Summer 8-10-2016

Feats and Failures of Corporate Credit Risk, Stock Returns, and the Interdependencies of Sovereign Credit Risk

Uche C. Isiugo
University of New Orleans, uisiugo@uno.edu

Feats and Failures of Corporate Credit Risk, Stock Returns, and the Interdependencies of Sovereign Credit Risk

A Dissertation

Submitted to the Graduate Faculty of the
University of New Orleans
in partial fulfillment of the
requirements for the degree of

Doctor of Philosophy
in
Financial Economics

by

Uche C. Isiugo

BBA, Finance and Economics, Temple University, PA, USA, 2007
MBA, Finance, Seattle Pacific University, WA, USA, 2010
M.S. Financial Economics, University of New Orleans, LA, USA, 2015

August, 2016

Dedication

To my wife, Nicky, for her boundless love and sacrifice during the particularly trying times of my PhD research, and to my daughter, Ifunanya, who remained cheerful through it all. To my parents, Prof. Uche and Prof. (Mrs.) Ifeoma Isiugo-Abanihe, who inspired my strong value for education, hard work, and determination. To my siblings, Nonye, Chioma and Kelechi, for their love and support.

Acknowledgement

I am deeply grateful to God for His special Grace in enabling my success in the PhD program. I sincerely appreciate my family and friends, who have been unfailing in their love, support, and kindness. Special thanks to my dissertation committee chair, Dr. Kabir Hassan, who has supervised my work and has been very helpful and supportive throughout the process. I would also like to extend my gratitude to all the members of my dissertation committee, who have been supportive in my dissertation as well as in other aspects of my PhD program: Dr. W. Lane, Dr. A. Naka, Dr. D. Zirek, and Dr. J. Yu. Many thanks go to Benito Sanchez, for his valuable insight in my research. A special acknowledgement goes to my colleague and friend Zhengyi Zhang, for his helpfulness and kindness. My gratitude also goes to my other PhD colleagues and friends, Austin Dejan, Chinedum Nwadiora, Shadiya Hossain, Yun Doo Lee, and Abdulrahman Alharbi, with whom I have shared a strong sense of camaraderie.

Table of Contents

Abstract ii

ESSAY ONE 1

Characterizing Sovereign Credit Risk Interdependencies: Evidence from the Credit Default Swap Market 1

1. Introduction 50

2. Literature Review 50

3. The Data 50

Binary Rolling Correlations 77

Correlation coefficients matrix 77

4. Empirical Methodology 77

4.1 DCC GARCH Methodology and Empirical Results 77

4.1.1 Binary VAR Model with DCC GARCH 20

4.1.2 Multivariate VAR Model with DCC GARCH 77

4.2 Alternative and Robustness Tests 25

4.3 Relation of Sovereign CDSs to Terms of Trade and Global Factors 29

4.3.1 Variables 77

4.3.2 Panel Regressions 77

5. Conclusion 35

6. References 36

ESSAY TWO 38

Differential Stock Market Returns and Corporate Credit Risk of Listed Firms 38

1. Introduction 77

2. Relevant Literature 77

2.1 The CDS Market 77

2.2 Types of Cross-listed firms 77

3. Sample Construction And Summary Statistics 49

4. Empirical Methodology 54

4.1 Event Study 77

4.1.1. 2-day window reactions to events in corporate CDS and equity markets 55

4.1.2 30-day window reactions to events in corporate CDS and equity markets 77

4.1.3 Cross-listed vs. non-cross-listed firms' 30-day window reactions to events in corporate CDS markets 59

4.2 Proportions of negative and positive Corporate CDS reactions following events 59

4.3 OLS and Panel Regressions of corporate credit risk and sovereign risk 66

4.3.1 Sovereign credit risk and corporate credit risk specifications 66
4.3.2 Differential reaction of Cross-listed vs. Non-cross-listed firms to Sovereign risk 69
4.3.3...Additional Test of Differential reaction of Cross-listed vs. Non-cross-listed firms to Sovereign risk 72
5. Conclusion 74
Appendix 77
References 80
Vita 91

List of Tables

ESSAY ONE

Table 1a: 19-country Sample Summary Statistics……12
Table 1b: 5-Country Summary Statistics……13
Table 2: Correlation Coefficients Matrix for Change in CDS……..……18
Table 3: Binary VAR with DCC GARCH……...21
Table 4: Information Criteria……..22
Table 5: Multivariate VAR Fitted with DCC GARCH……23
Table 5 PANEL B: DCC GARCH Coefficient Estimation……24
Table 6: OLS Regression With VIX and Stock Market Return in Each Country…….27
Table 7: Sovereign risk, terms of trade and global factors……34

ESSAY TWO

Table 1: Summary Statistics 52
Table 2: Sampled Negative and Positive Sovereign Credit Events 53
Table 3: Two-day corporate CDS and stock price reactions to events 56
Table 4: 30-Day corporate CDS reaction to sovereign credit events 58
Table 5: Cross-listed vs. non-cross-listed firms' 30-Day CDS reaction to sovereign credit events 60
Table 6: Chi-square test for equality of proportions of negative and positive firm reactions 62
Table 7: Chi-square test for equality of proportions of negative and positive reactions of CDSs of two groups 64
Table 8: Sovereign risk and corporate credit risk 68
Table 9: Sovereign risk and corporate credit risk of non-cross-listed firms 71
Table 10: Further test of Sovereign risk and corporate credit risk of non-cross-listed firms 73
Table A.3. Supplemenary Regression Tests of spillover to corporate risk 78
Table A.4. Supplementary Regression Tests of spillover to non-cross-listed firms' corporate risk 79

List of Figures

ESSAY ONE

Figure 1: Country pairwise correlation of changes in sovereign CDS spreads……..……15

ESSAY TWO

Figure 1: Spain average corporate CDS spreads 34

Abstract

This dissertation comprises two essays; the first of which investigates sovereign credit risk interdependencies, while the second examines the reaction of corporate credit risk to sovereign credit risk events. The first essay titled, *Characterizing Sovereign Credit Risk Interdependencies: Evidence from the Credit Default Swap Market*, investigates the relationships that exist among disparate sovereign credit default swaps (CDS) and the implications on sovereign creditworthiness. We exploit emerging market sovereign CDS spreads to examine the reaction of sovereign credit risk to changes in country-specific and global financial factors. Utilizing a VAR model fitted with DCC GARCH, we find that comovements of spreads generally exhibit significant time-varying correlations, suggesting that spreads are commonly affected by global financial factors. We construct 19 country-specific commodity price indexes to instrument for country terms of trade, obtaining significant results. Our commodity price indexes account for significant variation in CDS spreads, controlling for global financial factors. In addition, sovereign spreads are found to be related to U.S. stock market returns and the VIX volatility risk premium global factors. Notwithstanding, our results suggest that terms of trade and commodity prices have a statistically and economically significant effect on the sovereign credit risk of emerging economies. Our results apply broadly to investors, financial institutions and policy makers motivated to utilize profitable factors in global portfolios.

The second essay is titled, *Differential Stock Market Returns and Corporate Credit Risk of Listed Firms*. This essay explores the information transfer effect of shocks to sovereign credit risk as captured in the CDS and stock market returns of cross-listed and local stock exchange listed firms. Based on changes in sovereign credit ratings and outlooks, we find

that widening CDS spreads of firms imply that negative credit events dominate, whereas tightening spreads indicate positive events. Grouping firms into companies with cross-listings and those without, we compare the spillover effects and find strong evidence of contagion across equity and CDS markets in both company groupings. Our findings suggest that the sensitivity of corporate CDS prices to sovereign credit events is significantly larger for non-cross-listed firms. Possible reasons for this finding could in fact be due to cross-listed firms' better access to external capital and less degree of asymmetric information, relative to non-cross-listed peers with lower level of investor recognition. Our results provide new evidence relevant to investors and financial institutions in determining sovereign credit risk germane to corporate financial risk, for the construction of debt and equity portfolios, and hedging considerations in today's dynamic environment.

Keywords: VAR DCC GARCH; Credit Default Swaps; Corporate credit risk; Sovereign risk; Cross-listing; Commodity Prices; Terms of Trade

ESSAY ONE

Characterizing Sovereign Credit Risk Interdependencies: Evidence from the Credit Default Swap Market

---

ABSTRACT

We exploit emerging market sovereign CDS spreads to examine the reaction of sovereign credit risk to changes in country-specific and global financial factors. Utilizing a VAR model fitted with DCC GARCH, we find that comovements of spreads generally exhibit significant time-varying correlations, suggesting that spreads are commonly affected by global financial factors. We construct 19 country-specific commodity price indexes to instrument for country terms of trade, obtaining significant results. Our commodity price indexes account for significant variation in CDS spreads, controlling for global financial factors. In addition, sovereign spreads are found to be related to U.S. stock market returns and the VIX volatility risk premium global factors. Notwithstanding, our results suggest that terms of trade and commodity prices have a statistically and economically significant effect on the sovereign credit risk of emerging economies. Our results apply broadly to investors, financial institutions and policy makers motivated to utilize profitable factors in global portfolios.

JEL classification: F34, G13, G12, G15, P34

Keywords: Credit Default Swaps, Commodity Prices, Terms of Trade, DCC GARCH, Vector Autoregressive (VAR)

1. INTRODUCTION

The financial sector took heavy losses following sovereign debt crises that occurred in a number of countries in recent years. Particularly intriguing, was the Eurozone debt crisis, in light of the long-held notion that developed countries were supposedly immune from sovereign debt crisis. Compared to developed countries, several emerging economies have a higher dependence on commodity exports, some of which have recently suffered highly volatile and depressed prices and directly affect a country's terms of trade. In this essay, we therefore analyze emerging market sovereign CDS spreads to examine the reaction of sovereign credit risk to changes in country-specific factors and global financial factors.

We propose a VAR model fitted with DCC GARCH to determine if CDS spreads have significant correlations. Significant correlations of spreads suggest that changes in the sovereign credit risk of disparate, far-flung countries are commonly affected by a set of global financial factors. We also investigate country specific factors; particularly terms of trade, due to the possibility that shocks to terms of trade might affect a country's ability to service its debt. It is possible that both terms of trade and a set of global financial factors have significant roles in explaining changes in sovereign CDS spreads. Prior research on sovereign CDS spreads had not taken into account the effect of terms of trade but primarily focused on global financial factors. Previous findings in the literature have underlined the importance of global factors. (Longstaff et al., 2005; Pan and Singleton, 2008; Longstaff, et al., 2011). Overall, our analysis determines the significance of the interrelationships of various sovereign CDS spreads and also makes conclusions on the degree of importance of both terms of trade and a set of global financial factors, simultaneously analyzed over time.

A CDS is a derivative that transfers the credit risk of bonds between two parties. It provides the buyer of the contract, who sometimes owns the underlying bonds, with

protection against default, a credit rating downgrade, or other adverse credit events. Sovereign CDS derivatives present an opportunity to take a short position in a country's sovereign debt, whereas, it is difficult to directly short a country's bonds. The opportunity to go long or short on a sovereign credit presents new information about sovereign credit risk to the market.

By the end of 2014, the notional value of CDS stood at $6 trillion for contracts referencing non-financial firms, $4 trillion for financial firms, $4 trillion for multiple sectors, and $2 trillion for those referencing sovereigns. By rating, CDS contracts referencing investment grade entities totalled $10 trillion and those referencing lower-rated or unrated entities stood at $7 trillion. With respect to sovereign CDS contracts, the volume of contracts has increased steadily since the global financial crisis. The share of such contracts in the total notional amount of credit derivatives outstanding rose from 4% at the end-2008 to 16% by mid- 2015. In absolute terms, the notional amount of sovereign CDS contracts grew from $1.7 trillion at the end of 2008 to $3.0 trillion at the end of 2011. Thereafter, it declined to $2.0 trillion as of end-2015.[1]

Following the financial crisis of 2007 to 2009 and the ensuing Eurozone debt crisis, it became clear that sovereign credit risk was of important concern in developed and emerging economies. Prior to the financial crisis, sovereign credit risk was not a serious concern in developed countries. The bailouts of a number of European developed countries has made it integral to understand the nature of sovereign credit risk, particularly in emerging economies. Relative to a group of developing and developed economies, we examine closely related questions surrounding the comovements of sovereign CDS and factors causing changes in sovereign credit risk.

[1] Bank for International Settlements: Statistical release - OTC derivatives statistics, December 2015

1. First, how correlated is sovereign credit risk and what do the correlations imply? We find significant correlations, suggesting that sovereign CDS spreads are commonly affected by global financial factors.
2. Second, controlling for global financial factors, what is the role of terms of trade in determining the CDS spreads of the sovereign? Previous findings in the literature have underlined the importance of global factors. It is therefore important to analyze the relationship of sovereign credit risk with terms of trade, in the context of global factors. In this regard, we obtain novel results on the significant effect of terms of trade on sovereign CDS spreads, after we control for global factors.
3. Third, taking terms of trade into consideration, do global financial factors play an important role in igniting sovereign credit risk? We expect that global financial factors and terms of trade both play an important role.

Terms of trade measures the price of a country's exports relative to imports, calculated as the ratio of export prices to import prices. To instrument for terms of trade, we construct country-specific export weighted commodity price indexes. Global financial factors fall into the categories of, (i) volatility risk premium, measured as the difference between CBOE U.S. VIX option volatility index and historical volatility, typically viewed as a measure of event risk and volatility risk premium, (ii) the spread between the U.S. BB-rated corporate bond index and the 6-month U.S. Treasury bill rate, viewed as a measure of both U.S. macroeconomic and global financial market developments, (iii) U.S. stock market return. For the aforesaid variables, we use panel techniques to determine the significance of the relationships to the variability of the sovereign CDS spreads of several countries.

There are two main sections in this essay. In the first section, we utilize Dynamic Conditional Correlation Generalized Autoregressive Conditional Heteroskedasticity (DCC

GARCH) methodology to analyze the comovements of 5 sovereign CDS spreads of Brazil, Mexico, Panama, Venezuela and Ecuador, and find that they generally exhibit significant correlations. By doing so, our initial results on the time-varying correlations suggest that sovereign CDS spreads are commonly affected by global factors. Sources of some of this commonality are explored in some of the literature including, Jun Pan and Kenneth Singleton (2008); Iuliana Ismailescu and Hossein Kazemi (2010); Francis Longstaff, et al. (2011), and some others. In the second part of this essay, we study the sources of the strong commonality, focusing on the effect of country-specific fundamentals and global financial factors on changes in sovereign CDS spreads for a group of 19 emerging market countries.

Given the nature of several sovereign debt crises, contagion and cross-border spillovers of credit risk have been studied in the literatrue. These can be amplified when there are high correlations between the credit risk of different countries. The first part of this essay focuses on studying the correlations of several sovereign CDS spreads to one another. We carry this out by investigating the co-movement of the sovereign CDS spreads of several countries by employing a second order vector autoregressive (VAR) model fitted with DCC GARCH, as proposed by Engle (2002). The concept of comovement has been well documented by many researchers. Engle (2002) documents how time varying correlations may be estimated with multivariate GARCH models, now commonly used to study interdependencies amongst several economic variables. He develops a new class of multivariate dynamic conditional correlation models, which in addition to incorporating the flexibility of univariate GARCH models, include parsimonious parametric models for the correlations. They are not linear but can often be estimated quite simply with univariate or two-step methods based on the likelihood function. He shows that they perform well in a variety of situations.

Our binary results show that the pairwise correlations between countries are strongly significant and the variance of residuals from the VAR model is persistent over time. The multivariate DCC GARCH model also reveals consistent results. We explore the volatility of changes in the sovereign CDS spreads of Brazil, Mexico, Panama, Venezuela and Ecuador and the relationship of volatility to local stock market returns and the CBOE VIX index. In this respect, we do not fnd evidence of a significant relationship. Employing DCC GARCH, we contribute to the literature on the interdependency and co-movement of CDS, as previous research utilized simple VAR or error correction models to implement co-movements. With DCC GARCH, we show a dynamic moving correlation among various variables. Our results suggests strong commonality in the behavior of sovereign CDS spreads.

Expanding the sample to 19 countries, we then exploit panel regressions to study the sources of the variation in sovereign CDS spreads, exploring global financial factors and country terms of trade. Our results validate the importance of global financial factors and also confirm the prominence of terms of trade and commodity prices in explaining changes in sovereign CDS spreads, particularly in emerging economies. Since terms of trade drive a country's capacity to generate revenue and service its sovereign debt, we expect a significant effect on the sovereign CDS spreads of emerging economies. The sample of 19 sovereigns includes countries that are commodity-dependent, more diversified countries, developing countries and developed economies. The importance of terms of trade to emerging economies is apparent in more extreme cases of resource-reliant countries, such as oil-producing Venezuela's potential reaction to oil prices. Terms of trade can be interpreted as the amount of import goods a country can purchase per unit of export goods. If export revenues are spent on imports, debt service capacity is conceivably enhanced when

commodity prices are high. In the case of Venezuela, oil revenues are denominated in dollars, therefore negative impacts on its earnings of foreign exchange could potentially limit its ability to service dollar-denominated external debt. In extreme cases, multiple significant shocks to commodity prices may compel a resource dependent country to reschedule debt repayments.

2. LITERATURE REVIEW

The literature on CDS was sparse prior to 2003, due to data limitations. Our research aims to contribute to a number of threads of CDS research. First, we aim to contribute to the strand of research that explores the relationship between CDS and other assets. Hull et al. (2004), investigate the relationship between CDS spreads and bond yields, and reach conclusions on the benchmark risk-free rate and credit rating on the credit ratings announcement date. Blanco et al. (2005) test the theoretical equivalence of CDS prices and credit spreads originally derived by Duffie (1999), finding support for the parity relation as an equilibrium condition. They also find two forms of deviation from parity. For three firms, CDS prices are substantially higher than expected over long periods of time, hence they argue that the mispricing is mainly driven by imperfect contract specification and measurement errors when computing the credit default spread. Similar to our study of the co-movements of several sovereign CDSs, Norden and Weber (2009) study the co-movement among stock market, bond and CDS variables. They conclude that stock returns lead changes in CDS and bond spreads and this relationship is stronger for US firms than it is for European firms. Hassan et al. (2013) investigate the link between the price discovery dynamics in sovereign CDS and bond markets and the degree of financial integration of

emerging markets. They find that sovereign CDS and bond markets are co-integrated. In five out of seven sovereigns (71%), the bond market leads price discovery by adjusting before CDS spreads to new information regarding credit risk.

Additionally, we aim to extend previous results from the sovereign bond literature, relative to the effects of terms of trade on sovereign credits and risk. Catao and Kapur (2006) provide evidence that differences in terms of trade are important for determining sovereign bond yields, borrowing constraints and default risk. Our study is in the spirit of studies on sovereign credit and terms of trade including, Jens Hilscher and Yves Nosbusch (2010), who draw inferences on sovereign credit risk by relating terms of trade to sovereign bond yields. Using their results as a general guide, we extend this thread of the literature by relating terms of trade to sovereign CDS spreads, following the consensus in the literature that CDS spreads, rather than bond yields, can incorporate more precise and timely information about credit risk (Hull, Predescu, White (2004). Blanco, Brennan, and Marsh (2005), Stulz (2010)). CDS spreads consist of firm bid and offer quotes from dealers, which dealers are obligated to trade at the quoted price. Hull, et al. (2004) argue that CDS data is attractive compared to bond yield data because yields consist of merely indications from dealers, as opposed to commitments or an obligation to trade at a quoted price. Hilscher and Nosbusch (2010) construct country-specific commodity price indexes instrumenting for terms of trade, and find a significant relationship to sovereign bond yields and a substantial increase in the adjusted R^2 of the regressions that include the terms of trade variable, compared to specifications that only include global variables and credit ratings. To our knowledge, there has not been a study relating terms of trade to sovereign CDS spreads, which we exploit in our main analysis.

We contribute to a third thread of the literature which investigates the sources of commonality found in CDS markets. This has been explored in some articles, including Jun Pan and Kenneth Singleton (2008), Iuliana Ismailescu and Hossein Kazemi (2010), Francis Longstaff, et al. (2011) and some others. Pan and Singleton (2008) show significant correlations among the sovereign CDS spreads of Mexico, Turkey, and Korea and demonstrate that they are commonly related to the volatility of the U.S. stock market as measured by the VIX index. Further, the VIX index can be viewed as a barometer for event risk and reflects investors' sentiment regarding exposure to high yield bonds, often the designated credit class of emerging economies. Following Pan and Singleton (2008),we use the difference between U.S. BB-rated corporate bonds and the 6-month U.S. Treasury bill rate as a measure of both U.S. macroeconomic and global financial market developments. In addition to Pan and Singleton (2008), Schaefer and Strebulaev (2008) find significant results supporting the view that VIX is related to changes in sovereign CDS and is an indicator of investor sentiment and appetite for global event risk. Longstaff, et al. (2011) show that U.S. stock market return is more often significant in explaining variation in sovereign credit spreads than local stock market returns. Ismailescu and Kazemi (2010) identify the transmission mechanisms of spillovers as the common creditor problem and competition in trade markets. Improved credit ratings of a sovereign is found to have positive effects on other sovereigns' borrowing from a common creditor, due to increased access to capital. For an emerging economy, their findings suggest an increase in credit rating has negative effects on countries that exercise the same level of competition in trade markets.

The remainder of this essay is structured as follows. In section 2, we describe the data. Section 3 explains the VAR DCC GARCH model, the results and alternative tests.

Section 4 provides a panel model to simultaneously test terms of trade, global factors, as well as other controls and expounds key results. Section 5 concludes.

3. THE DATA

We obtain daily and monthly sovereign CDS spreads from Thomson Reuters. In our DCC GARCH model, we utilize daily sovereign CDS spread data from 5 countries. For our analysis of terms of trade and global factors, we expand our analysis to 19 countries, using monthly series, based on the availability of data. For our DCC GARCH model, we obtain each country's stock market index and the S&P 500 implied volatility index from Bloomberg using the same data span. We use the Morgan Stanley Capital International (MSCI) emerging market indexes for Brazil and Mexico, and the individual local stock market indexes for Panama, Venezuela and Ecuador. We then merge all the series by deleting specific day observations with missing variables. We calculate the change in each series by taking the log difference between the current value and lag value of each variable.

Our latter model specifications test the significance of terms of trade and global factors using monthly series for a sample of 19 countries: Argentina, Brazil, Bulgaria, China, Colombia, Ecuador, Egypt, Indonesia, Mexico, Panama, Peru, Philippines, Poland, Russia South Africa, Spain, Turkey, Ukraine and Venezuela. We select the longest available time series for the countries. Broadly, the CDS data starts from October 2000 going through October 2013. For each country, we construct an export weighted commodity price index. We obtain country commodity export value data from the UN COMTRADE database and monthly commodity prices from the World Bank commodity price database. To construct the indexes, we weigh the commodity prices by the country specific export shares. We

calculate the spread between the return on U.S. BB-rated industrial corporate bonds and the 6-month U.S. Treasury bill rate, using data obtained from the Federal Reserve Bank of St. Louis. We compute the realized volatility of the S&P 500 index and obtain the implied VIX index from Chicago Board Options Exchange (CBOE). We then calculate the monthly changes in the spreads between implied and realized volatility for index options to proxy for event risk and investor sentiment. The U.S. stock market excess return on all firms listed on the NYSE, AMEX, and NASDAQ in the Center for Research in Security Prices (CRSP) database is provided courtesy of Ken French.

Table 1a provides summary information for the 19 sovereign CDS premiums in the sample. All premiums are denominated in basis points. The values of the premiums range widely across countries. Across the sample, the daily sovereign CDS spreads of the 19 economies range from a minimum of 2.55 basis points (bps) for Spain to the maximum of 5304.89 for Ukraine. The lowest average in the sample is 64.59 bps for China while Ecuador has the highest average of 1982.56 bps. The standard deviations, minimum and maximum values suggest wide variation in the sovereign CDS spreads in the sample. For example, the cost of credit protection for Ukraine ranges from 126.13 to 5304.89 basis points during the sample period. The sovereign CDS spreads of Spain grows by a multiple of 251, from March 2007 to July 2012. Table 1b focuses on the 5 countries included in our DCC GARCH model, namely Brazil, Mexico, Panama, Venezuela and Ecuador. The daily mean returns of sovereign CDS spreads are all less than 0.1 percent per day. The returns fluctuate considerably and range from -74 percent (Ecuador) to 37 percent (Brazil).

Table 1a: 19-country Sample Summary Statistics

Country	Mean	SD	Standard Error	Minimum	Median	Maximum	Kurtosis	Skewness	Range	N	Sample Period
Argentina	1128.84	1019.26	18.37	182.53	787.50	4689.08	1.32	1.49	4506.55	3079	06/05 - 11/13
Brazil	427.63	622.71	9.36	61.50	161.59	3951.50	10.26	3.11	3890.00	4428	10/01 - 11/13
Bulgaria	212.77	161.56	2.34	13.22	197.10	697.50	-0.07	0.78	684.28	4781	10/00 - 11/13
China	64.59	47.28	0.75	10.00	62.00	276.30	2.19	1.37	266.30	3959	01/03 - 11/13
Colombia	226.15	155.46	2.47	64.70	152.92	850.00	1.79	1.50	785.30	3959	01/03 - 11/13
Ecuador	1982.56	1464.93	28.26	166.75	2300.03	4431.50	-0.99	0.55	4264.75	2687	07/06 - 11/13
Egypt	266.40	156.90	3.08	38.50	238.32	658.38	0.64	1.18	619.88	2590	10/06 - 11/13
Indonesia	224.80	131.50	2.28	92.26	189.62	1248.35	11.78	3.03	1156.09	3336	10/04 - 11/13
Mexico	139.27	83.67	1.26	28.17	116.05	601.21	2.86	1.62	573.04	4428	10/01 - 11/13
Panama	161.50	81.24	1.34	61.33	134.57	586.86	2.55	1.58	525.53	3676	11/03 - 11/13
Peru	176.28	97.27	1.60	59.66	141.13	605.83	2.88	1.74	546.17	3690	10/03 - 11/13
Philippines	265.04	145.95	2.24	81.02	197.20	824.78	-0.81	0.70	743.76	4254	04/02 - 11/13
Poland	83.89	75.96	1.10	7.67	53.34	415.00	1.58	1.40	407.34	4785	10/00 - 11/13
Russia	267.51	239.53	3.46	36.88	180.70	1113.38	1.70	1.62	1076.50	4793	10/00 - 11/13
South Africa	148.44	81.92	1.18	24.57	148.42	663.33	4.70	1.45	638.76	4799	10/00 - 11/13
Spain	137.81	155.52	2.62	2.55	72.51	641.98	0.02	0.99	639.43	3513	04/04 - 11/13
Turkey	375.43	284.50	4.11	110.95	249.71	1416.88	1.01	1.43	1305.93	4793	10/00 - 11/13
Ukraine	678.74	737.28	12.67	126.13	492.65	5304.89	9.27	2.85	5178.76	3386	08/04 - 11/13
Venezuela	807.76	544.08	8.65	117.50	751.41	3239.28	2.78	1.35	3121.78	3959	01/03 - 11/13

Table 1b: 5-Country Summary Statistics

Variable	Minimum	Maximum	Median	Mean	Std Dev	Skewness	Kurtosis	N
ΔCDS_{Brazil}	-0.2170	0.3762	0.0000	-0.0002	0.0306	0.9624	10.4101	4516
$\Delta CDS_{Venezuela}$	-0.1996	0.3629	0.0000	0.0001	0.0274	1.4206	20.1031	4516
ΔCDS_{Mexico}	-0.2468	0.3661	0.0000	-0.0003	0.0341	0.4799	7.1999	4516
ΔCDS_{Panama}	-0.2018	0.3509	0.0000	-0.0002	0.0300	0.5588	8.6630	4516
$\Delta CDS_{Ecuador}$	-0.7433	0.3313	0.0000	-0.0002	0.0302	-3.5183	111.1740	4516
Δr_{BRA}	-0.4826	0.2089	0.0006	0.0005	0.0240	-4.0797	87.2940	2994
Δr_{VEN}	-0.5143	0.3277	0.0003	0.0019	0.0230	-2.2155	116.8596	2994
Δr_{MEX}	-0.2915	0.2272	0.0009	0.0007	0.0187	-1.1267	40.4913	2994
Δr_{PAN}	-0.1126	0.1529	0.0000	0.0007	0.0084	4.2196	109.0236	2994
Δr_{ECU}	-0.2593	0.3963	0.0000	0.0001	0.0183	2.4005	153.0976	2994
ΔVIX	-0.4368	0.6659	-0.0048	-0.0002	0.0713	0.9357	8.6241	2994

Within the sample time period, Δr (change in stock market returns) for each country varies dramatically from -48 percent (Brazil) to roughly 40 percent (Ecuador).
Besides Mexico, no single country's daily mean stock market return exceeds 0.1 percent. Compared with the CDS premium returns, the stock market return in each country has higher kurtosis, suggesting that more extreme values are encountered in the stock market. Most countries' returns are negatively skewed, which indicates a more negative movement of the stock market.

Part of the goal of this essay is to study the comovements of sovereign CDS spreads by ascertaining if time varying correlations among the sovereign CDS spreads of different countries are significant. This might lend credence to the argument that sovereign credit risk is commonly affected by a set of global trends. This part of the analysis and the DCC GARCH analysis will focus on 5 Latin American countries, namely Brazil, Mexico, Panama, Venezuela and Ecuador. There are a number of ways to compute the correlations of the sovereign CDS spreads and the results of the different methods reinforce each other.

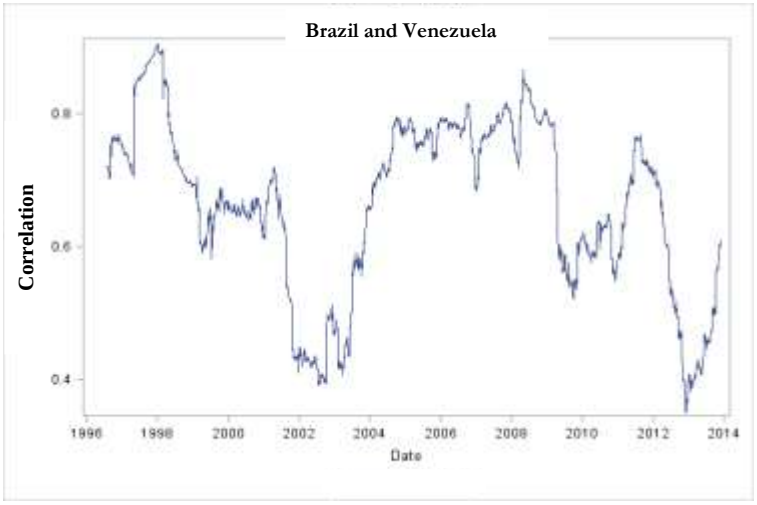
Binary Rolling Correlations

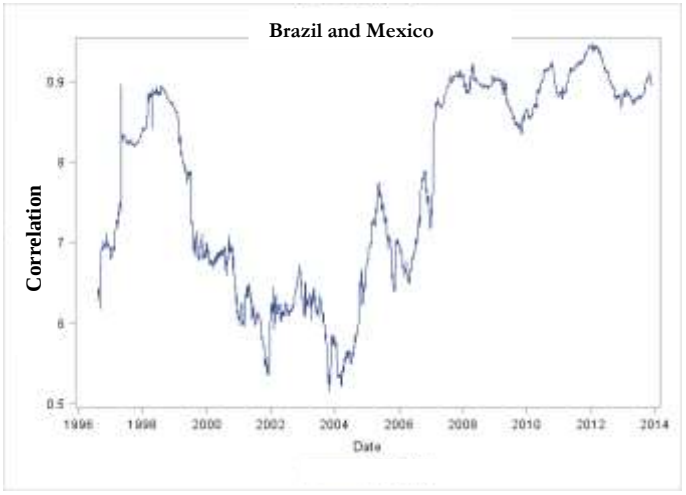
To show the correlation of the sovereign CDS spreads of the 5 countries over time, we calculate a binary rolling correlation between each pair of countries with a rolling window of 252 days, based on the number of trading days in a year. In each day, the correlation is calculated using the past one year percentage change in CDS.

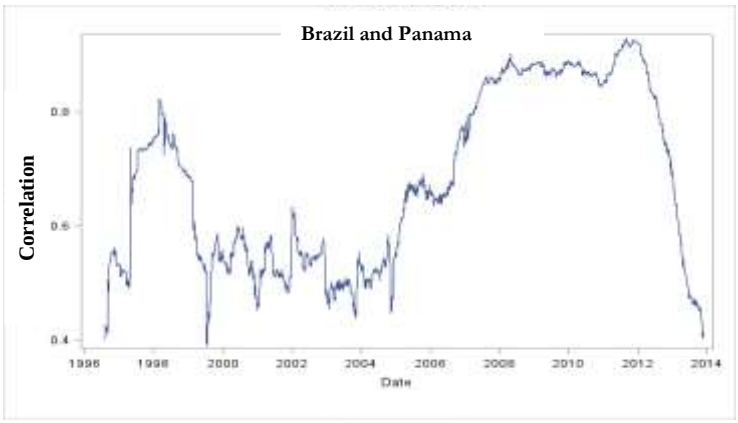
Overall the rolling correlation is highly varied over time for all country pairs. The correlations between the changes in sovereign CDS spreads of the largest economy in the sample, Brazil and that of other countries, have significant declines during the 2008 financial crisis, except for its correlation with Mexico. Interestingly, the correlation of the changes in

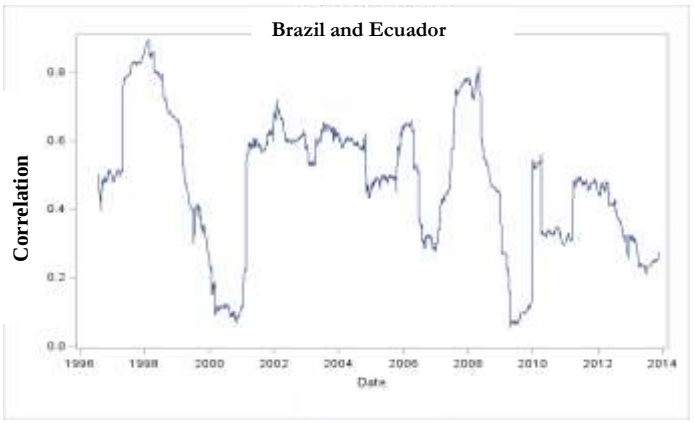
the Brazilian sovereign CDS spreads and that of Mexico is strong over time, as it never drops below 0.5, compared to the correlations of the Brazilian CDS spread with that of

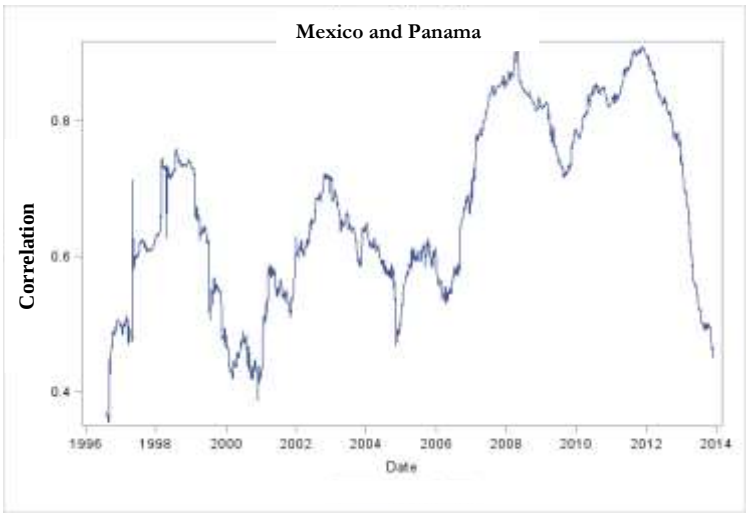
Figure 1: Country pairwise correlation of changes in sovereign CDS spreads

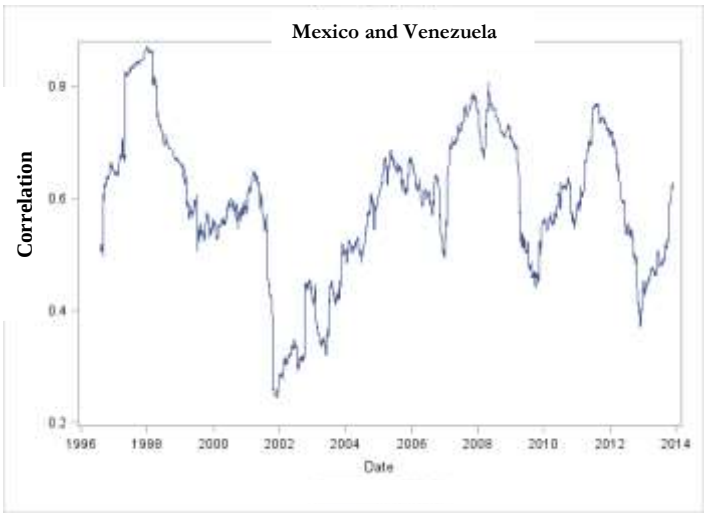


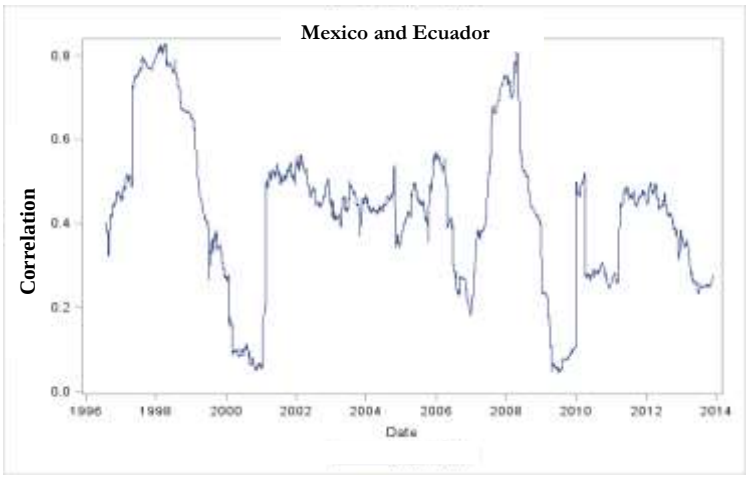


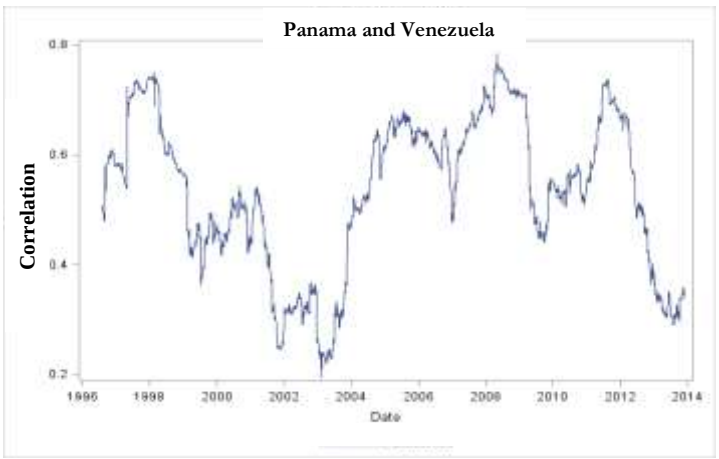


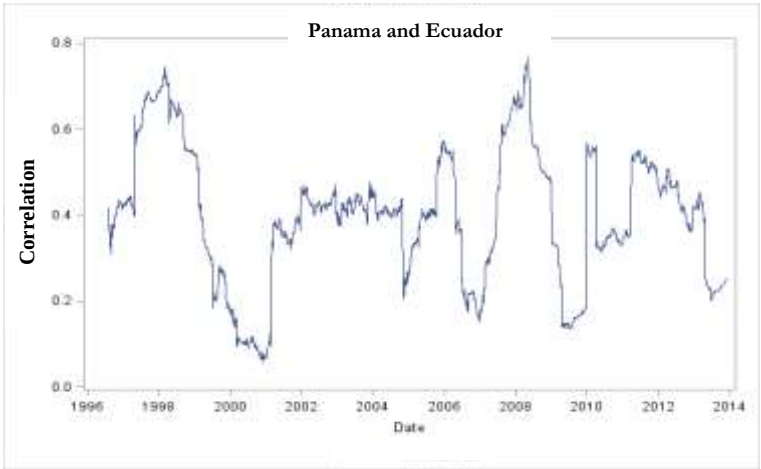


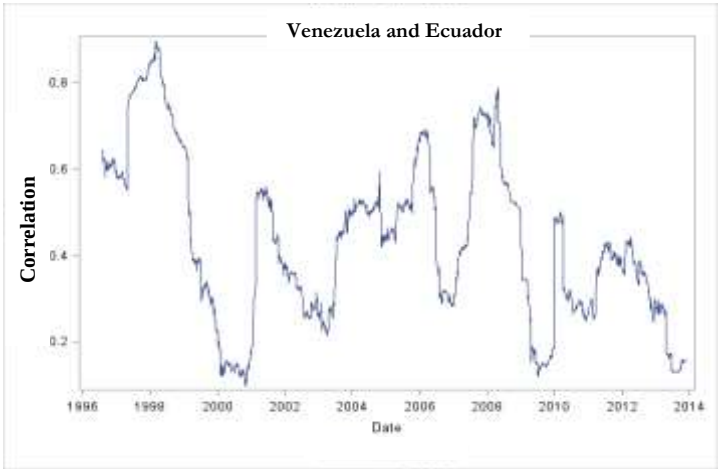












This figure shows a 252 day window rolling correlation measure between each country pair from 8/1/1996 to 11/21/2013.

other countries. We observe that this correlation between Brazil and Mexico continuously increases after 2001. For Mexico, the changes in sovereign CDS spreads generally have very low correlations (close to zero) with that of other countries during the time period of 1999-2001, around the time of the peso crisis. All correlations decrease during the time period of 1999 - 2002 and after the 2008 financial crisis. Altogether, we observe a theme of high positive correlations over time, which suggests that changes in sovereign CDS spreads are commonly affected by a set of factors. As a result, we investigate global financial factors later in this essay.

Correlation coefficients matrix

We calculate the correlation matrix of changes in sovereign CDS spreads for all five countries, provided in Table 2. First, all country pairwise correlations are significant. We observe that Brazil has its highest correlations with Mexico and Panama, where the correlations are both greater than 0.7. Similarly, Mexico has high correlations with Brazil and Panama and the correlation between Mexico and Panama is roughly 0.72.

Ecuador has the lowest correlation with the other countries where no single correlation is greater than 0.45. Venezuela has moderate correlation with the four countries where the correlation ranges within 0.38 and 0.80.

Table 2: Correlation Coefficients Matrix for Change in CDS

	ΔCDS_{Brazil}	$\Delta CDS_{Venezuela}$	ΔCDS_{Mexico}	ΔCDS_{Panama}	$\Delta CDS_{Ecuador}$
ΔCDS_{Brazil}	1.0000	0.6649***	0.8072***	0.7184***	0.4500***
		(<.0001)	(<.0001)	(<.0001)	(<.0001)
$\Delta CDS_{Venezuela}$	0.6649***	1.0000	0.5915***	0.5270***	0.4421***
	(<.0001)		(<.0001)	(<.0001)	(<.0001)
ΔCDS_{Mexico}	0.8072***	0.5915***	1.0000	0.7183***	0.3862***
	(<.0001)	(<.0001)		(<.0001)	(<.0001)
ΔCDS_{Panama}	0.7184***	0.5270***	0.7183***	1.0000	0.3563***
	(<.0001)	(<.0001)	(<.0001)		<.0001
$\Delta CDS_{Ecuador}$	0.4500***	0.4421***	0.3862***	0.3563***	1.0000
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	

Notes: The table reports correlation matrix of change in sovereign CDS spreads for all five countries. Numbers in the parenthesis are p-values.

4. EMPIRICAL METHODOLOGY

4.1 DCC GARCH Methodology and Empirical Results

To address interdependency among the changes in sovereign CDS spreads of the 5 countries, we investigate the data using a VAR model fitted with multivariate DCC GARCH, proposed by Engle (2002). The DCC GARCH model is as follows:

$$Y_t = \beta \sum_{p=1}^{i} X_{t-p} + \epsilon_t$$

Here, Y_t is the daily change in sovereign CDS spreads of each country and X_{t-p} are the lag terms of the dependent variables.

$$\epsilon_t = H_t^{1/2} \upsilon_t$$

$$H_t = D_t^{1/2} R_t D_t^{1/2}$$

$$R_t = diag(Q_t)^{-1/2} Q_t diag(Q_t)^{-1/2}$$

$$Q_t = (1 - \lambda_1 - \lambda_2)R + \lambda_1 \tilde{\epsilon}_{t-1} \tilde{\epsilon}'_{t-1} + \lambda_2 Q_{t-1} \qquad (1)$$

Equation 1 specifies the VAR model format and the preceding equations specify the GARCH format for the residuals from the estimated VAR model. H_t is the Cholesky factor of the time-varying conditional covariance matrix. D_t is a diagonal matrix of conditional variances. R_t is a matrix of conditional quasicorrelations expressed as:

$$R_t = \begin{pmatrix} 1 & \cdots & \rho_{1m,t} \\ \vdots & \ddots & \vdots \\ \rho_{1m,t} & \cdots & 1 \end{pmatrix}$$

We have a time-varying covariance matrix for the residuals from the VAR model and estimate the correlation matrix and λ_1 and λ_2 to determine if the residuals from VAR follow a GARCH (1, 1) process.

4.1.1 Binary VAR Model with DCC GARCH

First, we run a binary first order autoregressive model with DCC GARCH and estimate the pairwise correlations of the countries. From Table 3, it is evident that, irrespective of the country pairs used, all residuals are persistent, which indicates evidence of the GARCH (1, 1) process. λ_1 and λ_2 are highly significant at the 1 percent level. The correlations between all the country pairs are highly significant at the 1 percent level. The estimated correlations are similar to the results from the correlation matrix in Table 2. Again, Brazil is the most important country in the sample and none of its correlations with other countries is below 0.5.

To further our analysis, we include the sovereign CDS spreads of the five countries into the VAR model. In order to select the precise lag terms for the VAR model, we provide the criteria values for model fitness. Table 4 shows that, irrespective of the number of lags selected, all criterion values have no big difference. Therefore, VAR (2) and VAR (3) models have the lowest AIC and SBC, so due to parsimony purposes, we select two lags in our VAR model.

Table 3: Binary VAR with DCC GARCH

	BRA&VEN	BRA&MEX	BRA&PAN	BRA&ECU	MEX&PAN
Correlation	0.6659	0.7988	0.6953	0.5226	0.6941
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
λ_1	0.0431	0.0333	0.0540	0.0786	0.0518
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
λ_2	0.9382	0.9557	0.9294	0.9039	0.9243
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
	MEX&VEN	MEX&ECU	PAN&ECU	PAN&VEN	ECU&VEN
Correlation	0.5966	0.4233	0.3811	0.5330	0.5303
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
λ_1	0.0402	0.1090	0.0780	0.0413	0.0591
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
λ_2	0.9293	0.8521	0.9004	0.9323	0.9281
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)

Binary correlation between each country and coefficient for DCC GARCH estimation. The numbers in the parenthesis are *p*-values.

Table 4: Information Criteria

Lag	AIC	SBC	HQC	AICC
p=1	-37.7163	-37.7518	-37.7393	-37.7518
p=2	-37.7544	-37.6833	-37.7294	-37.7543
p=3	-37.7502	-37.6436	-37.7126	-37.75
p=4	-37.6084	-37.7506	-37.7005	-37.7504
p=5	-37.7498	-37.572	-37.6872	-37.7495

4.1.2 Multivariate VAR Model with DCC GARCH

Table 5 Panel A provides the detailed results for the estimated correlation matrix and estimated coefficients for λ_1 and λ_2. The results are consistent with the binary DCC GARCH model. Again, all the correlations of Brazil with other countries are higher than 0.5, with the exception of its correlation with Ecuador which drops to 0.43. Interestingly, the correlations between Ecuador and other countries decrease dramatically by roughly 10 - 15 percent, compared with the binary results. Similarly λ_1 and λ_2 are highly significant at the 1 percent level, which indicates the strong persistence of the residuals even in the multivariate format.

Table 5 Panel B provides the estimated parameters in the VAR model. The numbers in the parenthesis are p-values. Surprisingly, Panama seems to be the most important country in our sample; changes in CDS for the lag one and lag two periods are significant at the 1 percent level and all estimated coefficients are negative. Decreasing sovereign CDS spreads in Panama lead increasing sovereign CDS spreads in other countries in our sample.

Table 5: Multivariate VAR Fitted with DCC GARCH

Panel A: DCC GARCH Correlation

	ΔCDS_{Brazil}	$\Delta CDS_{Venezuela}$	ΔCDS_{Mexico}	ΔCDS_{Panama}	$\Delta CDS_{Ecuador}$
ΔCDS_{Brazil}	1.0000	0.6667 (<.0001)	0.7912 (<.0001)	0.7046 (<.0001)	0.4286 (<.0001)
$\Delta CDS_{Venezuela}$	0.6667 (<.0001)	1.0000	0.5926 (<.0001)	0.5140 (<.0001)	0.4093 (<.0001)
ΔCDS_{Mexico}	0.7912 (<.0001)	0.5926 (<.0001)	1.0000	0.7114 (<.0001)	0.3796 (<.0001)
ΔCDS_{Panama}	0.7046 (<.0001)	0.5140 (<.0001)	0.7114 (<.0001)	1.0000	0.3427 (<.0001)
$\Delta CDS_{Ecuador}$	0.4286 (<.0001)	0.4093 (<.0001)	0.3796 (<.0001)	0.3427 (<.0001)	1.0000
	$\lambda 1$	0.0276 (<.0001)	$\lambda 2$	0.9615 (<.0001)	

Table 5 PANEL B: DCC GARCH Coefficient Estimation

	ΔBRA_{t-1}	ΔVEN_{t-1}	ΔMEX_{t-1}	ΔPAN_{t-1}	ΔECU_{t-1}	ΔBRA_{t-2}	ΔVEN_{t-2}	ΔMEX_{t-2}	ΔPAN_{t-2}	ΔECU_{t-2}
ΔBRA	0.0974***	-0.0006	0.0372**	-0.0837***	-0.0158	0.0164	-0.0025	0.0522**	-0.0632***	-0.0121
	[<.0001]	[0.974]	[0.037]	[<.0001]	[0.189]	[0.469]	[0.882]	[0.004]	[<.0001]	[0.323]
ΔVEN	-0.0061	0.0885***	0.0354**	-0.0244	0.0012	0.0039	0.0033	0.0601***	-0.0691***	-0.0087
	[0.760]	[<.0001]	[0.027]	[0.115]	[0.914]	[0.843]	[0.858]	[<.0001]	[<.0001]	[0.441]
ΔMEX	0.1117***	-0.0149	0.0327	-0.0923***	-0.0136	0.0486**	0.0010	0.0320	-0.0988***	-0.0076
	[<.0001]	[0.453]	[0.140]	[<.0001]	[0.365]	[0.052]	[0.960]	[0.151]	[<.0001]	[0.612]
ΔPAN	0.0859***	0.0134	0.0607***	-0.0499**	-0.0147	0.0066	-0.0081	0.0732***	-0.0710***	-0.0134
	[<.0001]	[0.440]	[0.001]	[0.011]	[0.218]	[0.755]	[0.642]	[<.0001]	[<.0001]	[0.264]
ΔECU	0.0760***	-0.0905***	0.1267***	-0.0837***	-0.0279	-0.0393*	-0.0311	0.1512***	-0.1220***	0.0389**
	[0.001]	[<.0001]	[<.0001]	[<.0001]	[0.198]	[0.084]	[0.126]	[<.0001]	[<.0001]	[0.076]

Notes: Table 5 Panel B provides the estimated parameters in the VAR model. The numbers in the parenthesis are p-values.

For Mexico, the change in the sovereign CDS spread for lags one and two periods are significant for all other countries at the 5 percent level or higher except for itself. The coefficients are all positive which suggests that increasing sovereign CDS spreads in Mexico may lead to increasing sovereign CDS spreads in other countries. Finally, a lag one period change in the sovereign CDS spread of Brazil positively affects the change in sovereign CDS spreads in other countries except Venezuela. The lag two period change in the sovereign CDS spreads of Brazil is not significant in any country.

4.2 Alternative and Robustness Tests

To further exploit the asymmetric relationship of volatility and confirm the persistency of the variance of the residuals, we employ an OLS model following Daigler et al. (2014) expressed as follows.

$$\Delta\sigma_{i,t} = \beta_1\Delta r_{i,t} + \beta_2\Delta r_{i,t-1} + \beta_3\Delta r_{i,t-2} + \beta_4\Delta r_{i,t-3} + \gamma_1\Delta\sigma_{i,t-1} + \gamma_2\Delta\sigma_{i,t-2} + \gamma_3\Delta\sigma_{i,t-3} + \varepsilon_t \quad (2)$$

$$\Delta\sigma_{i,t} = \beta_1\left|\Delta R_{i,t}\right| + \beta_2\Delta r_{i,t-1} + \beta_3\Delta r_{i,t-2} + \beta_4\Delta r_{i,t-3} + \gamma_1\Delta\sigma_{i,t-1} + \gamma_2\Delta\sigma_{i,t-2} + \gamma_3\Delta\sigma_{i,t-3} + \theta_1\Delta VIX_t + \varepsilon_t \quad (3)$$

$$\Delta\sigma_{i,t} = \beta_1\left|\Delta r_{i,t}\right| + \beta_2\Delta r_{i,t-1} + \beta_3\Delta r_{i,t-2} + \beta_4\Delta r_{i,t-3} + \gamma_1\Delta\sigma_{i,t-1} + \gamma_2\Delta\sigma_{i,t-2} + \gamma_3\Delta\sigma_{i,t-3} + \theta_1\Delta Stock_{i,t} + \theta_2\Delta VIX_t + \varepsilon_t \quad (4)$$

Here, σ_i stands for the volatility of sovereign CDS spreads, and r_i represents the change in sovereign CDS spreads in each country, included in each equation. We include the S&P 500

implied volatility indexes in equation (3) and control for the local stock market return in equation (4). We calculate a rolling standard deviation for the change in sovereign CDS spreads in each country based on a 25-day rolling window as representative of volatility. We also include the lag terms for volatility and change in sovereign CDS spreads in each model. We then run these three equations for each country to investigate and confirm the persistence of the variance of changes in sovereign CDS spreads, as well as the relationship to local stock market returns and the U.S. VIX index. Table 6 reports detailed estimated parameters for each model and p-values in parenthesis.

The models in Table 6 confirm the persistence of the variance of the change in sovereign CDS spreads in all countries as is evident from the AR process for each model used in the 5 countries. For Brazil, Ecuador and Mexico, the volatility in the lag one (three) period is positively (negatively) significant at the 1 percent level and the contemporaneous change in CDS is also positively significant at the 1 percent level. There is possibly a mean reversion effect for the change in sovereign CDS spreads of these countries since the lag (-1) and lag (-3) terms seem to be negatively correlated. For Venezuela the lag one period volatility is positively significant at the 1 percent level and lag two periods volatility is negatively significant at the 10 percent level. Its volatility is not that persistent after three lags unlike the volatility of the aforementioned three countries. The volatility of Panama is persistent since all three lags are significant and the volatilities of lags two and three periods are negative, suggesting a possible mean reversion trend. We conclude at this point that the volatility of changes in sovereign CDS spreads is persistent in all countries and the contemporaneous change in sovereign CDS spreads positively affects the change in volatility. Moreover the local stock market return and VIX have no impact on the change in volatility of sovereign CDS spreads in any model.

Table 6: OLS Regression With VIX and Stock Market Return in Each Country

COUNTRY	Δr_t	Δr_{t-1}	Δr_{t-2}	Δr_{t-3}	$\Delta \sigma_{t-1}$	$\Delta \sigma_{t-2}$	$\Delta \sigma_{t-3}$	$\Delta Stock$	ΔVIX_i	$\Delta \lvert r_t \rvert$	R^2	*Adj.* R^2
Brazil	-0.0016	-0.0002	0.0018	0.0018	1.1390***	-0.0492	-0.0918***				0.9970	0.9970
	[0.1491]	[0.8532]	[0.2825]	[0.2274]	[<.0001]	[0.2012]	[0.0004]					
		-0.0005	0.0015	0.0015	1.1311***	-0.0459	-0.0914***	0.0019		0.0061	0.9971	0.9970
		[0.6491]	[0.3680]	[0.3463]	[<.0001]	[0.2338]	[0.0004]	[0.2424]		[3.78]		
		0.0001	0.0014	0.0014	1.1308***	-0.0453	-0.0918***	0.0013	-0.0004	0.0062***	0.9971	0.9970
		[0.6293]	[0.3855]	[0.3541]	[<.0001]	[0.2390]	[0.0004]	[0.4193]	[0.4191]	[0.0001]		
Venezuala	0.0003	-0.0004	0.0009	0.0011	1.2062***	-0.1965*	-0.0127				0.9955	0.9954
	[0.8349]	[0.7220]	[0.6098]	[0.4982]	[<.0001]	[0.0752]	[0.6053]					
		-0.0004	0.0006	0.0010	1.2014***	-0.1951*	-0.0134	0.0024*		0.0059***	0.9955	0.9955
		[0.7113]	[0.7073]	[0.5383]	[<.0001]	[0.0791]	[0.5815]	[0.0956]		[0.0031]		
		-0.0004	0.0006	0.0010	1.2016***	-0.1953*	-0.0133	0.0023	-0.0002	0.0060***	0.9955	0.9955
		[0.7032]	[0.7168]	[0.5558]	[<.0001]	[0.0789]	[0.5841]	[0.1110]	[0.6671]	[0.0032]		
Mexico	-0.0001	-0.0018	0.0003	0.0037***	1.1108***	-0.0143	-0.0981***				0.9974	0.9974
	[0.8894]	[0.1847]	[0.8458]	[0.0027]	[<.0001]	[0.6673]	[<.0001]					
		-0.0019	0.0000	0.0036***	1.1033***	-0.0132	-0.0961***	0.0024		0.0059***	0.9974	0.9974
		[0.1640]	0.9933	[0.0044]	[<.0001]	[0.6957]	[<.0001]	[0.2690]		[<.0001]		
		-0.0019	0.0000	0.0036***	1.1033***	-0.0131	-0.0962***	0.0017	-0.0003	0.0060***	0.9974	0.9974
		[0.1604]	[0.9886]	[0.0047]	[<.0001]	[0.6973]	[<.0001]	[0.4491]	[0.5133]	[<.0001]		

COUNTRY	Δr_t	Δr_{t-1}	Δr_{t-2}	Δr_{t-3}	$\Delta \sigma_{t-1}$	$\Delta \sigma_{t-2}$	$\Delta \sigma_{t-3}$	$\Delta Stock$	ΔVIX_i	$\Delta \lvert r_t \rvert$	R^2	*Adj.* R^2
Panama	-0.0002	0.0018*	0.0017	0.0031***	1.1074***	-0.0629**	-0.0461**				0.9972	0.9972
	[0.8838]	[0.0915]	[0.1508]	[0.0059]	[<.0001]	[0.0362]	[0.0127]					
		0.0018	0.0015	0.0031***	1.1010***	-0.0585*	-0.0493***	0.0033		0.0070***	0.9973	0.9973
		[0.1057]	[0.2089]	[0.0050]	[<.0001]	[0.0502]	[0.0075]	[0.5085]		[<.0001]		
		0.0018	0.0014	0.0030***	1.1016***	-0.0584*	-0.0502***	0.0026	-0.0009*	0.0073***	0.9973	0.9973
		[0.1077]	[0.2529]	[0.0061]	[<.0001]	[0.0501]	[0.0064]	[0.6115]	[0.0778]	[<.0001]		
Ecuador	0.0002	-0.0026	0.0032	0.0026	1.0196***	-0.0192	-0.0115*				0.9779	0.9779
	[0.9446]	[0.1782]	[0.1848]	[0.1647]	[<.0001]	[0.2884]	[0.0832]					
		-0.0034	0.0028	0.0025	1.0160***	-0.0176	-0.0141*	-0.0027		0.0104*	0.9780	0.9780
		[0.1106]	[0.2366]	[0.1804]	[<.0001]	[0.3386]	[0.0678]	[0.1156]		[0.0770]		
		-0.0035	0.0027	0.0024	1.0163***	-0.0178	-0.0143*	-0.0027	-0.0009	0.0105*	0.9780	0.9780
		[0.1027]	[0.2505]	[0.2023]	[<.0001]	[0.3350]	[0.0641]	[0.1191]	[0.2814]	[0.0754]		

4.3 Panel techniques: Relation of Sovereign CDSs to Terms of Trade and Global Factors

4.3.1 Variables

There is extensive evidence in the literature that shocks to U.S. equity and fixed income markets are transmitted globally. In this section, we expand our analysis to 19 countries which we simultaneously analyze in a panel regression format with 10 specifications. We explore terms of trade, proxied by country-specific commodity price indexes, the components of which are major commodities traded in world markets. Additionally, we update our measure of volatility from VIX to a measure of VIX volatility risk premium, which captures the risk premium embedded in the VIX index. In lieu of the local stock indexes, we replace this variable with the U.S. stock market return, in our consideration of global financial factors as sources of commonality in sovereign credit risk. In addition to global factors, we include our country-specific terms of trade variable in the analysis.

Country-specific variables: Following Hilscher and Noshbusch (2010), we construct our monthly country-specific commodity price index using data on country commodity shares of export from COMTRADE and commodity prices from World Bank commodity data. The indexes we construct are made up of major commodities that trade on world markets. Since terms of trade may be affected by similar factors that influence a country's capacity to repay its external debt, the country-specific commodity price indexes control for any potential endogeneity of terms of trade. We select 12 commodities to make up out index including, oil, coffee, textiles, copper, cotton, cocoa, meat, bananas, leather, gold, gas and silver. We calculate the commodity price change as the weighted average price change of the 12 commodity price series, weighted by the annual commodity percentage of export value for a sovereign. The time-varying commodity weight varies by country. We also include a variable for the volatility in the country-specific commodity price indexes.

Global Financial Factors: For the U.S. stock market return variable, we include the excess return on all CRSP firms incorporated in the US and listed on the NYSE, AMEX, or NASDAQ. The literature provides evidence that the difference between implied and realized (historical) volatility may proxy the volatility premium for holding an option (Mark Britten-Jones and Anthony Neuberger, 2000; Pan 2002, etc.). Using daily returns of the S&P 500 index, a 20-day rolling volatility of the returns is calculated for realized volatility. The month-end value of the realized volatility estimator is subtracted from the corresponding same-day CBOE volatility index (VIX) to obtain our proxy for the volatility risk premium embedded in the VIX index. The volatility risk premium proxy is the difference between the two time series. Additionally, we incorporate the change in the spread between the 10-year return on U.S. BB-rated corporate bonds and the 6-month U.S. Treasury bill rate, viewed as a measure of both U.S. macroeconomic and global financial market developments, to explore the effect on changes in sovereign CDS spreads.

Lags and dummy variables: we include lagged variables for the monthly changes in sovereign CDS spreads and commodity price index returns, to control for variation that may be caused by previous changes in these variables. Using a dummy variable, we also control for the changes in sovereign CDS spreads during the years of the financial crisis, from 2007 to 2009.

Regional and Country group dummy variables: Additionally, using the spreads of sovereigns within particular groups, we construct dummy variables as proxies for regional and external economic factors. We identify the BRICS and Latin America country groups and calculate the average sovereign CDS spreads and monthly changes in the spreads. We also regress the changes in sovereign CDS spreads on these country group dummy variables.

4.3.2 Panel Regressions

For the 19 countries, in successive model specifications, we regress the monthly change in sovereign CDS spreads on changes in terms of trade (country-specific commodity price index), U.S. stock market excess return, U.S. BB corporate bond index spread, volatility risk premium, volatility of commodity price index, lags of changes in sovereign CDS spreads, lags of changes in commodity price index, dummy variables for the financial crisis, BRICS and Latin America countries as well as interaction variables, and country fixed effects to control for these effects. Table 7 reports the t-statistics and adjusted R^2 of our 9 model regressions.

$$\Delta r_{i,t} = \propto + \beta_1 \Delta tot_{i,t} + \beta_2 \Delta US_{stk_t} + \beta_3 \Delta BB_t + \beta_4 VIX_{rp_t} + \beta_5 \sigma tot_{i,t} + \beta_6 \Delta r_{i,t-1} + \beta_7 \Delta r_{i,t-2} + \beta_8 \Delta tot_{i,t-1} + \beta_9 \Delta tot_{i,t-2} + dummies + \delta t + \varepsilon_t \qquad (5)$$

Starting with our country factor variable of interest, the country-specific commodity price index, Table 7 suggests that terms of trade affects the sovereign's credit risk. We observe striking results for changes in country-specific commodity price indexes. This variable is significant at the 1% level in 8 of our model specifications, even after we control for U.S. stock market return, U.S. BB corporate bond return and volatility risk premium. The sign of the coefficient for the country-specific commodity price index is uniformly negative across all specifications, indicating that good news for a sovereign's terms of trade is also favorable for its sovereign credit risk, as sovereign CDS spreads decrease. Our results suggest that narrowing CDS spreads may result from increasing country terms of trade. Hilscher and Nosbusch's (2010) results on terms of trade which use sovereign bond yields to proxy for sovereign credit risk are similar to ours, although we proxy for

sovereign credit risk with sovereign CDS spreads. This, to our knowledge, is a new result providing further evidence on sovereign CDS premiums.

Turning to the global financial factors, we observe consistent results to the literature on the sources of commonality in sovereign credit risk. The U.S. stock market return is significant in all specifications in explaining variation in sovereign credit risk. It is consistently negative in sign. We interpret the negative significant coefficients as implying that improving U.S. market conditions are associated with good news for sovereign CDS spreads. Likewise, sovereign CDS spreads are significantly related to the volatility risk premium embedded in the VIX index. The volatility risk premium has negative coefficients and is significant at the 1 percent level in all specifications. Our results are consistent with the view that global time-varying risk premiums are important in explaining sovereign credit risk. This is consistent with the view that global factors are responsible for our significant DCC GARCH correlations of the comovements of sovereign CDS spreads. Our significant results on VIX are consistent with previous findings (including, Schaefer and Strebulaev (2008) and Pan and Singleton (2008), and support the view that VIX is an indicator of investor sentiment and appetite for global event risk. Our U.S. BB corporate bond index spread variable, though significant at the 5 percent level in model 3, pales in significance when compared to the other global financial factors. Overall, our result on the influence of terms of trade on sovereign CDS spreads is particularly important, given that we obtain this result after controlling for global financial factors considered by the literature to be significant in explaining changes in sovereign CDS spreads.

The lagged variables for changes in sovereign CDS spreads (lags -1, -2) and changes in the country-specific commodity price index (lag -1) are also significant explanatory variables. The results for the lagged changes in CDS spreads are consistent with our earlier results from the DCC GARCH model, in that the coefficients of the lags (-1, - 2) changes are generally negative and

positive, respectively. The coefficient of the financial crisis is significant at the 10 percent level, though its explanatory power is not as strong as our constructed commodity price index terms of trade measure, U.S. equity return and BB corporate bond index spread. Overall, our results are not explained by our BRICS and Latin America groupings of countries, as these dummy variables are not significant. The interaction variable for Latin America and the changes in country-specific commodity price index is significant at the 5 percent level, which is weaker than the strong results for the U.S. equity returns and volatility risk premium global factors.

Table 7: Sovereign risk, terms of trade and global factors

$$\Delta r_{i,t} = \propto + \beta_1 \Delta tot_{i,t} + \beta_2 \Delta US_{stk_t} + \beta_3 \Delta BB_t + \beta_4 VIX_{rp_t} + \beta_5 \sigma tot_{i,t} + \beta_6 \Delta r_{i,t-1} + \beta_7 \Delta r_{i,t-2} + \beta_8 \Delta tot_{i,t-1} + \beta_9 \Delta tot_{i,t-2} + dummies + \delta t + \varepsilon_t$$

Monthly changes in CDS spreads are regressed on monthly changes in country commodity price indexes (Δtot) instrumenting for terms of trade, US Stock Market excess return (US_stk), US BB corporate bond spread (BB), VIX volatility risk premium (VIX_rp); volatility of commodity price index (σ_tot); lag changes in CDS spreads (lag -1 (Δr_{t-1}) and lag -2 (Δr_{t-2})); lag changes in commodity price indexes (lag -1 (Δtot_{t-1}) and lag -2 (Δtot_{t-2})); dummy variables for the financial crisis, BRICS countries, LATAM countries; interaction variables: BRICS*Price, LATAM * price; models include country fixed effects. We report the t-statistics and adjusted R^2 of the regressions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
VARIABLES	Model[1]	Model[2]	Model[3]	Model[4]	Model[5]	Model[6]	Model[7]	Model[8]	Model[9]
Δtot	-0.3411***	-0.2344***	-0.2275***	-0.1430***	-0.1537***	-0.1386***	-0.1490***	-0.1415***	-0.0809
	(-11.09)	(-8.48)	(-8.18)	(-5.21)	(-5.41)	(-4.91)	(-5.26)	(-3.86)	(-1.56)
US_stk_t		-1.6134***	-1.5913***	-1.3442***	-1.3549***	-1.3509***	-1.3671***	-1.3603***	-1.3586***
		(-24.89)	(-24.25)	(-20.47)	(-20.47)	(-20.28)	(-20.47)	(-20.26)	(-20.22)
BB_t			0.2350**	0.1366	0.1048	0.0160	0.0414	-0.0208	-0.0239
			(2.07)	(1.25)	(0.93)	(0.14)	(0.36)	(-0.17)	(-0.20)
VIX_rp				-0.7392***	-0.7327***	-0.6649***	-0.6642***	-0.6509***	-0.6439***
				(-13.68)	(-13.48)	(-12.01)	(-12.03)	(-11.62)	(-11.49)
σtot					0.2523	0.3269	0.2641	0.1086	0.0693
					(0.82)	(1.05)	(0.84)	(0.33)	(0.21)
lag -1 (Δr_{t-1})						0.1557***	0.1680***	0.1663***	0.1652***
						(8.45)	(9.02)	(8.91)	(8.85)
lag -2 (Δr_{t-2})						-0.0567***	-0.0575***	-0.0584***	-0.0609***
						(-3.14)	(-3.13)	(-3.18)	(-3.30)
lag -1 (Δtot_{t-1})							0.1093***	0.1097***	0.1099***
							(3.84)	(3.85)	(3.86)
lag -2 (Δtot_{t-2})							-0.0435	-0.0417	-0.0429
							(-1.55)	(-1.48)	(-1.52)
Financial crisis dummy								0.0134*	0.0137**
								(1.95)	(1.99)
Financial crisis variable*Price								-0.0195	-0.0445
								(-0.35)	(-0.76)
BRICS countries dummy									-0.0060
									(-0.91)
BRICS variable*Price									-0.0199
									(-0.31)
LATAM dummy variable									-0.0042
									(-0.71)
LATAM*Price									-0.1484**
									(-2.44)
Constant	0.0011	0.0088***	-0.0048	0.0275***	0.0259***	0.0277***	0.0266***	0.0278***	0.0314***
	(0.34)	(2.99)	(-0.67)	(3.78)	(3.31)	(3.49)	(3.34)	(3.46)	(3.61)
Observations	2,308	2,308	2,308	2,308	2,298	2,261	2,261	2,261	2,261
Adj. R-squared	0.0503	0.251	0.252	0.308	0.309	0.333	0.337	0.337	0.339

5. CONCLUSION

We investigate the co-movement of sovereign CDS spreads in several countries by employing a second order VAR model fitted with a DCC GARCH process as proposed by Engle (2002). In addition to finding that the country pairwise correlations are generally significant, we find consistent results across the binary and multivariate DCC GARCH models, suggesting commonality in the sources of variation of sovereign CDS spreads. Further, our results suggest that local stock returns and the U.S. VIX index are not important sources of variation of sovereign CDS spreads, though we obtain significant results when we isolate the volatility risk premium embedded in the VIX index. Exploring the variance of residuals from the VAR model, we find that they are persistent over time. Our results confirm that volatility is persistent in four out of five Latin American countries in our initial sample.

Expanding the sample size to 19 countries, we exploit panel regressions to study the sources of the strong commonality, exploring global financial factors and introducing terms of trade as a significant variable that explains changes in sovereign CDS spreads. Due to terms of trade endogeneity concerns, we construct 19 country-specific commodity price indexes to instrument for country terms of trade. Our novel results indicate that the country-specific commodity price indexes have a statistically and economically significant effect on changes in sovereign CDS spreads, even after controlling for global factors. In addition to this new evidence on sovereign CDS markets and terms of trade, we validate previous results on global financial factors, confirming that they are significant sources of variability in sovereign credit risk, with strongest results for U.S. stock market returns and the volatility risk premium embedded in VIX factors. Our results apply broadly to investors, financial institutions and policy makers.

REFERENCES

Adler, M., & Qi, R. (2012). Changes of Skewness and Coskewness in Latin American Stock Returns: Behavioral vs. Fundamental Factors. Fundamental Factors (January 16, 2012).

Blanco, R., Brennan, S., & Marsh, I. W. (2005). An empirical analysis of the dynamic relation between investment-grade bonds and credit default swaps. The Journal of Finance, 60(5), 2255-2281.

Britten-Jones, M., & Neuberger, A. (2000). Option prices, implied price processes, and stochastic volatility. The Journal of Finance, 55(2), 839-866.

Cato, L., & Kapur, S. (2006). Volatility and the debt-intolerance paradox. IMF Staff Papers, 195-218.

Daigler, R. T., Hibbert, A. M., & Pavlova, I. (2014). Examining the Return–Volatility Relation for Foreign Exchange: Evidence from the Euro VIX. Journal of Futures Markets, 34(1), 74-92.

Duffie, D. (1999). Credit swap valuation. Financial Analysts Journal, 55(1), 73-87.

Engle, R. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models. Journal of Business & Economic Statistics, 20(3), 339-350.

Gjika, D., & Horvath, R. (2013). Stock market comovements in Central Europe: Evidence from the asymmetric DCC model. Economic Modelling, 33, 55-64.

Greenwood, R., & Thesmar, D. (2011). Stock price fragility. Journal of Financial Economics, 102(3), 471-490.

Greenwood, R. M. (2005). A cross sectional analysis of the excess comovement of stock returns. HBS Finance Research Paper(05-069).

Hassan, M. K., Ngene, G. M., & Yu, J.-S. (2015). Credit default swaps and sovereign debt markets. Economic Systems, 39(2), 240-252.

Hassan, M. K., Ngow, T. S., Yu, J.-S., & Hassan, A. (2013). Determinants of credit default swaps spreads in European and Asian markets. Journal of Derivatives & Hedge Funds, 19(4), 295-310.

Hilscher, J., & Nosbusch, Y. (2010). Determinants of sovereign risk: Macroeconomic fundamentals and the pricing of sovereign debt. Review of Finance, rfq005.

Hull, J., Predescu, M., & White, A. (2004). The relationship between credit default swap spreads, bond yields, and credit rating announcements. Journal of Banking & Finance, 28(11), 2789-2811.

Ismailescu, I., & Kazemi, H. (2010). The reaction of emerging market credit default swap spreads to sovereign credit rating changes. Journal of Banking & Finance, 34(12), 2861-2873.

Longstaff, F. A., Pan, J., Pedersen, L. H., & Singleton, K. J. (2011). How sovereign is sovereign credit risk? American Economic Journal: Macroeconomics, 3(2), 75-103.

Narayanan, R., & Uzmanoglu, C. (2013). CDS Exposure and Credit Spreads.

Norden, L., & Weber, M. (2009). The co-movement of credit default swap, bond and stock markets: An empirical analysis. European financial management, 15(3), 529-562.

Pan, J., & Singleton, K. J. (2008). Default and recovery implicit in the term structure of sovereign CDS spreads. The Journal of Finance, 63(5), 2345-2384.

Schaefer, S. M., & Strebulaev, I. A. (2008). Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds. Journal of Financial Economics, 90(1), 1-19.

Stulz, R. M. (2010). Credit default swaps and the credit crisis. The Journal of Economic Perspectives, 24(1), 73-92.

Zhang, B. Y., Zhou, H., & Zhu, H. (2009). Explaining credit default swap spreads with the equity volatility and jump risks of individual firms. Review of Financial Studies, 22(12), 5099-5131

Essay Two

Differential Stock Market Returns and Corporate Credit Risk of Listed Firms

Uche Isiugo

ABSTRACT

This essay examines the information transfer effect of shocks to sovereign credit risk as captured in the credit default swaps (CDS) and stock market returns of cross-listed and local stock exchange listed firms. Based on changes in sovereign credit ratings and outlooks, we find that widening CDS spreads of firms imply that negative credit events dominate, whereas tightening spreads indicate positive events. Grouping firms into companies with cross-listings and those without, we compare the spillover effects and find strong evidence of contagion across equity and CDS markets in both company groupings. Our findings suggest that the sensitivity of corporate CDS prices to sovereign credit events is larger for non-cross-listed firms. Possible reasons for this finding could in fact be due to cross-listed firms' better access to external capital and less degree of asymmetric information, relative to non-cross-listed peers with lower level of investor recognition. Our results provide new evidence relevant to investors and financial institutions in determining sovereign credit risk germane to corporate financial risk, for the construction of debt and equity portfolios, and hedging considerations in today's dynamic environment.

JEL classification: F34, G14, G15, G32

Keywords: Cross-listing, Corporate credit risk, Credit Default Swaps, Sovereign risk, Credit ratings

1. INTRODUCTION

Understanding the impact of sovereign debt risk on domestic firms is important. This phenomenon, sometimes referred to as transfer risk, is represented by a spillover from sovereign to corporate credit risk. In more extreme cases, the debt encumbrance of a sovereign in financial distress may plausibly be shifted onto the private sector through some channels, including changes in available bank financing, decline in government aid or subsidy programs, heightened taxation. Sovereign credit events have been found to cause contagion across financial markets, therefore it is crucial to understand the dynamics of sovereign risk and its effects on the corporate credit risk and equity returns of domiciled firms.

Cross-listed firms have a proclivity to alter their access to foreign equity and debt markets. Holton et al. (2014), in examining the Euro credit crisis, show that the sovereign crisis spilled over into the real economy through tighter credit conditions, associated with an increase in loan rejections and interest rates for SMEs. Attempts to solve financing deficits may be employed by firms by making a cross-listing decision. Sovereign credit risk affects firms through a number of channels. First, during a sovereign default, both cross-listed and non cross-listed firms may have significant exposure to potential capital and currency controls that sovereigns sometimes impose in a crisis. Second, sovereign credit ratings have important implications on the ratings of companies domiciled within the country. Ratings agencies often impose a sovereign credit rating ceiling on the credit rating of companies. While a few companies are able to achieve a credit rating higher than that of the sovereign, there is a limit on how much a company's rating can exceed the sovereign's. Third, a downgrade or an upgrade of sovereign debt may lead to changes in the capital requirements of domestic financial institutions, which have implications on the capital and bank credit available to local firms, irrespective of their cross-listings or lack thereof. Changes in sovereign credit risk have effects on risk-weighted bank capital, which in turn can affect the financing of firms, as banks may

hold additional capital against increasingly risky sovereign debt. Fitch Ratings reports a EUR 2.3 trillion exposure of EU banks to sovereign risk at end-June 2015, two-thirds of which is weighted in the banks' domestic sovereigns. Sovereign bonds are usually deemed safe securities and play a big role in providing bank liquidity.

Exploiting a daily data set consisting of dollar denominated CDSs linked to corporate reference obligors, we examine the reaction of corporate CDS spreads to sovereign credit rating changes and the spillover effects of these events into credit and equity markets. Specifcally, we seek to address the following questions:

1. Do sovereign credit events significantly impact corporate credit risk? Is there significant reaction in the corporate CDSs and stock prices of domiciled firms? Do the sovereign credit rating announcements contain relevant new information for firms?
2. Compared to non-cross-listed firms, do cross-listed firms have a signifcantly differential reaction to sovereign credit events. Are cross-listed firms' CDS reactions more sensitive to changes in sovereign credit ratings?
3. Do positive (negative) sovereign credit events lead to a relatively lesser (greater) improvement in the CDS spreads of cross-listed firms, compared to the CDS spreads of non-cross-listed firms. Are non-cross-listed firms poised to gain more following an improved sovereign credit rating?
4. Are sovereign credit events anticipated in the corporate CDS market?

Following the above questions, our first hypothesis is:

H1: Sovereign credit events are associated with corporate credit risk.

Cross-listed corporations are likely able to more flexibly address gaps in financing and may enjoy improved access to external capital, such that their exposure to changes in sovereign credit worthiness or general credit conditions may be limited, leading to our second hypothesis:

H2: Cross-listed firms, compared to firms listed only on local-exchanges, have a differential reaction sovereign credit events.

Non-cross-listed firms, compared to cross-listed firms usually have a more limited access to raise capital in foreign markets. Hence, if firms generally suffer from more constrained access to foreign capital during negative credit events or downturns, non-cross-listed firms may experience a worse deterioration in financing. Our third hypothesis follows:

H3: Following negative sovereign credit events, CDS spreads of non-cross-listed firms are expected to rise to a greater degree than that of cross-listed firms

One reason for this is due to the limited ability of non-cross-listed firms to raise capital in foreign markets. We also investigate the reaction of firms to positive sovereign events

If changes in sovereign credit events reflect only publicly available information and are relevant to corporate risk, corporate CDS spread reactions should be anticipatory, to reflect impending sovereign credit announcements. This forms the basis of the following hypotheses.

H4: Corporate CDS spreads do not generally anticipate negative sovereign events

H5: Corporate CDS spreads do not generally anticipate positive sovereign events

Firms that decide to cross-list are expected to have growth opportunities and solve a financing deficit. Relative to firms that are listed only on local exchanges, cross-listed firms have improved access to external capital and may solve financing deficit problems more flexibly. We therefore expect a differential reaction of cross-listed firms to shocks to domestic capital supply that

might arise following significant sovereign credit events. To capture this, we examine the behavior of corporate CDSs and stock returns in assimilating new sovereign credit information from sovereign credit rating and outlook announcements made by Moody's Investors Service . By means of the reaction of corporate CDS spreads, we explore the relationship between changes in sovereign credit ratings and corporate credit risk. We also examine the association between sovereign credit ratings and the equity returns of domiciled firms. Using our results from the reactions of cross-listed firms and companies listed only on local exchanges, we are able to make inferences on the benefits and costs of cross-listing by comparing both groups of firms.

Major sovereign credit events commonly affect several companies in the economy, so it is important to understand how cross-listed firms react relative to their non-cross-listed peers. One of the justifications for cross-listing is to lower the cost of capital by overcoming investment barriers that segment capital markets (Doidge et al., 2009). We expect that an increase in sovereign risk may lead to greater weakening of corporate credit risk among non-cross-listed firms, due to their limited access to foreign capital sources. We expect a similar effect as seen across companies that rely on explicit and implicit government guarantees during episodes of heightened sovereign risk. As our main hypothesis, we therefore conjecture that changes in sovereign credit risk are associated with significantly differenct changes in corporate credit risk for local-exchange firms relative to cross-listed firms.

2. RELEVANT LITERATURE

There has been increased interest in research investigating the link between sovereign and corporate credit. This follows a preponderance of sovereign credit risk in developed economies, particularly in the Eurozone. Sovereign credit ratings can affect firms' investment and cost of debt.

Arteta and Hale (2006) find that sovereign debt crises are systematically associated with a decline in foreign credit issued by domestic private firms. This potentially leads to crowding out in domestic credit markets and more capital-constrained firms. Almeida, et al. (2014) find that firms reduce their investment and reliance on credit markets due to rising cost of debt capital following a sovereign rating downgrade. In the event that spillovers to corporate CDS markets depend on firm characteristics such as government aid, concentration of domestic sales, degree of reliance on bank financing (Bedendo and Colla (2015), we argue that there may in fact be differential spillover effects to cross-listed firms. Pagano, et al. (2002) document that cross-listed firms expand their foreign sales after listing abroad. Acharya, et al. (2014) model a loop between sovereign and bank credit risk and show that a distressed financial sector induces government bailouts, whose cost increases sovereign credit risk. This weakens the financial sector, and conceivably, diminishes the available credit to firms by eroding the value of government guarantees and bond holdings. There are direct costs related to the decline in sovereign creditworthiness and the resultant level of production in the economy. A deterioration of credit risk can impede future economic growth, and for that reason, make subsequent debt crises more probable.

Research also explores the transfer of information by investigating the reaction of CDS spreads to important events. Hull, Predescu, and White (2004), Longstaff, Mithal, and Neis (2004), Norden and Weber (2004), and Blanco et al. (2005) find that CDS prices are a source of valuable information on firms. Ismailescu and Kazemi (2010) examine the response of sovereign CDS markets to sovereign credit announcements, observing cross-country spillovers across different sovereign CDSs, found to be transmitted via common creditor and competition in trade markets. They argue that positive rating announcements have an immediate impact on sovereign CDS markets, while negative rating announcements have no impact. Jorion and Zhang (2007) examine the intra-industry information transfer effect of credit events, as captured in the corporate CDS and

stock markets and find evidence of contagion effects for Chapter 11 bankruptcies. Movements in firm's CDS spreads are often negatively related to changes in stock prices because some credit events imply differing movements across these markets. Acharya and Johnson (2007) argue that there is an information flow from the CDS markets to equity markets and that this flow is permanent and more significant for entities with a greater number of bank relationships.

There has been much debate in the literature regarding the relative benefits of cross-listing. According to the bonding theory, one benefit of a U.S. cross-listing is that firms can finance growth opportunities on better terms (Coffee (1999) and Stulz (1999). Some of the emphasized benefits include, the increase in liquidity of cross-listed foreign shares, the prospect of raising lower cost capital in a more efficient market, an enlarged shareholder base to diversify financial risk, and increased prestige and investors' recognition of cross-listing firms. Siegel (2005) suggests that reputational bonding could occur as the result of giving capital to a firm, observing the firm reveal its true type during a downturn, and then allocating a number of more economically significant rewards and punishments based on revelations. This line of research suggests that the market strongly rewards cross-listed firms for not being accused of any large-scale expropriation during an economic downturn.

Similar to our research, some studies have explored market announcement reactions of firms in the capital markets, deemed economic costs or benefits, and ascribed the resultant reactions to improved information flows across firms after cross-listing. Relative to differences in information, Ashcraft and Santos (2009) find economically significant adverse effects to the cost of debt of risky and informationally-opaque firms, stemming from the availability of CDS trading. This finding on firms with higher asymmetric information is different from the results on the average borrower. Our analysis is in the spirit of studies addressing the costs vs. benefits and economic impacts of cross-listings. It is expected that an increase in sovereign risk may lead to a differential reaction of

corporate credit risk among firms that are cross-listed. According to, Sarkissian and Schill (2009), firms decide to cross-list in order to surmount capital and informational barriers as well as gains to market characteristics. In studying the economic impact of a cross-listing, they find a prelisting runup and a postlisting decline and discover that the average cost of capital gains from cross-listing are statistically zero. Bailey, et al. (2006) study the implications of increased disclosure faced by cross-listed non U.S. firms and find that absolute return and volume reactions to earnings announcements typically increase significantly after cross-listing.

According to surveys of managers, capital market access is a primary motivation for foreign listings (Karolyi, 2012). This advantage is likely to be greatest for those firms that are financially constrained. Lins et al. (2005) shows that foreign firms that list in the U.S. become less credit-constrained due to cross-listing, as firms' investments depend less on their cash flows subsequent to the U.S. listing. Ndubizu (2007) finds that cash flows peak in years -1 and 0 of the cross-listing and fall significantly in subsequent years. Fresard and Salva (2010) show that the value investors attach to excess cash reserves is substantially larger for foreign firms listed on US exchanges and over-the-counter than for their domestic peers. They find that investors place higher value on the excess cash reserves of foreign firms listed on US exchanges and over-the-counter, due to US legal rules and disclosure requirements, greater informal monitoring and constraints on insiders' inefficient allocation of corporate cash. Doidge, et al. (2010) find that firms that subsequently delist from the United States financial markets do so because they do not foresee the need to raise funds externally. Edison and Warnock (2008) suggest that cross-listing of an emerging market firm on a U.S. exchange is an important but short-lived capital flows event. They suggest that the cross-listed stock is in effect a new security that U.S. investors quickly bring into their portfolios and conclude that most if not all of the effect of a cross-listing occurs in the month of the listing.

Prior to changes in sovereign credit ratings, we test whether there is anticipation in the CDS and the stock market returns of these two groups of firms. We expect that positive sovereign credit events are generally unanticipated by corporate CDS spreads. Relative to positive sovereign credit events, the CDS spreads of cross-listed firms are expected to narrow, though by a lower percent compared to that of firms that are not cross-listed. One reason for this is due to the ability of cross-listed firms to raise capital in foreign markets. Therefore, the credit risk of cross-listed firms is more integrated with global capital markets.

We investigate the reaction of firms to negative sovereign events, as we expect an association between the CDS spreads of both groups of firms and negative sovereign credit events. Further, adverse news such as a sovereign credit downgrade should have a greater impact on the volatility of the CDS spreads of local-exchange only firms. We expect these effects to be particularly strong in cases of sovereign downgrades from investment grade to speculative, and for defaults. In an efficient market new information is instantaneously absorbed. We utilize changes in sovereign bond ratings because they represent significant new information. We expect that the information transmitted from sovereign credit rating change events is not instantly incorporated in the corporate CDS spreads. We also expect differential speeds of adjustment in the CDS spreads of cross-listed firms and local-exchange firms. Our results suggest that new information is not instantaneously incorporated but that there is a steady and continuing adjustment for a significant period after the rating change.

We also investigate the stock returns of cross-listed firms and local-exchange firms, to explore the effects of changes in sovereign credit ratings. Additionally, we test to determine if stock returns anticipate sovereign credit events. Changes in sovereign credit ratings can potentially affect equity returns. We expect that positive sovereign credit events would be largely unanticipated by the stock returns. Cross-listed firms enjoy higher investor recognition, liquidity and have a higher

probability of being incorporated in portfolios. Positive sovereign credit events may therefore drive larger effects on the equity returns of cross-listed firms than stock returns of firms that are not cross-listed. Likewise, we investigate the reaction of firms to negative sovereign events. We expect that the stock returns of cross-listed firms would anticipate negative sovereign events. Furthermore, local-exchange only firms should experience greater volatility of stock returns than that of cross-listed firms. We expect these effects to be particularly strong in cases of sovereign downgrades from investment grade to speculative, and for defaults.

These effects are decidedly more muted in the stock market than in the corporate CDS market. In an efficient market, new information is instantaneously absorbed. We utilize changes in sovereign bond ratings because they represent significant new information. We expect that the information transmitted from sovereign credit rating change events is not instantly incorporated in the corporate CDS and stock markets. Our results suggest that this new information is not instantaneously incorporated but that there is a steady and continuing adjustment for a significant period after the rating change. However, the corporate CDS markets reflect the new information more rapidly than the stock market. One possible explanation for this difference might be that there are two distinct markets for corporate CDS and stocks.

2.1 The CDS Market

A credit default swap (CDS) is a contract that protects against the risk of bond default by a country or corporation. Buyers of CDS contracts pay the CDS premium to CDS sellers. Similar to a typical insurance contract, CDS buyers pay premiums over time. The premium is equal to the CDS spread, a percentage of the contract's notional value expressed in basis points. The similarity between CDS and insurance contracts does not hold in some important ways. CDS contracts are

traded, whereas insurance contracts are not traded. Additionally, buyers of CDS contracts do not have to own the underlying bonds in order to enter the CDS contract, while buyers of insurance contracts usually have to demonstrate a direct economic exposure to acquire insurance. By the end of 2014, CDS contracts referencing non-financial firms stood at $6 trillion, financial firms $4 trillion, multiple sectors $4 trillion while those referencing sovereigns stood at $2 trillion. By rating, contracts referencing investment grade entities equaled $10 trillion and those referencing lower-rated or unrated entities $7 trillion.

2.2 Types of Cross-listed firms

In addition to domestically listed firms, our sample contains cross-listed firms with Level I, II and III ADR United States programs as well as firms listed on the London Main Market. The cross-listing literature has demonstrated that only the Level II and III ADRs programs have a higher corporate governance quality (Doidge et al., 2004; Schrage & Vaaler, 2005) and benefit from bonding. With a level 1 ADR, a firm neither needs to register with the U.S. SEC nor does it need to abide by GAAP, with inherent risks. This extends the trading venue of a firm's securities to the U.S. OTC Bulletin Board or Pink Sheets trading systems, although level 1 ADRs are not traded on U.S. exchanges.

Level I ADRs may be either sponsored or unsponsored. An unsponsored ADR is set up by a depositary bank without conferring with the firm, while a sponsored ADR is set up by the listing firm in conjunction with a depositary bank. Level 2 and Level 3 sponsored ADRs must meet certain more stringent requirements, usually associated with higher corporate governance standards. They must register with the SEC, and financial statements must be reconciled to GAAP or IFRS. For a primary offering or raising capital, a level III sponsorship is required. Only level 2 and 3 ADRs can

be listed on the NYSE, the American Stock Exchange, or NASDAQ. Regulation S and Rule 144A are sections of the US Securities Act of governing an transactions of foreign stocks and other securities. Historically, securities of a non-US company were only to be offered for sale within the United States only after registration of those securities with the US Securities and Exchange Commission (SEC). An approval of an exemption from registering foreign securities can be conferred through Rule 144A, thus allowing a restricted offering of those foreign securities to Qualified Institutional Buyers. A restricted offering into the States is often combined with an unrestricted placement of securities offshore (i.e. outside of the US) under the provisions of Regulation S. firms are able to access foreign capital markets via these SEC provisions. Thus, we expect a differential reaction to sovereign credit events associated with the type of cross-listing across various firms.

3. SAMPLE CONSTRUCTION AND SUMMARY STATISTICS

This essay uses CDS spreads obtained from Bloomberg. The dataset which we have access to provides daily quotes on CDS spreads for over 400 obligors from August 2006 to January 2016. Quotes are collected from a large sample of banks and aggregated into a composite number, ensuring reasonably continuous and accurate price quotations. We use only the 5-year spreads because these contracts are the most liquid and constitute over 85% of the entire CDS market. To maintain uniformity in contracts, we only keep CDS quotations for senior unsecured debt. This sample has 400 obligors and 917,668 daily observations on firms' CDS spreads. The 400 firms are domiciled in 20 countries. Information on foreign firms that have their common stock listed on a U.S. exchange directly or in the form of an ADR is provided by Citigroup, Bank of New York and JP Morgan.

Types of U.S. Cross-listings

Type of Program	Description	SEC Filing required	Capital Raising
Unsponsored	ADRs traded on the US OTC market, using existing shares. No contractual relationship with company. Up to four depositary banks can establish	Form F-6 (filed by depositary bank), 12g3-2(b) exemption	No
Sponsored Level I	ADRs traded on the US OTC market, using existing shares. Company forms contractual relationship with single depositary bank	Form F-6 (filed by depositary bank and company, 12g3-2(b) exemption	No
Sponsored Level II	ADRs listed on a recognized US exchange (NYSE or NASDAQ), using existing shares	Form F-6, Form 20-F	No
Sponsored Level III	ADRs initially placed with US investors and listed on a recognized US exchange (NYSE or NASDAQ)	Form F-6, Form 20-F, Form F-1	Yes

From Deutsche Bank

Our sample of CDS spreads includes 400 obligors, though we compile over 4000 companies in our merged list of cross-listed foreign firms in the U.S. We drop some observations from firms domiciled in countries that do not experience a change in CCR, for example Canada does not experience a change in CCR, based on Moody's credit rating. From our sample of corporate CDS premiums, we identify foreign firms cross-listed in the U.S. and in the UK.

We summarize basic statistics for each data set in Table I and list the number of firms in each country, as well as the number of U.S. and U.K. cross-listings by country. Of the 20 countries

in our sample, 18 countries have domiciled firms with U.S. cross-listings, while 9 countries have firms with U.K. cross-listings. Based on available corporate CDS data, 16 of the 20 countries are in Europe.

There are 223 U.S. and 23 U.K. cross-listings. while 81 Japanese firms are cross-listed to the U.S. while 9 U.S. firms are cross-listed in the U.K.10 foreign firms are cross-listed in both the U.S. and the U.K. For companies for which both CDS return and stock return are available, we examine the reaction of both markets to changes in sovereign credit ratings.VWe match the changes in sovereign ratings to the 20 countries for which we have corporate CDS data. Summary statistics on the CDS spreads referencing the obligors are provided in Table 1. The top panel shows the number of positive and negative events by year and by country.

Following Ismailescu and Kazemi (2010), in order to quantify credit rating events, we assign numerical values to Moody's Credit ratings and credit outlooks. For letter credit ratings, we create a ratings scale from -1 to 17 with the Aaa rating taking the highest value and C (Typically in default) the lowest. For further details, see the Appendix A. Similarly, credit outlooks take on values from -0.5 for outlook "Negative" to 0.5 for outlook "Positive." Additionally, for each sovereign, we construct a cumulative comprehensive credit rating (CCR) by adding the numerical values assigned to the letter credit rating and credit outlook of that entity. For example, on September 22nd, 2009, Brazil's outstanding U.S. dollar denominated government debt was rated Baa3/Positive. Thus, from September 22nd, 2009 until Brazil's next credit rating event on June 20th, 2011, the cumulative comprehensive credit rating of Brazil was 8.5.

Table 1: Summary Statistics

				Corporate CDS Spreads		
By country	No. of firms	US Cross listing	UK Cross listing	Mean	Median	Standard deviation
Austria	1	1		73.7	67.6	51.1
Belgium	3	2		107.4	58.7	182.9
Brazil	3	3		148.9	97.7	255.1
Germany	24	23	2	123.5	73.0	72.1
Denmark	2	2		82.1	75.1	181.5
Spain	7	6	4	182.8	120.7	145.7
Finland	3	3		236.4	213.0	216.4
France	34	31	1	114.7	77.2	606.5
United Kingdom	46	38		119.3	73.7	187.8
Greece	1	1	1	413.3	115.1	150.6
Ireland	1	1	1	128.6	54.8	169.5
Italy	10	10		167.9	124.8	281.7
Japan	92	81	3	101.2	59.5	233.4
Luxembourg	5	3		193.4	39.0	61.9
Mexico	3	2		177.4	114.0	335.8
Netherlands	14	12	1	67.5	58.4	191.1
Portugal	3	3		273.8	155.2	186.1
Russian Federation	1	1	1	246.7	207.9	154.7
United States	146		9	136.2	70.4	253.6
Venezuela	1			1298.5	979.0	1527.8
By listing type / exchange						
LEVEL I	165					
LEVEL II	34					
LEVEL III	19					
144 A	5					
London Main Market	23					

Movement in a country's CCR signifies a credit rating event. A change greater than or equal to 1 (less than or equal to -1) indicates an upgrade (downgrade) of the country's letter credit rating, while a change between 0 and 1 or between -1 and 0 usually indicates, respectively, an upward or

downward revision in the sovereign's credit outlook. The succession of credit rating events of sovereigns and their distribution per year is set forth in Table 2.

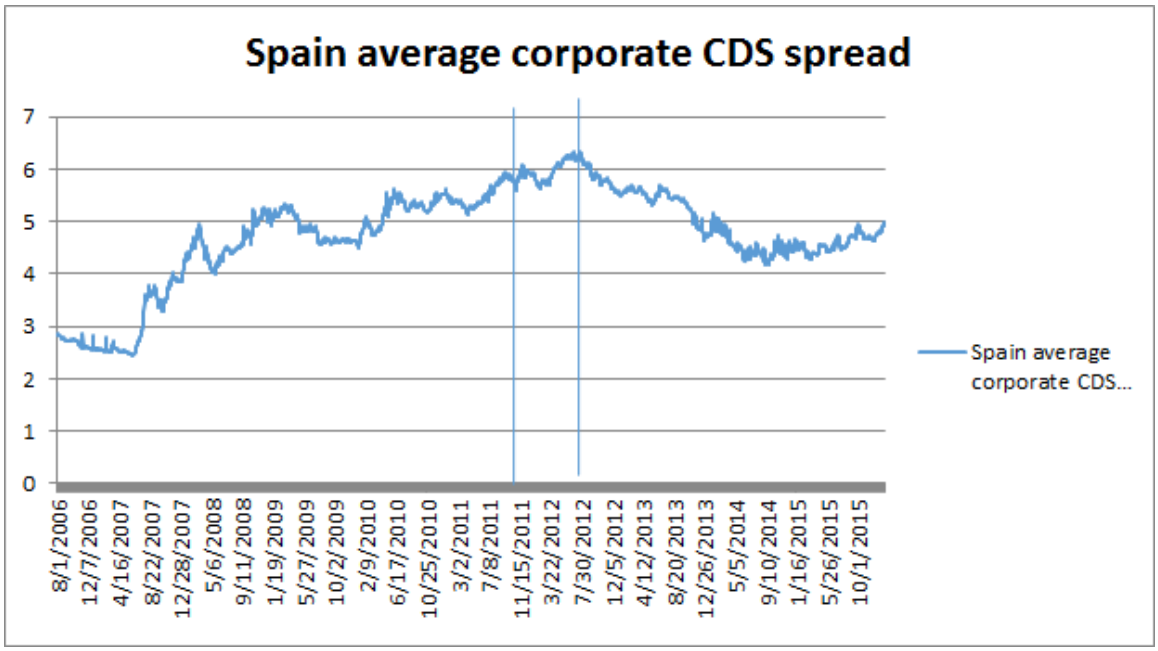
From August 2006 until March 2016, there are 121 single event days (with 41 positive and 80 negative rating announcements). Figure 1 shows the average corporate CDS spreads of Spain reflect higher credit risk during the negative credit events in 2011.

Table 2: Sampled Negative and Positive Sovereign Credit Events

Sovereign Credit Events	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Grand Total
NEGATIVE	1	2	1	9	11	18	14	4	5	10	5	80
POSITIVE	3	3	4	4	1	4		5	12	5		41
Grand Total	**4**	**5**	**5**	**13**	**12**	**22**	**14**	**9**	**17**	**15**	**5**	**121**

On October 2011, Spain was downgraded from Aa2 to A1. Spain's sovereign debt was further downgraded from A1 to A3 in February 2012. The movement of the corporate CDS spreads seem to suggest the possibility that these downgrades did not come as a surprise. Hence, it is possible that previous sovereign downgrades may help explain variation in the corporeate CDS market.

Figure 1: Spain average corporate CDS spreads



4. EMPIRICAL METHODOLOGY

We investigate the reaction of several corporate CDS to changes in sovereign credit ratings and credit outlook updates provided by Moody's for the years 2006 through 2015. Taking the same approach, we explore the reaction of stock prices to changes in sovereign credit ratings. Using the corporate CDS spread returns over the two-day period surrounding the sovereign credit event, we measure the response of the corporate CDS market. There are a few advantages of our chosen two-day window. We preclude the event window contamination problem while correcting for non-synchronous trading that may occurr due to differences in time zone between the the trade venue and the U.S., where Moody's makes the credit announcnement.

4.1 Event Study

We seek to determine how corporate CDS markets typically react to sovereign credit rating events. Additionally, we utilize the corporate CDS spreads to investigate the anticipatory effects prior to their announcement of sovereign credit events. we aim to answer outstanding questions on if sovereign events are largely unexpected or absorbed by the corporate CDS market prior to credit events. In the event that credit events are not anticipated, we expect that CDS spreads should change dramatically.

4.1.1 2-day window reactions to events in corporate CDS and equity markets:

Table 3 reports basic statistics of two-day CDS spread changes, spread percent changes, stock price changes and stock price percent changes of event country firms during sovereign rating events. For any rating event in country i occurring at time t, the two-day CDS spread change (stock price change) and spread percent change (stock price percent change) are calculated for the period [-1, 1], where day zero is considered the event day. A positive event is an upgrade of the Moody's letter credit rating or upward revision in the sovereign's credit outlook. A negative event is a downgrade of the Moody's letter credit rating or downward revision in the sovereign's credit outlook. Our variables of interest include, the two-day [-1, 1] percentage change in the CDS spreads of firms occurring around a given sovereign credit event. The 2-day window is preferred, in order to capture the immediate reaction to the announcement. In latter analysis, we explore a 30-day window to explore the longer term effects of changes in the credit environment.

Basic statistics of the two-day CDS spread changes are presented in Table 3. The two-day CDS spread change over period [t-1, t + 1] is defined as the difference between the CDS spread at time t + 1 and that of t -1, given a rating event at time t. The CDS spread percent change is the CDS spread change over period [t - 1, t + 1] to the CDS spread at time t - 1. During the two-day period

Table 3: Two-day corporate CDS and stock price reactions to events

	No. obs.	Mean	Median	Standard Deviation	Skewness	Kurtosis
Panel A: Two-day CDS spread changes (bps)						
Positive events	40	-0.772	-0.665	17.481	-1.839	54.647
Negative events	80	2.612	0.092	23.003	15.012	370.320
Panel A: Two-day CDS percent changes (%)						
Positive events	40	-0.8%	-0.8%	0.048	1.547	15.137
Negative events	80	0.9%	0.1%	0.049	0.225	10.233
Panel A: Two-day stock price changes						
Positive events	40	12.087	0.403	109.342	17.249	303.845
Negative events	80	-4.072	-0.220	56.317	-11.182	274.104
Panel A: Two-day stock price percent changes (%)						
Positive events	40	0.5%	0.9%	0.026	-0.543	1.327
Negative events	80	-0.8%	-0.6%	0.028	-0.159	1.329

surrounding the 40 positive sovereign credit events, CDS spreads of domiciled firms with corresponding data available, declined, on average, by 0.8 bps. Expectedly, subsequent to a negative event, the average CDS premium increased by a total of 2.6 bps from day -1 to day 1. Within the two-day period of a positive sovereign credit event, the average stock prices of corporations rose by 0.5%. We find that, during negative credit events, average stock prices decline by 0.8%, which

supports the notion that movements in CDS premiums and stock prices have an inverse relationship.

4.1.2 30-day window reactions to events in corporate CDS and equity markets:

From our results in table 4, 30 days prior to Moody's announcements of positive sovereign credit rating upgrades or outlooks, we do not find evidence that corporate CDS spreads anticipate these events. Corporate CDS reactions are not found to be significant, prior to positive sovereign announcements, therefore, we fail to reject the null hypothesis of lack of anticipation of positive sovereign credit events by corporate CDS spreads. With respect to the anticipation of negative events, we find a 1.06% median increase in corporate CDS spreads, which is significant at the 5% level, though the rest of the evidence is mixed and does not support the notion that corporate CDS spreads anticipate negative sovereign events.

30 days following favorable sovereign credit announcements in period [t, t+29], findings in Table 4 suggest significant reactions in the corporate CDS spreads for both positive and negative events, though corporate CDS spreads do not appear to decrease following favorable events as expected. Upon closer examination of both groups of firms separately in table 5, we find that both domestically listed and cross-listed firms exhibit this trait. We find consistently significant reactions in corporate CDS markets following negative sovereign announcements, as spreads rise by 22.16%, as seen in Table 4.One reason for our less than significant results prior to the announcement of positive events may be due to the possibility that positive sovereign events are widely anticipated for a long period of time, as a result of widely disseminated positive information to herald positive changes in economic and financial indicators.

Table 4: 30-Day corporate CDS reaction to sovereign credit events

All firms

	Positive events		Negative events	
	Period [-29,0]	Period [0,29]	Period [-29,0]	Period [0,29]
Thirty-day CDS spread changes (bps)				
Mean	-0.066	8.732**	-8.699	18.019***
t-test pval.	0.511	0.027	0.997	0.000
Median	-1.582	2.183	0.414	8.688***
t-test pval.	0.745	0.314	0.449	0.000
Thirty-day CDS spread percent changes (%)				
Mean	1.04%	4.28%***	0.05%	22.16%***
t-test pval.	0.214	0.000	0.467	0.000
Median	-2.20%	3.25%***	1.06%**	18.99%***
t-test pval.	0.745	0.000	0.038	0.000

* Significance at 10% level is denoted.
** Significance at 5% level is denoted.
*** Significance at 1% level is denoted.

4.1.3 Cross-listed vs. non-cross-listed firms' 30-day window reactions to events in corporate CDS markets:

In table 5, we find that spreads of both groups of firms increase following negative events. however, this effect appears to be more dramatic for firms that are not cross-listed, as their CDS spreads rise by 34.7% relative to a 17.3% increase in the CDS spreads of cross-listed firms following

the announcement of unfavorable sovereign events. this is consistent with our hypothesis that cross-listed firms cope better during downturns. We do not observe a decrease in the CDS spreads of both groups following positive sovereign events. In addition to the possibility that positive events do not come as a surprise, due to government announcements prior to Moody's, it is possibile that positive events may have been previously announced by S&P or Fitch. In such a scenario, Moody's sovereign upgrades would contain limited information. We formally compare the reaction of both groups of firms in latter regressions.

4.2 Proportions of negative and positive Corporate CDS reactions following events

As means are affected by outliers, another way to test whether rating events transmit new information to CDS markets is to evaluate the proportion of negative and positive CDS spread changes over the period [-1, 1]. We present these results in Table 6. We employ the chi-square test for equality of proportions to determine if the proportions of negative and positive CDS spread changes around credit events are significantly different from each other. It is expected that positive sovereign credit events beget improved corporate credit conditions, implied by decreasing (i.e., negative changes) CDS spreads of firms. Negative events should be associated with rising (i.e., positive changes) CDS spreads.

Table 5: Cross-listed vs. non-cross-listed firms' 30-Day CDS reaction to sovereign credit events

Panel A: Not Cross-listed firms

	Positive events		Negative events	
	Period [-29,0]	Period [0,29]	Period [-29,0]	Period [0,29]
Thirty-day CDS spread changes (bps)				
Mean	-0.748	7.119	6.238	61.979
Thirty-day CDS spread changes (bps)				
Mean	2.20%	6.17%	2.86%	34.70%

Panel B: Cross-listed firms

	Positive events		Negative events	
	Period [-29,0]	Period [0,29]	Period [-29,0]	Period [0,29]
Thirty-day CDS spread changes (bps)				
Mean	-1.449	4.520	-18.381	-2.390
Thirty-day CDS spread changes (bps)				
Mean	-1.42%	3.34%	-1.57%	17.30%

Generally, positive rating events appear to be associated with changes in corporate CDS spreads, although our results do not suggest a significant relationship in Table 6 Panel B, we do not obtain significant results for decreases, i.e. negative changes in CDS spreads in the periods prior to positive events. Based on these results, we cannot reject the null hypothesis that firms' CDSs anticipate positive sovereign events. Focusing on the two-day period around positive events, more than 64% of corporate CDSs in event countries decline from day -1 to day 1. Broadly, our results however, do not suggest a significant relationship between positive sovereign events and reactions in CDSs of firms. Prior to negative sovereign credit announcements as seen in Table 6 Panel B for periods [t-90, t-61] and [t-60, t-31], 64% and 55% of of CDS spreads suffer from positive changes, respectively. These results , are significant at the 1% level, and support the hypothesis that corporate CDS markets anticipate negative sovereign events. The CDS spreads of firms are expected to increase, following negative credit events, and decrease subsequent to announcements of positive events.

These results continue to hold when we divide the firms into groups of cross-listed and non-cross-listed in Table 7. We do expect the majority of positive events to be associated with negative changes in corporate CDS spreads. Our findings indicate that during positive events, in time [t-1, t+1], more than 80% of the positive upgrades and outlooks, are associated with shrinking CDS spreads of non-cross-listed firms, compared to less than 54% of the positive events for cross-listed firms. This result, though not significant, appears to lend support to the idea that the CDS spreads of domestically listed firms react more favorably following positive sovereign events. This is consistent with the idea that domestically listed firms, having limited financing options, are expected to benefit more from an improved credit outlook. An alternative explanation could be that the CDS spreads of cross-listed firms reflect positve sovereign credit information long before it is announced,

due to investors or bondholders of cross-listed firms having better information about sovereign credit conditions, combined with lower firm-level information asymmetry.

Table 6: Chi-square test for equality of proportions of negative and positive firm reactions

The proportion of positive and negative CDS spread changes of event country firms before and after the period surrounding a rating event. This table reports the proportion of negative and positive CDS spread changes over the periods [-1, 1], [0, 9], [0, 19], and [0, 29], where the sovereign credit rating event date is considered day zero. The last row in each time period presents the chi-square test for equal proportions and p-values.

No. of pos./neg. firm CDS spread changes	All sovereign rating events	Credit rating changes	Outlook changes	All sovereign rating events	Credit rating changes	Outlook changes
	All firms - CDS spread changes					
	Positive events			Negative events		
[-1,1]						
Positive	120	5	115	619	185	434
	35.82%	38.46%	35.71%	55.62%	52.86%	56.88%
Negative	215	8	207	494	165	329
	64.18%	61.54%	64.29%	44.38%	47.14%	43.12%
χ2 test	0.041			1.574		
	(0.839)			(0.210)		
[0,9]						
Positive	215	7	208	534	113	421
	64.95%	53.85%	65.41%	46.52%	31.22%	53.56%
Negative	116	6	110	614	249	365
	35.05%	46.15%	34.59%	53.48%	68.78%	46.44%
χ2 test	0.734			49.750***		
	(0.392)			(0.000)		
[0,19]						
Positive	197	7	190	605	122	483
	59.88%	53.85%	60.13%	54.50%	35.06%	63.39%
Negative	132	6	126	505	226	279
	40.12%	46.15%	39.87%	45.50%	64.94%	36.61%
χ2 test	0.205			77.313***		
	(0.651)			(0.000)		
[0,29]						
Positive	199	6	193	786	164	622
	62.78%	46.15%	63.49%	68.11%	45.30%	78.54%
Negative	118	7	111	368	198	170
	37.22%	53.85%	36.51%	31.89%	54.70%	21.46%
χ2 test	1.603			126.319***		
	(0.206)			(0.000)		

Table 6 Panel B: Chi-square test for equality of proportions of negative and positive firm reactions prior to events

No. of pos./neg. firm CDS spread changes	All sovereign rating events	Credit rating changes	Outlook changes	All sovereign rating events	Credit rating changes	Outlook changes
	CDS spread changes					
	Positive events			Negative events		
[-60,-31]						
Positive	148	3	145	621	164	457
	44.58%	30.00%	45.03%	55.45%	45.18%	60.37%
Negative	184	7	177	499	199	300
	55.42%	70.00%	54.97%	44.55%	54.82%	39.63%
χ2 test	0.89			108.26***		
	(0.35)			(0.00)		
[-90,-61]						
Positive	112	2	110	616	213	403
	32.94%	22.22%	33.23%	63.90%	58.68%	67.05%
Negative	228	7	221	348	150	198
	67.06%	77.78%	66.77%	36.10%	41.32%	32.95%
χ2 test	0.48			6.88***		
	(0.49)			(0.01)		

Table 7: Chi-square test for equality of proportions of negative and positive reactions of CDSs of two groups

The proportion of positive and negative CDS spread changes of event country firms before and after the period surrounding a rating event. This table reports the proportion of negative and positive CDS spread changes over the periods [-1, 1], [0, 9], [0, 19], and [0, 29], where the sovereign credit rating event date is considered day zero. The last row in each time period presents the chi-square test for equal proportions and p-values.

No. of pos./neg. firm CDS spread changes	All sovereign rating events	Credit rating changes	Outlook changes	All sovereign rating events	Credit rating changes	Outlook changes	All sovereign rating events	Credit rating changes	Outlook changes	All sovereign rating events	Credit rating changes	Outlook changes
	Cross-listed firms' CDS spread changes						Non cross-listed firms' CDS spread changes					
	Positive events			Negative events			Positive events			Negative events		
[-1,1]												
Positive	78	3	75	374	159	215	28	0	28	208	12	196
	46.15%	42.86%	46.30%	52.16%	53.18%	51.44%	19.72%	0.00%	19.86%	60.64%	40.00%	62.62%
Negative	91	4	87	343	140	203	114	1	113	135	18	117
	53.85%	57.14%	53.70%	47.84%	46.82%	48.56%	80.28%	100.00%	80.14%	39.36%	60.00%	37.38%
χ2 test	0.032			0.212			0.247			5.869		
p-value	(0.858)			'(0.645)			(0.619)			(0.015)**		
[0,9]												
Positive	120	4	116	289	94	195	84	0	84	224	12	212
	71.86%	57.14%	72.50%	38.64%	30.32%	44.52%	60.00%	0.00%	60.43%	64.55%	38.71%	67.09%
Negative	47	3	44	459	216	243	56	1	55	123	19	104
	28.14%	42.86%	27.50%	61.36%	69.68%	55.48%	40.00%	100.00%	39.57%	35.45%	61.29%	32.91%
χ2 test	0.782			15.434***			1.511			9.936**		
p-value	(0.376)			(0.000)			(0.219)			(0.002)		
[0,19]												
Positive	113	4	109	338	101	237	77	0	77	232	7	225
	67.26%	57.14%	67.70%	46.94%	33.89%	56.16%	55.00%	0.00%	55.80%	68.84%	24.14%	73.05%
Negative	55	3	52	382	197	185	63	2	61	105	22	83
	32.74%	42.86%	32.30%	53.06%	66.11%	43.84%	45.00%	100.00%	44.20%	31.16%	75.86%	26.95%
χ2 test	0.340			34.775***			2.480			29.564***		
p-value	(0.56)			(0.000)			(0.115)			(0.000)		
[0,29]												
Positive	101	4	97	448	137	311	90	0	90	311	14	297
	61.59%	57.14%	61.78%	59.42%	44.19%	70.05%	69.77%	0.00%	70.31%	89.63%	45.16%	93.99%
Negative	63	3	60	306	173	133	39	1	38	36	17	19
	38.41%	42.86%	38.22%	40.58%	55.81%	29.95%	30.23%	100.00%	29.69%	10.37%	54.84%	6.01%
χ2 test	0.061			50.593***			2.326			72.38***		
p-value	(0.805)			(0.000)			(0.127)			(0.000)		

The literature reports that cross-listed firms can improve information problems by deciding to cross-list (Fernandes and Ferreira (2008), Karolyi (2012)).

Relative to negative events, we obtain strikingly different results for cross-listed firms, when compared to firms that are not cross-listed. First, negative events appear to matter for both groups of firms, as a majority of firms suffer from a positive change in CDS spreads in period [-1, 1], albeit, only a slight majority of cross-listed firms. In the 30-day period after negative events, CDS premiums are expected to rise. In this regard, the initial reaction of the CDS spreads of cross-listed firms are not in line with this expectation, as 61% and 53% of spreads taper in periods [0, 9] and [10, 19], respectively.

Overall, 59% of the changes in CDS premiums of cross-listed firms experience an increase in the 30 day period subsequent to negative events. During the course of the 30-day period, the proportion of CDS spreads of non-cross-listed firms that experience increases is increasingly a majority. From the outset of negative events in period [-1, 1] , a significant proportion (60.6%) of the changes in CDS spreads of non-cross-listed firms experience increases in CDS spreads. This is not much higher than the 52.2% of CDSs of cross-listed firms that increase, though not a significantly different proportion. The unfavorable sovereign credit news is progressively incorporated in both groups of firms over the 30 day period. Among non-cross-listed (cross-listed) firms, following the negative event, roughly 90% (60%) of the changes in in CDS premiums represent increase, both significant at the 1% level. This suggests that both groups of firms are significantly affected by negative sovereign events, though this test this does not address the outstanding question regarding which group of firms is more significantly affected by changes in sovereign risk. In the next section, we investigate the differential CDS spread reactions of firms with cross-listings vs. firms without.

4.3 OLS and Panel Regressions of corporate credit risk and sovereign risk

We formally analyze the effect of variations in sovereign risk on corporate credit risk by regressing changes in monthly corporate CDS spreads on changes in sovereign cumulative comprehensive credit rating (CCR) changes. The cumulative comprehensive credit rating change comprises a change in sovereign credit rating and change in outlook.

4.3.1 Sovereign credit risk and corporate credit risk specifications

The literature suggests a number of variables that affect credit spreads. (Collin-Dufresne, et al., 2001; Campbell and Taksler, 2003) and sovereign credit spreads (Longstaff et al., 2011; Dieckmann and Plank, 2012). We therefore include a number of control variables suggested by the literature as determinants of corporate and sovereign CDS credit spreads.

Local/country variables. Corporate and sovereign creditworthiness are affected by the general state of the economy. The credit quality of corporations and firms are thus expected to be affected by an improvement or deterioration of the business climate in the country of domicile. To control for the state of the economy, we make use of two variables:

Domestic country excess returns, measured as difference between log returns on the domestic market index and log returns on a benchmark index. Domestic excess volatility is calculated using weekly changes in the standard deviation of local excess returns. These variables are described in Appendix table A.2.

Idiosyncratic/firm variables. A firm's probability of default is importantly linked to its equity returns and risk. Broad movements and volatility across equity markets generally affect all firms in an

economy. However, firm-specific equity returns and risk can play a bigger role in determining a firm's probability of default. Corporate CDS spreads of firms should have a positive (negative) correlation with idiosyncratic volatility (equity returns). We use firm excess returns, and proxy variations in idiosyncratic volatility with changes in the standard deviation of firm excess returns. Given the choice of control variables, we estimate the following pooled OLS regression:

$$\Delta(CCDS_{i\,jt}) = \alpha_i + \beta\Delta(CCR_{jt}) + \gamma\Delta X_{i\,jt} + \delta_t + \varepsilon_{i\,jt} \qquad (1)$$

where

$$\Delta(CCDS_{i\,jt}) = (CCDS_{i\,jt+29} - CCDS_{i\,jt}) \,/\, CCDSi_{\,jt}$$

i.e., $\Delta(CCDS_{i\,jt})$ is the 30-day percentage change in the CDS spread of firm i headquartered in country j from day t to day t+29, $\Delta(CCR_{jt})$ is the change in the cumulative comprehensive credit rating of country j on day t, $\Delta X_{i\,jt}$ are the changes from day t to day t+29 in the local and firm (idiosyncratic) variables, and α_i and δ_t are firm and time fixed effects. The models include simple OLS, fixed effects and random effects, each provided for negative, positive and non-events. The three models include the control variables, $\Delta X_{i\,jt}$ described in Table A2.

We obtain generally consistent results across models for OLS, fixed, and random effects, suggesting the existence of a significant relationship between changes in sovereign credit risk and reactions of corporate CDS spreads. Negative sovereign credit events are associated with an increase in corporate CDS spreads. Relative to positive events, our OLS results suggest that an increase in sovereign credit ratings is significantly associated with a decline in corporate CDS spreads,

Table 8

Sovereign risk and corporate credit risk: $\Delta(CCDS_{i\,jt}) = \alpha_i + \beta\Delta(CCR_{jt}) + \gamma\Delta X_{i\,jt} + \delta t + \varepsilon_{i\,jt}$

where

$\Delta(CCDS_{i\,jt}) = (CCDS_{i\,jt+29} - CCDS_{i\,jt}) / CCDS_{i\,jt}$. This table shows the effect of changes in sovereign credit risk on corporate credit risk. The dependent variable, $\Delta(CCDS_{i\,jt})$, is the monthly change in corporate CDS spread. Panels A, B and C report the results for negative, positive and non-events for specification (1), respectively. The models include simple OLS, fixed effects and random effects each provided for negative, positive and non-events. Three models include the control variables described in Table A2. where changes in country j sovereign credit risk, ΔCCR_{jt}, is the change in comprehensive credit ratings of event countries at time *t*.

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Intercept	$\beta\Delta(CCR_{jt})$	Firm exc ret_{jt}	ΔFirm vol_{jt}	Loc exc ret_{jt}	ΔLoc vol_{jt}	Hausman test H0: RE vs. FE	Adj R^2
Negative Events								
OLS	0.390	0.264***	-0.097***	-0.009	0.017	0.007		0.188
	[.000]	[.000]	[.005]	[.439]	[.656]	[.510]		
FE		0.292***	-0.058	-0.016	0.154**	0.02*		0.258
		[.000]	[.320]	[.153]	[.012]	[.074]		
RE	0.380	0.267***	-0.099***	-0.010	0.010	0.008	56.295***	0.188
	[.000]	[.000]	[.004]	[.363]	[.801]	[.459]	[.0000]	
Positive Events								
OLS	0.144	-0.147**	0.107***	-0.024**	-0.13***	0.038***		0.082
	[.000]	[.042]	[.004]	[.034]	[.001]	[.001]		
FE		0.014	0.069	0.510	0.032	-0.123		
		[.952]	[.772]	[.161]	[.864]	[.735]		
RE	0.024	0.064*	0.232***	-0.022**	-0.141***	0.014	3.248	0.030
	[.129]	[.081]	[.000]	[.043]	[.000]	[.183]	[.6619]	
Non events								
OLS	0.225	0.13***	-0.107***	-0.005	-0.146***	-0.005		0.116
	[.000]	[.000]	[.000]	[.630]	[.000]	[.622]		
FE		0.14***	-0.129***	-0.016	-0.121***	0.005		0.124
		[.000]	[.002]	[.153]	[.004]	[.669]		
RE	0.224	0.131***	-0.108***	-0.005	-0.146***	-0.005	16.548***	0.119
	[.000]	[.000]	[.000]	[.610]	[.000]	[.640]	[.0054]	

though our random effects model suggests a weakly significant relationship characterized by an increase in CDS spreads.[2]

4.3.2 Differential reaction of Cross-listed vs. Non-cross-listed firms to Sovereign risk

In this section, we investigate the possibility of cross-listing as a channel though which sovereign risk is transferred to corporate CDSs. Hail and Leuz (2009) show that firms with cross-listings on U.S. exchanges experience a decrease in their cost of capital between 70 and 120 basis points

Cross-listed firms have been found to improve their information as a result of increased regulatory filings and analyst coverage. Ashcraft and Santos (2009) find economically significant adverse effects to the cost of debt of risky and informationally-opaque firms, due to CDS trading. To evaluate whether cross-listed firms have a differential reaction to changes in sovereign risk, we create an indicator variable (D_i) that takes a value of one if the firm is not cross-listed in the U.S. or London. We then enrich specification (1) with the interaction terms between Di and our main variable of interest, Δ (CCR_{jt}).

[2] Lack of statistical significance of the Hausman specification test for positive events points to random effect panel data model as preferred to fixed effect.

$$\Delta(CCDS_{i\,jt}) = \alpha_i + \beta\Delta(CCR_{jt}) + \lambda D_i\,\Delta(CCR_{jt}) + \gamma\Delta X_{i\,jt} + \delta_t + \varepsilon_{i\,j} \quad (2)$$

In specification (2), λ encapsulates the extra-sensitivity to changes in sovereign credit quality for non-cross-listed firms. In line with our earlier analysis, we estimate specification (2) dynamic panel. To empirically assess the relevance of the cross-listing channel, we use non-cross-listed firms as the indicator variable D_i in specification (2). Regression coefficients are reported in Table 9. Our results provide evidence supporting the hypothesis of a statistically significant differential reaction of non-cross-listed firms' CDSs, following sovereign credit events. the coefficient on $\lambda Di\ \Delta(CCR_{jt})$ suggests that the credit risk of non-cross-listed firms is significantly more affected by negative changes in sovereign credit quality. We do not find evidence of a significant reaction of non-cross-listed firms to positive events.

Table 9

Sovereign risk and corporate credit risk of non-cross-listed firms: $\Delta(CCDS_{i\,jt}) = \alpha_i + \beta\Delta(CCR_{jt}) + \lambda D_i\,\Delta(CCR_{jt}) + \gamma\Delta X_{i\,jt} + \delta t + \varepsilon_{i\,jt}$

where, $\Delta(CCDS_{i\,jt}) = (CCDS_{i\,jt+29} - CCDS_{i\,jt}) / CCDS_{i\,jt}$. This table shows the effect of the spillover from sovereign to corporate credit risk for non-cross-listed firms. The dependent variable, $\Delta(CCDS_{i\,jt})$, is the monthly change in corporate CDS spread. D_i equals one if the firmis not cross-listed on a stock exchange in the U.S. or London. The interaction term is between $\Delta(CCR_{jt})$ and D_i. Panels A, B and C report the results for negative, positve and non-events for specification (2), respectively. The models include simple OLS, fixed effects and random effects, each provided for negative, positive and non-events. Three models include the control variables, $\Delta X_{i\,jt}$ described in Table A2. where changes in country j sovereign credit risk, ΔCCR_{jt}, is the change in comprehensive credit ratings of event countries at time *t*.

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Intercept	$\beta\Delta(CCR_{jt})$	$\lambda Di\ \Delta(CCR_{jt})$	Firm exc ret_{jt}	ΔFirm vol_{jt}	Loc exc ret_{jt}	ΔLoc vol_{jt}	Hausman test H0:RE vs. FE	Adj R^2
Negative Events									
OLS	0.403	0.197***	0.115***	-0.083**	-0.007	0.007	0.006		0.200
	[.000]	[.000]	[.000]	[.016]	[.544]	[.845]	[.607]		
FE		0.159***	0.205***	-0.060	-0.015	0.131**	0.018		0.282
		[.000]	[.000]	[.292]	[.184]	[.030]	[.108]		
RE	0.390	0.187***	0.132***	-0.087**	-0.008	-0.001	0.006	61.898***	0.200
	[.000]	[.000]	[.000]	[.012]	[.434]	[.974]	[.539]	[.0000]	
Positive Events									
OLS	0.090	-0.147**	-0.008	0.106***	-0.024**	-0.128***	0.038***		0.079
	[.001]	[.042]	[.875]	[.005]	[.034]	[.002]	[.001]		
FE		0.019	-0.147	0.075	0.497	0.032	-0.116		
		[.939]	[.924]	[.772]	[.221]	[.871]	[.765]		
RE	0.036	0.066*	-0.054	0.23***	-0.022**	-0.136***	0.017	2.896	0.027
	[.064]	[.070]	[.288]	[.000]	[.037]	[.000]	[.117]	[.8217]	
Non events									
OLS	0.228	0.08***	0.079***	-0.1***	-0.004	-0.159***	-0.006		0.282
	[.000]	[.000]	[.002]	[.001]	[.701]	[.000]	[.519]		
FE		0.061**	0.124***	-0.126***	-0.014	-0.139***	0.002		0.136
		[.022]	[.000]	[.002]	[.190]	[.001]	[.812]		
RE	0.226	0.078***	0.082***	-0.102***	-0.004	-0.159***	-0.006	20.426***	0.200
	[.000]	[.000]	[.001]	[.001]	[.666]	[.000]	[.544]	[.0023]	

4.3.3 Additional Test of Differential reaction of Cross-listed vs. Non-cross-listed firms to Sovereign risk

To further analyze the differential effects of sovereign credit risk on non-cross-listed vs. cross-listed firm, we add $\delta_t D_i$ to specification (2), as follows:

$$\Delta(CCDS_{i\,jt}) = \alpha_i + \beta\Delta(CCR_{jt}) + \lambda D_i \Delta\,(CCR_{jt}) + \gamma\Delta X_{i\,jt} + \delta_t + \delta_t D_i + \varepsilon_{i\,j} \qquad (3)$$

D_i as the indicator variable in specification (2) and estimated with OLS, fixed and random effects , similar to our earlier analysis. Findings in Table 10 are largely consistent with those found in Table 9. It is suggested by the significant p-values of the coefficients of $\lambda D_i \Delta\,(CCR_{jt})$ and the newly added $\delta_t D_i$ variable, that during negative sovereign credit events, there is higher sensitivity of the CDS spreads of non-cross-listed firms compared to cross-listed firms.

This finding is consistent with the idea that when sovereign risk increases, the sensitivity value of an option to access foreign capital via cross-listings increases. Our fixed effects results do not suggest higher sensitivity of non-cross-listed firms to positive events. The hausman test precludes consideration of the results from our random effects model, which suggests extra-sensitivity of the CDS spreads of non-cross-listed firms to positive changes in sovereign credit quality. We run specifications (2) and (3) again using dummy fixed effects and robusted heteroscedasticity OLS regressions and obtain results set forth in appendix tables A.3 and A.4, and consistent with the findings in tables 8, 9 and 10. Taken together, our results show strong significant results for greater adverse reactions of the CDS spreads of non-cross-listed firms to unfavorable sovereign credit risk.

Table 10

Further test of Sovereign risk and corporate credit risk of non-cross-listed firms: $\Delta(CCDS_{i\,jt}) = \alpha_i + \beta\Delta(CCR_{jt}) + \lambda D_i\,\Delta(CCR_{jt}) + \gamma\Delta X_{i\,jt} + \delta t + \delta_t D_i + \varepsilon_{i\,jt}$

where, $\Delta(CCDS_{i\,jt}) = (CCDS_{i\,jt+29} - CCDS_{i\,jt}) / CCDS_{i\,jt}$. This table shows the effect of changes in sovereign credit risk on corporate credit risk. The dependent variable, $\Delta(CCDS_{i\,jt})$, is the monthly change in corporate CDS spread. D_i equals one if the firmis not cross-listed on a stock exchange in the U.S. or London. The interaction term is between $\Delta(CCR_{jt})$ and D_i as well as between time fixed effects and D_i. Panels A, B and C report the results for negative, positve and non-events for specification (3), respectively. The models include simple OLS, fixed effects and random effects each provided for negative, positive and non-events. Three models include the control variables, $\Delta X_{i\,jt}$ described in Table A2. where changes in country j sovereign credit risk, ΔCCR_{jt}, is the change in comprehensive credit ratings of event countries at time *t*.

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Intercept	$\beta\Delta(CCR_{jt})$	$\lambda D_i\,\Delta(CCR_{jt})$	Firm exc ret_{jt}	ΔFirm vol_{jt}	Loc exc ret_{jt}	ΔLoc vol_{jt}	$\delta_t D_i$	Hausman test H0:RE vs. FE	Adj R^2
Negative Events										
OLS	0.335	0.159***	0.17***	-0.082**	-0.007	0.017	0.006	0.089**		0.203
	[.000]	[.000]	[.000]	[.018]	[.543]	[.654]	[.586]	[.040]		
FE		0.159***	0.205***	-0.060	-0.015	0.131**	0.018			0.281
		[.000]	[.000]	[.293]	[.184]	[.030]	[.108]			
RE	0.310	0.149***	0.187***	-0.086**	-0.008	0.010	0.007	0.105**	58.127***	0.208
	[.000]	[.000]	[.000]	[.013]	[.436]	[.801]	[.516]	[.020]	[.000]	
Positive Events										
OLS	0.050	-0.071	-0.181	0.107***	-0.026**	-0.123***	0.042***	0.076		0.082
	[.217]	[.425]	[.167]	[.004]	[.025]	[.004]	[.001]	[.152]		
FE		-0.071	-0.181	0.107***	-0.026**	-0.123***	0.042***			
		[.425]	[.167]	[.004]	[.025]	[.004]	[.001]			
RE		0.019	-0.147	0.075	0.497	0.032	-0.116	0.15***	2.362	0.070
		[.943]	[.928]	[.785]	[.246]	[.879]	[.778]	[.000]	[.8836]	
Non events										
OLS	0.193	0.064***	0.100***	-0.101***	-0.004	-0.158***	-0.007	0.042		0.122
	[.000]	[.009]	[.001]	[.001]	[.697]	[.000]	[.504]	[.162]		
FE		0.061**	0.124***	-0.126***	-0.014	-0.139***	0.002			0.135
		[.022]	[.000]	[.002]	[.190]	[.001]	[.812]			
RE	0.192	0.063***	0.102***	-0.102***	-0.004	-0.158***	-0.006	0.043	19.116***	0.122
	[.000]	[.010]	[.001]	[.001]	[.666]	[.000]	[.527]	[.170]	[.0040]	

5 CONCLUSION

We find significant market responses in the corporate CDS market for evidence of contagion around unanticipated negative and positive sovereign credit ratings and outlook changes. Sovereign credit events are found to be associated with significant changes in corporate CDS spreads and variability in equity returns, suggesting the presence of contagion effects across markets. First, relative to anticipation of sovereign credit events in the corporate CDS market, our findings support the hypothesis that corporate CDS spreads anticipate negative sovereign events. Leading up to the date of announcement of negative events, corporate CDS spreads rise, and continue to do so following the negative announcement, as new information is incorporated in the corporate CDS spreads over time. Comparing groups of cross-listed and domestically listed firms, we find significantly differential reactions in CDS markets. Our findings suggest that sovereign credit events are transmitted more strongly to non-cross-listed firms than firms with cross-listings. Possible reasons for this finding could in fact be due to cross-listed firms' better access to external capital and less degree of asymmetric information, relative to non-cross-listed peers with lower level of investor recognition. Oehmke and Zawadowski (2014) find that speculative trading concentrates in the CDS market which serves as "alternative trading venues" for both hedging and speculation in the underlying bond. Firms that are not cross-listed typically have less analyst coverage and information, such that they may face more short selling pressure decisions, via the CDS market.

Our findings suggest that positive events are generally not anticipated and do not convey new information. Taken together, we find that negative sovereign credit events generally have unfavorably significant effects on the majority of firms, though, as we show through corporate CDS reactions, cross-listed firms cope significantly better. This is consistent with the idea that when sovereign risk increases, the sensitivity value of an option to access external capital for cross-listed

companies increases. Broadly, our results provide new evidence relevant to investors and financial institutions in determining sovereign credit risk germane to corporate financial risk, for the construction of debt and equity portfolios, and hedging considerations in today's dynamic environment.

APPENDIX

Table A.1

Assigning numerical values to Moody's letter credit ratings and outlooks

	Credit Rating	Numerical Value
INVESTMENT GRADE	Aaa	17
	Aa1	16
	Aa2	15
	Aa3	14
	A1	13
	A2	12
	A3	11
	Baa1	10
	Baa2	9
	Baa3	8
NON-INVESTMENT GRADE SPECULATIVE	Ba1	7
	Ba2	6
	Ba3	5
	B1	4
	B2	3
	B3	2
	Caa1	1
	Caa2	1
	Caa3	1
	Ca	0
	C	-1
	Positive	0.5
	RUR+	0.25
	stable	0
	RUR-	-0.25
	Negative	-0.5

Table A.2

Control variables.

This table provides a detailed description of the control variables included in the model specifications and their source.

Variable	Description	Source
Firm exc ret_{jt}	Firm's stock log return in excess of the log return in the domestic Dow Jones Total Market index	Bloomberg
ΔFirm vol_{jt}	Change in the firm's (annualized) idiosyncratic volatility, computed as rolling standard deviation of the firm's excess stock returns over the past 180 days	Bloomberg
Loc exc ret_{jt}	Log return in the domestic Dow Jones Total Market index in excess of the log return in the EuroStoxx 50 index or local benchmark	Bloomberg; Fed (St. Louis)
ΔLoc vol_{jt}	Change in the domestic (annualized) volatility, computed as rolling standard deviation of the local excess stock returns over the past 180 days	Bloomberg; Fed (St. Louis)

Table A.3. Supplemenary Regression Tests of spillover to corporate risk

$$\Delta(CCDS_{i\,jt}) = \alpha_i + \beta\Delta(CCR_{jt}) + \gamma\Delta X_{i\,jt} + \varepsilon_{i\,jt}$$

	Dummy Fixed Effect		**Robust Heteroscedasticity OLS**		
	All CCR	Negative CCR	All CCR	Negative CCR	Positive CCR
$\beta\Delta(CCR_{jt})$	0.14***	0.292***	0.13***	0.264***	-0.147
	(7.021)	(9.968)	(10.246)	(10.29)	(-1.157)
Firm exc ret_{jt}	-0.129***	-0.058	-0.107***	-0.097***	0.107**
	(-4.267)	(-1.387)	(-4.316)	(-3.207)	(2.17)
ΔFirm vol_{jt}	-0.016***	-0.016***	-0.005	-0.009	-0.024
	(-2.707)	(-3.077)	(-0.818)	(-1.411)	(-1.27)
Loc exc ret_{jt}	-0.121***	0.154***	-0.146***	0.017	-0.13**
	(-3.294)	(2.794)	(-5.399)	(0.465)	(-2.424)
ΔLoc vol_{jt}	0.005	0.02***	-0.005	0.007	0.038*
	(0.809)	(3.768)	(-0.85)	(1.266)	(1.903)
Fixed effect	Y	Y	N	N	N
Adj-R2	0.12	0.26	0.12	0.19	0.08
N	1359	1071	1359	1071	288

Table A.4. Supplementary Regression Tests of spillover to non-cross-listed firms' corporate risk

$$\Delta(CCDS_{i\,jt}) = \alpha_i + \beta\Delta(CCR_{jt}) + \lambda D_i\,\Delta\,(CCR_{jt}) + \gamma\Delta X_{i\,jt} + \delta_t D_i + \varepsilon_{i\,j}$$

	Dummy Fixed Effect		**Robust Heteroscedasticity OLS**		
	All CCR	Negative CCR	All CCR	Negative CCR	Positive CCR
$\beta\Delta(CCR_{jt})$	0.061*	0.159***	0.064***	0.159***	-0.071
	(1.81)	(2.927)	(2.709)	(3.669)	(-0.43)
$\lambda D_i\,\Delta(CCR_{jt})$	0.124***	0.205***	0.100***	0.170***	-0.181
	(3.136)	(3.434)	(3.77)	(3.564)	(-1.054)
Firm exc ret_{jt}	-0.126***	-0.060***	-0.101***	-0.082***	0.107
	(-4.202)	(-1.494)	(-4.159)	(-2.755)	(2.074)
ΔFirm vol_{jt}	-0.014**	-0.015***	-0.004***	-0.007***	-0.026
	(-2.501)	(-2.992)	(-0.659)	(-1.116)	(-1.337)
Loc exc ret_{jt}	-0.139***	0.131***	-0.158***	0.017***	-0.123
	(-3.851)	(2.535)	(-6.02)	(0.502)	(-2.201)
ΔLoc vol_{jt}	0.002	0.018***	-0.007***	0.006***	0.042
	(0.454)	(3.513)	(-1.156)	(1.048)	(2.119)
D	0.080***	0.170***	0.042***	0.089***	0.076
	(7.516)	(13.591)	(1.086)	(1.362)	(1.078)
Fixed effect	Y	Y	N	N	N
Adj-R2	0.14	0.28	0.12	0.20	0.08
N	1359	1071	1359	1071	288

REFERENCES

Acharya, V., Drechsler, I., & Schnabl, P. (2014). A pyrrhic victory? Bank bailouts and sovereign credit risk. The Journal of Finance, 69(6), 2689-2739.

Acharya, V. V., & Johnson, T. C. (2007). Insider trading in credit derivatives. Journal of Financial Economics, 84(1), 110-141.

Almeida, H., Cunha, I., Ferreira, M. A., & Restrepo, F. (2016). The real effects of credit ratings: The sovereign ceiling channel. The Journal of Finance.

Arteta, C., & Hale, G. (2008). Sovereign debt crises and credit to the private sector. Journal of international Economics, 74(1), 53-69.

Bedendo, M., & Colla, P. (2015). Sovereign and corporate credit risk: Evidence from the Eurozone. Journal of Corporate Finance, 33, 34-52.

Borensztein, E., Cowan, K., & Valenzuela, P. (2013). Sovereign ceilings "lite"? The impact of sovereign ratings on corporate ratings. Journal of Banking & Finance, 37(11), 4014-4024.

Campbell, J. Y., & Taksler, G. B. (2003). Equity volatility and corporate bond yields. The Journal of Finance, 58(6), 2321-2350.

Coffee Jr, J. C. (1998). Future as history: The prospects for global convergence in corporate governance and its implications. Nw. UL Rev., 93, 641.

Coffee Jr, J. C. (2002). Racing towards the top?: The impact of cross-listings and stock market competition on international corporate governance. Columbia law review, 1757-1831.

Collin-Dufresne, P., Goldstein, R. S., & Martin, J. S. (2001). The determinants of credit spread changes. The Journal of Finance, 56(6), 2177-2207.

Dieckmann, S., & Plank, T. (2012). Default risk of advanced economies: An empirical analysis of credit default swaps during the financial crisis. Review of Finance, 16(4), 903-934.

Doidge, C., Karolyi, G. A., Lins, K. V., Miller, D. P., & Stulz, R. M. (2009). Private benefits of control, ownership, and the cross-listing decision. The Journal of Finance, 64(1), 425-466.

Edison, H. J., & Warnock, F. E. (2008). Cross-border listings, capital controls, and equity flows to emerging markets. Journal of International Money and Finance, 27(6), 1013-1027.

Fernandes, N., & Ferreira, M. A. (2008). Does international cross-listing improve the information environment. Journal of Financial Economics, 88(2), 216-244.

Frésard, L., & Salva, C. (2010). The value of excess cash and corporate governance: Evidence from US cross-listings. Journal of Financial Economics, 98(2), 359-384.

Gande, A., & Parsley, D. C. (2005). News spillovers in the sovereign debt market. Journal of Financial Economics, 75(3), 691-734.

Hail, L., & Leuz, C. (2009). Cost of capital effects and changes in growth expectations around US cross-listings. Journal of financial economics, 93(3), 428-454.

Holton, S., Lawless, M., & McCann, F. (2014). Firm credit in the euro area: a tale of three crises. Applied Economics, 46(2), 190-211.

Ismailescu, I., & Kazemi, H. (2010). The reaction of emerging market credit default swap spreads to sovereign credit rating changes. Journal of Banking & Finance, 34(12), 2861-2873.

Jorion, P., & Zhang, G. (2007). Good and bad credit contagion: Evidence from credit default swaps. Journal of Financial Economics, 84(3), 860-883.

Karolyi, G. A. (2012). Corporate governance, agency problems and international cross-listings: A defense of the bonding hypothesis. Emerging Markets Review, 13(4), 516-547.

Lins, K. V., Strickland, D., & Zenner, M. (2005). Do non-US firms issue equity on US stock exchanges to relax capital constraints? Journal of financial and quantitative analysis, 40(01), 109-133.

Longstaff, F. A., Mithal, S., & Neis, E. (2005). Corporate yield spreads: Default risk or liquidity? New evidence from the credit default swap market. The Journal of Finance, 60(5), 2213-2253.

Longstaff, F. A., Pan, J., Pedersen, L. H., & Singleton, K. J. (2011). How sovereign is sovereign credit risk? American Economic Journal: Macroeconomics, 3(2), 75-103.

Moody's Investor Service, Research & Ratings online,
https://www.moodys.com/page/lookuparating.aspx

Ndubizu, G. A. (2007). Do cross-border listing firms manage earnings or seize a window of opportunity? The Accounting Review, 82(4), 1009-1030.

Norden, L., & Weber, M. (2004). Informational efficiency of credit default swap and stock markets: The impact of credit rating announcements. Journal of Banking & Finance, 28(11), 2813-2843.

Oehmke, M., & Zawadowski, A. (2014). The anatomy of the CDS market. Available at SSRN 2023108.

Pagano, M., Röell, A. A., & Zechner, J. (2002). The geography of equity listing: why do companies list abroad? The Journal of Finance, 57(6), 2651-2694.

Sarkissian, S., & Schill, M. J. (2009). Are there permanent valuation gains to overseas listing? Review of Financial Studies, 22(1), 371-412.

Siegel, J. (2005). Can foreign firms bond themselves effectively by renting US securities laws? Journal of Financial Economics, 75(2), 319-359.

Stulz, R. M. (1999). Golbalization, corporate finance, and the cost of capital. Journal of applied corporate finance, 12(3), 8-25.

Stulz, R. M. (2010). Credit default swaps and the credit crisis. The Journal of Economic Perspectives, 24(1), 73-92.

Vita

Uche Isiugo was born in Philadelphia, PA and raised in Nigeria. He received a Bachelor of Business Administration in Finance and Economics at Temple University in Philadelphia, as well as a Master of Business Administration from Seattle Pacific University in Seattle, WA. He joined the University of New Orleans in August, 2012 and later earned a Master of Science in Financial Economics and a PhD in Financial Economics in August, 2016 from the Department of Economics and Finance. His research interests include investing, financial markets and institutions, corporate finance, and international finance. He has presented and served as discussant at several conferences, including those of the Financial Management Association, Eastern Finance Association, and the Southwest Finance Association. His industry work experience includes stints at Chevron Corp., The Boeing Company, and Citigroup Inc.