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Monetary policy spillovers and emerging market credit: The impact of Federal Reserve communications on sovereign CDS spreads

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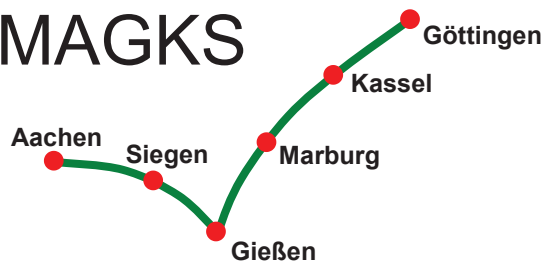
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Monetary policy spillovers and emerging market credit: The impact of Federal Reserve communications on sovereign CDS spreads

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Abstract

In this paper, we study the effects of US target rate changes and related communications by members of the Federal Reserve Board of Governors on spreads for emerging market sovereign credit default swaps (CDS). Using GARCH models, we find that during the pre-financial crisis sub-sample (April 2002–July 2007) CDS spreads react more to country-specific factors than to US monetary policy news. This finding is reversed during the financial crisis sub-sample (August 2007–December 2009), when US monetary policy actions and communications affect CDS spreads in a notable way. Finally, our analysis suggests that CDS spreads became more prone to spillover effects during the financial crisis.

Keywords: Credit default swaps, emerging markets, Federal Reserve communication, financial crisis, policy spillovers.

JEL classification numbers: E52, G14, G15.

1. Introduction

Walter Wriston, then Chairman of Citibank, once famously remarked that ‘countries don’t go bust’ (Guill (2009)). Yet, by October 1983, and only a few months after that statement had been made, 27 countries owing about \$240 billion in debt had rescheduled these obligations or were in the process of doing so—in what is now commonly known as the ‘LDC debt crisis’. Indeed, countries *do* go bust, in the sense of refusing to meet their financial obligations, even though such events remain a relatively rare occurrence. Historical data reveal a number of important patterns: sovereign defaults often occur in waves and have tended to be heavily concentrated in periods of extreme stress, with the largest wave of defaults coming during the Great Depression and World War II. The majority of defaults are on countries’ external debt, while defaults on domestic debt are less common. Defaults have included both emerging market and industrialised country issuers, but are dominated by the former. Specifically, based on the frequency with which a country has moved into default, emerging market borrowers are about 10 times more likely to default than their peers from developed markets.¹ That is, country risk is an important factor in the pricing of sovereign debt, especially for emerging market borrowers.

Assuming rational investors, we would expect that credit spreads on sovereign debt instruments reflect such risks. Surprisingly, the evidence on the importance of country-specific risks in the pricing of sovereign debt is rather mixed. Longstaff et al (2011), for example, show that returns on sovereign credit default swaps (CDS), a common measure of credit risk, are substantially more correlated across countries than corresponding stock index returns. They find that these spreads are more related to US stock and high-yield credit markets, proxies of global risk premia, and international liquidity patterns than they are to local economic measures. Thus, the country-specific risk premium—after adjusting for global and, in particular, US risk factors—appears to be almost negligible. This suggests a potentially important role for US monetary policy in the determination of non-US sovereign CDS spreads—and thus a channel for monetary policy spillovers into those countries’ funding costs in international debt markets.

We aim to explore these spillovers by building on the extant literature on the impact of US monetary policy actions on foreign asset returns. Our contribution is twofold. First, while previous studies of policy spillovers have typically focused on equity and bond markets, our analysis employs daily CDS spread data for twelve emerging market borrowers. Sovereign CDS are traded in liquid markets and provide a direct indicator of the credit risk premium demanded by investors. As such, CDS premia are close proxies of the excess funding costs of sovereign borrowers relative to benchmark US Treasury yields. They also often serve as a lower bound measure for the wholesale funding costs of banks and corporate issuers from the same countries.

Second, the impact of monetary policy has often been studied on the basis of regular policy announcements that can be interpreted as a formal way of communication accompanying monetary policy actions. Regular meetings of the decision making body of the US Federal Reserve (Fed), the Federal Open Market Committee (FOMC), take place only eight times a year and their contents are, at least to some extent, anticipated in market prices prior to the actual announcement.² We improve on this research strategy by constructing a new data set that

¹ Reinhart and Rogoff (2008) and Moody’s (2009).

² For instance, Nautz and Schmidt (2009) show that the Federal Reserve’s steps towards more transparency since 1994 further contributed to stabilise the federal funds rate.

accounts for more informal ways of central bank communication with the markets. Regular communication allows representatives of the Fed to share their views on the economic outlook and to provide market participants with hints about the future course of monetary policy. Although making up the greatest part of central bank communications, less formalised channels (such as speeches and testimony by members of the FOMC), have not been subject to many studies, particularly in the context of spillovers to emerging financial markets.

We investigate the importance of US monetary policy spillovers in the determination of sovereign CDS spreads by addressing three closely related research questions. First, are there common factors that cause daily sovereign CDS spread changes across emerging financial markets? Second, what is the impact of US monetary policy actions as well as related formal and informal communications on daily sovereign CDS spread changes? Third, are there noticeable differences in the reaction of CDS spreads before and during the recent financial crisis?

Our findings suggest that (i) common factors play a role for daily sovereign CDS spread changes across emerging financial markets, (ii) during the pre-crisis sub-sample (April 2002–July 2007) CDS spreads for emerging market sovereigns react much more to country-specific factors than to US monetary policy news. This finding is reversed during the financial crisis sub-sample (August 2007–December 2009), when US monetary policy actions and communications affect CDS spreads in a notable way. Finally, (iii) the amplified reaction to international financial variables suggests that CDS spreads are strongly influenced by spillover effects during the financial crisis.

The remainder of this paper is organised as follows. Section 2 provides a short review of the existing literature. Section 3 presents a brief introduction to the mechanics of sovereign CDS. Section 4 describes the CDS data and our sample selection process, explains the construction of the various monetary policy news indicators, and introduces further variables used in the empirical analysis. Section 5 presents the econometric methodology, illustrates the results and reports a number of robustness tests. Section 6 concludes.

2. Related literature

Our paper relates most closely to the growing literature on the effects of US news events—and, in particular, US monetary policy decisions and communications—on emerging market asset prices. Ehrmann and Fratzscher (2009) analyse 50 equity markets worldwide and show that returns react systematically to US monetary policy actions. They find that the degree of global real and financial integration, not a country's bilateral integration with the US, is a key determinant of the policy transmission process. Similarly, Wongswan (2009) documents the impact of US monetary policy surprises on equity indices in sixteen developed and emerging countries, and finds that the variation in the response across countries is more related to the degree of financial integration of these countries with the US than to trade linkages or the degree of exchange rate flexibility. Hayo et al (2010) and Hayo et al (2011) show that Federal Funds target rate changes and FOMC communication have a significant impact on developed and emerging equity market returns over the periods 1998–2006 and 1998–2009, respectively. Target rate changes have a larger impact, but markets also react to various types of informal communication.

A related branch of the literature focuses on the reaction of emerging bond markets to US target rate changes and other news. Andritzky et al (2007) show that global bond spreads respond to rating actions and changes in US interest rates rather than domestic data and policy announcements. Examining country sub-samples, they discover that US news matter less to

countries with more transparent policies and higher credit ratings. Arora and Cerisola (2001) explore how country risk—proxied by sovereign bond spreads—is influenced by US monetary policy, country-specific fundamentals, and conditions in global capital markets. They conclude that the stance and predictability of US monetary policy are important for stabilising capital flows and capital market conditions in emerging markets. Using monthly panel data for 17 countries, Alper (2006) concludes that the unanticipated component of US monetary policy is significant in explaining the movements in emerging markets' sovereign bond spreads. In this context, Miniane and Rogers (2007) find little evidence that capital controls effectively insulate countries from US monetary shocks. Other factors, such as the exchange rate regime or the degree of dollarization, explain more of the cross-country differences.

Finally, our approach is also related to the literature on the determinants of corporate credit spreads and the pricing of individual firms' CDS, which includes Collin-Dufresne et al (2001), Campbell and Taksler (2003), and Ericsson et al (2008). Longstaff and Rajan (2008), Bhansali et al (2008), and Fender and Scheicher (2009) apply similar methodologies to multi-name CDS contracts (ie, contracts based on portfolios of underlying credits). A standard finding of these studies is that broad factors, such as measures of risk appetite and market liquidity, play an important role in the determination of observed CDS spreads. Fontana and Schleicher (2010) study the relative pricing of euro area sovereign CDS and underlying government bonds and find that repricing of sovereign credit risk in the CDS market seems mainly due to common factors. Longstaff et al (2011) explore pricing patterns in sovereign CDS contracts and find that spreads are more associated with US stock and high yield bond markets, global risk premia and international liquidity patterns than they are to local economic measures. They conclude that there is little evidence of country-specific risk premia once global risk factors have been controlled for.

3. Sovereign credit default swaps (CDS)

Sovereign CDS are financial contracts offering insurance against losses from credit events on outstanding debt issued by sovereign entities. Standard contracts have two legs. The protection buyer pays a premium (the premium leg), expressed in basis points per notional amount of the contract, in exchange for a contingent payment (the contingent leg) if any of the contractually pre-specified credit events occurs. Settlement for these contracts has typically been by physical delivery of admissible bonds, in return for payment of the original face value.³ As such, CDS for both sovereign and corporate reference entities are defined by five separate contractual features: (1) The debt issuer (reference entity), (2) a set of reference obligations, (3) the contract term (eg, 5 years), (4) a notional principal amount and (5) a list of events triggering protection payments (Markit (2008b)).

Standard International Swaps and Derivatives Association (ISDA) documentation defines six different credit events, some or all of which may be selected for individual CDS contracts: (1) bankruptcy of the reference entity, (2) failure to pay (the reference entity fails to make interest or principal payments when due; a grace period and materiality threshold may apply), (3) debt restructuring (the configuration of debt obligations is changed in an unfavourable way for the creditor, eg maturity extension, coupon or par amount reduction, postponement in coupon dates or change in currency), (4) obligation default, (5) obligation acceleration, (6)

³ The first ever credit event auction for sovereign CDS was held on 14 January 2009, enabling cash settlement of contracts for Ecuador.

repudiation/moratorium. The range of restructuring events included in the CDS contract will depend on the chosen restructuring clause. In our sample, the clause most commonly found in sovereign CDS is the so-called complete (or cum-) restructuring (CR) clause, which allows for any form of restructuring and delivery of any bond of maturity up to 30 years.⁴ This stands in contrast to CDS for corporate issuers, which tend to limit the range of qualifying events as well as the allowable maturity of deliverable obligations.⁵

Pricing of such contracts results in a CDS premium (spread) equating the present value of both payment legs over the (expected) lifetime of the deal. Holding the annual probability of default (conditional on earlier non-default) constant over time, pricing can be interpreted in terms of a constant hazard rate (Duffie and Singleton (2003)). Making further assumptions, such as the absence of counterparty default risk and continuous premium payments, the CDS spread at origination (ie, with market value of zero) can then be shown to equal $(1-p)\lambda$, where p is the recovery rate and $(1-p)$ denotes loss given default (LGD). The hazard rate λ corresponds to a risk neutral loss probability that reflects the risk preferences of investors. Using actual probabilities of default (PD) instead, this yields the term $(1-p)PD + RP$ for the annual CDS spread, where a risk premium (RP) accounts for the difference between λ and PD, which is typically positive. In other words, observed CDS spreads tend to represent a combination of expected loss ($EL = (1-p)PD$) and an extra premium to compensate investors for risks in addition to EL.

Note that full-scale default is only one type of event that sovereign CDS insure against. In particular, relevant standard documentation tends to be based only on restructuring, repudiation/moratorium, and failure to pay (allowing for pre-defined grace periods). Thus, the bankruptcy credit event is generally not covered in sovereign CDS. Instead, the contingent CDS payment might be triggered when, for example, interest or principal payments (subject to minimum threshold amounts) on individual obligations are made with (even relatively short) delays, which would give the protection buyer the right to deliver (subject to any deliverability requirements) any discounted bonds at face value – an event that would tend to generate relatively high recovery rates. As a result, and abstracting from other factors, such as liquidity premia, observed increases in sovereign CDS spreads may reflect rising probabilities of such a scenario of ‘technical default’—along with the transition risk of a sovereign rating downgrade—as much as genuine concerns about principal losses on outstanding debt.

One advantage of working with sovereign CDS data is that these contracts are among the most actively traded instruments in credit derivatives markets, which in turn tend to be the most liquid part of the global credit market. Depository Trust and Clearing Corporation (DTCC) data for end-December 2009 indicate that, among the top-100 reference names (by US dollar-equivalent gross notional amounts outstanding) in the CDS market, 19 were sovereign entities (of which, 11 were emerging market sovereigns), including all of the top-6 names. In volume terms, at \$1.46 trillion, these sovereigns accounted for almost 30% of the aggregate notional amount of the top-100 reference names taken together. Detailed volume data for the period covered in this study

⁴ See Markit (2008b). Given the lack of maturity limitations, protection buyers can technically deliver long-maturity obligations (cheapest-to-deliver option, see above) in case of a credit event, as long as the bond is pari passu or senior to the reference obligation on the contract.

⁵ The CR restructuring clause dates back to the original 1999 ISDA credit derivatives definitions, with the MR and MM clauses introduced in 2001 and 2003, respectively. Note that in March 2009 a new, standardised CDS contract language in North America was introduced, which changed market conventions for the use of restructuring clauses and the quotation of trades. However, robustness tests suggest that our empirical results are virtually unaffected by these changes. Results are available on request.

(see below) are unavailable, but other studies suggest that the overall market for sovereign CDS has been active enough even during these earlier years to support our analysis (see Longstaff et al (2011)).

4. Sample selection and data

Our sample period extends from April 2002 to December 2009, comprising 1392 daily observations for the pre-crisis sub-sample (April 2002–July 2007) and 632 daily observations for the financial-crisis sub-sample (August 2007–December 2009).⁶ As a response to the crisis, major central banks, including the US Federal Reserve, embarked on a series of unprecedented policy measures. These measures have, at least temporarily, changed the way monetary policy operations are conducted and communicated. Therefore, we split the sample with the aim of comparing the influence of US monetary policy and other factors during ‘normal’ times and during major financial turbulences.⁷ The data set used in this paper is described in more detail below.

Creating a sample of sovereign CDS

The CDS data used in this paper are provided by Markit, one of the largest suppliers of CDS quotes and related services. Our sample is restricted to the most active market segment, namely contracts denominated in US dollars with a 5 year maturity. To enhance the reliability of the observed daily price quotes, we construct a sample of CR-equivalent spreads (ie, spread observations that correspond to contracts with complete restructuring). We start with the quotes available for CR contracts, which are the majority of the quotes in our sample. In those cases where CR quotes are not available, we fill the remaining gaps by finding any other quotes (ie, for contracts with zero restructuring (XR), modified restructuring (MR) or modified-modified restructuring (MM)) and then convert observed spreads into CR-equivalents using a set of ‘factors’ provided by Markit (Markit (2008a)).⁸ The available CR-equivalents are then averaged into implied CR quotes using arithmetic means.

This methodology provides us with a sample of daily CDS spreads for a total of 80 reference countries, which includes both mature and emerging market sovereigns. In the majority of cases, CDS spreads do not move over prolonged periods of time (in particular before the financial crisis and for mature countries), which raises doubts about the market liquidity of these particular contracts. Therefore, we keep only those countries for which spread changes are observed for at least 90 percent of the days in either sub-sample period. We then end up with a sample of 12 emerging market borrowers from four geographical regions: Bulgaria (BGR), Russia (RUS), and Turkey (TUR) from Central and Eastern Europe; Brazil (BRA), Colombia (COL), Peru (PER), and Venezuela (VEN) from Latin America; China (CHN), Malaysia (MYS), the Philippines (PHI), and Thailand (THA) from Asia, and South Africa (ZAR).

US monetary policy data

Our analysis of the role of US monetary policy in the determination of CDS spreads is based on a data set introduced and extensively described in Hayo et al (2008) and extended by Hayo et al (2011). The sample covers 690 speeches and congressional hearings by members of the Board

⁶ April 2002 marks the first month in our sample for which data is available systematically across the countries and on a daily basis.

⁷ See, for example, Fender and Hoerdahl (2007) and chapter VI in BIS (2008).

⁸ The various factors are given as follows: $CR = 1.0 = XR * 0.885 = MM * 0.96 = MR * 0.935$.

of Governors of the Federal Reserve System as well as 64 post-meeting statements and 16 monetary policy reports (MPR). Following the literature (eg Ehrmann and Fratzscher (2007)), these communications' content is split into a monetary policy and an economic outlook component. The coding for the US economic outlook part is either 'positive' (EO +) or 'negative' (EO -), whereas 'tightening' (MP +) or 'easing' (MP -) are the available categories for the Federal Reserve's monetary policy stance. In our analysis, we employ dummy variables that are split into positive and negative news to take into account possible asymmetric reactions in financial market prices.⁹ In total, there are 16 communication dummies, as the 4 communication types (statements, MPR, testimony and speeches) can be coded into the 4 different categories (EO +, EO -, MP +, and MP -). We also incorporate several variables controlling for the 'unconventional' monetary policy measures undertaken by the Fed during the financial crisis. These are grouped into five categories: (i) the discount rate change on 17 August 2007, (ii) the announcement of joint initiatives with the US federal government, (iii) the announcement of additional unilateral liquidity actions, (iv) the announcement of internationally coordinated liquidity actions, and (v) the announcement of measures to mitigate the problems in the asset-backed security (ABS) market.

In designing these categories of news, we carefully read the speeches twice, with a considerable time lag, and then coded them independently into the respective dummy categories. In the case of a conflict between the two gradings, we checked the relevant speeches yet another time and adjusted our indicators accordingly. We employed extensive robustness checks to ensure that our results do not depend on the particular coding of ambiguous individual observations. As there are no data on expectations about the content of an upcoming speech, we are not able to extract a surprise component directly for each communication event. Communication events after market closure are coded as if they happened the next day. All information about communication is obtained from official websites of the Board of Governors of the Federal Reserve System.¹⁰

Other explanatory variables

Central bank communication has a broad impact on many financial market series, which in turn exert an influence on CDS returns. To identify pure communication effects on CDS markets, we take a conservative approach and include additional control variables into our analysis. Furthermore, to take into account country-specific effects, we insert eleven country dummies, using Bulgaria as the reference country. We control for day of the week effects using four dummy variables, with Monday as reference day. Another dummy variable captures the impact of exchange rate pegs on CDS spreads, which allows us to control for modifications in a country's exchange rate regime on a year-to-year basis.¹¹ Interest rate changes (surprises) by the European Central Bank are included for comparison. In addition, adjustments in country risk and, hence, borrowing conditions for sovereign issuers are approximated using data on sovereign bond rating actions by Moody's as well as Standard & Poor's. For this purpose, one dummy variable covers improvements in either one of the two rating agencies' credit opinions on countries in our sample on the respective announcement dates, and another dummy indicates worsening opinions. We also control for the influence of several macroeconomic indicators (real

⁹ Evidence of this type of asymmetry can, for instance, be found in the effects of FOMC communication on US financial markets' returns (Hayo et al (2008)).

¹⁰ Table A.1 in the Appendix summarises the frequency of monetary policy news.

¹¹ Exchange rate regimes are coded according to the IMF's Exchange Arrangements and Exchange Restrictions data.

GDP growth, debt-to-GDP-ratio, deficit-to-GDP-ratio) in our setup. Finally, we include the annual change in the Aggregate Effective Currency Mismatch (AECM) indicator by Goldstein and Turner (2004) into our analysis. It is defined as the ratio of net foreign currency assets available for repayment of foreign currency debt relative to exports of goods and services times the foreign currency share in total debt. Defined this way, the AECM indicator captures the fact that currency movements can translate into credit risk if borrowing is in foreign currency and borrowers do not have matched foreign currency income.

In addition, several US financial market variables are incorporated, either in terms of growth rates or first differences (see Table A.3 in the appendix for an overview), to capture the effect of various continuous pricing factors in the determination of sovereign CDS spreads. Specifically, S&P 500 index returns and the Chicago Board Options Exchange Volatility Index (VIX Index) are used to proxy US stock market conditions. The latter index, a popular gauge of investor risk appetite in equity markets, measures the implied volatility of S&P 500 index options and is included as credit-risky products are known to compensate investors for more than pure expected losses from default (see section 3 above). US bond market conditions are covered by the US 3-month Treasury bill rate, the US yield curve slope (which is expressed as the difference between the 10-year Treasury bond rate and the 3-month Treasury bill rate) as well as the Merrill Lynch MOVE volatility index (which is a yield curve-weighted index of the normalised implied volatility on 1-month Treasury options and expected to capture risk preferences in fixed income markets). The CDX North American High Yield index spread, a measure of the cost of default protection on a portfolio of 100 corporate borrowers, serves as a benchmark of market sentiment in CDS markets for reference entities of broadly similar credit quality as the sovereign borrowers in our sample. Similarly, total returns on overall as well as regional EMBIG indices are used to control for conditions in the (cash) markets for traded external debt instruments by emerging market borrowers. Market liquidity conditions are proxied by the Refco spread, which compares ten-year yields on bonds issued by Resolution Funding Corporation with those on US Treasury bonds.¹² Finally, bilateral exchange rates for the currencies of our sample countries vis-à-vis the US dollar and returns on those countries' major domestic stock market indices are included into the analysis to control for changes in country-specific conditions.

5. Econometric methodology and results

Our econometric approach proceeds as follows. First, we conduct a principle components analysis to reveal systematic patterns in our sovereign CDS data and to illustrate broad relationships between the common factors extracted from these CDS spreads and the behaviour of other financial market variables. Second, we explain movements in CDS spread changes and their volatility using a variety of explanatory variables ('pricing factors') in the framework of a GARCH(1,1) model (Bollerslev (1986)). Note that such a procedure is consistent with a Bayesian updating process (Engle (2001)). In principle, the explanatory variables help decompose CDS spread changes into components related to expected loss (EL) and a variety of risk premia. However, given our focus on US monetary policy spillovers, we do not disentangle the drivers of these two components thoroughly. Finally, we explore the robustness of our findings using a variety of tests.

¹² Resolution Funding Corporation (Refco) is a US Treasury agency that was created to help resolve the bank failures that occurred during the US savings and loan crisis and whose debt carries an explicit guarantee by the US government.

Exploratory principal components analysis

Principal components analysis can shed some light on the importance of different factors in the determination of sovereign CDS spreads. For this purpose, our sample of 12 emerging market sovereigns is analysed using daily CDS spread data (absolute basis point changes) for the periods April 2002–July 2007 and August 2007–December 2009, respectively. The decomposition is based on maximum likelihood estimation and determines the overall number of factors on the basis of their shares in total observed variance. The common factors identified this way account for relatively high percentages of the observed correlations across the various CDS spread variables (Table 1).

[Table 1 about here].

Focussing on the first principal component indicates that, in the pre-crisis period, 32% of common variation of CDS spreads relate to the first factor. During the financial crisis, the explanatory power of the first factor increases up to 70%. In contrast, the influence of the two other factors remains almost unchanged and preliminary analysis points towards regional effects. Studying correlations of the first principal component with various financial market variables (Table 2) suggests that it is best interpreted as a broad ‘credit’ or ‘financial market’ factor—it correlates positively with measures of equity (S&P 500) and emerging credit market returns (EMBIG) and negatively with proxies for risk appetite (VIX, MOVE) and US CDX High Yield returns (CDX HY), though not that much with broad indicators of market liquidity (Refco spread). Another noteworthy finding is that the correlations of the first principal component with the global financial market variables increase substantially during the financial crisis. Thus, our results suggest that daily CDS spreads are related more to global and regional risk premia than country-specific risk factors. Nevertheless, idiosyncratic risk can play an important role for individual countries, but less so in periods of market stress or reduced risk appetite. Similar patterns are observed for equity returns, although, with about 26% (pre-crisis) and 45% (crisis), the predominance of the first factor in explaining observed variance is much less pronounced than for CDS spread changes.

[Table 2 about here].

Our results are broadly in line with earlier studies of sovereign CDS spreads, such as Longstaff et al (2011), who find, first, that sovereign credit is more correlated across countries than are equity returns. Second, the explanatory power of their first common factor also increases during the financial crisis period. In their sample of monthly CDS quotes, the first principal component accounts for about 43% (2000–2006) and 78% (2007–2009) of the variation in sovereign spreads, and there is little evidence of a country-specific risk premium once global risk factors are taken into account. At the same time, common factors turn out to be slightly less important at the higher frequencies.

Explaining CDS returns with a GARCH model

Descriptive statistics show that the emerging market CDS series exhibit excess kurtosis, but almost no skewness (see Tables A.2a and A.2b in the Appendix), which indicates volatility clustering (Engle (1982); see Figure A.1 in the Appendix for an example). This implies that (i) the amplitude of financial returns varies over time, (ii) some time periods are more volatile and

therefore more risky than others and these periods are not scattered randomly, and (iii) there is a noticeable degree of autocorrelation in the riskiness of financial returns. Since preliminary OLS estimations show significant ARCH effects in both sub-samples (with $F(1,16702) = 2219$ and $F(1,7582) = 276$, respectively), we employ GARCH models for both periods. The models are specified in terms of a panel framework (ie, using a stacked sample with country-specific fixed effects), which is helpful for obtaining a larger number of observations for each type of news event and in improving estimation efficiency. Given this setup, we implicitly assume equal coefficients across countries and a common error structure. We start with a general GARCH(1,1) specification (Bollerslev (1986)) as follows:

(1) *CDS changes*_{*t*}

$$\begin{aligned}
&= \gamma + \delta \text{ financial control variables}_{t-1} + \zeta \text{ country dummies}_t \\
&+ \eta \text{ day of the week effects}_t + \xi \text{ FX regime dummy}_t + \theta \text{ macroeconomic variables}_t \\
&+ \vartheta \text{ ECB interest rate changes}_t + \iota \text{ rating changes}_t + \lambda \text{ US monetary policy news}_t \\
&+ \mu_t,
\end{aligned}$$

$$\mu_t = \varepsilon_t h_t^{1/2},$$

$$h_t = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \beta_1 h_{t-1},$$

where $\alpha_0, \alpha_1, \beta_1, \mu, \kappa_1, \kappa_2, \gamma, \delta, \zeta, \eta, \xi, \theta, \nu, \iota,$ and λ are parameters or vectors of parameters, and $\varepsilon_t | \Gamma_{t-1} = t(\nu)$, with Γ_{t-1} capturing all the information up to $t-1$, and $t(\nu)$ a t -distribution with ν degrees of freedom. The residuals μ_t are not assumed to be independent and identically distributed (i.i.d.). Instead, μ_t is the product of the i.i.d. error component ε_t and the square root of an explicitly modelled variance equation. The latter consists of a constant term α_0 , the ARCH term $\alpha_1 \mu_{t-1}^2$, which captures the impact of lagged residuals on today's variance, and the GARCH term $\beta_1 h_{t-1}$, which measures the persistence in the variance equation.

The vector of control variables in equation (1) contains past CDS spread changes and the financial variables described in section 4 above. The contemporaneous other markets' and US returns are omitted to avoid simultaneity problems. Country-specific effects and day of the week effects are captured by (step) dummies and another dummy variable is created for countries with pegged exchange rates.¹³ Changes in country ratings (split into improvements and degradations), ECB and US target rate changes (split into expected and unexpected rate hikes and cuts¹⁴) and our Federal Reserve communication dummies (similarly split into tightening versus accommodating policy stance as well as positive versus negative economic outlook) enter the equation on the day the news actually reaches the respective market. Finally, student- t distributed errors (Bollerslev (1987)) are assumed; these provide a better approximation to residuals that are not normally distributed (even after using a GARCH model specification).

Starting from this comprehensive GARCH(1,1) model, we exclude all insignificant variables in a consistent general-to-specific testing-down approach ($\text{Chi}^2(31) = 48.3$ and $\text{Chi}^2(35) = 54.5$, respectively) at a conservative one percent significance level. The simplified GARCH(1,1)

¹³ The IMF data used to code the exchange rate regimes for the countries in our sample distinguishes eight different exchange rate regimes (of which six amount to some sort of a peg).

¹⁴ Bloomberg surveys are used to identify surprises from scheduled meetings. Inter-meeting moves are naturally classified as surprises. Target rate changes are coded as follows: 25 bps change: 1; 50 bps change: 2; 75 bps change: 3; otherwise: 0.

models remove the ARCH effects in the residuals ($F(2,16677) = 0.02$ and $F(2,7557) = 0.84$, respectively). Table 3 reports the results.

[Table 3 about here].

Financial factors: We find that past changes in CDS spreads can be used to predict today's returns in the pre-crisis subsample. This could be an indication that CDS markets are relatively thin during the first years of our sample, in spite of the fact that we concentrate on the most liquid contracts. A negative constant term indicates a declining trend in CDS spreads during that period (-0.09 bps). Positive US stock market returns are found to reduce CDS spreads. A one percentage point increase in the S&P 500 induces an average absolute CDS spread decline by 0.06 bps (pre-crisis) or by 0.72 bps (crisis). This is in line with Merton (1974)-type models, which suggest that an improving US stock market environment should be associated with a higher 'distance to default' for US borrowers. Our result suggests that such a positive sentiment in US markets spills over into sovereign credit markets as well. Risk appetite as proxied by the VIX implied stock market volatility index significantly reduces CDS spreads after July 2007 (-0.03 bps). Higher yields in the US bond market also decrease average CDS spreads by 3.96 bps for each one percentage point increase in the 3 month yield in the financial crisis period and by 0.52 bps (pre-crisis) or by 2.61 bps (crisis) for the same increase in the yield curve slope. Thus, consistent with our expectations, for a given level of sovereign yields, an increase in the US reference rate lowers the spread between both rates (as proxied by the CDS premium), but not to the same extent.

Sentiment in high yield CDS and cash credit markets also plays a role. The spread on sovereign CDS increases by an average 0.83 (4.69) bps after a one percentage point hike in similarly rated US corporates before (after) July 2007. As expected, liquidity in the (cash) market for US bonds represents another significant driver of sovereign CDS spreads. During the financial crisis, a higher Refco spread increases average CDS premia by 3.93 bps. Finally, positive returns on the global EMBIG index tend to compress sovereign CDS spreads, by 0.18 and 1.80 bps, respectively. Domestic stock market returns are also found to have explanatory power as higher returns lead to an increase in CDS spreads during the financial crisis (0.09 bps). This may suggest that, to some degree, sovereign debt and equity market exposures are considered as substitutes in investors' portfolios.

In general, sovereign CDS are found to be sensitive to changes in a broader set of financial variables (most noteworthy, the US 3 month yield and the Refco spread) during the financial crisis. Furthermore, the reaction to international financial variables is much stronger, by a factor ranging from 5 to 10 during that period, as can be inferred from the estimated coefficients. The rise in spillovers from other financial markets is further illustrated by considering some descriptive statistics (Tables A.2a and A.2b in the Appendix): the standard deviation of CDS spread changes is only marginally higher over the second sub-sample and the absolute mean of CDS changes even declined during the financial crisis.

Country-specific factors: In the pre-crisis sub-sample, Turkish and Colombian, Peruvian, and Venezuelan spread changes are, respectively, $0.38/0.27/0.26/0.51$ bps lower on average than those of Bulgaria, Russia, Brazil, the Philippines, and South Africa.¹⁵ CDS changes in China

¹⁵ Bulgaria is used as reference country and the country dummies for Russia, Brazil, the Philippines, and South Africa can be excluded jointly ($\text{Chi}^2(4) = 8.67$).

(0.11 bps), Malaysia (0.13 bps), and Thailand (0.07 bps) are found to be, on average, higher than those for the five countries mentioned above. In contrast, country dummies do not significantly explain spread changes during the financial crisis (exclusion test: $\text{Chi}^2(11) = 2.59$).

Macroeconomic variables exert a significant impact on CDS spreads only before the financial crisis. Intuitively, lax fiscal policy worsens credit conditions, as a higher budget deficit (in percentage of GDP) increases CDS spreads (0.02 bps). Surpluses of foreign currency income, as measured by changes in the AECM indicator, are found to improve a country's credit conditions. A one unit change in the indicator reduces the observed average spread by 0.01 bps. Credit ratings, our main measures of country risk, also affect CDS spreads. On average, each one notch improvement in sovereign ratings by either Moody's or Standard & Poor's decreases observed spreads by 0.40 bps. The corresponding effect of a one notch downgrade increases spreads by around 1.22 bps. Statistical tests confirm the asymmetric reaction to good and bad news, as the latter effect is significantly larger ($\text{Chi}^2(1) = 1412930$). During the financial crisis, neither macroeconomic factors nor rating variables have a significant impact on sovereign CDS spreads.¹⁶

Monetary policy news: Turning to ECB and US monetary policy variables, neither interest rate changes nor central bank communications significantly affect daily CDS spreads before July 2007. During the second sub-sample, US interest rate cuts matter: a 25 bps decrease in the Federal Funds target rate lowers the average sovereign CDS spread by 3.39 bps. However, if such an interest rate cut hits the markets as a surprise, this decrease is fully offset by an increase of 3.46 bps.¹⁷ In our interpretation, if the central bank cuts the rate by more than expected (or at an unscheduled meeting), the action is interpreted by financial market agents as a signal that the central bank has new information, indicating that the economy will perform (much) worse than expected. Relatedly, coordinated liquidity actions by several central banks decrease CDS spreads by 3.97 bps.

Several communication indicators have significant effects on CDS spread changes, too. The indication of a future rate cut in a post-meeting statement causes the spread to narrow further. This effect (7.20 bps) is even larger, both economically and statistically, than those of (unexpected) interest rate cuts or coordinated liquidity actions ($\text{Chi}^2(1) = 5.91/6.31/5.24$, respectively). Congressional hearings and speeches increase the spread by 1.46 bps when a hawkish monetary policy course (and, hence, a scenario of rising policy rates) is implied.¹⁸ Regarding the sign of the effect of interest rate decisions and related indications in communications on CDS spread changes, we find some kind of overshooting reaction of foreign interest rates. Based on simple spread mechanics, one might expect any decrease in US monetary policy rates to induce a widening of sovereign CDS spreads for any given level of the foreign interest rate. Our results suggest that the adjustment effects of CDS spreads to US policy rates are more complex, implying that expectations about future developments may be important. Specifically, we find that spreads tend to decrease in response to communications about an

¹⁶ Rating changes are typically found in the literature to lag market information. Hull et al (2004), for example, find that spread changes tend to anticipate negative rating announcements, especially when extreme deterioration in credit quality materialises within a short time period. Nevertheless, negative rating events (ie, downgrades and announcements of reviews for possible downgrade) are generally found to give rise to statistically significant contemporaneous price or spread movements. However, the changes are often economically insignificant and much smaller than would be suggested by the magnitude of the rating change itself; see Cantor (2004).

¹⁷ Statistical testing confirms this offsetting effect ($\text{Chi}^2(1) = 0.01$).

¹⁸ This is consistent with earlier studies, which find that US interest rates rise after the corresponding type of news event (Ehrmann and Fratzscher (2007); Hayo et al (2008)).

impending US monetary expansion. In principle, we would expect declining CDS spreads to be associated with lower expected loss from default or reductions in other pertinent risks, and spreads would react only to the extent that communications about US interest rate adjustments affect the corresponding risk premia. On this basis, one possible explanation for the observed positive correlation between (expectations of) US policy rate changes and sovereign CDS spreads would be expectations of global credit supply or economic growth effects based on changing monetary conditions in the United States.¹⁹

This interpretation is supported by the impact of communications regarding the US economic outlook on CDS spreads. Post-meeting statements presenting a brighter economic outlook reduce the spreads by 1.63 bps. Negative news conveyed in the same type of communications exerts an opposite effect and increases spreads by 11.01 bps, which is the largest coefficient found for all monetary policy variables. Similarly to changes in ratings, we find negative news to have a statistically larger influence ($\text{Chi}^2(1) = 26.6$). Positive news in the semi-annual monetary policy report also lessens CDS spreads (6.63 bps). In fact, these results show that CDS spreads are negatively correlated to information on the economic outlook in the US.

Discussion: Our findings suggest, first, that during the pre-crisis sub-sample (April 2002–July 2007), CDS spreads for emerging market sovereigns react relatively more to country-specific factors than to ECB and US monetary policy news. Thus, emerging market borrowing conditions tend to be determined by domestic economic conditions more than by international monetary policy news. Second, this finding is reversed in the financial crisis sub-sample (August 2007–December 2009), when US monetary policy actions and communications are found to affect CDS spreads in an economically relevant fashion. During that period, ratings and macroeconomic conditions in emerging markets do not significantly explain spread changes. Hence, in times of a worldwide crisis, investors appear to care less about country-specific conditions and adjust their portfolios mainly to global developments. In line with this intuition, the explanatory power of the first common factor for CDS spread changes increases from 45% to 70% during the financial crisis. Third, more international financial variables are found to significantly influence CDS spreads during the second sub-sample, which also suggests that spillover effects have a stronger impact on CDS spreads during the financial crisis. Moreover, the coefficients size of the international financial variables is 5 to 10 times larger than before July 2007, even though the standard deviation of CDS spread changes is only marginally higher during the second sub-sample and the absolute mean of CDS changes even declined during the financial crisis..

*Robustness tests*²⁰

To explore the robustness of our findings, we first conduct a detailed country-specific analysis. We obtain only a few additional significant variables and conclude that our pooling approach is not invalidated by strong heterogeneity across countries. In general, the sample countries are affected in a very similar way regardless of the degree of trade or financial integration with the United States. Second, we confirm that our selection of countries is appropriate. We calculate country-specific models for the emerging market countries that were left out of the sample due to concerns about illiquidity in their sovereign CDS spreads. We find that CDS spreads from these

¹⁹ This could be based, for example, on (negative) financial accelerator effects (Bernanke et al (1996)). On this basis, improved refinancing conditions for US financial institutions might be expected to improve access to credit over-proportionally, as easing balance sheet constraints translate into easier credit conditions and a more favourable economic outlook outside the United States.

²⁰ To conserve space, we do not report these regressions in detail. All the omitted results are available upon request.

countries are not as systematically and symmetrically affected by the various pricing factors than those in our sample. Third, we extensively control for the influence of the exchange rate regime on the reaction of CDS spreads. For this purpose, we split our data set into one group of countries characterised by pegged exchange rate regimes and another group operating floating exchange rates. As we do not obtain further insights from this analysis, we confirm the superiority of our more parsimonious approach. Fourth, we proxy exchange rate risk using (i) the standard deviation of the respective bilateral exchange rates and (ii) a time-variant measure of risk provided by the conditional variance of the respective bilateral exchange rates. Again, this does not yield further insights. Fifth, we include several variables to control for additional extraordinary events and measures undertaken by governments and central banks during the financial crisis. For that purpose, we rely on a list of major events compiled by the BIS (BIS, 2009). The financial factors and monetary policy variables in our model remain virtually unchanged. Sixth, we insert our variables of interest in the volatility part of Equation (1). However, the size of the (very few) significant coefficients indicates a negligible economic impact. This suggests that US monetary policy action and communication generates primarily wealth effects rather than risk effects, as measured by the conditional variance of returns (Hayo et al 2011). Finally, our results are robust to several variations in the GARCH specification.

6. Conclusion

Our currency, your problem. This is what John Connolly, Secretary of the US Treasury in the early 1970s, reportedly told his European counterparts about policy spillovers. This paper investigates the broader relevance of Secretary Connolly's statement by focusing on the effects of monetary policy spillovers for changes in spreads for emerging market sovereign credit default swaps (CDS). Specifically, we use GARCH models estimated over the periods April 2002–July 2007 and August 2007–December 2009 to establish the impact of Federal Funds target rate changes and various types of monetary policy communication (policy statements, monetary policy reports, testimony and speeches referring to monetary policy inclinations and economic outlook) by officials of the Federal Reserve on daily changes in CDS spreads. We control for the influence of a broad range of potential influences, particularly those exerted by other financial variables. Our study provides answers to three closely related questions regarding the importance of spillovers from US monetary policy actions and communications for the determination of sovereign CDS spreads.

First, our results suggest that daily CDS spreads for emerging market sovereigns are related more to global and regional risk premia than country-specific risk factors, although idiosyncratic risk can play an important role for individual emerging market borrowers. This is in line with earlier findings that diversification opportunities from spreading fixed income investments across countries and regions might be more limited than expected (and more so for fixed income instruments than for equity market investments; see Longstaff et al (2011)). In particular, measures of equity and emerging market credit returns, proxies for risk appetite, and US CDX High Yield returns turn out to be the most dominant drivers of changes in emerging market sovereign CDS spreads.

Second, in addition to these broad market factors, US monetary policy actions and related formal and informal communications are found to exert an important influence on daily sovereign CDS spread changes during the financial crisis. This contrasts with the pre-crisis period and may reflect significant international US monetary policy spillovers on country risk premia for sovereign borrowers in emerging markets in the latter part of our sample. Specifically, US interest rate cuts,

coordinated liquidity actions by central banks and communications about the economic outlook and the future course of monetary policy are found to have a potentially substantial economic influence on emerging market CDS spreads.

Third, we detect noteworthy differences in the determination of CDS spreads over time. During the early years of our sample, CDS spreads react to country-specific factors. ECB and US monetary policy news are insignificant. This finding is reversed during the financial crisis: US monetary policy actions and communications affect CDS spreads in a notable way and country-specific factors do not play a significant role. Finally, the amplified reaction of CDS spreads to international financial variables suggests that spillover effects play a much larger role during the financial crisis and overshadow domestic factors.

We also confirm a number of established findings on the impact of central bank decisions and communications on financial market variables. In particular, (i) central bank communication is found to be an important tool (at least during the financial crisis period), given that actual target rate changes are largely priced by the markets before the policy decisions occur (see Blinder et al (2008)); (ii) US monetary policy actions and communications can be important drivers of financial markets outside the US (Hayo et al, 2010 and Hayo et al, 2011); and (iii) the strong reactions during the financial crisis show how crucial central bank communication is in turbulent times, as financial markets show a larger reaction than they do during 'normal times' (Hayo et al, 2011).

Overall, these findings establish that there is reason to believe in the existence of significant international spillovers from US monetary policy decisions and their communication to sovereign borrowers—an issue of particular importance in the context of current discussions about exit strategies from historically low, crisis-induced monetary policy rates. We find evidence suggesting that decisions taken and communicated by US monetary policy makers can have direct and economically relevant effects for the pricing of emerging market sovereign CDS in times of major financial turbulences. More generally, as CDS premia are close proxies for the excess funding costs of sovereign borrowers relative to benchmark US Treasury yields, US policy-induced changes to these spreads can exert a meaningful influence on the funding costs of sovereign issuers, banks and corporate borrowers from emerging market economies.

References

- Alper, CE (2006): 'U.S. Monetary Policy Surprises and Emerging Markets Sovereign Spreads', 2007 AEA Conference Papers.
- Andritzky, JR, GJ Bannister and NT Tamirisa (2007): 'The Impact of Macroeconomic Announcements on Emerging Market Bonds', *Emerging Markets Review*, 8, pp 20–37.
- Arora, V and M Cerisola (2001): 'How Does U.S. Monetary Policy Influence Sovereign Spreads in Emerging Markets?', *IMF Staff Papers*, 48 (3), Washington.
- Bank for International Settlements (2008): '78th Annual Report', June, Basel.
- Bank for International Settlements (2009): '79th Annual Report', June, Basel.
- Bernanke, BS, M Gertler and S Gilchrist (1996): 'The Financial Accelerator and the Flight to Quality', *Review of Economics and Statistics*, 78, pp 1–15.
- Bhansali, V, R Gingrich and F Longstaff (2008): 'Systemic credit risk: What is the market telling us?', *Working Paper*, UCLA.
- Blinder, A, M Ehrmann, M Fratzscher, J de Haan and DJ Jansen (2008): 'Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence', *Journal of Economic Literature*, 46, pp 910–945.
- Bollerslev, T (1986): 'Generalized Autoregressive Conditional Heteroscedasticity', *Journal of Econometrics*, 31, pp 307–327.
- Bollerslev, T (1987): 'A Conditional Heteroscedastic Model for Speculative Prices and Rates of Return', *Review of Economics and Statistics*, 69, pp 542–547.
- Bollerslev, T and J Wooldridge (1992): 'Quasi-Maximum Likelihood Estimation and Inference in Dynamic Models with Time Varying Covariances', *Econometric Reviews*, 11, pp 143–172.
- Campbell, J and G. Taksler (2003): 'Equity Volatility and Corporate Bond Yields', *Journal of Finance*, 58, pp 2321-2349.
- Cantor, R (2004): 'An introduction to recent research on credit ratings', *Journal of Banking and Finance*, 28, pp 2565-2573.
- Collin-Dufresne, P, R Goldstein and JS Martin (2001): 'The Determinants of Credit Spread Changes', *Journal of Finance*, 56, pp 2177-2207.
- Doornik, J and M Ooms (2008): 'Multimodality in the GARCH Regression Model', *International Journal of Forecasting*, 24, pp 432–448.
- Duffie, D and KJ Singleton (2003): '*Credit Risk: Pricing, Measurement, and Management*', Princeton.
- Ehrmann, M. and M Fratzscher (2007): 'Communication by Central Bank Committee Members: Different Strategies, Same Effectiveness?', *Journal of Money, Credit and Banking*, 39, pp 509–541.
- Ehrmann, M. and M. Fratzscher (2009): 'Global financial transmission of monetary policy shocks', *Oxford Bulletin of Economics and Statistics*, 71, pp 739-759.
- Engle, RF (1982): 'Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation', *Econometrica*, 50, pp 987–1008.
- Engle, RF (2001): 'GARCH 101: The Use of ARCH/GARCH Models in Applied Econometrics', *Journal of Economic Perspectives* 15, pp. 157–168.

- Ericsson, J, K Jacobs and R Oviedo-Helfenberger (2008): 'The Determinants of Credit Default Swap Premia', forthcoming, *Journal of Financial & Quantitative Analysis*.
- Fender, I and P Hoerdahl (2007): 'Markets hit by renewed credit woes', *BIS Quarterly Review*, December, pp 1-17.
- Fender, I and M Scheicher (2009): 'The pricing of subprime mortgage risk in good times and bad: Evidence from the ABX.HE indices', *Applied Financial Economics*, 19, pp 1925-1945.
- Fontana, A and M Scheicher (2010): 'An analysis of euro area sovereign CDS and their relation with government bonds', ECB Working Paper No 1271, December.
- Guill, GD (2009): 'Bankers Trust and the Birth of Modern Risk Management', Wharton School, University of Pennsylvania, April.
- Goldstein, M and P Turner (2004): 'Controlling currency mismatches in emerging markets', *Institute for International Economics*, Washington DC, April.
- Hayo, B, A Kutan and M Neuenkirch (2008): 'Communicating with many tongues: FOMC speeches, media coverage, and US financial market reaction', *MAGKS Joint Discussion Paper Series in Economics*, 08-2008, Marburg.
- Hayo, B, A Kutan and M Neuenkirch (2010): 'The Impact of U.S. Central Bank Communication on European and Pacific Equity Markets', *Economics Letters*, 108, pp 172-174.
- Hayo, B, A Kutan and M Neuenkirch (2011): 'Federal Reserve communications and emerging equity markets', *Southern Economic Journal*, forthcoming.
- Hull, J, M Predescu and A White (2004) The relationship between credit default swap spreads, bond yields, and credit rating announcements, *Journal of Banking and Finance*, 28, pp 2789-2811.
- Longstaff, FA, S Mithal and E Neis (2005): 'Corporate yield spreads: default risk or liquidity? New evidence from the credit default swap market', *Journal of Finance*, 60, pp 2213-2253.
- Longstaff, FA, J Pan, LH Pedersen and KJ Singleton (2011): 'How sovereign is sovereign credit risk', *American Economic Journal: Macroeconomics* 3, pp 75–103..
- Markit (2008a), 'XML User Guide—Markit Data', January.
- Markit (2008b): 'Markit Credit Indices: A Primer', November.
- Merton, RC (1974): 'On the Pricing of Corporate Debt: The Risk Structure of Interest Rates', *Journal of Finance*, 29, pp. 449–470.
- Miniane, J and JH Rogers (2007): 'Capital Controls and the International Transmission of U.S. Money Shocks', *Journal of Money, Credit and Banking*, 39, pp 1003–1035.
- Moody's Investor Service (2009): 'Sovereign default and recovery rates, 1982-2008', *Special Comment*, March.
- Nautz, D and S Schmidt. (2009): 'Monetary policy implementation and the federal funds rate', *Journal of Banking & Finance* 33, pp. 1274–1284.
- Reinhart, C and K Rogoff (2008): 'The forgotten history of domestic debt', *NBER Working Paper* no 13946, April.
- Wongswan, J (2009): 'The Response of Global Equity Indexes to U.S. Monetary Policy Announcements', *Journal of International Money and Finance*, 28, pp 344–365.

Table 1: Factor analysis¹

Changes in CDS spreads versus stock market returns

	CDS Spreads		Stock Market Returns	
	% Expl.	Cum. % Expl.	% Expl.	Cum. % Expl.
Pre-Crisis (04/2002 – 07/2007)				
PC1	32.03	32.03	25.98	25.98
PC2	14.10	46.13	10.45	36.42
PC3	7.86	53.99	8.36	44.78
Financial Crisis (08/2007 – 12/2009)				
PC1	70.22	70.22	45.08	45.08
PC2	11.10	81.31	11.57	56.65
PC3	5.43	86.74	8.33	64.98

¹ First three factors; maximum likelihood estimation; overall number of factors is determined on the basis of their shares in total observed variance.

Table 2: PCA correlations¹

Correlations of first CDS factor with various financial market variables

	Pre-Crisis (04/2002 – 07/2007)	Financial Crisis (08/2007 – 12/2009)
S&P 500	0.11	0.43
VIX	-0.15	-0.38
US 3 month rate	0.02	0.15
Yield curve slope	0.00	0.05
Move volatility index	-0.08	-0.21
CDX HY index spread	-0.27	-0.47
Refco spread	-0.02	0.26
Global EMBIG spread	0.60	0.86
Africa EMBIG spread	0.03	0.43
Asia EMBIG spread	0.28	0.75
Europe EMBIG spread	0.50	0.76
Latin EMBIG spread	0.57	0.77

¹ First factor, see Table 1.

Table 3: Explaining changes in sovereign CDS spreads¹

Results of simplified GARCH regressions

Mean Equation	Pre-Crisis (04/2002 – 07/2007)	Financial Crisis (08/2007 – 12/2009)
Tuesday		0.4031
Wednesday	-0.0394	
Thursday	-0.0340	0.3067
Constant Term	-0.0873	
CDS 1st lag	0.1939	
S&P500 1st lag	-0.0594	-0.7179
VIX 1st		-0.0309
US 3 Month Yield 1st lag		-3.9601
US Yield Curve Slope 1st lag	-0.5188	-2.6083
CDX HY 1st lag	0.8309	4.6913
REFCO Spread 1st lag		3.9320
EMBIG Global 1st lag	-0.1752	-1.7956
Domestic Stock Returns 1st lag		0.0934
Turkey	-0.3787	
Colombia	-0.2663	
Peru	-0.2578	
Venezuela	-0.5124	
China	0.1113	
Malaysia	0.1330	
Thailand	0.0722	
Deficit/GDP	0.0195	
$\Delta(\text{AECM})$	-0.0139	
Improved Rating	-0.4027	
Worse Rating	1.2260	
Interest Rate Cut		-3.3931
Interest Rate Cut Surprise		3.4566
Coordinated Liquidity Action	—	-3.9748
Statement MP minus		-7.1987
Statement EO plus		-1.6304
Statement EO minus		11.0134
Monetary Policy Report EO plus		-6.6300
Testimony and Speech MP plus		1.4598
Testimony and Speech EO minus		-0.8182
Variance Equation	Pre-Crisis (04/2002 – 07/2007)	Financial Crisis (08/2007 – 12/2009)
α_0	0.0000	0.3303
α_1	0.1196	0.1765
β_1	0.8804	0.8235
Student-t d.o.f.	3.3226	4.8595

¹ Table 1 shows all variables of the reduced model resulting from the testing-down process at the one percent significance level. EO = Economic Outlook and MP = Monetary Policy. Standard errors are heteroscedasticity-consistent (Bollerslev and Wooldridge (1992)).

Appendix

Sovereign CDS spreads, such as those for Russia (Figure A.1), display a pattern typical for financial time series. Whereas the early sample period from 2002 through 2005 is characterised by several bouts of extraordinarily high volatility, observed spreads are subject to a much lower degree of volatility in the years up to the end of our first sub-sample in July 2007. During the financial crisis, we observe further periods of increased volatility (in particular since September 2008), which slowly lessens towards the end of the sample in December 2009. This phenomenon of changing amplitude of spread changes (returns) over time, which is commonly known as volatility clustering. GARCH models, which have been introduced by Bollerslev (1986), take these changes in volatility explicitly into account and thus increase estimation efficiency compared to OLS. Similar patterns of volatility clustering emerge for the other CDS spread series in our sample, which (expressed in daily, absolute basis point changes) exhibit excess kurtosis (the fourth central moment of the distribution, pointing to evidence of ‘fat tails’), but only limited skewness (the third moment, with the positive sign suggesting a somewhat more pronounced right-hand tail for most series), as indicated by Tables A.2a and A.2b below. Table A.3 provides an overview of the other financial variables included in the analysis.

Figure A.1: Volatility clustering in daily CDS spread changes for Russia

April 2002 – December 2009

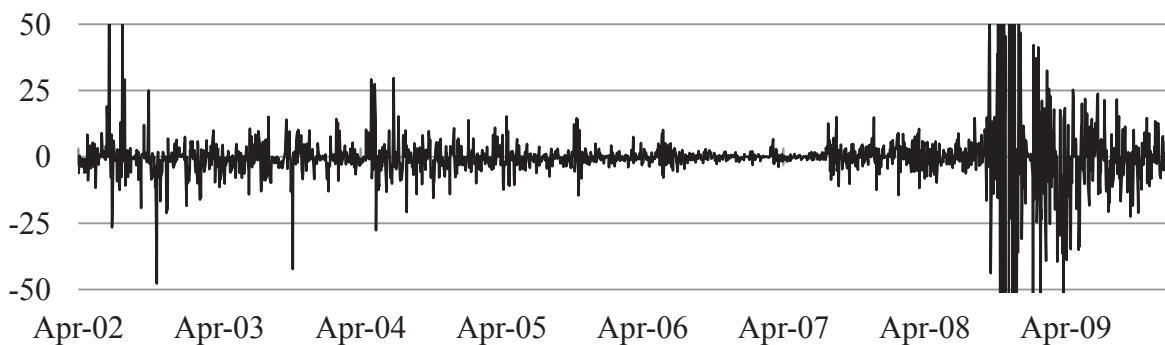


Table A.1: Number of non-zero values for the dummy variables¹

Dummy measures of FOMC policy decisions and communications

	Pre-Crisis (04/2002 – 07/2007)				Financial Crisis (08/2007 – 12/2009)			
	MP +	MP –	EO +	EO –	MP +	MP –	EO +	EO –
Target Rate Changes	17	3	—	—	0	20.5	—	—
Target Rate Surprises	0	1	—	—	2	6.5	—	—
Statements	24	0	24	4	0	13	9	10
Monetary Policy Reports	4	0	10	1	1	3	1	3
Testimony and Speeches	27	2	67	15	3	9	11	26
Discount Rate Action	—	0	—	—	—	1	—	—
Joint Actions w/ Government	—	0	—	—	—	6	—	—
Liquidity Unilateral	—	0	—	—	—	12	—	—
Liquidity Coordinated	—	0	—	—	—	10	—	—
Asset Backed Securities	—	0	—	—	—	7	—	—

¹ See Hayo et al (2008) and Hayo et al (2011) for details on the compilation and coding of the data.

Table A.2a: Descriptive statistics - Pre-Crisis (04/2002 – 07/2007)¹

Daily changes in sovereign CDS spreads (in basis points)

	Mean	Std. Dev.	Skewness	Kurtosis	Minimum	Maximum
World	-0.21	15.43	5.91	265.82	-404.25	511.42
BGR	-0.21	2.92	0.85	42.86	-27.50	36.88
RUS	-0.24	6.18	5.48	112.98	-47.79	120.00
TUR	-0.26	14.37	2.73	39.23	-102.05	185.56
BRA	-0.43	41.01	3.27	52.70	-404.25	511.42
COL	-0.34	12.36	2.25	27.12	-73.51	133.63
PER	-0.20	10.56	-0.78	34.96	-144.00	75.17
VEN	-0.54	24.71	1.60	57.43	-272.00	371.00
ZAF	-0.10	1.99	2.20	27.96	-12.14	24.28
CHN	-0.01	0.78	1.65	24.17	-5.10	9.59
MYS	-0.05	1.90	1.01	40.35	-20.27	22.67
PHL	-0.11	6.10	0.38	10.11	-41.17	56.18
THA	-0.02	1.65	0.66	11.92	-10.22	11.45

¹ Note: Number of observations: 1392 for each country, 12*1392 = 16704 for total sample.

Table A.2b: Descriptive Statistics - Crisis (08/2007 – 12/2009)¹

Daily changes in sovereign CDS spreads (in basis points)

	Mean	Std. Dev.	Skewness	Kurtosis	Minimum	Maximum
World	0.16	19.16	2.78	73.89	-223.97	450.78
BGR	0.32	14.30	0.22	11.00	-86.22	91.81
RUS	0.17	25.21	1.58	25.03	-168.80	206.86
TUR	-0.02	17.14	0.50	17.00	-119.49	133.92
BRA	0.01	14.82	1.54	42.30	-124.68	174.70
COL	-0.02	15.06	1.31	36.43	-127.02	169.79
PER	-0.01	14.93	1.53	37.20	-123.64	168.34
VEN	1.17	41.73	2.47	28.66	-223.97	450.78
ZAF	0.13	14.71	0.71	19.09	-109.42	123.57
CHN	0.07	6.69	-0.01	26.06	-58.25	57.25
MYS	0.09	11.32	0.56	49.52	-110.61	130.64
PHL	-0.05	18.34	0.67	41.16	-163.42	180.10
THA	0.05	11.54	0.10	40.92	-111.22	118.52

¹ Note: Number of observations: 632 for each country, 12*632 = 7584 for total sample.

Table A.3: Explanatory financial variables

Standard & Poor's S&P 500 index	Daily growth rates in percent
Chicago Board Options Exchange Volatility Index	Daily growth rates in percent
US 3-month Treasury bill rate	Daily absolute changes in percentage points
US yield curve slope	Daily absolute changes in percentage points
Merrill Lynch MOVE volatility index	Daily growth rates in percent
CDX North American High Yield index spread	Daily absolute changes in percentage points
Global and regional EMBIG indices	Daily growth rates in percent
Refco spread	Daily absolute changes in percentage points
Bilateral exchange rates vis-à-vis the US dollar	Daily growth rates in percent
Major domestic stock market indices	Daily growth rates in percent