CHAPTER 2

A NEW LOOK AT THE ROLE OF SOVEREIGN CREDIT DEFAULT SWAPS

Summary

The debate about the usefulness of sovereign credit default swaps (SCDS) intensified with the outbreak of sovereign debt stress in the euro area. SCDS can be used to protect investors against losses on sovereign debt arising from so-called credit events such as default or debt restructuring. SCDS have become important tools in the management of credit risk, and the premiums paid for the protection offered by SCDS are commonly used as market indicators of credit risk. Although CDS that reference sovereign credits are only a small part of the sovereign debt market ($3 trillion notional SCDS outstanding at end-June 2012, compared with $50 trillion of total government debt outstanding at end-2011), their importance has been growing rapidly since 2008, especially in advanced economies.

With the growing influence of SCDS, questions have arisen about whether speculative use of SCDS contracts could be destabilizing. Such concerns have led European authorities to ban uncovered, or "naked," purchases of SCDS protection referencing European Economic Area sovereign debt obligations, that is, banning purchases in which there is no offsetting position in the underlying debt. The prohibition is based on the view that, in extreme market conditions, such short selling could push sovereign bond prices into a downward spiral, which would lead to disorderly markets and systemic risks, and hence sharply raise the issuance costs of the underlying sovereigns.

The empirical results presented in this chapter do not support many of the negative perceptions about SCDS. In particular, spreads of both SCDS and sovereign bonds reflect economic fundamentals, and other relevant market factors, in a similar fashion. Relative to bond spreads, SCDS spreads tend to reveal new information more rapidly during periods of stress, though not typically at other times. The use of SCDS as proxy hedges for other types of credit risks (notably for financial and nonfinancial corporate bonds) means that spillovers to other markets are inevitable. Whether SCDS markets propagate contagion is difficult to assess since the risks embedded in SCDS cannot be readily isolated from those in the financial system. However, SCDS markets do not appear to be more prone to high volatility than other financial markets. While there are some signs that SCDS overshoot their predicted value for vulnerable European countries during periods of stress, there is little evidence overall that such excessive increases in countries' SCDS spreads cause higher sovereign funding costs.

Overall, the evidence here does not support the need to ban purchases of naked SCDS protection. Such bans may reduce SCDS market liquidity to the point where these instruments are less effective as hedges and less useful as indicators of market-implied credit risk. In fact, in the wake of the European ban, SCDS market liquidity already seems to be tailing off, although the effects of the ban are hard to distinguish from the influence of other events that have reduced perceived sovereign credit risk. In any case, concerns about spillovers and contagion effects from SCDS markets could be more effectively dealt with by mitigating any detrimental outcomes from the underlying interlinkages and opaque information. Hence, efforts to lower risks in the over-the-counter derivatives market, such as mandating better disclosure, encouraging central clearing, and requiring the posting of appropriate collateral, would likely alleviate most SCDS concerns.

The impact of sovereign credit default swaps (SCDS) on the stability of financial markets is the subject of heated debate. SCDS are analogous to insurance: in exchange for a fee paid to the seller, they provide protection to buyers from losses that may be incurred on sovereign debt resulting from a "credit event." Credit events include failure to pay interest or principal on, and restructuring of, one or more obligations issued by the sovereign.[1] Many view these swaps as useful market-based risk indicators and valuable hedging instruments. Others consider them to be speculative tools—suggesting their prices do not reflect underlying fundamentals or actual risks and they can therefore unduly raise funding costs for governments, threatening fiscal sustainability and exacerbating market tensions.

Evaluating these contrasting positions requires a clear exposition of the issues and empirical evidence. Sovereign debt and rollover requirements remain large in a number of key countries (see the April 2013 *World Economic Outlook*), and elevated sovereign risk in many advanced economies is likely to drive up the demand for hedging instruments (see Chapter 3 in the April 2012 GFSR). Investors who require appropriate instruments to manage sovereign risk as well as sovereign debt issuers themselves increasingly need to know whether SCDS markets can accommodate hedging needs efficiently while providing reliable information.

This chapter aims to guide the regulatory and policy discussion regarding the usefulness and financial stability implications of SCDS by focusing on some key questions:

- Are SCDS spreads as good as credit spreads derived from government bonds in reflecting the macroeconomic fundamentals that characterize sovereign risk?[2]
- Are SCDS markets as efficient as sovereign cash bond markets in rapidly pricing-in new information?
- Are SCDS markets more likely than other financial markets to be destabilizing?

Overall, we find that SCDS spreads provide indications of sovereign credit risk that reflect the same economic fundamentals and market conditions as the underlying bonds, with little indication that they raise sovereign funding costs. Hence, SCDS can provide a useful hedge to offset sovereign credit risk and can thereby enhance financial stability. In terms of their performance as market indicators relative to bond spreads, SCDS tend to adjust more rapidly to new information during periods of stress, though not typically at other times. For a few countries, we find some evidence that, during the latest period of stress, SCDS spreads moved more than would normally be expected. SCDS can propagate risks and exacerbate systemic events due to their linkages with other markets; but so, too, can other financial assets, which makes it difficult to isolate their independent influences. Finally, as regards policy, the results do not justify the recent ban imposed in Europe on uncovered purchases of SCDS, as it may result in unintended consequences that could negatively affect market liquidity and cause dislocations in other markets. The regulatory reforms underway for over-the-counter (OTC) derivatives generally represent a better avenue to countering any deleterious effects of SCDS markets.

In the remainder of the chapter, we discuss the structure of SCDS markets; provide empirical evidence regarding the main questions; examine key regulatory issues, focusing on bans on uncovered purchases of SCDS protection; and summarize and provide policy recommendations.

Note: This chapter was written by Brenda González-Hermosillo (team leader), Ken Chikada, John Kiff, Hiroko Oura, and Nico Valckx, with contributions from Jorge A. Chan-Lau, Dale Gray, and Heiko Hesse. Research support was provided by Yoon Sook Kim.

[1]Restructuring events include interest or principal reductions and postponements, subordination of creditor rights, and redenominations into a nonpermitted currency, and are binding on all holders of the restructured obligations. Permitted currencies are euros or the legal tender of a G7 country or currency issued by a member country of the Organization for Economic Cooperation and Development (OECD) rated AAA/Aaa by Fitch, Moody's, or Standard and Poor's.

[2]An SCDS spread is the effective annual cost of the protection it provides against a credit event, expressed as a percent of the notional amount of protection. A credit spread on a government bond is the difference between its yield to maturity and that of an otherwise similar "riskless" benchmark fixed-income instrument.

Overview of CDS Markets: The Rise of SCDS

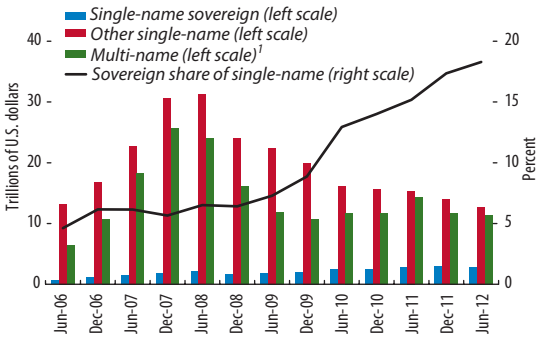
SCDS developed in response to the need to use flexible instruments to hedge and trade sovereign credit risks.[3] Three main purposes are:

- *Hedging.* Owners of sovereign debt buy SCDS to protect themselves against losses arising from a default or other credit event affecting the value of the underlying debt. SCDS are also used widely in so-called proxy hedging, that is, to hedge risks of other assets (such as those of domestic banks or utility companies) whose value is correlated with the creditworthiness of the sovereign.[4]
- *Speculating.* SCDS contracts can be used to buy (or sell) protection on a naked basis—that is, without an offsetting position in the underlying reference assets—to express a negative (or positive) opinion about the credit outlook of the issuer of the underlying bonds. Hence, although SCDS and other CDS are often called "default insurance," they clearly differ from traditional insurance in that the purchasers need not own or have a financial interest in the reference asset. Expressing an opinion about prospective changes in the creditworthiness of a sovereign entity can be executed using other markets (e.g., interest rate futures, cash bond markets, and other derivatives), but they reflect other types of risks in addition to sovereign credit risk.
- *Basis trading.* SCDS are used to profit from pricing differences between SCDS and the underlying debt obligations by taking offsetting positions in the two ("basis trading"). This strategy is based on the principle that CDS can be used to replicate the cash flows of underlying obligations. In this regard, when CDS spreads are narrower than the credit spreads of the underlying debt (i.e., the "basis" is negative), arbitragers may be able to profitably buy the obligations and buy CDS protection—and vice versa if the basis is positive. In theory, the basis should always be close to zero as a result of this arbitrage activity, but in practice there are various costs and frictions that can alter the profitability of these transactions (Annexes 2.1 and 2.2).

[3]Annex 2.1 provides a primer on the SCDS market.

[4]For example, an investor can mitigate the market risk of a corporate equity holding if it has a high negative correlation with SCDS spreads referencing the debt of the country in which the firm is domiciled.

Figure 2.1. Credit Default Swap (CDS) Contracts, Gross Notional Amounts Outstanding



Sources: Bank for International Settlements; and IMF staff calculations.
[1]A contract with a reference entity that is more than one name, as in portfolio or basket CDS or CDS indices.

SCDS are a small but rapidly growing part of the CDS market, which began in earnest in the early 2000s.[5] Initially, some avenues for hedging or trading the credit risk of sovereigns were provided by Brady bond futures contracts (for three countries—Argentina, Brazil, and Mexico) on the Chicago Mercantile Exchange (CME).[6] Some argue that the rise of SCDS probably contributed to the demise of these contracts in October 2001 by providing a superior and more flexible hedging alternative (Skinner and Nuri, 2007). By end-June 2012, the gross notional amount of SCDS outstanding was about $3 trillion, versus $27 trillion in CDS as a whole (Figure 2.1).[7] However, the size of the SCDS market has increased noticeably since 2008, while other CDS markets have fallen off. The post-2008 surge likely relates to the need to hedge derivative counterparty credit risk exposure that had to be more fully disclosed under new accounting rules that came into effect in 2006 (see below). Table 2.1 shows the ranking of selected CDS reference

[5]The Bank for International Settlements (BIS) did not begin collecting comprehensive CDS statistics until 2004. The CDS market was purported to have begun in the early 1990s, initially on corporate debt.

[6]Brady bonds were sovereign bonds that had been exchanged for previously defaulted bank loans to those sovereigns and which had partial collateral in the form of set-aside foreign reserves or guarantees.

[7]Based on latest available data, released in November 2012 (BIS, 2012).

Table 2.1. Rankings of CDS Amounts Outstanding
(In billions of U.S. dollars)

Gross Notional Amounts Outstanding

Rank		End-2008	Rank		End-2010	Rank		End-2012
Top 10			**Top 10**			**Top 10**		
1	Turkey	165	1	Italy	267	1	Italy	388
2	Italy	158	2	Brazil	160	2	Spain	212
3	Brazil	126	3	Turkey	135	3	France	177
4	Russia	98	4	Spain	132	4	Brazil	156
5	Morgan Stanley	79	5	Mexico	111	5	Germany	154
6	Goldman Sachs	76	6	Russia	96	6	Turkey	137
7	Mexico	74	7	GE Capital	96	7	Mexico	117
8	GE Capital	74	8	Germany	80	8	Russia	109
9	GMAC	74	9	Bank of America	80	9	Korea	85
10	Merrill Lynch	72	10	JPMorgan Chase	80	10	Japan	79
Below Top 10			**Below Top 10**			**Below Top 10**		
14	Spain	67	12	Greece	77	14	Portugal	71
48	Greece	37	14	Portugal	69	15	United Kingdom	71
150	Portugal	26	24	United Kingdom	61	30	Ireland	51
262	Ireland	18	44	Ireland	46	124	United States	23
377	United Kingdom	14	50	Japan	41			
592	Japan	7	291	United States	16			
740	United States	5						

Net Notional Amounts Outstanding

Rank		End-2008	Rank		End-2010	Rank		End-2012
Top 10			**Top 10**			**Top 10**		
1	Italy	18	1	Italy	26	1	Italy	21
2	Spain	14	2	France	18	2	Brazil	17
3	GE Capital	12	3	Spain	17	3	France	16
4	Brazil	10	4	Brazil	15	4	Germany	15
5	Germany	10	5	Germany	15	5	Spain	13
6	Deutsche Bank	9	6	GE Capital	12	6	Japan	10
7	Greece	7	7	United Kingdom	12	7	GE Capital	9
8	Morgan Stanley	7	8	Portugal	8	8	Mexico	8
9	Russia	6	9	Mexico	8	9	United Kingdom	8
10	Goldman Sachs	6	10	Austria	7	10	China	8
Below Top 10			**Below Top 10**			**Below Top 10**		
13	Portugal	5	11	Greece	6	12	Turkey	7
16	Turkey	5	12	Turkey	6	15	Russia	5
20	Ireland	5	13	Japan	6	20	Portugal	4
25	Mexico	4	27	Ireland	4	26	United States	3
92	United Kingdom	3	28	Russia	4			
222	Japan	2	40	United States	3			
322	United States	1						

Sources: Depository Trust and Clearing Corporation (DTCC); and IMF staff calculations.

Note: CDS = credit default swaps. Shaded cells indicate advanced ( ) and emerging market ( ) economies' sovereign CDS.

[1]DTCC reports only the top 1000 CDS names; outstanding amounts for Greek sovereign CDS are no longer reported.

entities since 2008, illustrating the increasing role of SCDS. However, SCDS remain a small fraction of total government debt outstanding ($50 trillion at end-2011).[8]

[8]Total government debt outstanding (IMF, World Economic Outlook database) is an aggregate of the general government debt of 55 countries that had SCDS notional amounts outstanding in the Depository Trust and Clearing Corporation trade repository database.

Before the global financial crisis, the SCDS market consisted largely of contracts on sovereigns of emerging market economies because investors viewed those issuers as having higher and more variable credit risk. However, since end-2009, the deterioration in the perceived safety of the sovereign debt of advanced economies and rising hedging demands have boosted activity in SCDS referencing

those economies.[9] Such activity rose first for SCDS referencing the euro area periphery countries, then the core (particularly Germany), and then Japan and the United Kingdom, with some of the countries serving as proxy hedges or as safe haven trades (Table 2.1). Nonetheless, as of end-2011, trading in SCDS (gross notional amounts outstanding) tended to be a larger proportion of the underlying government debt for emerging market economies (19 percent) than for advanced economies (3 percent).

Gross notional amounts provide a convenient measure of market size, but net notional amounts (after subtracting the value of the collateral posted) represent the maximum economic transfer if a credit event transpires. The net notional amount represents a counterparty's nominal amount of credit risk exposure to a particular entity at any given time, considering offsetting transactions.[10] Gross notionals far exceed net notionals because of the market practice of reducing or reversing positions by using offsetting transactions rather than by terminating contracts or transferring them to other parties. However, gross notional amounts outstanding are also useful in gauging the risk arising from interconnections among the contract holders ("counterparty risk"), particularly during periods of stress, since the entire value of all the contracts associated with a given counterparty would be at risk if that counterparty failed.

Dealer banks (global systemically important financial institutions or G-SIFIs) dominate the buy and sell sides of the SCDS markets largely because of their market-making activities and risk management of their exposures to sovereigns. A high level of market concentration could potentially lead to market dysfunction when the dominant dealers are under stress.[11] Dealer banks are exposed to sovereigns because of their direct holdings of sovereign debt as well as the counterparty credit risk associated with their derivatives trades with sovereigns, the effective values of which they have been obliged to disclose since 2006.[12] Sovereigns traditionally have not agreed to post collateral to cover the mark-to-market risks of their OTC positions in interest rate and cross-currency swaps and other derivatives; therefore, dealer banks have credit exposures on these OTC contracts when sovereigns owe money on them. SCDS can therefore provide dealer banks with a convenient hedge. The amount of SCDS trading by dealer banks that facilitates transactions compared with the amount for hedging their own sovereign risk is not discernible from existing data.[13] Non-dealer banks and securities firms are the next most important group of buyers and sellers of SCDS protection, followed by hedge funds, but the SCDS activity of all these is much smaller than that of dealer banks (BIS, 2012).

A given type of institution has no consistent role as either buyer or seller of SCDS protection. Subtracting notional amounts outstanding sold from notional amounts bought by the dealer banks provides a rough measure of the positions for their counterparties. On this basis, other banks and securities firms have been net sellers of SCDS protection, thereby taking credit risk and earning premiums (Figure 2.2). Many of these banks also own sovereign debt and are hence "doubling up" on this type of credit exposure. Hedge funds have been prominent net buyers of SCDS protection since 2010, but they were sellers before then. It is not possible to discern from publicly available data whether the protection is meant to cover risks of existing debt holdings or are uncovered (naked) to profit from expected spread widening. Moreover, hedge fund prominence appears larger in SCDS than in other CDS holdings. The use of SCDS by other investors, including nonfinancial institutions, appears much more limited, although anecdotal evidence suggests that some large asset

[9]The perceived safety of sovereign debt of advanced economies is discussed in Chapter 3.

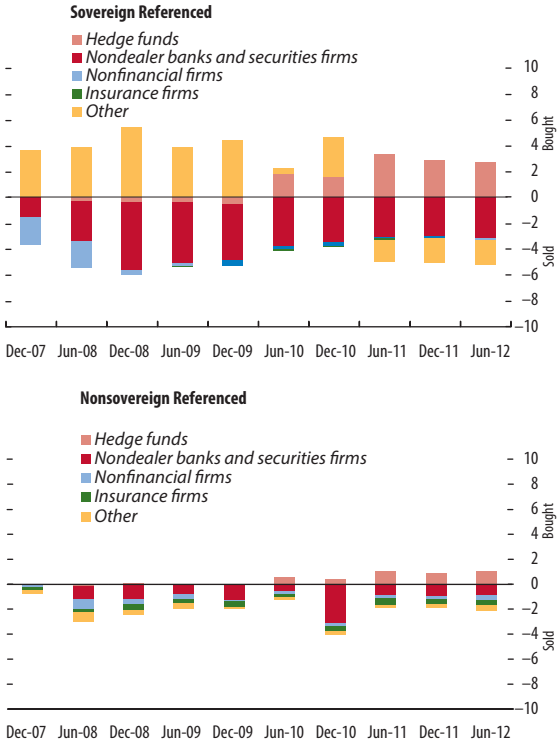
[10]An even better metric would include the risk mitigation impact of any collateral posted, but these data are unavailable.

[11]Fitch Ratings (2011) reports that the top 10 U.S. and European financial institutions constitute about 80 percent of all CDS trade counterparties. However, the 2011 EU Capital Exercise conducted by the European Banking Authority indicates that exposures of large European banks to SCDS (protection sales) are minuscule when compared with their exposures to sovereign debt.

[12]The International Accounting Standards Board IAS 39 and, in the United States, the Financial Accounting Standards Board FAS 157 phased in a mandate (between 2006 and 2007) for fuller disclosure of counterparty credit risk, in the form of "credit value adjustments" (CVAs).

[13]The prominence of outstanding SCDS referencing Italy may reflect dealers' hedging their counterparty risk associated with large uncollateralized OTC interest rate and cross-currency swap transactions with the government of Italy.

Figure 2.2. Nondealer Buyers and Sellers of Credit Default Swap Protection: Net Positions by Counterparty
(In percent)



Sources: Bank for International Settlements; and IMF staff calculations.
Note: For a detailed definition of dealer banks, see BIS (2012). "Other" comprises financial institutions such as mutual funds and central counterparties.Net positions are calculated as (notional amounts bought minus notional amounts sold)/(gross notional amounts outstanding), where gross notional amounts outstanding is calculated as an average of total notional amounts bought and sold. By construction of the statistics, net position for dealer banks is close to zero.

managers (including some mutual funds) are active participants.[14]

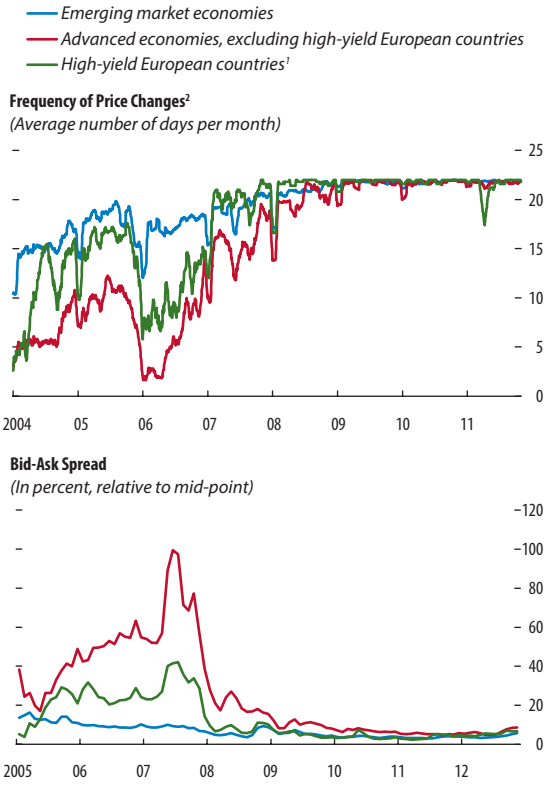
Measures of market liquidity in the SCDS market indicate the following:

- According to data from the Depository Trust and Clearing Corporation (DTCC), SCDS transactions volumes vary widely by reference entity and tend to be concentrated in contracts referencing larger emerging market economies and economies experiencing financial stress.
- During 2010 and 2012, on average, the number of trades was larger in high-stress periods, when SCDS spreads were relatively elevated.
- In general, market liquidity in SCDS (proxied by narrow bid-ask spreads) has been higher for those referencing emerging market economies than for those referencing advanced economies; the difference probably reflects the fact that the SCDS market was largely represented by emerging market sovereigns before the crisis. However, liquidity for SCDS referencing advanced economies began improving after 2008 with higher volumes (Figure 2.3).

What Drives SCDS Spreads and How Do They Relate to Other Markets?

Some view SCDS markets, especially relative to underlying bond markets, as more prone to specula-

Figure 2.3. Liquidity Indicators in the Sovereign Credit Default Swaps (SCDS) Market



Sources: Bloomberg, L.P.; and IMF staff calculations.
Note: See Table 2.3 for the list of countries.
[1]Greece, Ireland, Italy, Portugal, and Spain.
[2]Number of days per month on which the SCDS price changed from the previous day, averaged across countries.

[14]A survey by the IMF (see Chapter 2 of the September 2011 GFSR) also found that the use of CDS by most long-term institutional investors (mainly pension funds and asset managers) was considerably less than their use of other derivatives products, such as futures contracts and interest rate swaps.

tion and opacity and disassociated from economic fundamentals. These views are given plausibility, for instance, by seemingly excessive volatilities of SCDS spreads relative to spreads in government bond markets in some countries (Figure 2.4).[15]

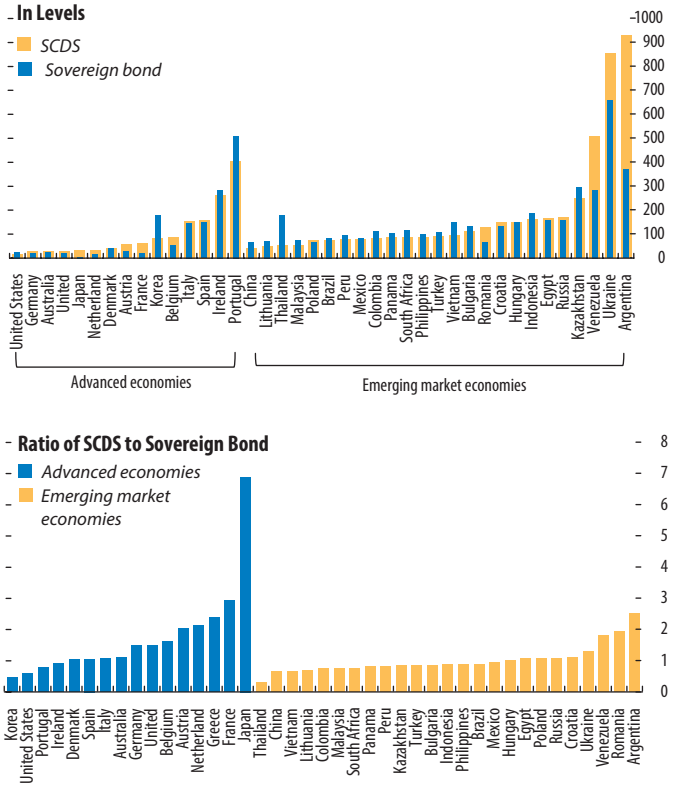
We examine these views by analyzing the drivers of SCDS spreads relative to those influencing government bond spreads, by investigating the dynamic relationships between the two, and by assessing the prognosis for contagious linkages to other markets.[16] Presumably, both SCDS spreads and bond spreads respond to economic fundamentals, market microstructure factors, and global financial market factors (see Annex 2.2 and Tables 2.3 and 2.4 therein for a description of the sample countries, framework, results, variables, and sources).[17] If SCDS spreads indeed indicate that SCDS are more speculative than government bonds, we might find that SCDS spreads are not explained by economic fundamentals to the same extent as government bonds and that they are instead driven more by financial market factors than are bonds.[18]

Determinants of Spreads on SCDS and Government Bonds

The fundamental economic factors that drive spreads for SCDS and government bonds are generally the same, suggesting that both types of instrument reflect sovereign risk according to the empirical evidence provided in Figure 2.5, and in Table 2.5 in Annex 2.2:[19]

- Government debt, GDP growth, and, to a lesser extent, foreign reserves are significant economic factors for spreads for both instruments, and the magnitudes of the effects for SCDS and government bonds are comparable.
- There is some evidence that a weaker financial sector (proxied by lower bank returns on assets) adds to sovereign risk in both SCDS and government bond

Figure 2.4. Volatility of Sovereign Credit Default Swap (SCDS) Spreads and Sovereign Bond Spreads
(Standard deviation 2008-12)



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

Note: For sovereign bond spreads, JPMorgan Asia credit indices are used for Korea and Thailand; EMBI Global indices are used for other emerging market economies; and Bloomberg L.P.'s constant maturity yields minus swap spreads are used for other advanced economies. See Table 2.4 for the definition of SCDS and bond spreads.

[15]The large spike shown for Japan in the bottom panel of Figure 2.4 is largely driven by the unusually low volatility in its sovereign bond market, as yields have been close to zero for an extended period of time.

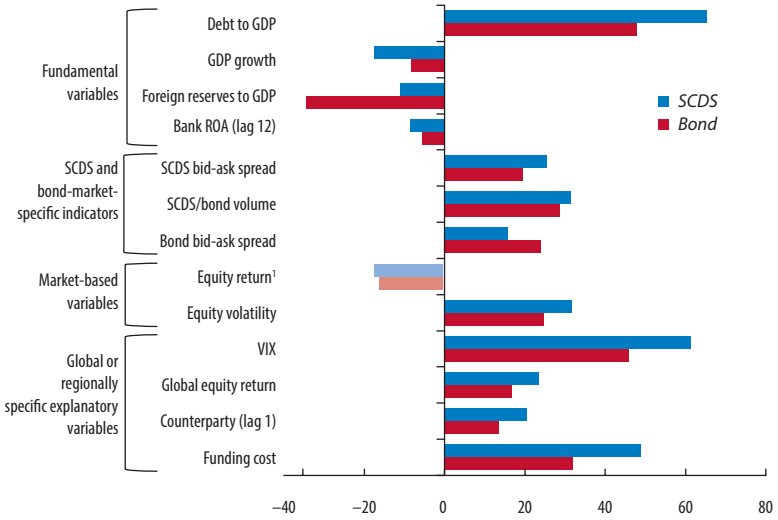
[16]SCDS spreads and bond spreads represent appropriate measures for comparing SCDS and government bonds. For advanced economies, bond spreads are constructed as bond yields minus the interest swap rate (i.e., fixed rate for floating LIBOR rate); for individual emerging market economies, they are the EMBI spreads. Use of these measures is motivated by arbitrage trading actually undertaken in markets that identically match the cash flows of the two sides of the trade (see Figure 2.13, in Annex 2.1).

[17]Credit ratings were not included in the list of independent variables because they reflect fundamental factors (see Chapter 3 of the October 2010 GFSR), and adding credit ratings to other fundamental variables is likely to cause multicollinearity problems (see Hartelius, Kashiwase, and Kodres, 2008). Moreover, rating agencies have started to use SCDS spreads when they determine their own ratings, introducing reverse causality from SCDS spreads to ratings.

[18]The wide range of countries used here distinguishes this study from earlier ones that focus on emerging market economies and from more recent ones whose data primarily focus on advanced euro area economies (Table 2.3).

[19]Broadly similar results are obtained for groups of advanced and emerging market economies estimated separately, and for differences rather than levels.

Figure 2.5. Determinants of Sovereign Credit Default Swap (SCDS) Spreads and Bond Spreads, October 2008–September 2012
(Relative sizes of factors)



Source: IMF staff estimates.
Note: ROA = return on assets; VIX = implied volatility on S&P 500 index options. For explanation of the variables, see Table 2.4. Relative sizes computed as coefficients from full country panel estimation multiplied by one standard deviation of each explanatory variable (averaged across countries). Results based on Table 2.5. Relative size is significant at the 90 percent confidence level or greater, except as noted.
[1]Not statistically significant .

markets, especially during periods of stress.[20] Box 2.1 illustrates how the connection between sovereigns and the financial sector can run in both directions.

Market microstructure characteristics are also influential in both markets:

- Larger bid-ask spreads for SCDS and government bonds (i.e., lower liquidity) are associated with higher levels of spreads for both SCDS and government bonds. This could happen if liquidity in the markets for SCDS and government bonds is correlated,[21] or if this measure reflects some elements of underlying sovereign credit risk common to both SCDS and government bonds.[22]
- Larger SCDS trading volume (relative to government bonds) is associated with higher spreads for SCDS and their reference bonds. This could imply that trading volume surges when the need to hedge or the desire to speculate is higher because of higher credit risks. In most markets, improvements in liquidity with larger volumes are associated with lower CDS spreads.[23]

The relationship with variables representing general financial market conditions is also similar across the SCDS and government bond markets:

- There is evidence that SCDS are more sensitive than government bonds with respect to market risk factors, although the difference between the two is not statistically significant, especially in terms of the VIX and funding costs.

[20]This is in line with Diekman and Plank (2012), who emphasize the role of risk transfer from the financial sector to sovereigns for SCDS pricing.

[21]Calice, Chen, and Williams (2013) find similar effects, which they interpreted as liquidity spillovers between CDS and bond markets.

[22]Supplemental analysis confirms that SCDS and government bond bid-ask spreads increase when perceived sovereign risk (lagged SCDS or bond spread) rises.

[23]Supplemental analysis confirms that SCDS volumes relative to government bonds outstanding increase when perceived sovereign risk (lagged SCDS or government bond spreads) rises.

Box 2.1. Interconnectedness between Sovereigns and Financial Institutions

A network analysis performed in a contingent claims analysis framework shows how SCDS and sovereign credit risk endanger financial stability via two-way risk transmission between sovereigns and financial institutions.

Risks can be transmitted in both directions between sovereigns and financial institutions through several well-known channels. Banks are exposed to sovereign risks through their holdings of sovereign bonds and through the influence of the sovereign's funding costs on their own funding costs. In the other direction, explicit and implicit government guarantees and potential fiscal costs of recapitalization transmit bank risk to the sovereign. Such two-way feedback between the sovereign and financial institutions can create a destabilizing spiral if risks arise in one or the other.

Strong evidence supports the claim that implicit and explicit government backing for banks depresses bank CDS spreads to levels below where they would be in the absence of government support. Bank creditors are thus beneficiaries of implicit and explicit government guarantees, but equity holders are not. Contingent claims analysis (CCA), which uses bank equity market information together with balance sheet data, can estimate credit risk indicators and infer a fair-value CDS spread (FVCDS) for financial institutions.[1] The FVCDS is an estimate of the spread without implicit or explicit government support and thus identifies its effect.

The extent to which sovereign risk is linked to banks varies across countries, with correspondingly varied implications for financial stability and the effective use of proxy hedging of sovereign risk with bank CDS. The average bank CDS tracked the SCDS in the periphery euro area countries from 2007 to 2012 (Figure 2.1.1). During the earlier part of the crisis, in 2008–09, observed bank CDS spreads were somewhat lower than FVCDS because of the depressing effect of implicit and explicit government guarantees on observed CDS, especially during times of stress. After 2010, however, bank FVCDS remained lower than both the observed bank CDS and SCDS as high sovereign spreads spilled over, increasing bank CDS. For banks in countries with low sovereign spreads, such as core euro area countries, the ratio of bank FVCDS to sovereign spreads was around 20 times sovereign CDS in 2008–09, declining to 10 in 2010–11, showing a decrease in the implicit guarantees and less integration between sovereign and bank risks.[2] If the ban on naked SCDS protection encourages market participants to use bank-referenced CDS as a proxy for SCDS, hedges may be less effective in countries where the correlations between the sovereign and the bank are likely to be lower (as seen in the core euro area countries).

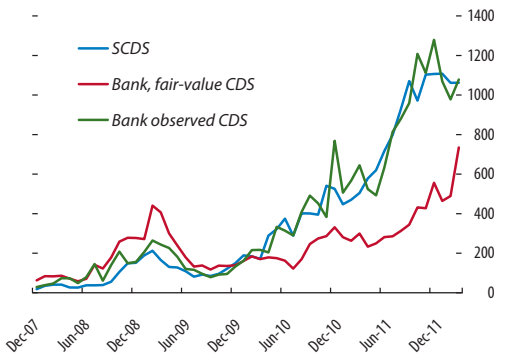
By integrating network models using CCA risk indicators between sovereigns and selected types of financial institutions (banks and insurance companies), we can gauge how, when, and how

Note: Prepared by Dale Gray.

[1]The FVCDS are calculated and reported by Moody's Analytics (2011) using CCA. See related work: the April 2009 GFSR (Chapter 3); Gray and Jobst (2011); Schweikhard and Tsesmelidakis (2012); and Billio and others (2012, and forthcoming).

[2]Similarly, SCDS may be affected by explicit and implicit support from international institutions or by special purpose vehicles guaranteeing sovereign debt, such as the European Financial Stability Facility, but quantifying the impact is not yet possible.

Figure 2.1.1. Measures of Sovereign Credit Risk for Euro Area Periphery Countries
(In basis points, average, five-year spreads)



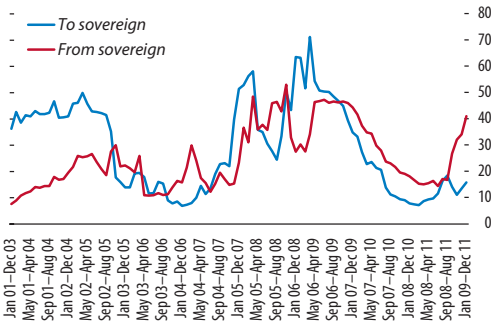
Sources: Bloomberg L.P.; Moody's Analytics; and IMF staff estimates.
Note: CDS = credit default swap; SCDS = sovereign credit default swap. Euro area periphery countries are Greece, Ireland, Italy, Portugal, and Spain.

Box 2.1 *(continued)*

strongly sovereign risks are transmitted to financial institutions and vice versa.[3] An examination of 17 sovereigns (15 in the EU plus the United States and Japan), 63 banks, and 39 insurance companies shows that from 2003 to 2005 the proportion of significant connections to sovereigns from financial institutions was greater, whereas the reverse (connections *from* sovereigns to institutions) was dominant from mid-2009 to 2012 (Figure 2.1.2). Significant connections are those at a 99 percent confidence level or higher using a Granger causality test. This suggests that risks embedded in SCDS cannot be readily isolated from the risk of the financial system and that a holistic approach to both sectors is required.

[3]Network models using correlation and Granger causality relationships are based on the approach described in Billio and others (2012). The indicators used are expected loss ratios derived from sovereign SCDS and from bank and insurance FVCDS (see Billio and others, forthcoming).

Figure 2.1.2. Interconnectivity Measures: Financial Institutions, to and from Sovereigns
(In percent, monthly average over three-year rolling window)



Source: Billio and others (2012).
Note: Interconnectivity measures based on 17 sovereigns, 63 banks, and 39 insurance companies. Percent of significant connections to sovereigns from financial firms and from financial firms to sovereigns.

Looking specifically at periods of stress (see interaction terms in Table 2.5), there is some evidence that the SCDS and government bond markets react to different economic fundamentals and microstructure proxies, but mostly in the same direction as during the nonstress periods.[24]

Which Market Leads: SCDS or Government Bonds?

We also examine whether SCDS or government bonds adjust relatively faster to new information by analyzing lead-lag relationships between SCDS spreads and government bond spreads.[25] Thus, the price leadership of SCDS would be superior if SCDS markets are faster than government bond markets at eliminating pricing differences from the long-run equilibrium relation between SCDS spreads and government bond spreads. Specifically, SCDS markets are relatively faster in incorporating new information when the Hasbrouck statistic is greater than 0.5, and bond markets are faster if the statistic is less than 0.5.[26]

Using this definition, our analysis shows that the information value of SCDS has become more important but varies across countries and over time.[27] Across countries, SCDS incorporate information faster as SCDS liquidity increases (Figure 2.6), as one would expect in well-functioning, efficient markets. Over time, the degree of price leadership is quite volatile. That said, a few observations are worth noting:

- SCDS markets processed information faster in emerging market economies in the early crisis

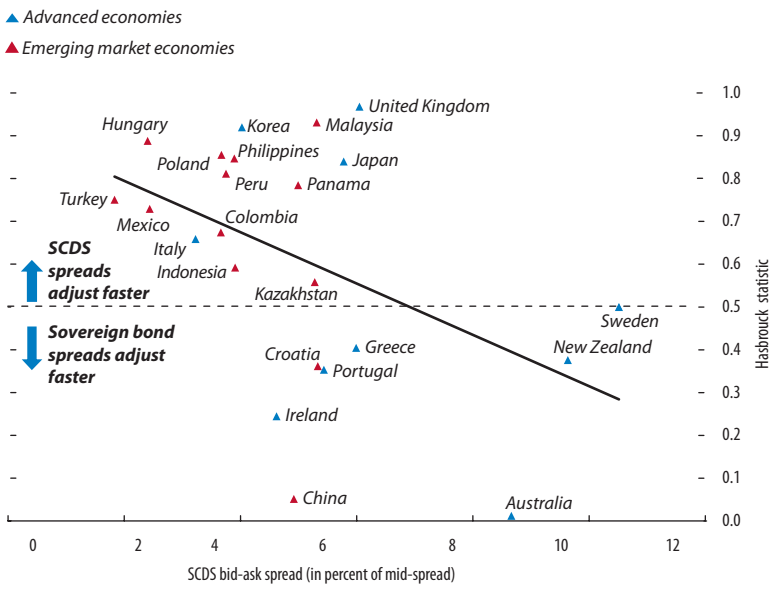
[24]The periods of stress are determined by a Markov switching model technique that detects when the VIX (the implied volatility of the S&P 500 index options) is in the highest one-third of the volatility distribution (see González-Hermosillo and Hesse, 2011).

[25]The literature refers to this as "price discovery" power, to denote the relative information value of the market in question.

[26]Hasbrouck (1995) and Gonzalo and Granger (1995) quantified how fast various related markets adjust to a new equilibrium, and the measures used in each paper are closely related. In practice, the results in the two papers are very similar and therefore only the statistic from Hasbrouck is reported here.

[27]This is in line with the literature on price discovery. See, for example, Augustin (2012).

Figure 2.6. Sovereign Credit Default Swap (SCDS) Price Leadership and Liquidity, March 2009–September 2012



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

Note: Hasbrouck statistic shows whether SCDS or sovereign bond markets move faster to incorporate news: when the statistic is higher than 0.5,SCDS lead the price discovery process; otherwise bonds lead. Statistics are estimated at the country level using a vector error correction model.

period (2006–08) and then again in the most recent period (Figure 2.7).[28]

- In advanced economies, SCDS seemed to move faster than bonds around crisis times.
- Euro area countries show patterns that are broadly similar to those of other EU countries, including a notable decline in the power of SCDS price leadership since mid-2011. This could reflect the market's anticipation of plans for banning naked short SCDS sales in the EU, or central bank interventions in the sovereign bond markets, or simply the dissipation of any informational processing advantage for the SCDS market.[29]

[28]Because activity in SCDS markets in advanced economies began in earnest only in the current crisis, comparisons across advanced and emerging market economies during earlier periods is not possible.

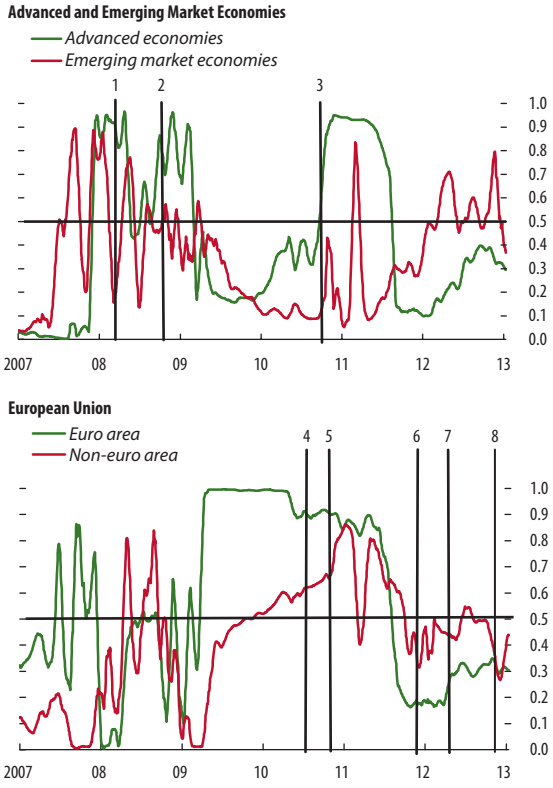
[29]See the section below on effects of regulations and policy initiatives, and Box 2.2.

Are SCDS Markets More Prone To Be Destabilizing than Other Markets?

Concerns about excessive SCDS volatility and contagion across countries partly underpin policies attempting to limit SCDS trading (discussed in the next section). Hence, it is useful to examine measures that identify spillovers and those that might suggest SCDS move more than warranted using known explanatory factors. Also useful is an examination about whether such overshooting raises the borrowing costs of the underlying sovereign issuer.

Indeed, there is evidence of significant co-movement of SCDS spread volatilities across some countries in the euro area, especially during periods of stress. The effect can be seen by determining the residual volatility of SCDS spreads of selected euro area countries (i.e., the volatility for each country not explained by factors specific to that country) and then decomposing that residual into common market factors (VIX and TED spread) and the spillover effects from the SCDS volatility of other euro area countries (Figure 2.8). For Germany,

Figure 2.7. Time-Varying Price Leadership Measures of Sovereign Credit Default Swaps (SCDS)
(Hasbrouck statistic)



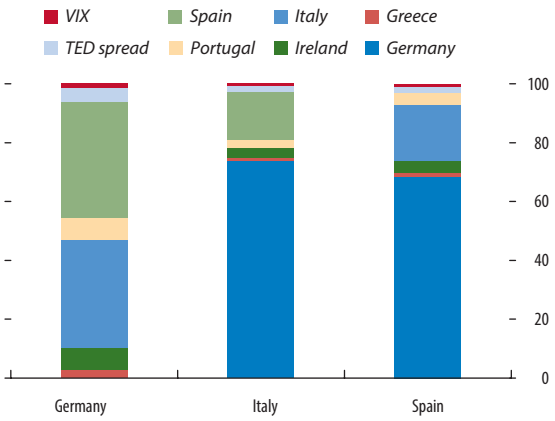
Sources: Bloomberg, L.P.; and IMF staff estimates.
Note: The Hasbrouck statistic shows whether SCDS or sovereign bond markets move faster to incorporate news: when the statistic is higher than 0.5, SCDS lead the price discovery process; otherwise, bonds lead. Statistics are estimated from a panel vector error correction model using rolling two-year windows of daily data. Resulting series are smoothed using a one-month moving average. Vertical lines indicate events related to the global financial and sovereign debt crisis (upper panel) and to the EU's ban on naked short sales of SCDS instruments (lower panel) as follows:

1. Bear Stearns collapse (March 14, 2008).
2. Lehman Brothers bankruptcy (September 15, 2008).
3. EU debt crisis intensifies in October 2010 ahead of Ireland's financial aid request.
4. European Commission consultation on short selling (June 14, 2010).
5. European Commission short selling regulation proposed, banning naked short sales and SCDS protection sales (September 15, 2010).
6. European Parliament adopts short selling regulation (November 15, 2011).
7. Final Version of EU short selling regulation published (March 24, 2012).
8. EU short-selling regulation becomes effective (November 1, 2012).

most of the volatility that is not explained by Germany's own country-specific factors is driven by volatility in the SCDS for Italy and Spain, with other EU periphery countries under stress (Greece, Ireland, and Portugal) having a comparatively small effect.[30] For Spain, almost

[30]Germany's SCDS are often viewed by markets as instruments to hedge systemic risk, or general concerns, in the euro area (Credit Suisse, 2012).

Figure 2.8. Sovereign Credit Default Swaps (SCDS): Decomposition of Volatility Factors for Germany, Italy, and Spain, February 2009–October 2012
(In percent)



Source: IMF staff estimates.
Note: VIX = implied volatility on S&P 500 index options. Figure shows decomposition of SCDS volatility that is not explained by own (or idiosyncratic) factors.

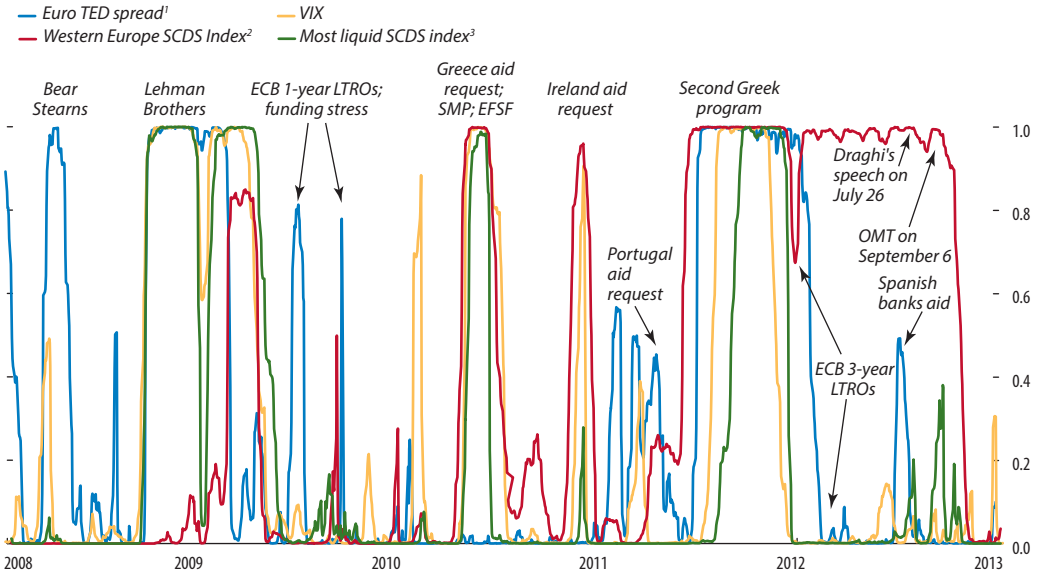
three-fourths of its residual volatility is driven by Germany's SCDS, while Italy's volatility is also a significant contributor (almost 20 percent), with the other factors having a much smaller impact. Roughly the same results hold for Italy, where Germany and Spain are large contributors and other factors less so.[31]

In general, the question of whether SCDS markets are more likely to be contagious than other markets is difficult to answer because the interconnections across many markets are high. The most critical set of interconnections has probably developed among sovereigns and financial institutions, quite apart from the development of SCDS markets per se. Indeed, risks embedded in SCDS cannot be readily isolated from the risks of the financial system; a more integrated analysis of both sectors is required (see Box 2.1).

Yet, many researchers have found that other financial asset markets, not merely those for SCDS, tend to exhibit high and correlated volatility during

[31]The results are based on a stochastic volatility model and standard GARCH specifications using daily data; see González-Hermosillo and Johnson (forthcoming). Beirne and Fratzscher (2013) also find evidence of sharp and simultaneous increases (which they term "herding contagion") in sovereign yields across countries at certain times and among a few markets.

Figure 2.9. Markov-Switching ARCH Model of VIX, European TED Spread, and Sovereign Credit Default Swap (SCDS) Indices
(Probability of being in high-volatility state)



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

Note: ECB = European Central Bank; EFSF = European Financial Stability Facility; LTRO = longer-term refinancing operations; OMT = outright monetary transactions; SMP = Securities Market Programme; VIX = implied volatility on S&P 500 index options.

[1]Spread between yields on three-month euro LIBOR and on the three-month German government bill.

[2]Average five-year ITRAXX SCDS spread of 12 western European countries (Austria, Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom).

[3]Average five-year ITRAXX CDS spread of the 20 most liquid sovereign names (Austria, Brazil, China, Colombia, Croatia, France, Germany, Italy, Japan, Korea, Malaysia, Mexico, Peru, Poland, Qatar, Russia, South Africa, Spain, the United Kingdom, and the United States).

periods of systemic stress.[32] Using a statistical model to detect periods of high volatility among four commonly watched market indices (including the Western Europe SCDS index), we too find that since 2008 several periods of stress have been characterized by high volatility among all four of the indices (Figure 2.9).[33] The main exception was in the first eight months of 2012, during the most severe bout of turbulence in Europe, when the Western Europe SCDS index was the only one of the four to remain in a state of high volatility—a situation that abated only after the establishment of the European Central Bank's (ECB's) Outright Monetary Transactions (OMT) program. Based on the probability of being in a high volatility state, the results suggest that the three other markets decoupled from the Western Europe SCDS index in early 2012, as they were more sensitive to the policy moves represented by the second Greek program and the introduction of the ECB's three-year longer-term refinancing operation (LTRO).

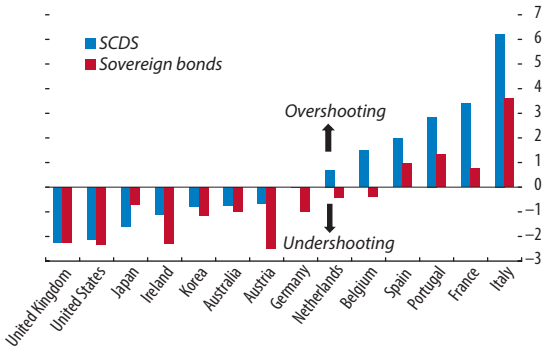
Claims of overshooting are not unfounded, as there is some evidence of overshooting in SCDS and sovereign bond markets for a few European countries during the height of the European debt crisis. Reexamining the model discussed above for SCDS and government bond spreads, we ask how well the model predicts SCDS and government bond yields during the period when the European crisis deepened (July 2011 through September 2012).[34] Spreads on SCDS (and, to a lesser extent, on bonds) overshot the model's predictions for

[32]See, for example, Forbes and Rigobon (2002); Dungey and others (2011); and Forbes (2012).

[33]The estimated ARCH Markov regime-switching volatility model is described in González-Hermosillo and Hesse (2011).

[34]Predictions are calculated using the parameters reestimated from the base models in Table 2.5 using data from October 2008 to June 2011 for 14 advanced economies, including those in the euro area, where concerns about overshooting were most concentrated.

Figure 2.10. Overshooting and Undershooting of Sovereign Credit Default Swaps (SCDS) and Sovereign Bond Markets
(Standardized average prediction error for July 2011–September 2012)



Source: IMF staff estimates.
Note: Ratio of the average out-of-sample prediction errors relative to the standard deviation of in-sample residuals. The in-sample estimation uses the results of the base model (as shown in Table 2.5) for 14 advanced economies during October 2008–June 2011.

the relatively more distressed European countries (Italy, France, Portugal, Spain, and Belgium) and undershot the model for the other nine countries, most of which are not in the euro area (Figure 2.10). Hence, during the height of the European debt crisis, SCDS (and government bond) spreads in more vulnerable European countries rose above the level that can be explained by the changes in the fundamental and market drivers considered in our model. Some of the reason for the overshooting behavior in SCDS and government bond markets may also reflect illiquidity in these markets during periods of acute stress.

Despite concerns that overshooting leads to higher borrowing costs for governments, we do not find strong and pervasive evidence of such effects. To examine the concern, we perform a Granger causality test using the SCDS and the bond residuals from the base model. This allows us to formally test the timing relationships between the measures of overshooting spreads in the two markets after controlling for the effects from common drivers.[35] If we find that SCDS residuals generally lead government bond residuals and not vice versa, this would be consistent with the view that the overshooting of SCDS spreads artificially increases sovereign funding costs. The results (Table 2.2) show that this may be the case for a couple of countries in our sample (Italy and the United States) but not for the majority of the advanced economies examined. Bond residuals also have a unidirectional impact on SCDS in the cases of Austria, France, the Netherlands, and Portugal, suggesting that bond market overshooting influences the SCDS markets. Overall, the evidence is mixed, and there is no consistent pattern for periphery European countries. Therefore, we do not find support for the view that, on average, increases in SCDS spreads generally increase the cost of sovereign bond funding for these countries.

Summary

In sum, the empirical results do not support many of the negative perceptions about SCDS relative to their underlying sovereign bond markets, although there is some evidence of overshooting for euro area countries during periods of stress. A battery of tests suggests that:

- Both SCDS and government bond spreads exhibit similar and significant dependence on key economic fundamentals, and both are similarly influenced by financial market risk factors.

[35]To better capture the dynamics in advanced economies, the base model in Table 2.5 is reestimated using data for 14 advanced economies rather than for all 33 countries. SCDS and bond residuals are highly correlated, and adding SCDS (bond) residuals (contemporaneous or lagged) to the base model for bonds (SCDS) produces statistically significant positive coefficients while appreciably raising the explanatory power of the models. This seems to indicate that there are other common drivers that are not in the model but that are relevant for explaining both SCDS and bond spread dynamics.

Table 2.2. Lead-Lag Relationship between Sovereign Credit Default Swaps (SCDS) and Bond Residuals

	SCDS Granger cause Bonds	SCDS do not Granger cause Bonds
Bonds Granger cause SCDS	Korea, Spain	Austria, France, Netherlands, Portugal
Bonds do not Granger cause SCDS	Italy, United States	Australia, Belgium, Germany, Ireland, Japan, United Kingdom

Source: IMF staff estimates.
Note: SCDS = sovereign credit default swaps. Based on Granger causality test. Residuals from base model estimation (as shown in Table 2.5) for 14 advanced economies.

- New information seems to be incorporated faster in SCDS markets than in sovereign bond markets during periods of stress despite wide differences across countries in normal times. Generally, the more liquid the SCDS market, the more rapidly it incorporates information relative to bond markets.
- Overall, SCDS markets do not appear to be particularly more prone to high volatility than other financial markets.
- However, there is evidence of significant comovement of SCDS spread volatilities across some countries and signs of overshooting for some vulnerable European countries during the height of the debt crisis.
- There is no pervasive evidence that the unexplained portion of SCDS spreads (part of which could be attributable to speculative activities) leads to increases in sovereign funding costs.
- Whether SCDS markets are more likely to propagate shocks than other markets is unclear because the risks embedded in SCDS cannot be readily isolated from the risks of the financial system.

Effects of SCDS Regulations and Policy Initiatives on Financial Stability

Several regulatory and policy initiatives are under way that have affected, or are likely to affect, the functioning of SCDS markets and their implications for financial stability. Evidence presented above casts doubt on the idea that SCDS markets unduly influence underlying bond markets, but some regulations are aimed at limiting the use of SCDS contracts—the most prominent being the EU's ban on naked short selling that was announced on March 24, 2012, and went into effect on November 1, 2012 (Box 2.2).[36] The ban is likely to increase the cost of SCDS trading, as are other new regulations such as those associated with broader reforms of OTC derivatives designed to make markets safer. The relative merits of the ban and the broader reforms of OTC derivatives are discussed below.

The EU ban on SCDS naked protection buying is part of a regulatory effort to harmonize EU short selling and CDS trading rules. Underpinning it is a view that "in extreme market conditions there is a risk that short selling can lead to an excessive downward spiral in prices leading to a disorderly market and possible systemic risks" (European Commission, 2010a, p. 3). In general, the benefits of bans on short positions—to stabilize financial markets, support prices, or contain credit spreads—have not been empirically verified in studies of other bans. Bans on short selling in equity markets are generally viewed as merely reducing market liquidity, hindering price discovery, and increasing price volatility (Beber and Pagano, 2013).

However, using theoretical models, some researchers show that a ban on uncovered CDS could help remove behavior that leads to instability. For example, Che and Sethi (2012) use a theoretical model to show that when naked CDS protection buying is allowed, there is greater volatility in borrowing costs and scenarios could develop in which borrowers would not be able to roll over their maturing debt. In addition, the analysis conducted here of the relative efficiency with which news is incorporated into prices in euro area countries found that SCDS markets generally incorporate new information faster than bond markets during periods of turbulence. Some researchers interpret this lead-lag relationship as indirect evidence that SCDS drive up the cost of government funding (bond yields) and cause fiscal sustainability problems (Palladini and Portes, 2011; and Delatte, Gex, and López-Villavicencio, 2012). However, results from Granger causality tests based on the residuals from a more full-fledged panel model suggest that this relationship is only discernible for two advanced economies in our sample (Table 2.2).[37]

The impact report from the European Commission (2010b) assessed the possibility of imposing

[36]On November 15, 2011, the European Parliament formally adopted the proposed regulation, the final version of which was passed on March 14, 2012, and published on March 24, 2012. On June 29 and July 5, 2012, the European Commission published various technical standards, and on November 1, 2012, the bans applicable to all relevant trades executed after March 25, 2012, went into effect.

[37]See Ashcraft and Santos (2009); and Subrahmanyam, Tang, and Wang (2011) for evidence that CDS trading increased the cost of funding for some companies because of "empty-creditor" problems (i.e., insured lenders lose incentives to monitor borrower performance or to renegotiate). There is no similar empirical study for sovereign issuers.

Box 2.2. The European Union's Ban on Buying Naked Sovereign Credit Default Swap Protection

The European Union's ban on naked short selling and naked SCDS protection buying is summarized and compared with the similar but temporary ban of 2010/11 in Germany.

The EU regulation "Short Selling and Certain Aspects of Credit Default Swaps" went into effect on November 1, 2012. Its purported aim is to harmonize fragmented short selling rules and regulations with respect to sovereign debt and CDS across the European Economic Area (the 27 countries of the EU plus Iceland, Liechtenstein, and Norway). In particular, it seeks to reduce the risks of negative price spirals for sovereign debt and settlement failures caused by uncovered (naked) short selling and CDS protection buying.

The regulation applies to debt issued by all 30 EEA countries, including their agencies and their regional, local, and municipal governments.[1] However, according to the European Securities and Markets Authorities, the naked SCDS ban applies to all market participants, including those outside the EEA. Also, the regulation applies only to transactions executed after March 25, 2012. Implementation and enforcement is delegated to the relevant country authorities, but enforcement will be difficult (see Annex 1.2 in the October 2010 GFSR).

Under the regulation, market participants can buy protection referencing EEA sovereign debt only if they hold the issuer's debt or if they have exposures that are "meaningfully" correlated with the relevant sovereign debt at the time of execution.[2] Transactions that do not meet these conditions are permitted only if they are related to market-making activities and primary-dealer operations.[3]

The ban is similar to the temporary naked CDS ban in effect in Germany from May 19, 2010, to March 31, 2011, except that the current ban appears to be seen as a permanent measure. In the German case, the policy covered all euro area sovereigns, but it applied only to transactions concluded in Germany, and the exceptions were not as clear-cut as those in the current ban. The ban resulted in reduced liquidity in the market for SCDS referencing the debt of Greece, Ireland, Italy, Portugal, and Spain. In contrast, SCDS market volatility declined for all contracts referencing euro area countries, whereas volatility usually increases during bans on short sales in equity markets.

The German ban was accompanied by prohibitions against naked short positions in the underlying sovereign debt and in corporate equities, as is the new EU ban, although the German ban was temporary and applied only to the shares of major financial institutions.

Note: Prepared by John Kiff.

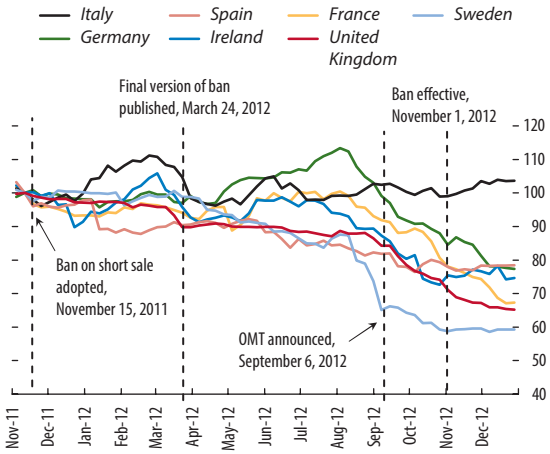
[1]Agencies include the European Investment Bank and may include special-purpose vehicles such as the European Financial Stability Facility.

[2]To meet the "correlation" exemption, the hedged exposure must be to an entity in the same country, and the amount of protection bought must be proportional to the delta-adjusted size of the exposure. The correlation criteria can be satisfied by a quantitative or qualitative test or by an analytic proof (e.g., by showing that the exposure is to an entity whose fortunes are significantly dependent on the relevant sovereign). The quantitative test is satisfied if the adjusted Pearson's correlation coefficient between the value of the exposure and the referenced sovereign debt over the previous 12 months is at least 70 percent.

[3]However, the exemption does not apply to the other activities of market makers and primary dealers.

temporary bans. In particular, it found some evidence that "circuit breakers" provided a cooling-off period for investors to reassess intrinsic value. On the other hand, some of the studies they reviewed found that circuit breakers merely lengthened the period over which the pent-up (large) price movements would occur while interfering with market liquidity. Pu and Zhang (2012) found similar effects for the 2010–11 temporary German ban on naked SCDS protection buying. Moreover, determining a priori the optimal time for officials to call for a temporary suspension of trade in OTC markets is difficult, especially without the exchange-trading platforms in place whereby trading can be physically halted. Given the number of countries involved in the SCDS market, it may be unclear which body would call for a halt. Although the European Markets in Financial Instruments Directive (MiFID) as it currently stands is well able to deal with abusive trading practices, including any that regulators deem important to SCDS markets, the

Figure 2.11. Sovereign Credit Default Swaps: Net Notional Amounts Outstanding, Selected EU Countries
(November 11, 2011 = 100, weekly data)



Sources: Depository Trust and Clearing Corporation; and IMF staff calculations.
Note: OMT = Outright Monetary Transactions.

results of the forthcoming review by the European Securities and Markets Authority may reduce the perceived neeed for the trading ban.

Since March 2012, when the European Parliament adopted the final version of the rules banning naked SCDS protection buying, market liquidity has declined for SCDS referencing European Union sovereigns, although not clearly because of the ban. Net notional outstandings had already fallen off ahead of November 1, 2012, the starting date for enforcement of the ban, perhaps because short positions, including proxy positions, were unwound early (see France and Germany in Figure 2.11). Notably, net outstandings of contracts referencing Italy have remained fairly steady, possibly because banks have related sovereign counterparty hedging activity.[38] Discussions with some market participants indicate that they are removing positions even if they are covered; they fear that the hedging rules are so vague that they may be viewed as speculating even if they are not. The drop in market liquidity (and a narrowing of many of the euro area SCDS spreads) has coincided with other events, notably policy announcements such as the OMT, which may have reduced the demand for insurance (Figure 2.12). Given the confluence of events, the reduced SCDS market liquidity cannot be unequivocally interpreted as evidence that the ban has impaired the SCDS market.

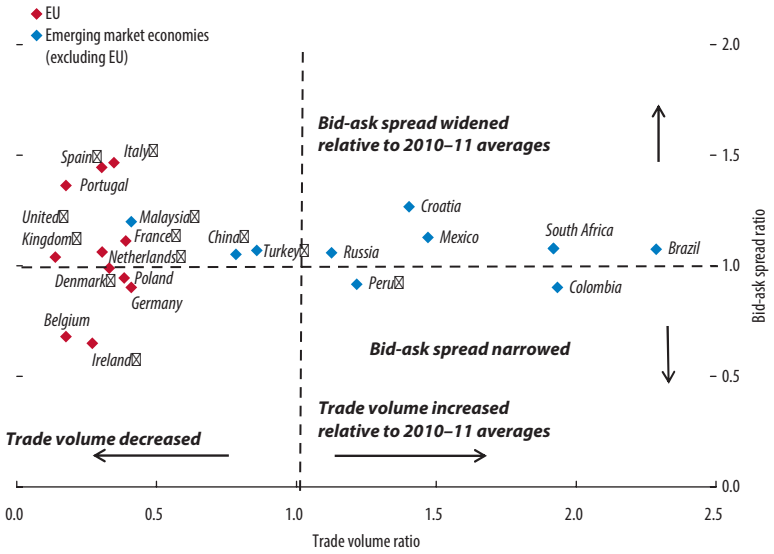
With lower SCDS liquidity, market participants could be expected to substitute less liquid proxies such as bank-referenced CDS and government bond futures contracts for SCDS in their hedging and trading strategies. Box 2.3 outlines how a hypothetical impairment of the SCDS market could force a migration of trading and affect different types of countries. In general, hedging using the "next best" market (bank and some corporate CDS contracts and bond futures) is likely to be more expensive and less precise. While the recent ban is more likely to affect smaller advanced economies (where SCDS are a larger proportion of underlying bonds), ultimately, this could reduce investor interest in the underlying bond market of many countries, raising the costs of debt issuance there. However, it is encouraging that the European Securities and Markets Authority is in the process of evaluating the effects of the regulation, and will present the results of its investigations to the European Parliament by June 30, 2013. Furthermore, there are provisions in the regulation that allow European authorities to suspend the ban in the event it is found to be reducing market liquidity unduly.

A route that will make the SCDS market safer without disenfranchising specific types of participants is the push to clear all standardized OTC derivatives contracts through central counterparties (CCPs). The higher costs that will be incurred by the move to CCPs are balanced by the benefits that central clearing could bring to reduce counterparty risk by enforcing robust risk management standards, the multilateral netting of positions, and the sharing of extreme losses. These costs will be borne by all participants, not just those that take certain types of positions. Clearing members are required to cover their negative mark-to-market positions by the daily posting of collateral ("variation margin") and to post "initial margin" to cover potential losses in excess of their posted variation margin in the event of their own default. Moreover, members must contribute to a default fund to cover extreme losses arising from their own default or that of other clearing members.

Although the movement of contracts to CCPs is likely to reduce risks in OTC derivatives markets

[38]According to market sources, Italy has substantial uncollateralized interest rate swap, swaption, and cross-currency swap positions with a number of banks. Such banks are purportedly using Italy-referenced SCDS to hedge the counterparty risk on these contracts.

Figure 2.12. Market Liquidity Measures before and after Ban on Short Sales of Sovereign Credit Default Swaps (SCDS)



Sources: Bloomberg L.P.; Depository Trust and Clearing Corporation; and IMF staff estimates.
Note: The vertical axis is the ratio of an average bid-ask SCDS spread in November–December 2012 to that in 2010–11. The horizontal axis is the ratio of new trades in November–December 2012 to new trades in 2010–11.

generally, SCDS are more difficult to clear than other derivatives—so far the SCDS of only four reference countries are cleared in CCPs.[39] The reason that CCPs are reluctant to clear SCDS is their concern about "wrong-way" risks, a term referring to the fact that the posted initial margin and the default fund contributions would be in dollars or euros or in government securities denominated in those currencies. Such securities are the same as those underlying most of the SCDS contracts. So distress of a sovereign would create a vicious cycle (a realization of the wrong-way risk) by impairing the value of the collateral while at the same time increasing the risk in the SCDS contract, which would require more such collateral to be posted. In any case, according to recent proposals being considered by the European Parliament, European sovereigns and their agencies will be exempt from the requirement that their trades be moved to CCPs, leaving their counterparties with continuing counterparty risks when money is owed to them.

An alternative to moving SCDS to CCPs would be to require margin posting by all counterparties to bilateral OTC SCDS transactions. While variation margin is currently transferred between most bank-dealer counterparties, the posting of initial margin is not currently the market norm.[40] Regulations requiring all financial firms and systemically important nonfinancial entities to post initial and variation margin on non-centrally cleared transactions are currently being developed by standard setters (BCBS-IOSCO, 2013). They will likely help lower counterparty risks and help protect both parties in case one of them reneges on the contract, but they will also increase the cost of using the SCDS

[39]Almost all CDS central clearing is done through the U.S. and European facilities of Intercontinental Exchange Inc. (ICE); and according to the Financial Stability Board (2012), only 12 percent of outstanding CDS contracts are centrally cleared, virtually all of them dealer-to-dealer transactions. Among all SCDS, the four referencing sovereigns currently cleared are Argentina, Brazil, Mexico, and Venezuela.

[40]According to the ISDA (2012a) margin survey, 93.4 percent of CDS transactions are subject to collateral posting requirements versus 71.4 percent on all OTC derivatives. The survey does not distinguish between initial and variation margin requirements, but the ISDA (2012b) analysis of the costs of imposing initial margin requirements suggests that few market participants post initial margin.

Box 2.3. What Could Be the Impact of the Demise of SCDS?

To assess a hypothetical scenario in which SCDS markets are effectively shut down, it is useful to examine the benefits and costs of SCDS markets and of potential substitutes.

Why is buying naked SCDS protection economically useful and what are the alternatives?

Naked SCDS protection buying is economically equivalent to short selling the underlying bonds. In both cases, trades are usually profitable if the likelihood of a credit event increases. Also, both provide useful functions by increasing the liquidity of the underlying markets (Beber and Pagano, 2013). In addition, both CDS protection buying and short selling keep prices from reflecting the activity of only the most optimistic market participants.

In general, SCDS are more efficient than short sales as a means of trading on, or hedging against, negative credit events. Short selling requires a sufficient quantity of bonds that can be borrowed and deep repurchase agreement (repo) markets in which to borrow them. Only a handful of advanced economies have such repo markets (Australia, France, Germany, Japan, the Netherlands, the United Kingdom, and the United States). Particularly for countries experiencing stress, short selling demand can sometimes overwhelm the supply of bonds available to lend. Moreover, such loans may be recalled at any time so, unlike with SCDS, positions cannot be locked in over longer terms.

Other alternatives include government bond futures contracts and proxies such as the CDS of large financial corporations and utilities. However, government bond futures contracts are available on only a handful of sovereigns, and bond futures embed both credit and interest rate risk, whereas SCDS isolate credit risk. Although the interest rate risk of a futures contract can be mostly offset using interest rate swaps, such transactions will increase operational risks and require the posting of additional safe assets as collateral (see Chapter 3 in the April 2012 GFSR). The problem with proxy-hedging sovereign risk using the CDS of large financial firms or utilities is that these markets are generally not big enough, plus their usage could involve other unwanted risks (Table 2.3.1). Any meaningful transfer of risk from SCDS to financial CDS markets is likely to further strengthen the connectivity between these two markets—in contrast to the goal of other policies. Also, other, more opaque and customized OTC derivative contracts, such as total return swaps, could serve as alternatives to SCDS.[1]

Table 2.3.1. Relative Size of Sovereign and Bank Credit Default Swaps Markets
(In billions of U.S. dollars, net notional amounts)

	July 2012	December 2012	Change
France			
SCDS	23.3	15.7	–7.6
Bank CDS	7.1	6.3	–0.8
Germany			
SCDS	22.1	15.3	–6.8
Bank CDS	6.2	6.6	0.4
Italy			
SCDS	20.4	21.3	0.9
Bank CDS	6.4	5.9	–0.5
Spain			
SCDS	13.6	12.7	–1.0
Bank CDS	5.2	5.0	–0.3
United Kingdom			
SCDS	10.9	8.2	–2.7
Bank CDS	10.0	10.5	0.5

Sources: Depository Trust and Clearing Corporation; and IMF staff calculations.

Note: Net notionals demonstrate the risk exposures in both markets relevant for hedging effectiveness. Bank CDS are contracts referencing the following large banks: for France, BNP Paribas, Crédit Agricole, and Société Générale; for Germany, Deutsche Bank and Commerzbank; for Italy, Banca Monte dei Paschi di Siena, Banca Popolare di Milano, Intesa Sanpaolo, and UniCredito; for Spain, BBVA, Banco de Sabadell, Banco Santander, and Bankia; and for the United Kingdom, Barclays, HSBC, Lloyds TSB, Standard Chartered, and Royal Bank of Scotland.

What would happen to the market for the underlying bonds if SCDS contracts ceased to exist?

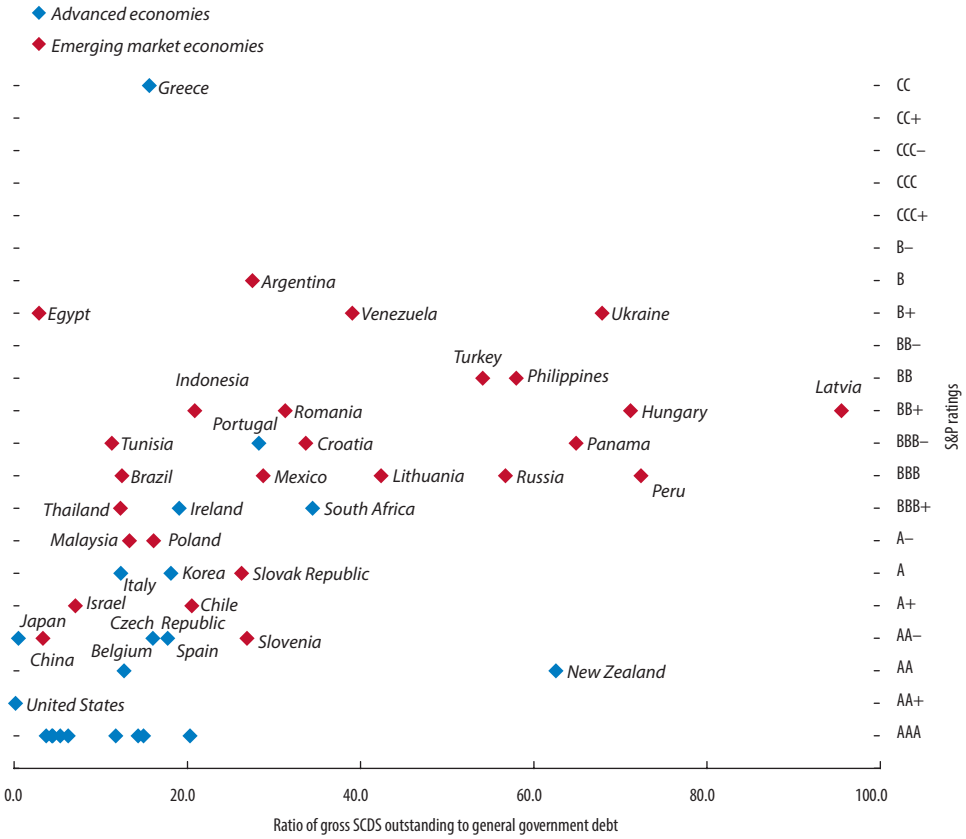
For advanced economies, especially larger economies and those perceived to be safe, SCDS markets are generally small compared with the underlying government debt outstanding, indicating that the demise of the SCDS market would have little effect on the underlying bond market. However, SCDS gross notional amounts are large relative to underlying government debt for many emerging market

Note: Prepared by Brenda González-Hermosillo, Ken Chikada, and John Kiff.

[1]A total return swap is a derivative in which the variable payments are based on the return of an underlying asset.

Box 2.3 *(continued)*

Figure 2.3.1. Country Credit Ratings and Ratio of Outstanding Sovereign Credit Default Swaps (SCDS) to Government Debt, 2011



Sources: IMF, World Economic Outlook and International Financial Statistics databases; Standard and Poor's; and IMF staff estimates.
Note: Countries rated AAA, in order of the ratio of gross SCDS outstanding to general government debt, are the United Kingdom, Germany, Norway, the Netherlands, France, Australia, Sweden, Finland, Denmark, and Austria.

economies and some European countries (Figure 2.3.1, horizontal axis).

Generally, prohibiting the purchase of naked SCDS protection could permanently impair SCDS markets, as trading would exclude a set of participants that help provide liquidity and balance to markets—a complete ban on SCDS contracts would be even more dire.[2] However, the effects of a loss of liquidity and pricing influence will likely depend on the type of country. For example, some advanced economies have substitute markets through which negative sovereign credit risk views can be expressed. However, in many emerging market economies, such alternatives are unavailable, so the loss of SCDS as a hedging instrument could have negative consequences for other credit markets, including the underlying bond markets, and could raise issuance costs. In addition, SCDS dealers that hedge their counterparty risk on their other derivative transactions with sovereigns would face higher costs on such hedging activities.

[2]Beber and Pagano (2013), studying bans on short selling around the world, concluded that they were detrimental for market liquidity and may not have the intended effect of supporting market prices.

market. However, sovereigns and their agencies may be exempt from margin posting on bilateral and centrally cleared trades (BCBS-IOSCO, 2013).[41]

In summary, in an effort to remove destabilizing speculation, the likely effects of the ban on naked short selling are a continuing drop in volumes and liquidity, which could harm the hedging role of SCDS markets. Less liquidity is likely to lead to more proxy hedging and higher spillovers to other markets—potentially with the unintended consequence of reducing financial stability. Whether the ban restrains speculation that could be related to overshooting, and hence to unstable market conditions, remains to be seen. The policy of moving OTC derivatives to CCPs appears a concrete method of making the SCDS market safer. Although, in the short term, the cost of posting initial margin would be high, it is expected to have positive stability implications in the medium term, as counterparty risks would be lowered and transparency potentially improved. However, the exemption of sovereign counterparties from posting collateral is problematic, as it continues to leave dealer banks exposed to sovereign default risks that they will likely hedge with the purchase of SCDS protection.

Conclusions and Policy Implications

The findings in this chapter suggest conclusions and policy implications in the following areas:

- *Role of SCDS as generally reliable market indicators.* When examined relative to their comparable bond spreads, SCDS spreads are approximately equivalent as indicators of sovereign credit risk—reflecting the same economic fundamentals and other market factors. SCDS markets appear to incorporate information faster than bond markets during periods of stress, but this is not always the case at other times.
- *Financial stability implications.* SCDS can be used to hedge sovereign credit risks, thus enhancing financial stability. However, like other instruments, SCDS may be prone to spillovers during periods of stress (especially given their use as proxy credit hedges for other financial and nonfinancial institutions). Our analysis suggests that this threat is no more tied to SCDS markets than to the underlying bond markets; indeed, both may be destabilizing during periods of stress, as contagious forces are present across all financial market assets during these periods. We find evidence of overshooting using the model-based predicted values for some euro area countries' SCDS spreads during the most recent period of distress, though the tendency was not widespread.
- *Role of government and regulation.* Governments and regulators have the opportunity to improve the functioning of SCDS and of CDS markets more generally.
  - Cases in point are recent efforts, in line with the G20 regulatory agenda, to require counterparties to post initial margin on bilateral trades or move them to CCPs (where such margin requirements would be lower). While costly in the short term, such improvements in risk management could yield benefits in the longer term by lessening counterparty risks and reducing the potential for spillovers from sovereign credit events.
  - The recent European ban on purchasing naked SCDS protection appears to move in the wrong direction. While the effects of the ban are hard to distinguish from the influence of other policy announcements, the prohibition may have already caused some impairment of market liquidity. And the ban may yet cause some important buyers of SCDS net protection, including those not targeted by the ban, to withdraw from the market; if so, SCDS market liquidity will likely be further reduced and hedging costs raised. The effects of the ban on speculation, hedging costs, and the information value of SCDS remain to be seen, but they bear scrutiny as evidence accumulates.
  - More broadly, as an apparently permanent measure, the ban may fundamentally impair the functioning of the SCDS market by generating alternative trading schemes or the transfer of risk to other markets that may be less transparent. Even temporary trading bans have been found to be of only limited usefulness and to

[41]That said, if sovereigns and their agencies are not obliged to post collateral, their European bank counterparties may get relief from the new Basel III capital requirements for counterparty credit risk on transactions with those entities. As far as we know, no other jurisdictions are considering such relief.

have many of the negative consequences of permanent ones.
  - The concerns that SCDS can overshoot fundamentals or cause contagion in other markets would be better addressed by mechanisms to temporarily halt trading, such as "circuit breakers" with bright-line criteria for triggering and lifting such halts. Granted, imposing temporary trading halts in an OTC market, as opposed to an exchange trading environment, is particularly difficult, as there is no formal trading platform. But enforcing a ban, which requires identifying institutions that maintain uncovered short positions, is also quite difficult although upcoming reporting requirements for short positions should help.
- *Data gaps.* While it may be inappropriate to release detailed information about individual counterparty SCDS positions to the public, macroprudential supervisors should be able to access these data. Such information may enable them to assess risks to financial stability and circumvent, or at least anticipate, channels for contagion. To the degree that uncertainty about exposures and interconnections can be lessened through the public release of some aggregated or masked information, potential contagion and overshooting (among the motivations for the ban on uncovered SCDS protection) could be diminished.

Overall, SCDS markets help enhance financial stability by providing a mechanism to hedge sovereign risks. We find no evidence to support the concern that SCDS markets may be less effective than government bond markets in reflecting economic fundamentals, and we find little evidence that the SCDS market is any more destabilizing than other financial markets. That said, we find some evidence of SCDS overshooting in a few euro area countries during the most recent period of stress. Spillovers to other countries' SCDS markets and the ongoing linkages between domestic banks and sovereigns also exist within the context of CDS markets, as they do more generally. Recent efforts to address the underlying, fundamental nature of these connections would be more productive than placing restrictions on the SCDS market that can limit and distort its role as "messenger."

Annex 2.1. A Primer on Sovereign Credit Default Swaps

CDS are bilateral agreements to transfer the credit risk of debt obligations of "reference entities"—corporations (financial and nonfinancial), sovereigns, and other legal entities such as securitization special-purpose vehicles. Purchasers of CDS are protected against losses relating to predefined credit events (such as failure to pay) during the term of the contract in return for premium payments to the protection seller.[42] If a credit event occurs, the premium payments terminate and the contract is settled; settlement consists of the protection seller paying an amount equal to the contract notional value minus the value of "deliverable" debt obligations issued by the reference entity ("recovery value").[43]

To illustrate, suppose that CDS protection could be purchased for a spread of 100 basis points per year until contract termination. If it terminates with a credit event, and the recovery value is 20 percent of par, the protection seller would pay 80 percent of the notional value to the protection buyer. The recovery value is based on the value of a reference asset as determined after the credit event; the types and characteristics of the reference assets are contractually specified, with protection buyers effectively determining specifically which of them is used and ultimately the recovery price used to settle the contracts.[44]

Since June 2005 there have been 103 CDS credit events but only two SCDS credit events with publicly documented settlements.[45] The most recent SCDS event was the March 2012 Greece debt exchange, which serves as an example of the potential complexity of SCDS credit event triggering and settlement (Box 2.4). Concerns about European banks rumored to be large sellers of Greek debt protection (and the losses they could potentially suffer) led to various tactics by international authorities to delay SCDS settlement triggering.[46] The SCDS contracts were eventually triggered and rumors shown to be unfounded, but the episode led some to question the usefulness of SCDS.

CDS can be used to take unfunded short (or long positions) in the reference obligations by buying (or selling) protection. Also, traders try to exploit pricing differences between CDS and underlying reference bonds by taking offsetting positions, called "basis trading." For example, suppose that a five-year par bond with a 5 percent coupon could be funded over

Note: Prepared by Ken Chikada, John Kiff, and Hiroko Oura.

[42]Before 2009, the annual premium paid by the protection buyer was equal to the CDS par spread—the spread at which the discounted present value of the periodic premium payments is equal to the expected present value of the settlement amount in case of a credit event. Starting in 2009, the protection buyer pays an annual premium that has been fixed at one of several standard levels (25, 100, 300, 500, and 1,000 basis points) plus or minus an upfront payment to compensate for the difference between the par spread and the fixed premiums. The SCDS spreads used in the chapter's empirical work are the par spreads (Willemann, Leeming, and Ghosh, 2010).

[43]The protection buyer also pays premiums accrued since the previous payment to the protection seller. Also, CDS used to usually settle physically through the delivery of defaulting obligations to the protection seller in exchange for an amount equivalent to the CDS' notional value. They are now mostly settled via a two-stage auction-based CDS protocol to produce fair and unbiased recovery values to feed into cash, not physical, settlements.

[44]In the two-stage auction referred to above, participants who are selling bonds will deliver the cheapest of the bonds designated as eligible by the International Swaps and Derivatives Association's Determination Committee. See Andritzky and Singh (2006) and Ammer and Cai (2011) for more on this potentially valuable cheapest-to-deliver option that drives the auction recovery price.

[45]Of the sovereign credit events and restructurings since June 2005, when information on CDS settlements became available, only the credit events for Ecuador in 2008 and Greece in 2012 resulted in CDS settlements. According to various market sources, at least three other credit events may have triggered CDS settlements (Belize in 2006, Seychelles in 2008, and Jamaica in 2010). In addition, according to Das, Papaionnou, and Trebesch (2012), there have been 26 sovereign restructurings since June 2005.

[46]Legislation was adopted to effectively "retrofit" collective action clauses (CACs) to €177 billion of old Greek government bonds (GGBs) on February 24, 2012, in case voluntary participation would not be high enough. The retrofitted CACs allowed bondholders with one-third of the aggregated outstanding principal of old GGBs to bind all bondholders to the restructuring. In contrast, typical CACs apply only to a specific bond series, and require a supermajority to change the bond terms, allowing investors with large positions to block a restructuring of that series. The Greek retrofit law did not allow any bond series to drop out and the aggregate nature of the CAC made blocking unlikely. To protect the ECB and national central banks, their bond holdings were swapped for new bonds with identical terms but different serial numbers, to ensure that they would not be covered by any debt exchange. Since bondholders were not legally subordinated, the SCDS were not triggered. Gelpern and Gulati (2012) argue that a credit event may have been triggered earlier if the issuance of new bonds to the ECB for the express purpose of excluding them from a restructuring had been recognized as subordination. A more "textualist" reading of the CDS contracts in this case blurred the trigger criteria, but this may have been needed to reconcile competing demands of the authorities and market participants.

Box 2.4. The Greece Debt Exchange and Its Implications for the SCDS Market

The March 2012 Greek debt exchange was the largest sovereign restructuring event in history. About €200 billion of Greek government bonds (GGBs) were exchanged for new GGBs. Holders of old GGBs who had SCDS protection on them recovered roughly the par value of their holdings, but the uncertainties of the process cast doubts on the viability of SCDS as a hedging tool. An industry-led initiative is rethinking the settlement process of SCDS credit events.

Two main factors determine the effectiveness of CDS protection: (1) whether the event responsible for the losses triggers the CDS payout and (2) if it is triggered, whether the payout offsets the losses. On the surface, the Greek SCDS settlement went according to plan. A restructuring event was called on March 9, and the ensuing March 19 settlement yielded SCDS payouts roughly in line with losses incurred in the debt exchange.

Many market participants regarded the outcome a fortunate coincidence because the payout could have been much smaller than the losses on the old GGBs. The exchange removed all outstanding old GGBs *before* the CDS settlement, thus requiring the new GGBs to be accepted as deliverable obligations. Luckily, the new GGBs were trading at about 22 percent of par going into the CDS settlement, the same price at which the old GGBs were trading before the exchange; hence, the payout matched the losses on the old GGBs. Nevertheless, the uncertainty surrounding the payout of the CDS contracts eroded market confidence in SCDSs.

However, if markets had viewed the exchange as supportive of Greece's debt sustainability, the market value of the new GGBs would have been higher than that of the old bonds. In this case, the SCDS payout would not have covered the losses caused by the exchange. As a result, the International Swaps and Derivatives Association (ISDA) is looking at ways to alter standard CDS documentation to deal with such situations.

One proposal is to settle by delivering a package of new instruments in proportion to the instruments they replace (see Duffie and Thukral, 2012). In this case, every €100 of Greek SCDS would have been exchanged for €31.5 of new GGBs, €15.0 of European Financial Stability Facility-guaranteed notes, and €31.5 of GDP warrants. With the new GGBs trading at about 22 percent of par, this package, excluding the value of the warrants, would have also been worth about 22 percent of par—€31.5 of the new GGBs at 22 percent plus €15 of the guaranteed notes.

Note: Prepared by Jorge A. Chan-Lau and John Kiff.

the full five years at a fixed 4 percent.[47] That would produce expected annual cash inflows of 100 basis points (500 – 400 basis points). For the CDS–bond "basis" to be zero, the CDS referencing that bond must also be trading at 100 basis points (Figure 2.13).[48] Also, if a credit event occurs, the bond and CDS basis package would suffer identical losses.[49]

When the basis is positive, selling CDS protection and covering it by short selling reference bonds can be profitable. When the basis is negative, it can be arbitraged by buying the bonds and buying CDS protection. These actions should narrow the basis. In practice, the basis is seldom zero due to factors such as transactions costs, funding and counterparty risks, the protection buyer's cheapest-to-deliver option, currency mismatches between the CDS and reference bonds, and nonpar bonds used as reference bonds (Figure 2.14). However, a nonzero SCDS basis may also reflect obstacles to arbitrage in combination with differential reactions of SCDS and bond markets to economic and market developments (O'Kane, 2008).

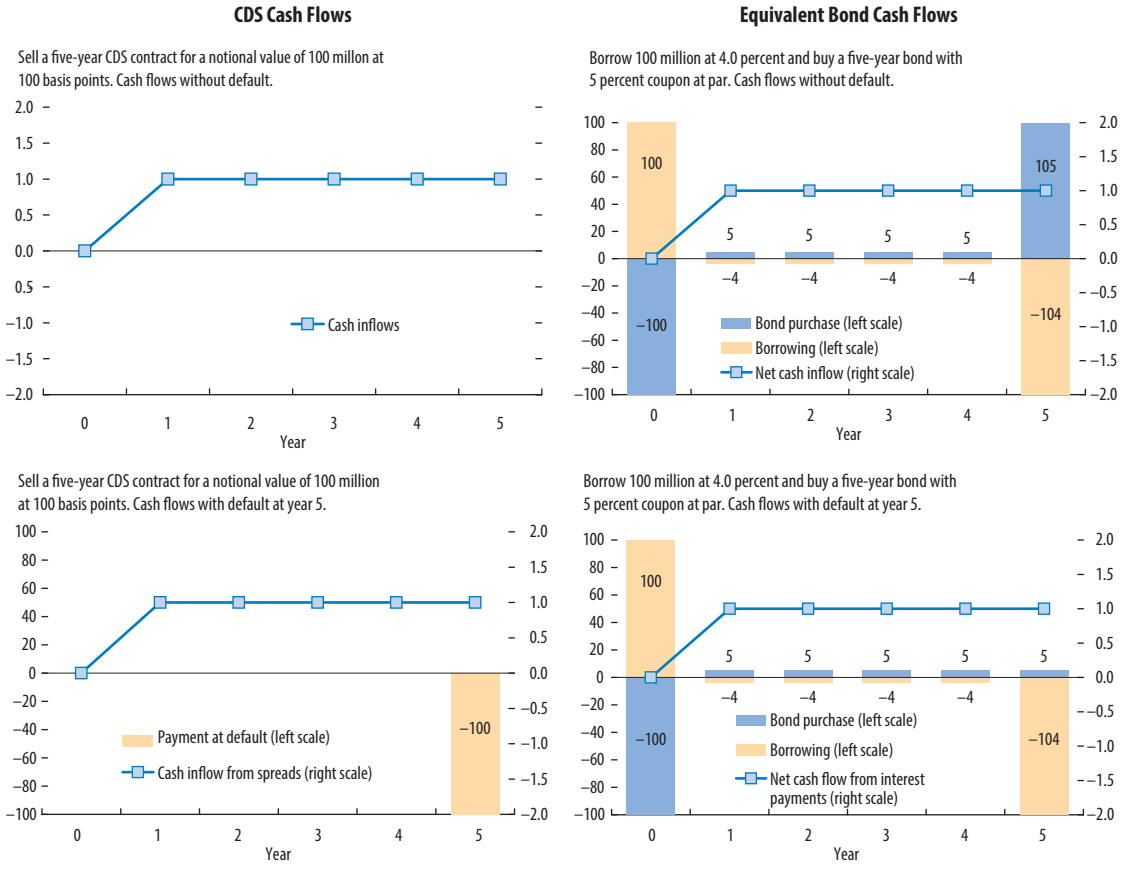
Measuring the risks of SCDS contracts turns on the differences between gross notional amounts outstanding and net notional amounts. Most

[47]In order to achieve fixed-rate funding, the bonds are typically funded in the repo market on a floating-rate basis and swapped into fixed rates over the full term using interest rate swaps.

[48]If there is no credit event, the package and the reference obligation both return par value. In the example, if there is a default, the CDS package returns zero percent of par (the par value of the riskless investment minus the 100 percent of notional CDS protection payment), which is identical to the reference obligation recovery value.

[49]The transaction in Figure 2.13 assumes zero recovery of principal upon a credit event.

Figure 2.13. Constructing the Arbitrage Trade between Credit Default Swaps (CDS) and Bonds
(In millions)



Source: IMF staff.

SCDS data are collected and disbursed using these concepts.

Gross notional values are calculated on a per-trade basis. For example, if Bank A sells $100 of CDS protection to Bank B, the gross notional amounts (the transactions highlighted in orange in the following table) and net notional amounts are reported as $100.

	Gross Sold	Gross Bought	Net Sold	Net Bought
Bank A	–100		–100	
Bank B		100		100
Total	–100	100	–100	100

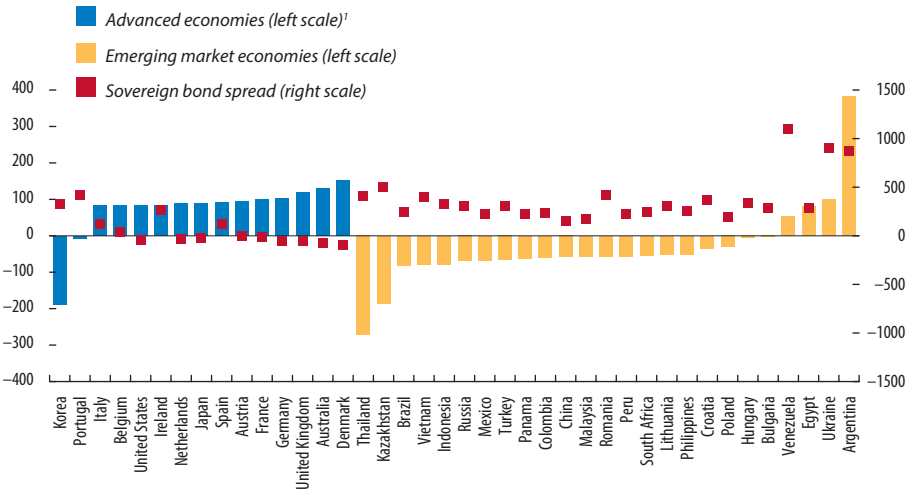
If Bank A hedges its position by buying $100 of CDS protection on the same reference entity from Bank C (the transactions highlighted in blue in the following table), the total gross notional amount rises to $200 but the net notional amount remains at $100. The $100 number is a relevant metric of risk transfer, but $200 is relevant as a counterparty risk metric because, although Bank A is "flat" (no exposure), Banks B and C remain exposed to the risk of Bank A defaulting on its contractual obligations.

	Gross Sold	Gross Bought	Net Sold	Net Bought
Bank A	–100	100		
Bank B		100		100
Bank C	–100		–100	
Total	–200	200	–100	100

Trade compression and "tear ups" can be used to reduce gross notional amounts by canceling offsetting

Figure 2.14. Difference between Sovereign Credit Default Swap Spreads and Sovereign Bond Spreads, Selected Countries

(In basis points, average for 2008–12, five-year tenors)



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

Note: For sovereign bond spreads, the JPMorgan Asia credit indices are used for Korea and Thailand; EMBI Global indices are used for other emerging market economies; and Bloomberg L.P.'s constant maturity yields minus swap spreads are used for other advanced economies. A similar relationship holds if the EMBI yield-swap rate is used for emerging market conomies.

[1]Excluding Greece, where the average basis is more than 1300 basis points.

redundant contracts. In this case Bank A can transfer ("novate") to Bank B its contractual obligations to Bank C as shown in the table below, bringing gross notional amounts in the system back to $100.

	Gross Sold	Gross Bought	Net Sold	Net Bought
Bank B		100		100
Bank C	–100		–100	
Total	–100	100	–100	100

In reality, a proliferation of these redundant offsetting trades has created large gaps between gross and net notional amounts. That said, compression operations are limited, as some transfers do not work on account of counterparty limits and restrictions, or the offsetting trades are not quite perfect matches (for example, the same reference entity but different contractual terms) and only dealers (and not end users) take part in the operations.

Annex 2.2. Technical Background: Determinants of SCDS Spreads and Bond Spreads

When comparing SCDS and bond markets, research papers often compare SCDS spreads to bond spreads instead of bond yields.[50] Bond spreads for most advanced economies are measured by the difference between bond yields and interest swap rates, as in Fontana and Scheicher (2010).[51] For emerging market economies, we use the EMBI spread, as in Chan-Lau and Kim (2005). The results are robust if EMBI yields minus swap rates are used instead.

Data

We examine a wide range of countries (Table 2.3) that have meaningful data on SCDS and government bond spreads and other variables used in the analysis. The sample includes both advanced and emerging market economies (33 in total), whereas most previous analyses use one or the other.[52] We use data from October 2008, when the liquidity (bid-ask spread) for SCDS in the advanced economies improved appreciably and DTCC started to provide volume data. For most advanced economies, SCDS contracts reference domestic government bonds, and hence we use their domestic government bond yields. For advanced economies whose SCDS contracts reference external government bonds (e.g., Korea, New Zealand, Sweden,), we use their external bond yields if possible (Korea) or drop them from the analysis. For emerging market economies the SCDS contracts reference their external debt, and we take their external bond spreads from JPMorgan indices (EMBI or the JPMorgan Asia Credit Index).

Determinants of the Spreads

We estimate panel models regressing SCDS spreads and government bond spreads (y_i) on various economic and financial explanatory variables (Xi) listed in Table 2.4 using monthly data. If SCDS markets are more speculative or more influenced by financial market conditions than bond markets, we should see smaller or insignificant coefficients (β) for economic fundamentals variables and larger and more significant coefficients for market and global variables in the SCDS model than in the bond model.

$$\text{Base model } y_i = \alpha_i + \beta X_i + \varepsilon_i \text{ for country } i \quad (2.1)$$

We selected the explanatory variables that are frequently used in the literature on sovereign risk (Table 2.4).[53]

- *Macroeconomic fundamental variables.* The model includes countries' debt-to-GDP ratios, real GDP growth rates, and international reserves. The first variable would be expected to increase spreads, whereas the latter two would reduce them. In addition, lagged return-on-assets (ROA) of the country's banking sector is included to reflect the possible risk transfer effects from the banking sector to sovereigns (higher bank ROA should reduce the expected contingent liability to the government and lower sovereign risks), as in Diekman and Plank (2012).
- *Market microstructure indicators.* We also include market liquidity (bid-ask spreads) and volume measures (net SCDS volumes outstanding in percent of sovereign debt outstanding). Low

Note: Prepared by Hiroko Oura; based on Oura and Valckx (forthcoming).

[50]Augustin (2012) provides a comprehensive overview of SCDS literature.

[51]Some studies examine euro area countries by looking at bond spreads vis-à-vis German bunds (e.g., Palladini and Portes, 2011), but that approach precludes including Germany in the analysis and complicates bond spread measurements for other advanced economies outside of the euro area such as Japan, the United Kingdom, and the United States. Discussions with market participants suggest that they use measures very similar to ours (i.e., asset swap spreads), taking interest rate swap rates as the relevant funding cost for arbitrage trading. Asset swap spreads and our measures have a high correlation (close to 1).

[52]Beirne and Fratzscher (2013) study a similar sample but with more focus on contagion across countries, taking SCDS and bonds as alternative measures of sovereign risk.

[53]Early studies (Edwards, 1984, 1986; and Boehmer and Megginson, 1990) established the role of fiscal and macro fundamentals for credit spreads. Others emphasized that market factors such as risk appetite, risk premiums, and liquidity are also important (Duffie, Pederson, and Singleton, 2003; Baek, Bandopadhyaya, and Du, 2005; Remolona, Scatigna, and Wu, 2008; Hartelius, Kashiwase, and Kodres, 2008; Pan and Singleton, 2008; Caceres, Guzzo, and Segoviano, 2010; and Alper, Forni, and Gerard, 2012).

Table 2.3. List of Countries Included in Empirical Studies

Countries Used in Panel Estimations[1]			Countries Used in Price Discovery Estimations and Stylized Fact Section										
				Advanced Economies (AE)					Emerging Market Economies (EM)				
All (33)	Advanced Economies (14)	Emerging Market Economies (19)	All (40)	All AE (15)	Euro Area (9)	Core Euro Area (5)	Other Euro Area (4)	Non-Euro Area (6)	All EM (25)	European EM (9)	Other EM (16)	EU (16)	Non-EU (24)
Argentina	Australia	Argentina	Argentina	Australia	Austria	Austria	Ireland	Australia	Argentina	Bulgaria	Argentina	Austria	Argentina
Australia	Austria	Brazil	Australia	Austria	Belgium	Belgium	Italy	Denmark	Brazil	Croatia	Brazil	Belgium	Australia
Austria	Belgium	Bulgaria	Austria	Belgium	France	France	Portugal	Japan	Bulgaria	Hungary	China	Bulgaria	Brazil
Belgium	France	China	Belgium	Denmark	Germany	Germany	Spain	Korea	China	Lithuania	Colombia	Denmark	China
Brazil	Germany	Colombia	Brazil	France	Ireland	Netherland		United Kingdom	Colombia	Poland	Egypt	France	Colombia
Bulgaria	Ireland	Egypt	Bulgaria	Germany	Italy			United States	Croatia	Romania	Indonesia	Germany	Croatia
China	Italy	Hungary	China	Ireland	Netherlands				Egypt	Russia	Kazakhstan	Hungary	Egypt
Colombia	Japan	Indonesia	Colombia	Italy	Portugal				Hungary	Turkey	Malaysia	Ireland	Indonesia
Egypt	Korea	Kazakhstan	Croatia	Japan	Spain				Indonesia	Ukraine	Mexico	Italy	Japan
France	Netherlands	Malaysia	Denmark	Korea					Kazakhstan		Panama	Lithuania	Kazakhstan
Germany	Portugal	Mexico	Egypt	Netherlands					Lithuania		Peru	Netherlands	Korea
Hungary	Spain	Peru	France	Portugal					Malaysia		Philippines	Poland	Malaysia
Indonesia	United Kingdom	Philippines	Germany	Spain					Mexico		South Africa	Portugal	Mexico
Ireland	United States	Poland	Hungary	United Kingdom					Panama		Thailand	Romania	Panama
Italy		Russia	Indonesia	United States					Peru		Venezuela	Spain	Peru
Japan		South Africa	Ireland						Philippines		Vietnam	United Kingdom	Philippines
Kazakhstan		Thailand	Italy						Poland				Russia
Korea		Turkey	Japan						Romania				South Africa
Malaysia		Ukraine	Kazakhstan						Russia				Thailand
Mexico			Korea						South Africa				Turkey
Netherlands			Lithuania						Thailand				Ukraine
Peru			Malaysia						Turkey				United States
Philippines			Mexico						Ukraine				Venezuela
Poland			Netherlands						Venezuela				Vietnam
Portugal			Panama						Vietnam				
Russia			Peru										
South Africa			Philippines										
Spain			Poland										
Thailand			Portugal										
Turkey			Romania										
Ukraine			Russia										
United Kingdom			South Africa										
United States			Spain										
			Thailand										
			Turkey										
			Ukraine										
			United Kingdom										
			United States										
			Venezuela										
			Vietnam										

Note: Greece excluded; including it tremendously affects the estimated parameters in estimations owing to substantial jumps in credit default swap (CDS) spreads and bond spreads since 2011. Greek sovereign CDS spread and bond spread rose from about 1,000 and 1,100 basis points, respectively, at end 2010 to a peak of over 25,000 and 6,000 basis points in March 2012.

[1]Countries are included only when CDS and referenced bond yields are available from mid-2008 (Croatia, Denmark, Lithuania, and Romania are excluded). Some countries are excluded because of missing explanatory variables: Panama (equity prices), Venezuela (equity prices), and Vietnam (CDS volume).

Table 2.4. List of Variables Used in Regression Analysis

Variables	Definition	Original Frequency	Method of Frequency Conversion	Data Source
Dependent variables				
SCDS spread	Five-year sovereign CDS spread, in basis points.	Daily	Period average	Bloomberg L.P.
Bond spread[1]	Advanced economies: five-year generic government bond yield from Bloomberg – (five-year fixed-for-floating [LIBOR]) interest swap rate. Emerging market economies: five-year EMBI spread for each EMBI member country. Country-specific spreads from JPMorgan Asia Credit indices for Korea and Thailand. In basis points.	Daily	Period average	Bloomberg L.P.
Basis	Sovereign CDS spread – bond spreads, in basis points.	Daily	Period average	Bloomberg L.P.
Country-specific explanatory variables				
Fundamental variables				
Debt-to-GDP ratio	Gross general government debt in percent of GDP.	Annual	Cubic spline	IMF, WEO
GDP growth	Real GDP growth rate, in percent.	Annual	Cubic spline	IMF, WEO
Ratio of foreign reserves to GDP	International reserves minus gold, in percent of GDP.	Monthly	Period average	IMF, IFS
Bank ROA	Market-capitalization-weighted average return on assets for the financial sector in each country, in percent.	Annual	Cubic spline	IMF, CVU[2]
SCDS and bond market-specific indicators				
SCDS bid-ask spread	Sovereign CDS bid-ask spread in percent of mid spread.	Daily	Period average	Bloomberg L.P.
Bond bid-ask spread	Government bond bid-ask yield in percent of mid yield. Available only for countries where the CDS contract references domestic bonds (i.e., advanced economies excluding Korea). Values for other countries are set at zero.	Monthly	Period average	Bloomberg L.P.
Sovereign CDS/bond volume	Notional amount for outstanding sovereign CDS contracts (net of offsetting contracts) in percent of government debt outstanding.	Weekly	Period average	DTCC; WEO
Central bank operation	Central bank bond purchase amount per period, in percent of government bond outstanding. Available only for euro area countries (ECB), Japan, the United Kingdom, and the United States. For euro area economies, the variable is calculated as total bond purchase by ECB/country-specific government bond outstanding. Values are set at zero for the other economies.	Weekly	Period sum	Central bank websites
Market-based variables				
Equity return	Annualized return of MSCI country equity index (U.S. dollars). Calculated net of MSCI Global Equity Index (residual from linear regression), in percent, in order to avoid multicollinearity issues.	Monthly	Period average	Bloomberg L.P.; IMF staff estimates
Equity volatility	Volatility estimated by GARCH (1,1) using (gross) returns of MSCI country equity index (U.S. dollars). Calculated net of the GARCH (1, 1) estimated volatility for MSCI Global Equity Index (residual from linear regression), in percent, in order to avoid multicollinearity issues.	Monthly	Period average	Bloomberg L.P.; IMF staff estimates
Global or region-specific explanatory variables				
VIX	Implied volatility on S&P 500 index options.	Daily	Period average	Bloomberg L.P.
High stress	High market stress period, measured by the probability that the VIX is in a high volatility state (out of three possible states), estimated by a regime-switching framework (Gonzalez-Hermosillo and Hesse, 2011).	Daily	Period average	Bloomberg L.P.; IMF staff estimates
Global equity return	Annualized return in excess of one-month U.S. Treasury yields, in percent.	Monthly	Period average	Bloomberg L.P.
Counterparty	Average CDS spreads for 12 CDS dealer banks (Bank of America, Barclays, BNP Paribas, Citi, Credit Suisse, Deutsche Bank, Goldman Sachs, HSBC, JPMorgan, Royal Bank of Scotland, Société Générale, and Wells Fargo). Calculated net of VIX (residual from linear regression) in basis points in order to avoid multicollinearity issues.	Monthly	Period average	Bloomberg L.P.; IMF staff estimates
Funding cost	Three-month LIBOR-OIS spread, in basis points. In own currency for advanced economies, excluding Korea, and in U.S. dollars for emerging market economies and Korea.	Daily	Period average	Bloomberg L.P.

Source: IMF staff.

Note: AE = advanced economies; CDS = credit default swaps; CVU = Corporate Vulnerability Utility; DTCC = Depository Trust and Clearing Corporation; ECB = European Central Bank; EM = emerging market economies; IFS = IMF, International Financial Statistics database; OIS = overnight indexed swap; ROA = return on assets; WEO = IMF, World Economic Outlook database.

[1]For all AE (except for Korea) in the panel sample, sovereign CDS contracts reference domestic bonds, hence domestic government bond yields are used to calculate corresponding bond spreads. For all EM and Korea, sovereign CDS contracts reference external debt, hence JPMorgan's EMBI country-specific spreads are used (country-specific spreads from JPMorgan's Asia Credit indices are used for Korea and Thailand). AE, EM definitions follow IMF, WEO classification of countries and groups.

[2]CVU: an internal database at the IMF constructed using market data from DataStream and company financial statement data from Worldscope.

market liquidity (i.e., high bid-ask spreads) is expected to increase SCDS spreads. The impact of volume is ambiguous: spreads increase with volume if more trading takes place when sovereign risk and demand for insurance are high but decrease if more trading improves market liquidity (e.g., as the SCDS market develops).

- *Country-specific market variables and global variables.* Positive domestic or international equity returns should be associated with better economic performance and lower SCDS spreads. Higher uncertainty and risk aversion (higher country-specific equity volatility and VIX—the implied volatility on S&P 500 index options) should raise SCDS spreads. Higher counterparty risk (proxied by lagged average CDS spreads of major dealer banks) should reduce SCDS spreads, as it reduces the value of SCDS protection sold by financial firms (Arce, Mayordomo, and Pena, forthcoming; and Chan-Lau, 2008). Higher funding costs (LIBOR-OIS spreads and repo haircuts) could make it more expensive to buy reference bonds, and higher margin requirements could reduce the supply of SCDS protection sales, thereby raising spreads. Some of these variables are highly correlated, which may cause multicollinearity problems. Therefore, we use country-specific equity returns net of global equity returns, country specific equity volatility net of global equity volatility, and counterparty risk net of VIX.[54]

We also estimate a variation of the base model to examine different sensitivities to each explanatory variable during distressed time periods. We proceed by including interaction terms constructed by multiplying a high market stress indicator by the explanatory variables (X_i). Our measure of high stress, based on González-Hermosillo and Hesse (2011), is the probability (ranging from 0 to 1) that VIX is in a high volatility regime (see Figure 2.9).

$$\text{Variation } y_i = \alpha_i + \beta X_i + \gamma HighStress \cdot X_i + \varepsilon_i \quad (2.2)$$

Models are then estimated with and without cross-section and time fixed effects, using robust or clustered standard errors. They are estimated both in levels and in differences as a robustness check, as in Diekman and Plank (2012), to account for possible unit roots or for unobserved cross-section-specific effects. The results are broadly consistent with each other, and the level results are used in Figure 2.5 and Table 2.5.

[54]For instance, we use residuals of a simple ordinary least squares regression of country-specific equity returns on global equity returns. See Table 2.4 for details.

Determinants of the "SCDS-Bond Basis"

The SCDS-bond basis is usually positive for most advanced economies and negative for most emerging market economies.[55] This is because spreads on advanced economy government bonds are negative given that their sovereign yields are generally lower than their comparable interbank rates, which are used to calculate the bond spread, while SCDS spreads are always positive (see Figure 2.14). The opposite is true for emerging market economies whose bond spreads are in foreign currency and are calculated relative to the corresponding maturity U.S. Treasury bonds. At the same time, generalized periods of distress were reflected in notable jumps in the basis for both advanced and emerging market economies.

We estimate a panel model similar to equations (2.1) and (2.2) with the same explanatory variables but with the SCDS-bond basis as the dependent variable (see Table 2.6 for results). The role of central bank purchases is also explored. In general, the results for the SCDS-bond basis should reflect the relative effects of the various factors on the SCDS spreads and government bond spreads. The effects of factors would have a positive effect if SCDS markets are more sensitive to the factor than are government bond markets. Similarly, an opposite sign is expected if the government bond market is the more sensitive. Regarding market microstructure factors, all else remaining constant, liquid SCDS markets would reduce SCDS spreads and hence lower the basis.[56] In

[55]For purposes of the model estimated here, the basis is the difference between the CDS spread and bond spread, which is equivalent to the basis measure described in Annex 2.1.

[56]See Arce, Mayordomo, and Pena (forthcoming); Ammer and Cai (2011); and Chan-Lau (2008). Ammer and Cai (2011) also show that the option for protection buyers to deliver a wide range of bonds, allowing them to choose the cheapest, leads to a positive basis because protection sellers charge a higher premium to account for the possibility of being delivered less valuable bonds.

Table 2.5. Summary of Estimation of Monthly Drivers for Sovereign Credit Default Swap (SCDS) Spreads and Bond Spreads, October 2008–September 2012

	Expected Sign		CDS, Level			Bond, Level		
				Estimation: With High Stress[2]			Estimation: With High Stress[2]	
	SCDS	Bond	Estimation: Base Model[1]	Direct Impact	High-Stress Interaction term	Estimation: Base Model[1]	Direct Impact	High-Stress Interaction term
Country-specific explanatory variables								
Fundamental variables								
Debt-to-GDP ratio	+	+	12.73***	13.32***	-0.64	9.26***	9.76***	–1.17*
GDP growth	–	–	–6.70***	–10.03***	11.49	–2.64*	–4.23***	0.41
Ratio of foreign reserves to GDP	–	–	–6.93*	–5.13	–1.73*	–19.82***	–18.14***	0.33
Bank ROA (lag 12)	–	–	–7.15*	–4.01	–21.79**	–4.54**	–3.75**	–11.22
SCDS and bond market-specific indicators								
SCDS bid-ask spread	+	+/–	10.78***	16.54***	-4.31	8.23***	14.18***	–6.73**
SCDS/bond volume	+/–	+/–	45.16***	48.26***	6.30	41.05***	40.56***	5.44
Bond bid-ask spread, selected advanced economies[3]	+/–	+	37.33***	26.18***	13.25	56.86***	47.62***	17.10*
Market-based variables								
Equity return	–	–	–0.22	–0.29**	0.14	–0.20	–0.29***	0.24
Equity volatility	+	+	1.16***	–0.01	1.68*	0.91***	–0.01	1.38***
Global and region-specific explanatory variables								
VIX	+	+	5.22***	–0.59	8.00**	3.83***	0.25	6.49**
Global equity return	–	–	0.32*	–0.47*	0.97**	0.23*	–0.33**	0.71**
Counterparty (lag 1)	–	+/–	0.31***	–0.05	0.23	0.18**	–0.07	0.30
Funding cost	+	+	1.03**	4.19***	–3.86***	0.63**	2.77***	–2.71***
Adjusted *R*-squared[4]			0.67	0.68		0.77	0.78	

Source: IMF staff estimates.

Note: ROA = return on assets; VIX = implied volatility on S&P 500 index options. This table summarizes the results of the fixed-effects panel estimation on monthly drivers for SCDS and bond spreads using level data. + and – indicate the sign of expected coefficients. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels of confidence based on clustered standard errors. For explanation of the variables, see Table 2.4.

[1]Model estimates for 33 advanced and emerging market economies. See Table 2.3 for the list of countries.

[2]This estimation includes the interaction term for high-stress periods. The results are shown in two columns: "Direct Impact" shows the coefficients for explanatory variables on their own, and "High-Stress Interaction Term" shows the coefficients for high-stress period indicator multiplied by explanatory variables (see the text). High-stress periods are identified as the ones in the highest one-third of the volatility distribution for VIX using a Markov-Switching approach. See Figure 2.9.

[3]Bond bid-ask spreads are available only for advanced economies using domestic bond yields, except for Korea, which is an advanced economy following the World Economic Outlook classification, but whose SCDS references external debt.

[4]In the high-stress estimation, the adjusted *R*-squared applies to both the direct impact and high-stress interaction terms.

contrast, in several advanced economies, programs of the central bank to purchase government bonds lower their government bond yields, widening it (see IMF, forthcoming). Since these market features might affect advanced economies differently from emerging market economies, these two groups are estimated separately.

The expected relationships for the variables are as follows:

- *Factors limiting arbitrage.* Higher counterparty risk and funding costs could reduce the basis, as the impact of counterparty risk should fall more on SCDS as an OTC derivatives contract, and the impact of funding costs should fall more on bonds that make it more expensive to borrow cash for trading. Larger SCDS (bond) bid-ask spreads should increase (decrease) basis as lower liquidity in the market should primarily bid up spreads in that specific market. The impact of volume is ambiguous.
- *Factors creating differential reactions between the markets.* For the analysis of basis, we introduce bond purchase operations by central banks, as such purchases are expected to reduce bond spreads below SCDS spreads. The coefficients for other variables (fundamentals and markets), together with the results from spread determinants analysis, should indicate which market reacts more to economic and market developments. For example, if both SCDS spreads and bond spreads show positive and significant signs vis-à-vis the debt-to-GDP ratio, and the bond market reacts more than (about the same as)

SCDS, its coefficient in basis regression should be negative (insignificant). Making the assessment in combination with determinants analysis is critical because a negative or insignificant coefficient may also reflect insignificant or unreasonable estimates in both SCDS and bond spread analysis.

The regression analysis of the SCDS-bond basis shows that, overall, the SCDS market is not more sensitive than the government bond market to the factors evaluated (Table 2.6). For some factors, the SCDS spreads react more; for some others, the reverse; and for still other factors, no statistical relationship is detected at all.

- For the full sample of countries and the sample of emerging market economies, SCDS react more than bonds to some economic fundamental factors but less to others.
- On the other hand, the SCDS-bond basis appears to be only weakly related to financial market risk factors.[57]
- The SCDS-bond basis is significantly related to specific forces in the SCDS and government bond market microstructures. However, for advanced economies, higher SCDS bid-ask spreads reduce the basis, suggesting that less SCDS market liquidity has a larger effect on bond spreads than on SCDS spreads. This result is somewhat counterintuitive, as usually one would expect market liquidity to have a larger effect on the underlying market.

During stress periods, the SCDS market appears to react more than the bond market, but mostly for emerging market economies.

[57]This is in line with other studies, including Fontana and Scheicher (2010) and Arce, Mayordoma, and Pena (forthcoming).

Table 2.6. Summary of Estimation Results on Drivers for Basis, October 2008–September 2012

		Full Sample			Advanced Economies			Emerging Market Economies		
			Estimation: With High Stress[2]			Estimation: With High Stress[2]			Estimation: With High Stress[2]	
	Expected sign	Estimation: Base Model[1]	Direct Impact	High-Stress Interaction term	Estimation: Base Model[1]	Direct Impact	High-Stress Interaction term	Estimation: Base Model[1]	Direct Impact	High-Stress Interaction term
Country-specific explanatory variables										
Fundamental variables										
Debt-to-GDP ratio	+/–	3.31**	2.95***	0.77*	–2.12***	–2.33***	0.15	17.50***	15.00***	2.81***
GDP growth	+/–	–4.92***	–4.62***	8.52**	16.48***	3.89***	8.97***	–5.12**	–5.11***	13.14**
Ratio of foreign reserves to GDP	+/–	19.06***	17.16***	–2.70**	28.81***	31.88***	–2.30**	14.09***	11.48***	–1.81**
Bank ROA (lag 12)	+/–	–3.67*	–0.55	–8.95**	–0.56	–2.41**	–3.48	–5.61**	–1.95	–9.66*
SCDS and bond market-specific indicators										
SCDS bid-ask spread, EM	+	39.65***	37.04***	7.98	…	…	…	59.59***	51.13***	–5.69
SCDS bid-ask spread, AE	+	1.62	–1.53	4.32	–4.60***	–4.12***	–0.41	…	…	…
SCDS/bond volume, EM	+/–	–3.62	–1.53	3.60	…	…	…	9.13**	10.33*	6.19**
SCDS/bond volume, AE	+/–	58.58***	39.28***	14.94	11.69	14.99	–9.17	…	…	…
Bond bid-ask spread, AE excluding Korea[3]	–	–12.64***	–15.79***	–4.41	–9.39**	–9.90*	1.89	…	…	…
Central bank operation, selected AE[4]	+	2.51**	0.14	–1.03	2.79**	2.57	0.27	…	…	…
Market-based variables										
Equity return	+/–	–0.05	0.01	–0.14	–0.02	–0.01	–0.04	–0.14	–0.11	0.11
Equity volatility	+/–	0.18	–0.14	0.36	0.09	0.45***	–0.41**	0.07	–0.29	0.52
Global and region-specific explanatory variables										
VIX	+/–	…	0.04	–0.32	…	0.02	1.39	…	–2.27	–0.46
Global equity return	+/–	…	–0.13	0.04	…	–0.12*	0.27***	…	–0.41*	0.39
Counterparty (lag 1)	–	…	0.12	0.15	…	0.49***	–0.32**	…	0.01	–0.14
Funding cost	+	…	1.05***	–0.94**	…	0.41**	–0.14	…	1.58*	–1.68**
Adjusted *R*-squared[5]		0.55	0.55		0.79	0.77		0.52	0.51	

Source: IMF staff estimates.

Note: AE = advanced economies; EM = emerging market economies; ROA = return on assets; VIX = implied volatility on S&P 500 index options. The table summarizes the results of the fixed-effects panel estimation on drivers for the "basis" (SCDS-bond spreads) using monthly level data. + and – indicate the sign of expected coefficients. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent levels of confidence based on robust standard errors for the base model and on clustered standard errors for the other models. Cells with "..." indicate that the variables are not part of the model. For explanation of the variables, see Table 2.4.

[1]Model estimates for 33 advanced and emerging market economies. See Table 2.3 for the list of countries.

[2]This estimation includes the interaction term for high-stress periods. The results are shown in two columns: "Direct Impact" shows the coefficients for explanatory variables on their own, and "High-Stress Interaction Term" shows the coefficient for high-stress period indicator multiplied by explanatory variables (see text). High-stress periods are identified as the ones in the highest one-third of the volatility distribution for VIX using a Markov-Switching approach. See Figure 2.9.

[3]Bond bid-ask spreads area available only for countries using domestic bond yields. Korea is an advanced economy following WEO definition. However, their SCDS references Korea's external debt.

[4]Countries that have central bank bond purchase operation data, including euro area countries, Japan, the United Kingdom, and the United States.

[5]In the high-stress estimation, the adjusted *R*-squared applies to both the direct impact and high-stress interaction terms.

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