.7	35,042.1	10,796.2	7,166.7	515.6	8,531.9
Equities	22,440.8	40,827.1	-39,490.0	64,383.2	84,103.5	30,319.9	36,391.1	-18,389.2	11,887.8
Global	4,208.6	15,223.3	-9,114.1	34,471.3	56,093.2	20,707.6	22,225.4	-11,274.7	9,333.4
Asia	16,790.2	16,404.6	-19,586.8	19,108.6	19,593.0	7,505.0	8,174.2	-8,160.1	4,615.7
Europe/Middle East/Africa	-1,877.4	-953.3	-4,928.7	2,017.3	3,298.2	635.6	3,298.2	-1,819.4	-978.1
Latin America	3,319.5	10,152.6	-5,860.4	8,786.0	2,693.3	1,471.7	2,693.3	2,865.1	-1,083.1
Net Asset Values									
						2010		2011	
	2006	2007	2008	2009	2010	Q3	Q4	Q1	Q2
Bonds	48,603.9	68,577.6	43,829.2	63,929.4	117,830.4	107,013.9	117,830.4	122,592.9	140,489.5
Equities	330,555.9	557,624.3	236,888.1	518,386.7	713,731.9	635,444.6	713,731.9	706,462.3	723,397.3
Global	153,337.9	244,270.5	108,732.8	243,740.4	358,661.6	313,365.2	358,661.6	353,167.4	369,978.7
Asia	113,235.0	205,956.3	92,147.3	191,450.9	245,777.2	226,890.5	245,777.2	239,995.5	245,127.2
Europe/Middle East/Africa	42,004.1	58,652.0	17,696.5	32,360.4	49,464.7	41,412.5	49,464.7	57,857.3	56,380.6
Latin America	21,978.9	48,745.5	18,311.6	50,835.0	59,828.4	53,776.4	59,828.4	55,442.1	51,910.8

Source: EPFR Global.

Note: Flows data derive from both traditional and alternative funds domiciled globally with \$13 trillion in assets. The country and regional classifications used in this table follow the conventions of Emerging Portfolio Fund Research and individual fund managers, and do not necessarily conform to IMF country classifications or regional groupings.