CONFERENCE OVERVIEW AND SUMMARY OF PAPERS

INTERNATIONAL CONFERENCE ON FINANCIAL CYCLES, SYSTEMIC RISK, INTERCONNECTEDNESS, AND POLICY OPTIONS FOR RESILIENCE

Sydney, Australia, 8–9 September 2016

ASIAN DEVELOPMENT BANK

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Contents

Conference Program

THURSDAY, 8 SEPTEMBER

Master of Ceremony: Fariborz Moshirian, Director, Institute of Global Finance

8:15 a.m.–8:45 a.m.	Registration and Coffee *Shang-Jin Wei,* Chief Economist and Director General, ADB to introduce the speakers

Opening Session

8:45 a.m.–8:55 a.m.	Opening Remarks *Fariborz Moshirian,* Director, Institute of Global Finance
8:55 a.m.–9:10 a.m.	Welcoming and Introductory Remarks *Philip Lowe,* Governor-Designate, Reserve Bank of Australia
9:10 a.m.–9:20 a.m.	Welcoming and Introductory Remarks Bambang Susantono, Vice-President, Asian Development Bank
9:20 a.m.–9:50 a.m.	Keynote Address **Interconnectedness and Prospects for Global Financial Stability** *Nobel Laureate Professor Robert Engle,* New York University
9:50 a.m.–10:00 a.m.	Photo Session Distinguished Participants and Guests: Keynote Speakers, Government Officials, Paper Presenters
10:00 a.m.–10:30 a.m.	Coffee Break

Session 1

Financial, Commodity, and Business Cycles: Linkage and Transmission of Risks in Asia

Chair: Li Yang, UNSW Business School

10:30 a.m.–10:50 a.m.	**Foreign Investment, Regulatory Arbitrage and the Risk of US Financial Institutions** *W. Scott Frame,* Federal Reserve Bank of Atlanta *Atanas Mihov,* Federal Reserve Bank of Richmond *Leandro Sanz,* Federal Reserve Bank of Richmond (Presenter)
10:50 a.m.–11:00 a.m.	Discussant: *Jean-Pierre Fenech,* Monash University

11:00 a.m.–11:10 a.m.	Open Discussion
11:10a.m. –11:30 a.m.	**Exchange Rate Dynamics, US Interest Rate and Sovereign Bond Prices in Emerging Markets** *Po-Hon Chau,* Chinese University of Hong Kong *Cho-Hoi Hui,* Hong Kong Monetary Authority (Presenter) *Chi-Fai Lo,* Chinese University of Hong Kong
11:30 a.m.–11:40 a.m.	Discussant: Cyn-Young Park, Asian Development Bank
11:40 a.m.–11:50 a.m.	Open Discussion
11:50 a.m.–12:10 p.m.	**Foreign Booms and Domestic Busts** *Ambrogio Cesa-Bianchi,* Bank of England *Fernando Eguren Martin,* Bank of England (Presenter) *Gregory Thwaites,* Bank of England
12:10 p.m.–12:20 p.m.	Discussant: *Eugenio Cerutti,* International Monetary Fund
12:20 p.m.–12:30 p.m.	Open Discussion
12:30 p.m.–1:30 p.m.	Lunch Break

Session 2: Part I

Financial Interconnectedness, Spillovers and Contagion, Propagation Mechanisms and Implications for Systemic Risks in Asia

Chair: Shang-Jin Wei, Chief Economist and Director General, Asian Development Bank

1:30 p.m.–1:50 p.m.	**Keynote Presentation: Whatever it takes: The Real Effects of Unconventional Monetary Policy** *Professor Viral Acharya,* New York University Stern School of Busness (Video Presentation)
1:50 p.m. –2:00 p.m.	Open Discussion
2:00 p.m.–2:20 p.m.	**Coherent Financial Cycles for G-7 Countries: Why Extending Credit can be an Asset** *Yves S. Schüler,* European Central Bank (Presenter) *Paul P. Hiebert,* European Central Bank *Tuomas A. Peltonen,* European Systemic Risk Board
2:20 p.m.–2:30 p.m.	Discussant: *Ju Hyun Pyun,* Korea University Business School

2:30 p.m.–2:40 p.m. Open Discussion

2:40 p.m.–3:00 p.m. **The Changing International Network of Sovereign Debt and Financial Institutions**
Mardi Dungey, University of Tasmania (Presenter)
John Harvey, University of Tasmania
Vladimir Volkov, University of Tasmania

3:00 p.m.–3:10 p.m. Discussant: *Filip Zikes,* Federal Reserve Board

3:10 p.m.–3:20 p.m. Open Discussion

3:20 p.m.–3:30 p.m. Coffee Break

Day 1: Policy Panel

Chair: Natalie Oh, UNSW Business School

3:30 p.m.–4:00 p.m. **Keynote Speech on 'Financial Cycles and Crisis in Asia'**
Dr. Stijn Claessens, Federal Reserve Board

4:00 p.m.–4:20 p.m. Panelists:
Perry Warjiyo, Deputy Governor, Bank Indonesia
Johnny Noe Ravalo, Assistant Governor, Bangko Sentral ng Pilipinas
Cyn-Young Park, Asian Development Bank

4:20 p.m.–4:30 p.m. Open Discussion

Session 2: Part II

Financial Interconnectedness, Spillovers and Contagion, Propagation Mechanisms and Implications for Systemic Risks in Asia

Chair: Ed Johnson, Bureau Chief for Sydney, Bloomberg News

4:30 p.m.-4:50 p.m. **Bad Bad Contagion**
Juan Miguel Londono-Yarce, Federal Reserve Board

4:50 p.m.–5:00 p.m. Discussant: *Mardi Dungey,* University of Tasmania

5:00 p.m.–5:10 p.m. Open Discussion

Concurrent Sessions

5:10 p.m.–5:30 p.m.	**Push Factors and Capital Flows to Emerging Markets: Why Knowing Your Lender Matters More Than Fundamentals** *Eugenio Cerutti*, IMF (Presenter) *Stijn Claessens,* Federal Reserve Board *Damien Puy,* IMF	**Systemic Bank Panics in Financial Networks** *Zhen Zhou,* Tsinghua University	**Does Increased Non-interest Income Result in Increased Bank Systemic Risk?** *Barry Williams* *Abdul Wasi* *Jean-Pierre Fenech* (Presenter), all from Monash University	**Divergent EME Responses to Global and Domestic Monetary Policy Shocks** *Woon Gyu Choi* *Byongju Lee* (Presenter) *Taesu Kang* *Geun-Young Kim,* all from Bank of Korea
5:30 p.m.–5:40 p.m.	Discussant: *Paul Hiebert,* European Central Bank	Discussant: *Di Gong,* University of International Business and Economics	Discussant: *Leandro Sanz,* Federal Reserve Bank of Richmond	Discussant: *Xuehui Han*, Asian Development Bank
5:40 p.m.–5:50 p.m.	Open Discussion	Open Discussion	Open Discussion	Open Discussion
5:50 p.m.–6:10 p.m.	**Systemic Risk in a Structural Model of Bank Default Linkages** *Yvonne Kreis* *Dietmar Leisen* (Presenter), both from Gutenberg University of Mainz	**Securitization, Connectedness and Shadow Banking** *Dirk Baur,* University of Western Australia Business School (Presenter) *Issam Hallak* Joint Research Centre EU	**Early Warning Indicators of Systemic Financial Risk in an International Setting** *Jeffrey Sheen* *Stefan Truck* *Chi Truong* (Presenter) *Ben Z Wang,* all from Macquarie University	**International Transmissions of Monetary Shocks: Two-and-a-half Lemma** *Xuehui Han* *Shang-Jin Wei* (Presenter), both from Asian Development Bank
6:10 p.m.–6:20 p.m.	Discussant: *Stefano Zedda,* University of Cagliari	Discussant: *Alfred Lehar,* University of Calgary	Discussant: *Juan Miguel Londono-Yarce,* Federal Reserve Board	Discussant: *Byongju Lee,* Bank of Korea
6:20 p.m.–6:30 p.m.	Open Discussion	Open Discussion	Open Discussion	Open Discussion
7:00 p.m.–8:30 p.m.	Dinner			

FRIDAY, 9 SEPTEMBER

Master of Ceremony: Junkyu Lee, Principal Economist, Asian Development Bank

8:00 a.m.–8:30 a.m. Registration and Coffee

Session 3 (Financial Authorities Session)

Financial Network Analysis for Systemic Risks and Lessons Learnt from the Systemic Risks and Interconnectedness

Chair: Dr. Stijn Claessens, Federal Reserve Board

Keynotes/Presentations on Systemic Risks, Interconnectedness and Financial Resilience

8:30 a.m.–8:50 a.m. *Takuo Komori,* Deputy Commissioner, Financial Services Agency, Japan
8:50 a.m.–9:10 a.m. *In-Chang Song,* Deputy Minister, Ministry of Strategy and Finance, Republic of Korea
9:10 a.m.–9:30 a.m. *Shigeto Nagai,* Director General, Bank of Japan
9:30 a.m.–9:50 a.m. *Meghan Quinn,* Head of Financial System Division, Australian Treasury
9:50 a.m.–10:10 a.m. *Bambang P. S. Brodjonegoro,* Minister, Ministry of National Development Planning, Indonesia

10:10 a.m.–10:40 a.m. Open Discussion
10:40 a.m.–10:50 a.m. Photo Session
Distinguished Participants and Guests: Keynote Speakers, Government Officials, Paper Presenters
10:50 a.m.–11:00 a.m. Coffee Break

Session 4

Financial Globalization, Regional Financial Integration and Stability, Predictive Indicators of Vulnerability in Asia

Chair: Chris Adam, Associate Dean and the Deputy Director of the IGF, UNSW Business School

11:00 a.m.–11:20 a.m. **Systemic Risk-taking at Banks: Evidence from the Pricing of Syndicated Loans**
Di Gong, University of International Business and Economics (Presenter)
Wolf Wagner, Rotterdam School of Management

11:20 a.m.–11:30 a.m. Discussant: *Christina Bui,* University of Technology Sydney

11:30 a.m.–11:40 a.m. Open Discussion
11:40 a.m.–12:00 p.m. **The Transmission of Real Estate Shocks through Multinational Banks**
Ata Can Bertay, World Bank

12:00 p.m.–12:10 p.m. Discussant: *Adalbert Winkler,* Frankfurt School of Finance and Management

12:10 p.m.–12:20 p.m.	Open Discussion
12:20 p.m.–1:30 p.m.	Lunch Break

Day 2: Policy Panel

Chair: Bambang Susantono, Vice-President, Asian Development Bank

1:30 p.m.–2:00 p.m.	**Keynote Speech on 'Financial Resilience and Policy Recommendations: Stressing Financials in the Asia Pacific Region'** *Nobel Laureate Professor Robert Engle,* New York University
2:00 p.m.–3:00 p.m.	Panelists (15 minutes each): *Bambang P. S. Brodjonegoro,* Minister Ministry of National Development Planning, Indonesia *Perry Warjiyo,* Deputy Governor, Bank Indonesia *Johnny Noe Ravalo,* Assistant Governor, Bangko Sentral ng Pilipinas *Meghan Quinn,* Head of Financial System Division, Australian Treasury
3:00 p.m.–3:20 p.m.	Open Discussion
3:20 p.m.–3:30 p.m.	Coffee Break

Concurrent Sessions

3:30 p.m.–3:50 p.m.	**Volatility Contagion across the Equity Markets of Developed and Emerging Market Economies** *Masazumi Hattori,* Hitotsubashi University *Ilhyock Shim,* Bank for International Settlements (Presenter) *Yoshihiko Sugihara,* Bank of Japan	**Identifying Contagion in a Banking Network** *Alan Morrison,* Oxford University Michalis Vasios, Bank of England Mungo Wilson, Oxford University *Filip Zikes*, Federal Reserve Board (Presenter)	**The Value of Bank Capital Buffers in Maintaining Financial System Resilience** *Christina Bui,* University of Technology Sydney (Presenter) *Harald Scheule,* University of Technology Sydney *Eliza Wu,* University of Sydney	**More Inclusive, More Stable? The Financial Inclusion - Stability Nexus in the Global Financial Crisis** *Tania Lopez Adalbert Winkler* (Presenter), both from Frankfurt School of Finance and Management
3:50 p.m.–4:00 p.m.	Discussant: *Fernando Eguren Martin,* Bank of England	Discussant: *Cho-Hoi Hui,* Hong Kong Monetary Authority	Discussant: *Ju Hyun Pyun,* Korea University Business School	Discussant: *Ata Can Bertay,* World Bank
4:00 p.m.–4:10 p.m.	Open Discussion	Open Discussion	Open Discussion	Open Discussion

4:10 p.m.–4:30 p.m.	**Measuring Spillovers between the US and Emerging Markets** *Tom Pak Wing Fong* (Presenter) *Ka Fai Li* *Angela Kin Wan Sze,* all from Hong Kong Monetary Authority	**Too Big To Fail: Toward Optimal Incentive Regulation** *Chang Ma,* Johns Hopkins University *Xuan-Hai Nguyen,* Chinese University of Hong Kong (Presenter)	**Does Credit Market Integration Amplify the Transmission of Real Business Cycle During the Crises?** *Ju Hyun Pyun,* Korea University Business School (Presenter) *Jiyoun An,* Kyung Hee University	**Analysis of Banks' Systemic Risk Contribution and Contagion Determinants through the Leave-one-out Approach** *Stefano Zedda,* University of Cagliari (Presenter) *Giuseppina Cannas,* European Commission
4:30 p.m.–4:40 p.m.	Discussant: Sang Hoon Kang, University of South Australia	Discussant: Zhen Zhou, Tsinghua University	Discussant: Dirk Baur, University of Western Australia	Discussant: Dietmar Leisen, Gutenberg University of Mainz
4:40 p.m.–4:50 p.m.	Open Discussion	Open Discussion	Open Discussion	Open Discussion
4:50 p.m.–5:10 p.m.	**Dynamic Spillovers between U.S. and BRICS Stock Markets during the Financial Crises** *Sang Hoon Kang,* Pusan National University (Presenter) *Ron McIver,* University of South Australia	**Emergency Liquidity Facilities, Signalling and Funding Costs** *Céline Gauthier,* University de Quebec *Alfred Lehar,* University of Calgary (Presenter) *Hector Perez-Saiz,* Bank of Canada *Moez Souissi,* IMF		
5:10 p.m.–5:20 p.m.	Discussant: *Tom Pak Wing Fong,* Hong Kong Monetary Authority	Discussant: *Xuan-Hai Nguyen,* Chinese University of Hong Kong		
5:20 p.m.–5:30 p.m.	Open Discussion	Open Discussion		

5:30 p.m.–5:40 p.m.	Closing Remarks *Shang-Jin Wei,* Chief Economist and Director General, Asian Development Bank
6:45 p.m.–9:30 p.m.	Dinner

Conference Concludes

Note: A lot of the work that has been presented was still work in progress. This implies that the results presented during the conference may possibly change in the course of future revisions of the papers.

Session 1 Summary of Papers

Foreign Investment, Regulatory Arbitrage and the Risk to US Financial Institutions

W. Scott Frame, Federal Reserve Bank of Atlanta
Atanas Mihov, Federal Reserve Bank of Richmond
Leandro Sanz, Federal Reserve Bank of Richmond (Presenter)

Summary[1]

In the aftermath of the recent global financial crisis, which highlighted the pivotal role of international financial linkages within and between banks in the global economy, the importance of international coordination in banking regulation has received renewed attention. For example, more than half of the ten recommendations of the 2011 Report of the Cross-Border Bank Resolution Group of the Basel Committee for Banking Supervision (BCBS) suggested increased cooperation and coordination of country resolution measures to address the increasingly important cross-border business activities of banking institutions.[2] Nevertheless, much of banking regulation and supervision remains at the national level (Houston et al. 2012). In this paper, we explore the implications of cross-country differences in banking regulation for the subsidiary location choices and risk profile of United States (US) bank holding companies (BHCs).

The centralization of banking regulation on an international scale is costly and would necessarily limit the flexibility in policy design tailored to the banking sector of individual countries (Morrison and White 2009). However, more coordination in banking regulation could mitigate the risk of negative externalities that may arise in an increasingly financially integrated world with mobility of capital.[3] A particular concern for academics and regulators is related to the risks posed by regulatory arbitrage: the situation where countries with lax

1 The views expressed in this paper do not necessarily reflect the views of the Federal Reserve Bank of Atlanta, the Federal Reserve Bank of Richmond or the Federal Reserve System.
2 Details on the report and recommendations of the Cross-Border Bank Resolution Group can be found at http://www.bis.org/publ/bcbs169.htm
3 McGuire and Tarashev (2008) and Houston et al. (2012) provide evidence that the international banking system is evolving into an increasingly important cross-border conduit for the transfer of capital.

regulatory environments attract international capital flows and spur activity by banks from countries with stricter regulations.[4,5]

Different perspectives on the implications of regulatory arbitrage have emerged. In one respect, it may enable banks to effectively evade costly regulation, which improves capital allocation efficiency and enhances global economic growth. For instance, banks could benefit from pursuing profitable investment opportunities in foreign markets in which they are not constrained by domestic regulations. In contrast, another view equating regulatory arbitrage to a "race to the bottom" also exists (Barth et al. 2004). In this context, banks may practice regulatory arbitrage by engaging in value-destroying activities in the form of excessive risk-taking through operating in countries with lax regulations and weak supervisors. This second form of regulatory arbitrage could have adverse consequences on bank-specific performance. In addition, by undermining stricter domestic bank regulation, regulatory arbitrage might contribute to a build-up of risks at the system level. Understanding whether banks engage in regulatory arbitrage, what banks do so, and whether there are bank risk implications, is thus important for comprehending the motives and consequences of regulatory arbitrage.

In this study, we examine BHC-level data and investigate whether US BHCs engage in regulatory arbitrage. While banks with the intention to expand internationally can do so through pursuing various strategies, the approach in this paper is to analyze the distribution of US BHCs' foreign subsidiaries through time and identify whether there is a tendency for subsidiaries to be located in countries with lax regulatory environment. Foreign subsidiaries are a particularly useful setting for the analysis. As pointed out by Fiechter et al. (2011), foreign branches typically fall under the supervisory jurisdiction of a BHC's head office and therefore are likely to be more aligned with the home country's regulations. A similar argument can be made about cross-border exposures originating from the BHC or domestic affiliates to its customers abroad. In contrast, foreign subsidiaries are usually separate legal entities incorporated in the host countries and they typically abide more closely by the rules and regulations set forth by their host country functional regulators. This is, to the best of our knowledge, the first study to examine regulatory arbitrage as it pertains to subsidiary location decisions of US BHCs.

Using regulatory data on the international structure of US BHCs from 1995 to 2013, we first investigate whether differences in the stringency of regulations across countries influence the international subsidiary locations of said institutions. Consistent with the interpretation that regulatory arbitrage is a motive in the location decisions of foreign subsidiaries, we provide robust empirical evidence that US BHCs are more likely to have operations in countries with lax regulatory environment (defined by fewer restrictions on activities, less stringent capital

[4] The International Monetary Fund's Managing Director at the time, Dominique Strauss-Kahn, stated: "One of the lessons of the crisis is that we must avoid regulatory arbitrage. Key aspects of prudential regulations must be applied consistently across countries and across financial activities. This is especially important today, as the road to a safer future involves strengthened financial regulation and supervision, not only of cross-border institutions but also of cross-border markets. This will only work if all countries sign on and take ownership of the initiative, and resist the temptation to offer loopholes" ("Crisis Management and Policy Coordination: Do We Need a New Global Framework?", Oesterreichische Nationalbank, Vienna, 15 May 2009).

[5] Other forms of regulatory arbitrage exist. For instance, Munyan (2015) presents evidence of regulatory arbitrage in the repurchase agreement markets.

requirements, and weaker supervision).[6] The documented associations hold after controlling for a number of economic, legal, and institutional factors. At the extensive margin, a one standard deviation decrease in the stringency of regulation and supervision corresponds to an increase of 0.68 percentage points in the probability of having a subsidiary in a given country. These values are economically significant, given that the unconditional probability of a US BHC having a subsidiary in any particular foreign country is 4.9% in our data set. In addition, we take a step further and also investigate the association between regulatory stringency and subsidiary locations at the intensive margin. On that front, we present evidence suggesting that not only are US BHCs more likely to operate in countries with weak regulations, but also tend to have proportionately more subsidiaries there.

To check the robustness of our results, we re-run our analyses using alternative estimation methods, measures of regulatory environment and variable definitions. While we consistently find a strong association between regulatory environment and US BHCs' foreign subsidiary location choices, there are endogeneity concerns that omitted variables or reverse causality might be driving estimated correlations. We mitigate such issues by using instrumental variables for differences in banking regulation and by accounting for unobserved time-invariant country characteristics, which might play a role in US BHCs' foreign subsidiary location decisions. Admittedly, none of these econometric techniques used as alternative identification approaches addresses concerns completely. Nevertheless, in each of these robustness checks, we find evidence in support of our main findings.

Second, we investigate what types of banks tend to engage in regulatory arbitrage. We focus on an attribute of BHCs, the quality of their risk management function, that previous research has shown to be important for curtailing risk exposures (Ellul and Yerramilli 2013). Specifically, we investigate the potential interaction between BHC risk management quality and country regulatory environment with respect to foreign subsidiary location decisions. We leverage a BHC risk management rating internally developed by the Federal Reserve System and find significant relationships. Importantly, the institutions operating subsidiaries in countries with weak regulatory environment and potentially engaging in regulatory arbitrage tend to have stronger internal controls and risk management functions in place, a result that partially mitigates concerns of excessive risk-taking.

Finally, we investigate the risk implications of BHCs' foreign subsidiary location decisions. We find that US BHCs with subsidiaries in weaker regulatory regimes face higher risk at the company level. More importantly, however, using measures of banks' contribution to systemic risk introduced by Tobias and Brunnermeier (2015), we also provide evidence that such BHCs contribute to the build-up of systemic risk in the United States. The risk management quality of BHCs seems to play a critical role in such risk outcomes—the link between increased risk and the regulatory laxness of subsidiary locations is primarily driven by financial institutions with weak risk management functions. Overall, the evidence we present suggests that regulatory arbitrage may have dangerous consequences and is consistent with the "race to the bottom" interpretation. However, it also highlights the importance of internal

[6] Our study leverages the global banking regulation database presented in Barth et al. (2013), which builds on four surveys sponsored by the World Bank (released in 1999, 2003, 2007 and 2011). The data set provides information on measures of bank regulation and supervision in 180 countries over the period (1999-2011).

controls and risk management in overseeing the risks associated with subsidiaries in poorly regulated markets.

Our study contributes to several research streams. First, this study contributes to the small but growing literature focused on regulatory arbitrage and the implications of differences in banking regulation across countries.[7] Karolyi and Taboada (2015) examine how country regulatory differences impact cross-border bank acquisition volumes and study how share prices react to such deal announcements.[8] Similar to our study, the authors show evidence of regulatory arbitrage—cross-border bank acquisition deals predominantly involve buyers from jurisdictions with stronger regulations compared to their targets. However, the authors find no evidence of systemic risk implications related to such mergers and acquisitions activity and interpret their evidence to be consistent with "a more benign form of regulatory arbitrage."

Houston et al. (2012) examine the extent to which cross-country differences in regulatory environment impact international bank flows. Results suggest that banks have transferred funds to locations with weaker regulatory environment, evidence again consistent with the existence of regulatory arbitrage. Ongena et al. (2013) provide evidence that bank regulation has cross-border spill-over effects in the context of multinational banks' lending practices. Specifically, based on evidence from Europe, the authors find that a tougher regulatory environment in domestic markets is associated with lower lending standards and riskier loans abroad. In contrast to such literature, our study focuses exclusively on US BHCs, some of the very institutions that played a central role in the 2008–2009 global financial crisis.

By examining US BHCs' foreign subsidiary location choices, we provide new direct evidence on the extent to which banks engage in regulatory arbitrage and the dimensions of regulatory arbitrage they engage in. Importantly, we also provide unique evidence on the interaction effects between country regulatory environment and BHCs' risk management quality about subsidiary location choices. Finally, we document a direct association between BHCs' subsidiary location choices, regulatory environment stringency and BHCs' risk profiles.

Second, our paper contributes to the large stream of literature on risk-taking by banks. Keeley (1990) suggests that fixed-rate deposit insurance systems bring forth a moral hazard for excessive risk-taking. Through a dynamic model of moral hazard, Hellmann et al. (2000) show that competition can erode prudent bank behavior and promote excessive risk-taking even in the presence of capital-requirement regulations. Demsetz and Strahan (1997) argue that diversification does not necessarily translate into lower risk. Diversification might, for example, induce consolidation by allowing riskier lending practices and increased leverage. Demirguc-Kunt and Detragiache (2002) find that government-run deposit insurance could be detrimental to bank stability and makes banking crises more likely, especially so in countries with weak institutional environments and deregulated interest rates.

[7] More broadly, our research also contributes to the large literature examining the economic effects of cross-country differences in banking regulation and economic liberalization in an international context (e.g., Beck et al. (2006), Houston et al. (2010), Barth et al. (2008), Dell'Ariccia and Marquez (2006)).

[8] For other recent studies that link regulatory issues to cross-border merger activity see Hagendorff et al. (2008) and Carbo-Valdere et al. (2012).

Using data on privately owned banks in different countries, Laeven and Levine (2009) examine the importance of bank ownership structure and country regulations for bank risk-taking. Dell'Ariccia and Marquez (2010) discuss banks' corporate structures when expanding into foreign markets and show important implications for banks' risk exposure and risk-taking. Berger et al. (2015) document a positive relation between internationalization and bank risk, hypothesizing that internationalization of US banks increases their risk as a result of market-specific factors in foreign markets. In relation to this literature, we document a direct association between bank risk-taking and subsidiary location decisions. Importantly, we present evidence linking regulatory arbitrage to an increase in bank risk, including positive contributions to systemic risk.

Our study also contributes to the literature on the determinants of global bank activities and bank foreign investments. Mian (2006) examines the extent to which cultural and geographical distance limits foreign lending in poor economies. Sengupta (2007) examines interactions between foreign entry and bank competition, and discusses lending patterns by foreign banks. Focarelli and Pozzolo (2005) examine the importance of institutional characteristics and market profitability for bank location choice. Focusing on European Union linkages and using country level data, Buch (2003) finds that information cost and regulation are correlated with international asset choices of banks. Goldberg and Saunders (1980) test various hypotheses on the drivers of US bank expansion abroad, with particular emphasis on the United Kingdom. The authors find that the most important determinants of growth were expansion of domestic bank activity and US trade overseas, with British regulation having little constraining effects. Complementary to such literature, we find that cross-country differences in banking regulation are an important determinant of the foreign subsidiary location decisions of US BHCs.

Finally, our study also has potential policy implications, and contributes to the ongoing debates about international regulatory coordination. We find evidence consistent with the interpretation that US BHCs engage in regulatory arbitrage by locating subsidiaries in countries with lax regulatory environment. Furthermore, such BHCs tend to be riskier as compared to those with subsidiaries in countries with more stringent regulations. Therefore, regulatory arbitrage may undermine attempts to limit risk-taking in the aftermath of the recent global financial crisis, unless policymakers are able to improve the coordination in banking regulation and supervision at a global level.

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Exchange Rate Dynamics, US Interest Rate and Sovereign Bond Prices in Emerging Markets

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Summary

The relationship between sovereign risk and exchange-rate stability has long been a subject of interest in international finance. In the aftermath of the global financial crisis of 2008–09, capital inflows to emerging markets surged and have been volatile since then. At the same time, the Federal Reserve System of the United States (US) lowered the policy interest rate to the zero lower bound. In view of such market development, this paper studies the dynamic linkage between US dollar-denominated sovereign bond prices and exchange rates in emerging markets by deriving a two-factor risky bond pricing model with closed-form solutions in which the exchange rate and US risk-free interest rate are the underlying factors.

In the proposed model, a currency's exchange rate, i.e., the US dollar price of the local currency is the same as the stock price by using an analogy between corporate valuation and budget constraints for an economy proposed by Sims (1999) and Cochrane (2005). Such analogy assumes that the exchange rate adequately reflects country fundamentals anticipated in the market, similar to a firm's value measured by its stock price. On the balance sheet of an economy, foreign and domestic debt sum to the present value of the future budget surplus. Foreign debt of the economy is the "actual" debt while domestic debt and fiat money act like equity in a firm. Given that the government promises only to pay the domestic debt in local currency in future, the function of domestic debt is to absorb fiscal risk by adjustment of its foreign currency (e.g., US dollar) equivalent value. The currency price, e.g., the US dollar price of the local currency, is the same as the stock price.

The proposed model incorporates two features different from the previous models. First, the correlation between the exchange rate and risk-free interest rate is explicitly incorporated into the model and its closed-form solutions. Second, the stochastic risk-free interest rate in the proposed model is assumed to follow the double square-root (DSR) process proposed by Longstaff (1989). One important characteristic of the DSR model is that it has a nonlinear restoring force in its drift term such that the interest rate is sticky downward. It is therefore particularly relevant to the low interest rate environment since the global financial crisis in 2008 when the short-term interest rate has tended to persist near the zero bound instead of moving back toward higher levels in a short time as implied by the other models.

We conduct an empirical test on dollar-denominated sovereign credit spreads in emerging markets, including Brazil, Colombia, Mexico, the Philippines, the Russian Federation and Turkey to study their relationship with each country's exchange rate and US Treasury yields.

We obtain daily data on sovereign bond yields from 1 June 2003 to 29 September 2014. Based on data availability, the tenors of the bonds are as follows: Brazil, Mexico, and Turkey (10-year, 15-year, 20-year, and 30-year); Colombia (10-year and 30-year); the Philippines (10-year, 15-year, and 20-year); and the Russian Federation (15-year). Given the illiquid sovereign bond markets during the global financial crisis in 2008 and the structural differences before and after the onset of the crisis, we split the sample into two periods. The first period is from 1 June 2003 to 31 December 2007 (i.e., pre-crisis), and the second period is from 1 January 2009 to 29 September 2014 (i.e., post-crisis).

As a factor for changes in interest rates, we use changes in Treasury yields of a corresponding tenor. Let ΔCS denote the change in the credit spread, ΔY denote the change in the Treasury yield and ΔI denote the change in the exchange rate of the corresponding country. The regression equation is given by:

$$\Delta CS = a + b\Delta I + c\Delta Y + \varepsilon$$

where a, b, and c are regression coefficients.

Table 1 reported the regression results. The coefficients b for all the countries are statistically significant at the 1% level and suggest a positive relationship between credit spreads and

Table 1: Results from Regressing Daily Changes in Credit Spreads on Changes in Treasury Yields and Exchange Rates during Pre-crisis (1 June 2003–31 December 2007) and Post-crisis (1 January 2009–29 September 2014) Periods

	a	b	c	Adj. R^2	N
Brazil pre-crisis					
10Y	−1.79E−05	0.032579***	−0.423821***	0.301740	1069
15Y	−2.28E−05	0.022915***	−0.456325***	0.247755	1091
20Y	−2.63E−05	0.024404***	−0.434065***	0.269502	1194
30Y	−2.39E−05	0.026017***	−0.377374***	0.274398	1193
Brazil post-crisis					
10Y	−1.51E−05	0.008872***	−0.759033***	0.564520	1365
15Y	−1.12E−05	0.008278***	−0.908440***	0.714829	1495
20Y	−1.18E−05	0.008134***	−0.795108***	0.559443	1495
30Y	−1.63E−05	0.009925***	−0.777030***	0.474237	988
Mexico pre-crisis					
10Y	−8.88E−05	0.002285***	−0.388730***	0.250256	1083
15Y	−7.67E−05	0.002536***	−0.438689***	0.264938	1148
20Y	−1.38E−05	0.002025***	−0.351745***	0.199819	921
30Y	−8.88E−06	0.002381***	−0.422331***	0.254845	1193
Mexico post-crisis					
10Y	−1.66E−05	0.001129***	−0.757392***	0.305870	1425
15Y	−1.15E−05	0.000752***	−0.874257***	0.321954	1438
20Y	−1.16E−05	0.001270***	−0.856517***	0.546522	1494
30Y	−1.02E−05	0.001863***	−0.717229***	0.538340	1493

Continued on next page

Table 1 continued

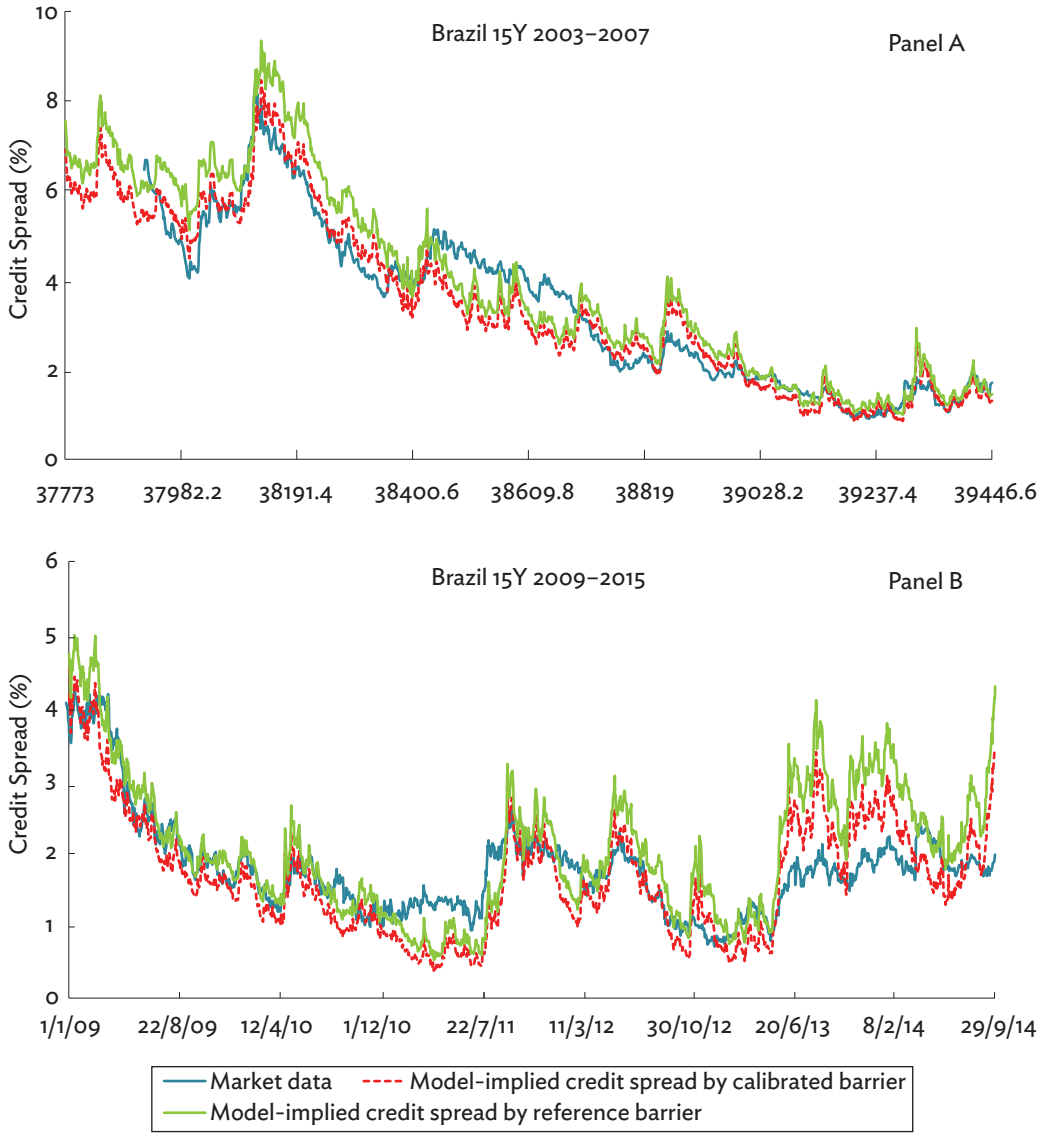
	a	b	c	Adj. R^2	N
Turkey pre-crisis					
10Y	−4.60E−05	0.037080***	−0.725606***	0.312478	931
15Y	−3.04E−05	0.032201***	−0.704508***	0.437636	1148
20Y	−4.84E−05	0.020255***	−0.750334***	0.506729	768
30Y	−2.79E−05	0.027035***	−0.705168***	0.380692	1195
Turkey post-crisis					
10Y	−2.88E−05	0.024269***	−0.988732***	0.475544	1494
15Y	−2.79E−05	0.021272***	−1.043532***	0.589325	1438
20Y	−2.44E−05	0.020266***	−0.999196***	0.559800	1491
30Y	−2.88E−05	0.019635***	−1.022787***	0.548374	1497
Colombia pre-crisis					
10Y	−2.69E−05	2.00E−05***	−0.878571***	0.226331	1082
30Y	−8.41E−06	1.78E−05***	−0.671917***	0.241309	1192
Colombia post-crisis					
10Y	−2.07E−05	1.60E−05***	−0.857612***	0.517760	1280
20Y	−1.04E−05	1.04E−05***	−0.858695***	0.536560	1135
30Y	−1.59E−05	1.57E−05***	−0.796530***	0.579839	1470
Philippines pre-crisis					
15Y	−3.16E−05	0.000519***	−0.897891***	0.453476	761
Philippines post-crisis					
10Y	−1.83E−05	1.44E−05***	−0.973819***	0.528773	919
15Y	−2.46E−05	0.000486***	−0.999035***	0.652513	1498
20Y	−1.45E−05	0.000621***	−0.964019***	0.601138	1290
Russian Federation pre-crisis					
15Y	−5.22E−06	0.001060***	−0.650849***	0.304584	1128
Russian Federation post-crisis					
15Y	−3.96E−05	0.000980***	−0.991912***	0.564024	1438

ΔCS = change in credit spread, $\Delta CS\_t = a+b\Delta I\_t+c\Delta Y\_t+\varepsilon\_t$, ΔI = change in exchange rate, ΔY = change in US Treasury bond yield, Y = year.
Note: *** indicates significant at 1% level.
Source: Authors' regression results.

exchange rates. This is consistent with the expected sign: that credit spreads increase with weaker currencies (i.e., higher exchange rates per dollar). The magnitude of the estimates of b shows that the relation between credit spreads and interest rates is economically significant.

The coefficients c are all statistically significant at the 1% level and indicate a negative relationship between credit spreads and US Treasury yields. This finding supports the argument that investors, in particular risk-averse ones, sell risky asset (i.e., sovereign bonds in emerging markets) and buy US Treasuries which are treated as safe-haven assets in stressed markets. The magnitude of the estimates of c shows that the relation between credit spreads and US Treasury yields is economically significant. Comparing the coefficients c in the two sample periods, the effects are generally stronger for the sample countries in the post-crisis period, reflecting a more important role of US Treasuries as safe-haven assets after the crisis. Comparing the adjusted R-squared in the two sample periods, the explanatory power of

Figure 1: Comparison of Model and Market Sovereign Bond Credit Spreads



Source: Authors.

exchange rates in the post-crisis period (about 0.31–0.71) is stronger than that in the pre-crisis period (about 0.2–0.51). This indicates that the link between sovereign credit spreads and the dynamics of the exchange rates and US interest rates has become stronger in the post-crisis period.

Given that default barriers are not observable, we use two simple methods to set the barriers to test the proposed model. The first method is to set the barriers at the highest exchange rates during the full period, i.e., the lowest values of the currencies against the US dollar, which are denoted as reference default barriers. The second method is to calibrate the barriers (denoted as calibrated default barriers) by minimizing the differences between the market and model-implied credit spreads. The comparison between the market and model credit spreads of the 15-year Brazilian sovereign bonds illustrated in Figure 1 show that the

Table 2: Performances of the Model in Pre-crisis (1 June 2003–31 December 2007) and Post-crisis (1 January 2009–29 September 2014) Periods

	Pre-crisis Period			Post-crisis Period		
	RMS error (basis points)	**Percentage error**	**Absolute percentage error**	**RMS error (basis points)**	**Percentage error**	**Absolute Percentage error**
Brazil		(Reference barrier)			(Reference barrier)	
Aggregate	162.18	1.064%	21.49%	102.66	6.267%	24.27%
		(27.39%)	(18.32%)		(28.68%)	(19.39%)
Brazil		(Calibrated barrier)			(Calibrated barrier)	
Aggregate	69.84	–2.592%	16.92%	38.93	–6.217%	23.43%
		(18.37%)	(11.65%)		(35.03%)	(20.42%)
Mexico		(Reference barrier)			(Reference barrier)	
Aggregate	68.79	–28.62%	36.99%	279.01	173.9%	171.2%
		(22.72%)	(15.58%)		(78.19%)	(76.51%)
Mexico		(Calibrated barrier)			(Calibrated barrier)	
Aggregate	41.80	–0.784%	20.97%	49.62	–3.701%	26.55%
		(27.54%)	(17.21%)		(29.96%)	(22.68%)
Turkey		(Reference barrier)			(Reference barrier)	
Aggregate	116.69	7.670%	35.67%	393.7	130.4%	131.7%
		(39.86%)	(34.24%)		(63.60%)	(62.83%)
Turkey		(Calibrated barrier)			(Calibrated barrier)	
Aggregate	108.9	0.275%	27.18%	109.82	–14.65%	35.03%
		(35.32%)	(21.78%)		(38.15%)	(20.45%)
Colombia		(Reference barrier)			(Reference barrier)	
Aggregate	234.7	36.35%	58.16%	107.25	–10.89%	36.45%
		(40.44%)	(39.22%)		(38.98%)	(25.80%)
Colombia		(Calibrated barrier)			(Calibrated barrier)	
Aggregate	98.39	0.203%	26.50%	69.93	–12.99%	29.97%
		(32.26%)	(17.92%)		(32.67%)	(19.88%)
Philippines		(Reference barrier)			(Reference barrier)	
Aggregate	67.73	9.111%	19.55%	78.23	–35.94%	38.00%
		(21.83%)	(13.32%)		(26.17%)	(22.90%)
Philippines		(Calibrated barrier)			(Calibrated barrier)	
Aggregate	58.68	–1.219%	16.49%	55.68	–9.911%	25.94%
		(20.78%)	(12.70%)		(29.49%)	(18.33%)
Russian Federation		(Reference barrier)			(Reference barrier)	
15Y	272.45	121.8%	122.1%	135.12	38.52%	40.59%
		(73.15%)	(72.63%)		(33.16%)	(30.58%)
Russian Federation		(Calibrated barrier)			(Calibrated barrier)	
15Y	68.74	–8.773%	32.31%	71.48	–3.048%	19.00%
		(38.42%)	(22.57%)		(23.77%)	(14.61%)

RMS = root-mean-square. Y = year.
Note: The numbers in parentheses are the standard deviations of the errors.
Source: Authors.

proposed model can generate credit spreads which track the changes of the market credit spreads.

Table 2 summarizes the pricing errors of the model in terms of credit spreads using the bonds in the previous section. There are three error measures including: (i) root-mean-square errors (RMS) in basis points (bps); (ii) percentage errors; and (iii) absolute percentage errors. The percentage errors, and their absolute values, are calculated as the predicated (model) spread minus the market spread divided by the market spread. Their means are reported and the numbers in parentheses are the standard deviation of the errors.

The results show that the RMS errors are smaller in the post-crisis period than those in the pre-crisis period. However, the absolute percentage errors are larger in the post-crisis period, indicating that the differences in the RMS errors are mainly due to the lower credit spreads in the post-crisis period compared with the pre-crisis period. As expected, the performance of the model based on the calibrated barriers is better than that based on the reference barrier. However, if we compare the ranges and aggregates of errors for the two types of barriers in post-crisis period, the use of the calibrated barriers does not outperform substantially compared with the reference barrier.

Using US dollar-denominated sovereign bonds with different tenors, the numerical results from the closed-form solution with default before maturity show that the credit spreads generated from the pricing model broadly track changes in the market credit spreads in both the pre- and post-crisis periods. The corresponding absolute percentage errors vary among the bonds. Our results support the findings of a strong relationship between emerging markets' sovereign risk and exchange-rate stability in the literature on international finance and studies about twin sovereign debt and currency crises. This paper's findings suggest that dollar-denominated sovereign bonds are directly influenced by exchange rate dynamics. This suggests that both governments and investors might be better served by issuing debt in local currency, and letting investors hedge these risks in currency markets.

Discussion

There are two major questions for the paper raised in the discussion. The first one is whether macro variable could be incorporated into the model. Given that the model simply captures the contributions due to exchange rate dynamics, future research could develop multi-factor models augmented to allow for the possible sensitivity of bond credit spreads to exchange rates and its volatility, and to depend on observable country-specific or macroeconomic variables such as foreign reverses which affect sovereign risk.

The second question is whether the long-end risk premium of the US dollar interest rate term structure is an important factor in the pricing of sovereign bond. To address this issue, an additional risk factor should be added into the model to reflect the changes in the risk premium. In addition, the risk premium could be partially incorporated into the market price of risk of the US dollar risk-free interest rate of the pricing model. However, this may need further study.

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Foreign Booms and Domestic Busts

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Summary

The global financial crisis that began in 2008 was an extreme example of an empirical regularity: financial crises come in waves. That is, crises tend to take place simultaneously across countries. Credit also comes in waves: domestic credit growth is correlated across countries, and therefore one could argue for the existence of a common cycle in domestic credit growth too.

In this paper we link these two facts with the well-known result in the literature that domestic credit growth seems to be the single best predictor of domestic banking crises, due to the influential work of Schularick and Taylor (2012). Specifically, the observations that (1) banking crises come in global waves, (2) credit growth is correlated across countries, and (3) credit growth predicts financial crisis naturally lead us to ask the following question: do global conditions have a role in predicting domestic banking crises, over and above that of domestic credit?

For this purpose, we combine two existing databases (namely, the data on systemic banking crises compiled by Laeven and Valencia (2013), and the BIS data on credit) in a novel way, and come up with a panel of 38 countries over 1970–2015.

Armed with this data, we first present a number of novel stylized facts on the international synchronization of credit and of crisis episodes. We show that credit growth is correlated across countries and that this synchronization has increased over time. We also show that the empirical distribution of banking crises has fatter tails than a binomial distribution, i.e., the distribution they would follow if crises were independently distributed across countries. We formally test for this correlation with a "stable correlation binomial model" and find strong statistical evidence of a positive cross-country correlation in the occurrence of banking crises.

We then test our main hypothesis (i.e., that foreign variables can help explaining the occurrence of domestic banking crises) in the simplest possible way: we construct an information set that includes lagged values of some variables of interest for each country in our panel. We then use this information set as explanatory variable for the occurrence of banking crises, which are quantified by the use of dummy variables. We use both linear probability and Logit models.

Given the proven importance of domestic credit growth for the occurrence of banking crises, one plausible conjecture is that credit growth in the rest of the world could also affect the probability of a banking crisis taking place at home. So, as a first step, we study the role of

"foreign" credit growth (i.e., domestic credit growth in the rest of the world) in affecting the probability of experiencing domestic banking crises at home.

Our results show that the information contained in foreign credit substantially increases the predictive power of models that only focus on domestic credit as explanatory variable for the occurrence of crises. In particular, we find that credit growth in the rest of the world is a significant predictor of domestic banking crises, even when controlling for domestic credit growth. This is true for our new data set and for the longer, narrower panel in Schularick and Taylor (2012) (which covers 14 countries over 1870–2008). Foreign variables are not only significant statistically, but also substantially increase the ability of the model to distinguish between forthcoming crisis and no-crisis episodes.

We further explore our findings in the following two dimensions. First, we consider as an additional explanatory variable corporate credit spreads in the United States (US), which Lopez-Salido et al. (2016) show to be a good predictor of US economic activity. Second, we explore the role of (trade and financial) openness in affecting our results.

Given the centrality of the US in the global financial system and the global reserve currency status of the US dollar, we conjecture that changes in US credit market spreads can be transmitted across borders and affect financial stability elsewhere. Our conjecture is supported by the data, as we find that compressed spreads in the US corporate credit market tend to be associated with the subsequent occurrence of banking crises in the rest of the world.

We then explore the role of openness as a potential source of heterogeneity in the impact of foreign credit growth (and US credit spreads) on domestic financial stability. There are at least two relevant dimensions in which a country can be open: it can be open to trade, and it can be open to financial transactions with nonresidents (which we refer to as financial openness). We explore these two dimensions by interacting proxies of these degrees of openness with measures of credit growth abroad.

We begin by exploring the effect of financial openness. Although the period considered in this section (1970–2011) is one of high capital mobility at the global level, there can still be differences across countries in terms of their financial openness. Our proxies of financial openness are countries' gross external liability positions, as estimated by Lane and Milesi-Ferretti (2007). The results show that the effect of credit growth abroad is indeed more important for financially open countries.

When it comes to trade openness, we follow the standard approach of proxying it with the sum of exports and imports (normalized by gross domestic product). Our results show that credit growth in the rest of the world is not more relevant for explaining the occurrence of domestic banking crises in countries more open to trade.

In the discussion that followed the presentation, many useful insights were put forward. While our finding is intuitive and robust to different model specifications, more effort should be devoted to the understanding of its underlying mechanisms. In an upcoming revision of our paper we explore further the role played by a number of other covariates, which (as suggested by the literature) should help us distinguish between the potential economic

mechanisms that drive our findings. These include other measures of capital flows (such as portfolio equity and debt flows), measures of risk aversion in center-country financial markets (such as the VIX index), the leverage of US broker-dealers, and the stance of US monetary policy.

In this paper we provide novel empirical evidence showing that (i) banking crises are correlated across countries and (ii) there exists a global credit cycle in domestic credit growth. We then link these facts and study the role of credit growth in the rest of the world in affecting domestic financial stability. Our analysis is motivated by the influential work of Schularick and Taylor (2012) who show that domestic credit growth seems to be the single best predictor for banking crises at home. We extend their analysis in two dimensions. First, we apply it on a new data set for 38 advanced and emerging economies over 1970–2011. Second, we augment their specification with the inclusion of a measure of "foreign" real credit growth and a measure of credit spreads in the United States (Lopez-Salido et al. 2016). We find that both foreign credit growth and US credit spreads increase significantly the predictive power of the model, and that both variables are more important for financially open economies. Our results provide prima facie evidence of the spillovers that financial developments in one country can create for others, suggesting the case for the co-ordination of financial and macroprudential policies at the international level.

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Session 2 Summary of Papers

Coherent Financial Cycles for G7 Countries: Why Extending Credit Can Be an Asset

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Summary

This paper touches upon the topic of identifying, characterizing, and evaluating financial cycles for Group of Seven (G7) countries. It is motivated by the vivid illustration provided by the global financial crisis of the real effects of systemic risk that was related to a build-up of macro-financial imbalances and vulnerabilities related to excesses in the financial cycle.

The attenuation of financial cycles is one of two fundamental goals of macroprudential policy that many countries have inherited from past global financial crises. Despite the prominence of this goal, there is no generally agreed definition of the financial cycle. Moreover, analyzes on financial cycles remain scarce, and are in many ways not yet suitable for policy use. Limitations include the geographic coverage of the analysis (in that it tends to focus on a few countries) and a lack of consensus on the mechanics of measurement, such as the choice of indicators and the method used to construct them.

For instance, measuring financial cycles has become critical in the European Union in the context of new macroprudential tools included in the European Union legislation, and due to the launch of the Single Supervisory Mechanism with new macroprudential role for the European Central Bank. Therefore, there is an urgent need to obtain a robust view on capturing financial cycles -- balancing cross-country consistency with individual country relevance. However, as financial cycles are not directly observable, they must be inferred. Against this backdrop, we present a methodology aimed at furthering the basis for country-specific macroprudential policymaking.

Specifically, our research proposes a novel spectral method called “power cohesion” to capture financial cycles at the country level, applied to over 40 years of quarterly data for each of the G7 countries (1970 to 2013). In a first step, frequencies common to a set of indicators summarising financial and business cycles, respectively, are separately identified using spectral methods—providing insights on financial and business cycle length and volatility. In a second step, composite measures of the financial and business cycle are constructed for

each G7 country using time varying aggregation weights—which can be compared to better understand within and across country cycle interaction. Results are obtained using both a narrow measure of the financial cycle (consisting credit and house prices) and a broad measure (completing portfolio choice among all asset classes, bringing in equity and bond prices). A narrow and broad measure is chosen on the basis of statistical properties and the academic literature on leverage cycles and leveraged asset price bubbles. Historically, mortgage lending and house price developments have been important determinants for financial stability; however, asset prices in general are an important determinant for the health of the balance sheets of economic agents. Further, we conduct an early warning exercise using our composite cycles to predict the vulnerability period preceding systemic banking crises. For this we use a logit model. The predicted probabilities are used in the usual signalling framework. Further, we derive Type I and Type II errors using a policymaker's loss function with equal preferences between these two errors. This exercise is similar to Schularick and Taylor (2012), however in comparison; we do not employ lagged values of our indicator but allow for a prolonged vulnerability period, such as one to four quarters preceding the actual crises. We use the crises dates by Laeven and Valencia (2012).

Our results suggest that focusing on specific variables such as credit aggregates, housing, and equity prices to capture financial cycles can be hazardous. Rather, combining credit with asset prices is not only consistent with the theoretical construct of leverage cycles (Geanakopolos 2010) but also empirical studies such as Jorda et al. (2015) concerning the detrimental effects of leveraged asset price bubbles. We go beyond this, however, showing that combining credit with asset prices for the identification of financial cycles leads to marked accuracy of financial crisis prediction, while also reconciling empirical puzzles concerning cycle length derived from frequency decompositions and standard turning point analysis.

Further, we find that country financial cycles are distinct in many ways from business cycles. Financial cycles tend to exhibit pronounced booms and busts, with amplitude of more than twice than that of business cycles. Financial cycles tend to also be long, lasting on average between 14–15.5 years in contrast to business cycles of only 9 years (or 6.7 years excluding Japan). At one extreme, Germany's financial cycle is found to have the lowest amplitude and shortest length of the G7 countries, and a close correspondence with business cycles lasting around 9 years. At the other extreme, Japan's financial cycle is long, and closely corresponds to a protracted business cycle (lasting over 20 years). Outside these extremes, most other countries differ in financial and business cycle length. In spite of these differences in length, we find that financial and business cycles tend coincide in the medium term.

At last, financial cycle integration across G7 countries is more heterogeneous than business cycle integration. The financial cycles of Germany and Japan seem to be least integrated among G7 countries; having shown very distinct movements in credit and house prices in the recent past, which has also been documented by other studies.

Taken together, these findings have at least two policy implications. First, they suggest a case for a differentiated application of macro policies. Policies targeting financial cycles, such as countercyclical macroprudential policies, can act as a powerful complement to traditional stabilization policies targeting the business cycle, such as macroeconomic policies, including monetary policy—particularly in periods where there may be real and financial disconnect.

Second, there is the need for a broad scope in financial stability surveillance given our finding that actually the combined role of indicators is important for the build-up of systemic risk.

Future studies of financial cycles should focus on the structural driving forces that may explain diverging business and financial cycles over the short term. This is of great importance to be a able for informing the use of, for instance, macroprudential policies.

Discussion

Q: How do financial cycles interact across countries?

Indeed, this is a very interesting question, which due to reasons of time, we have not touched upon. It seems that there is some clustering of closely linked financial cycles. A common component to the broad financial cycle measure, explaining around 45% of total variance, is strongly correlated with all US financial cycle indicators, while it is weakly correlated with DE financial cycle indicators, but equity prices.

Q: How do financial cycles interact with business cycles?

The interaction of financial and business cycles is an interesting and important topic. However, this paper aims at advancing our knowledge about stylized facts on financial cycles, proposing a novel methodology for its measurement. Thorough evaluation of business and financial cycle interaction is left for future research. What can be said already is that we find periods of decoupling.

Q: What is the role of equity prices in your approach?

Equity prices themselves share important characteristics with business cycles. However, our study shows that also with financial cycles, as there is evidence of medium term cycles (8–20 years of duration) that explain important co-movement of credit, house, and bond prices with equity prices. Note that our approach aims at describing financial cycles through the co-movement of indicators.

Q: Does the prolonged period of deleveraging after the global financial crisis pose problems to the measurement of financial cycles?

This is actually a feature of financial cycles and is reflected in the increased length of financial relative to business cycles. Future research should try to understand exactly these periods, where business and financial cycles decouple.

Q: With respect to the early warning exercise, how does it compare to the study of Schularick and Taylor (2012)?

Our early warning exercise aims at predicting the vulnerability preceding financial crises and not the start of the financial crises start itself. The authors include lagged values of their predictors, while we do not. In our approach, however, our vulnerability period spans a couple of quarters, as 1–4 or 4–12 quarters before the inception. The reason for our approach lies in

that policies counteracting the build-up of financial imbalances have to be applied before a final outbreak of the crises. Therefore, we focus on the vulnerability periods.

Q: Is it likely that changes in policies have affected the properties of financial cycles?

Of course, this is very likely. The same holds true for business cycles, however. Indeed, it is important to note that our approach is descriptive and does not account for changes in policies. How policies have affected financial cycles is an important research area, however, we leave this for future research.

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The Changing International Network of Sovereign Debt and Financial Institutions

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Summary

The paper develops a global empirical network of financial institutions, which incorporates both their links with each other and their links through investments in sovereign debt. We extend the theoretical framework of Acemoglu et al. (2015) to show that shocks from the investment decisions of financial institutions and their choice of portfolio holdings in sovereign bonds pose a risk to the stability of the financial network. In particular, although many models assume that sovereign debt is a risk-free asset, once we allow for the potential of default, this provides another channel through which shocks may destabilize the financial system. That is, the network of financial institutions and sovereign debt is "robust-but-fragile"; it is capable of absorbing most shocks most of the time, but when exposed to large shocks or a coincidence of many small shocks, it may become fragile.

In modeling the network of financial institutions and sovereign debt, we embed the notion of contagion as evidenced by extreme changes in the links between them. Consistent with the definition of Forbes and Rigobon (2002), crisis periods can result in increased correlation of previously unrelated firms, interpreted as an increasing strengthening of linkages during periods of stress. In contrast, during periods of stress, linkages between networks of financial institutions may break due to mechanisms such as credit hoarding, as discussed in Gai and Kapadia (2010). Consequently, contagion tests are embedded into our model of the systemic risk in a network of financial institutions by looking at changing linkages comparing periods of "peace" and crisis.

The links between the nodes of the network (the financial institutions and sovereigns) are measured using Granger causality, popular in both the network finance literature and as a useful test for the presence of contagion. Where a significant link exists between two nodes, this is recorded as a (directed) link in the network. In this way, we build an adjacency network for the model. This method has been applied in the literature for networks of financial institutions by authors such as Billio et al. (2012). We extend the empirical application to weighting the significant linkages by the strength of the spillover between the nodes by adapting the forecast error variance decomposition used in the spillover index of Diebold and Yilmaz (2009, 2014) for our purposes. In this way, the paper explores both the changing number of linkages in the network, *and* the changing strength of these linkages.

Table 1: Outcome Matrix from Banks' Decisions to Invest in Firms and Sovereign Debt

	Sovereign debt pay off	Sovereign debt subject to haircuts or default
Investments in firms pay off	Good times	Poor government
Investments in firms do not pay off	Poor investment	Crisis

Source: Authors.

Modeling Framework

By extending the Acemoglu et al. (2015) three-period model of the banking sector to include investment in sovereign bonds besides real economy projects we determine four possible scenarios which may occur in the face of a stochastic shock to either the investment returns in firms or in sovereign bonds. In good times, investments and sovereign bonds all pay off their best outcomes and there are no liquidity problems in the network of banks. When investments in firms do not pay off, but sovereign debt remains intact this is classified as Poor Investment outcomes. These two cases are the same as those explored in Acemoglu et al. (2015) and in the second case they demonstrate that it is possible for the network to exhibit fragility. Our extension to allow stochastic shocks to affect sovereign debt leads to two further cases. In one case, investments in firms continue to pay off but sovereign debt does not which we denote as Poor Government, and in the worst case both investments and sovereign debt are subject to negative shocks, which we denote as Crisis. In both of these two possibilities there is the potential for breakage and fragility in the network of financial institutions in a similar manner to the cases demonstrated in Acemoglu et al. (2015). Table 1 lays out these possibilities.

Empirical Framework

The links between the financial institutions and sovereign debt are modelled as a set of nodes connected by the presence of significant Granger causality relationships between nodes. The matrix elements take the value 1 in the presence of a significant bivariate link between two nodes, and zero otherwise. This forms the adjacency matrix for forming the network of connectedness. In addition we weight these linkages by the weights from generalized H-step ahead forecast error variance decompositions akin to those developed in Diebold and Yilmaz (2009) in constructing their spillover index between markets. This allows us to explore not only the changing number of linkages, but also the strength of the linkages in the network.

Empirical Application

Using data on the spreads for US dollar denominated CDS contracts on 40 sovereign and 67 financial institutions for 2004–2013 we estimate the adjacency and weighting matrix between them. We divide the sample period into three sub-samples, phase 1 to 14 September 2008; phase 2 from 15 September 2008 to 31 March 2010 and phase 3 from 1 April 2010 to the end of the sample. These are broadly representing of the pre-crisis, global financial crisis and European debt crisis periods. We analyze the changing nature of the network between these three periods in terms of the number of links, the average strength of links and the completeness of the network; the results are reported in Table 2.

Table 2: Links, Average Link Strength, and Completeness Statistics for Each Phase

	Phase 1	Phase 2	Phase 3
Number of links	8217	6202	6943
Average strength	0.0101	0.0094	0.0050
Completeness	0.8203	0.5555	0.3302

Source: Authors.

The results in Table 2 show that of the potential 107!/105!(=11,342) possible bivariate links in the system, 8,217 were present in Phase 1, but this decreased dramatically in Phase 2—and in the full paper we show this is due primarily to large drops in the links from the financial institutions. In Phase 3, this recovers somewhat, although the net figure of links masks that between Phase 2 and Phase 3 some 1,948 links were removed and 2,689 new links formed for a net gain of 741 links. The formation of links over the period is consistent with the existing literature. However, the average strength of the links decreases over the three Phases. That is, the newly formed links are weaker than the stronger links which are being removed. As a consequence, the completeness measure, which takes into account how much of the total available weighted linkages are statistically significant in the network, decreases quite dramatically over the three Phases. This illustrates the importance of accounting for both the strength of the links and the number in interpreting networks of financial institutions. Completeness measures based entirely on numbers of linkages give a different perspective than those which take account of the strength—reconciling our result with those already in the literature; for example Billio et al. (2012), who concentrate on the evidence for links, and Diebold and Yilmaz (2016), who concentrate on spillovers without accounting for statistical significance.

Conclusion

The results reinforce the "robust-but-fragile" conclusions in the theoretical literature on networks of financial banks, and extend the potential sources of shocks to the banking sector to their decisions to invest not only in risky real economy firms, but also in sovereign debt which faces a non-zero probability of haircut or default. In implementing this model we embed definitions of contagion from the existing literature which highlight mechanisms which both increase links and decrease links during periods of stress.

Using three phases of data over 2003–2013, we find that for the combined network of 107 financial institutions and sovereign debt CDS there are times when the net number of linkages may fall, and times when it may rise. However, through the two crisis periods of Phase 2 and Phase 3, the newly formed links are consistently weaker than those they replace. Unpacking the strength and changing existence of linkages between nodes reveals that the completeness of the network decreases in a way which may leave it more connected but potentially more fragile.

Discussion

The discussant made useful comments about linking the theoretical framework with the empirical application, particularly about the selection of data, the structure of the paper, and the interpretation of the Granger Causality tests. This led to an interesting discussion about the need for networks which encompass many of the possible sources of interconnection between financial institutions, presenting more of an interwoven fabric of differing types of linkages. This is the type of work that is beginning to emerge with multilayer networks. There is also a drive forward to consider how to best include the contagion linkages within the network and summarize the changing nature of the information contained in these networks. In future work the research team will be looking at forms of shrinkage estimators and whether they can be used to identify critical points of potential weakness or strength within or between networks in advance of crisis conditions using simulation methods.

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Bad Bad Contagion

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Summary

In this paper, I provide new empirical evidence that episodes of downside or bad contagion are followed by a drop in international stock prices and by a deterioration of financial stability indicators. Bad contagion occurs when several international stock markets simultaneously experience unusual and unexpected drops in prices. To obtain data for unexpected returns, I propose a world CAPM model with jumps, where the exposure of each country's stock index to the world portfolio is a function of a set of country-specific and global economic fundamentals (Bekaert et al. 2005). This setting allows me to differentiate the transmission of international shocks due to changes in fundamental integration from pure contagion in unexpected returns. Therefore, my definition of contagion focuses on cross-country tail correlations beyond what are expected from economic fundamentals. This method is therefore not subject to the correlation bias documented by Forbes and Rigobon (2002). To detect jumps in unexpected returns, I use a percentile threshold for each country's stock index. I first explore whether bad contagion has predictive power for international stock returns using a panel-data regression setting. Using the same setting, I then explore the predictive power of bad contagion for the following measures of stability in the financial sector of each country: bank index stock returns, bank CDS spreads, SRISK (Brownlees and Engle 2016), and capital-to-assets ratios. I find that episodes of bad contagion are followed by significant and economically meaningful deteriorations of financial stability indicators. I also find that the exposure of countries to contagion is somewhat heterogeneous. In particular, more-open economies are usually more vulnerable to bad contagion.

A common debate in the literature is the proper definition of contagion. Contagion usually has a negative connotation and is frequently used in a broad context to describe the transmission of shocks, especially negative shocks, across international markets. Not surprisingly, the number of papers on contagion increases considerably following a crisis, as researchers try to explain the observed coincidence of drops in international asset prices.

In this paper, I use a specific definition of contagion based on a world Capital Asset Pricing Model (CAPM) with jumps. I allow for the exposure of each country's excess stock returns to the global risk factor, the return of the world portfolio, to be time varying as a function of country-specific and global economic fundamentals. Therefore, an increase in the exposure to the global factor is one way to characterize the increased transmission of shocks across international markets.

However, I focus on the transmission of shocks that cannot be explained by fundamentals. In particular, I obtain the unexpected component of stock returns—i.e., the residuals from the world CAPM model—and propose a simple method to extract the jump component of unexpected returns based on a threshold to determine extreme unexpected returns. I aggregate the information from country-level jumps to calculate a global contagion measure. Specifically, my measure of contagion is the proportion of international stock markets that simultaneously experience extreme unexpected returns. Therefore, the measure

of contagion in this paper focuses on tail correlations among international stock returns that are higher than can be expected from changes in economic fundamentals that drive international integration. I decompose contagion into its downside or bad component (the co-exceedance of low returns) and its upside or good component (the co-exceedance of high returns). I calculate contagion using weekly excess returns of headline stock indexes for 33 countries between 2000 and 2014.

To understand the predictive power of contagion for international excess stock returns, I use a panel-datasetting. I find that contagion is a useful predictor of stock returns. In particular, episodes of contagion are followed by a significant and economically meaningful drop in stock prices for horizons of up to one year. Decomposing contagion into its bad and good components yields that bad contagion is a more useful predictor for stock returns—the gains in predictive power from adding bad contagion to a regression with good contagion and a set of control variables are higher than the gains from adding good contagion. Interestingly, excess stock returns drop significantly following episodes of either bad or good contagion.

The predictive power of bad contagion for stock returns adds to that of measures of stock market volatility, risk aversion (Bekaert et al. 2014), and time-varying correlation. Moreover, the predictive power of bad contagion adds to those of dividend yields and unexpected jumps in returns at the country level. The empirical evidence is robust to alternative control variables and alternative specifications of the contagion measure.

Contagion remains a useful predictor of stock returns after removing the later part of the sample related to the collapse of Lehman Brothers and the eurozone crisis, although the gains in predictive power for stock returns from adding bad contagion are lower than those for the full sample. I then explore whether the predictive power of bad contagion for stock returns is related to the occurrence of contagion or to its severity. I find that the occurrence of contagion, even if only very few markets are involved, is followed by a significant drop in international stock prices. However, the gains in predictive power from adding contagion are much smaller for low-severity (few markets involved) contagion episodes. In contrast, as long as more than one-fourth of the countries in the sample are involved, contagion becomes a more useful predictor for stock returns—the coefficient associated with contagion is negative and significant at any standard confidence level, and the gains in predictive power converge to those in the benchmark regression setting.

To explore the extent to which bad contagion has long-lasting effects on financial sector stability, I propose a panel-datasetting for the predictive power of contagion for alternative financial stability indicators. I find that episodes of bad contagion are followed by a significant deterioration of country-level bank index stock returns. In fact, the drop in bank stock prices is much larger than the drop in headline stock index prices following episodes of contagion. Episodes of bad contagion are also followed by a significant increase in country-level average bank CDS spreads. I also explore the predictive power of contagion for SRISK, the measure in Brownlees and Engle (2016). SRISK quantifies the amount of capital that banks would need if markets experienced large drops and has been largely used in the literature to quantify systemic risk. I find that bad contagion is a useful predictor of SRISK—episodes of bad contagion are followed by a significant increase in SRISK.

Finally, I use measures of financial stability that do not depend on market prices and that characterize banks' resilience. In particular, I investigate the predictive power of bad contagion for capital-to-assets ratios and for regulatory-capital-to-risk-weighted-assets ratios. As for the market-based financial stability measures, I find that episodes of bad contagion are followed by a deterioration in these ratios. The financial stability implications of contagion are robust to an extended set of control variables, to alternative contagion measures, and to a subsample excluding the collapse of Lehman Brothers and the euro-area crisis.

I investigate whether the effect of bad contagion on financial stability indicators varies across countries and whether the economic fundamentals driving international integration explain these heterogeneous patterns. Although I find that financial stability indicators in more open economies are more sensitive to contagion, overall, the results suggest that very few of the variables driving international integration actually explain the heterogeneous predictability patterns of contagion for financial stability indicators. I interpret this result as preliminary evidence that the effect of contagion is mostly uniform across countries.

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Push Factors and Capital Flows to Emerging Markets: Why Knowing Your Lender Matters More Than Fundamentals

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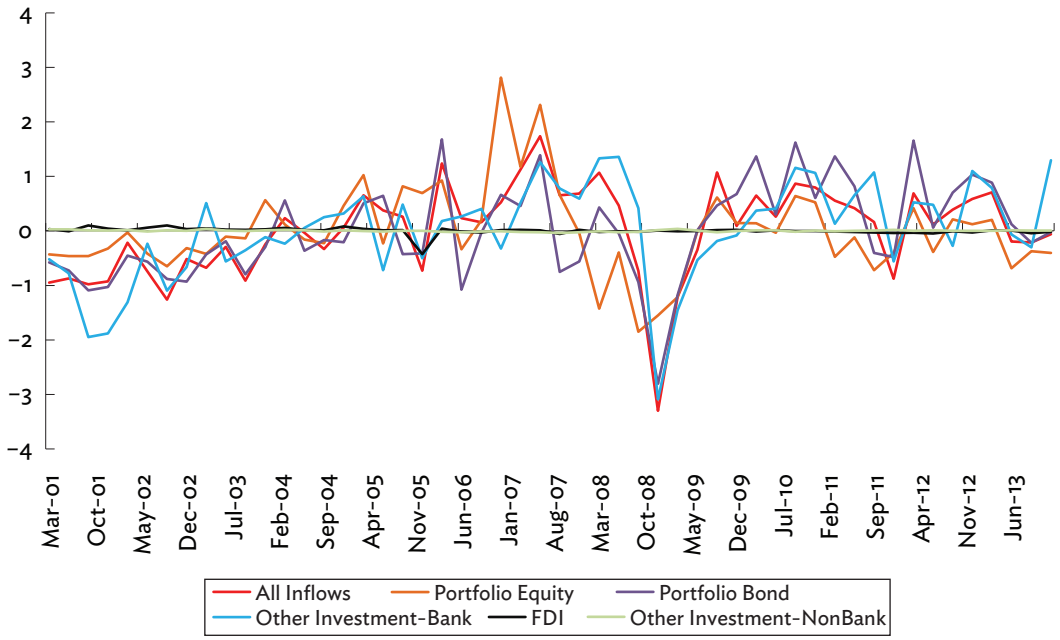
Summary

Cerutti, Claessens, and Puy (2015) conduct a systematic analysis of the sensitivity of 34 emerging market economies (EMs) to global push factors using quarterly balance of payments data for 2001–2013. The objective is to understand why some EMs always lose (or gain) more capital inflows when economic and financial conditions in core countries change.

Our analysis improves on the existing literature in three important ways. First, it takes into account the potential heterogeneity among different types of gross capital inflows. Specifically, it analyzes not just total gross inflows but also disaggregated gross inflows, using the standard balance of payments distinction between foreign direct investment (FDI) flows, Portfolio Equity flows, Portfolio Bonds flows, and other investment (OI) to Banks and OI to Nonbanks. Second, after compiling a panel data set, it uses a latent factor model to extract the common dynamics in gross inflows (total and by component) to all EMs. Using a latent factor approach provides a more general way to identify commonality in flows and avoids having to determine which specific factors drive the commonality. We nevertheless confirm that traditionally used global push factors in advanced economies can explain the common dynamics. Last, but not least, we study how different EMs react to deviations in the estimated (asset-specific) common factors, by analyzing their cross-country heterogeneity as a function of macroeconomic fundamentals and financial market characteristics—including, in the latter, new metrics that we develop to assess the composition of the foreign investor bases.

At a very general level, our paper results confirm the main findings in the literature. In addition, it finds that gross inflows to EMs co-move greatly across countries because global (push) factors, but that the magnitudes of these effects vary substantially across countries. More specifically, the factor decomposition yields the following results. First, the model identifies precisely the commonality in (total) aggregated gross capital inflows to all EMs. Second, it shows that using total inflows conceals significant heterogeneity across assets. While Portfolio Equity flows, Portfolio Bond flows and OI Banks do co-move across EMs, FDI and OI nonbanks do not (Figure 1). Actually, except for periods of global instability, during which all flows go in the same direction, inflow dynamics can vary greatly across types of asset. This suggests, in turn, that different assets do not respond to the same driving (push

Figure 1: Estimated Common Factors—All Inflows and Subcomponents



FDI = foreign direct investment.
Source: Cerutti, Claessens, and Puy (2015).

or pull) forces, an aspect we analyze further in the next subsection. Third, the quantitative impact of the common EM dynamics varies a lot across markets and types of flows.

At the same time, the paper's findings qualify these results in several important respects. First, although we rely on a different methodology, we are naturally connected to the literature on push factors and their impacts on capital flows to EMs (see Forbes and Warnock, 2012 for a review). The use of latent factors (rather than observed proxies) to capture the "true" co-movement in inflows avoids the problem of choosing specific global factors, the significance of which has been found to vary across studies and samples.

In addition, contrary to most contributions in this field, our analysis largely relies on disaggregated inflows. Besides highlighting the wide heterogeneity in the behavior of different types of flows, this approach makes clear that the sensitivity of EMs to push factors is not universal and identical across type of flows. In fact, most EMs are found to be exposed to push factors through one or two capital flow components only. Three groups of EMs can be broadly identified. The "high sensitivity" group contains countries relatively sensitive in all components, such as Brazil, Indonesia, Thailand, Turkey, or South Africa. The "asymmetric" group features countries with a high sensitivity in only one (or two) components, such as Pakistan, the Philippines, India or Mexico. Interestingly, the highest sensitivities across all asset types are in this group. For instance, in Pakistan and the Philippines, more than half of the variance in equity funding is accounted for by the common EM factor, implying that, to a great extent, both countries gain (or lose) equity funding whenever other EMs do. Finally, the "insensitive" group includes countries such as Estonia, Latvia, or Chile that display very low relative sensitivity in all components.

Second, our findings on the important roles of financial market characteristics for various types of inflows relate to recent findings on the pro-cyclical behavior of global investors, and the related impact on the variability of EMs' external funding. As documented by Bruno and Shin (2015a and 2015b), large, international active banks expand and contract their cross-border claims in part in response to monetary policy in advanced economies, notably in the United States. As the global supply of credit expands (contracts), it tends to be directed at the margin toward (away from) EMs. Related, financial markets in economies more internationalized and with a larger foreign bank presence, which typically are EMs, have been found to be more affected by global financial and monetary conditions (e.g., Rey 2013; Cetorelli and Goldberg 2012a, 2012b; and Cerutti, Claessens, and Ratnovski 2014).

Finally, for portfolio flows, investors such as mutual funds have been found to transmit shocks in advanced economies to a wide range of markets, and often independently of the state of fundamentals. Raddatz and Schmukler (2012) and Puy (2016) have found that international fund flows tend to be highly pro-cyclical, in particular for EMs, with funds reducing their exposure to all countries when financial conditions deteriorate at home (i.e., in advanced markets) and increasing them when conditions at home improve. Using data on global mutual funds, Jotikasthira et al. (2012) have found that funding shocks originating in advanced economies, i.e., where funds are domiciled, can translate into fire sales (and purchases) for countries included in their portfolios, in particular for EMs.

Discussion

The paper triggered a lot of discussion about the interpretations of results during and after the session (e.g., differences between the factors that affect capital flows and the sensitivity to changes in core countries). Based on the comments and discussions received during this and other conferences, a revised version of the paper is under way, which also will include analysis of capital inflows to advanced economies.

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Systemic Bank Panics in Financial Networks

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Summary

This paper makes the first attempt to incorporate panic-based runs in financial networks into the analysis of the stability of financial networks. An interbank network is more fragile (or less stable) if each bank in the network is more likely to default. I model the panic among financial market participants as a self-fulfilling prophecy. Therefore, panics can be very sensitive to the information and expectations that market participants hold on the financial health of institutions and the actions that others intend to take.

Introducing panics into the analysis enables us to better understand how financial fragility is influenced by the pattern of financial linkages. It also helps us to understand the impact of information disclosure and creditors' beliefs on financial stability. From the perspective of panic-based runs, this paper sets out to address the following questions: How does the network structure affect financial fragility? Does the position of a bank in the network affect its soundness? What is the impact of information disclosure on the fragility of financial networks?

I construct a stylized model of financial networks formed by interbank liabilities. The exogenously given network structure specifies the creditor banks for each bank, and the face value of the interbank loans that banks need to repay to each of their creditor banks. Every bank has its own continuum of creditors (and depositors). All (nonbank) liquidity suppliers, including retail depositors, wholesale depositors, and short-term creditors are called creditors in this model.

The model captures the maturity mismatch in banks' assets and liabilities. Before long-term investments mature, each bank will use its liquid assets, and the interbank repayments it has received, to repay its interbank loans and meet withdrawals from creditors. Every bank experiences some liquidity shock to the value of its liquid assets, and creditors receive noisy private information about their bank's liquidity shock. This information helps creditors to learn about the realization of liquidity shock (fundamental uncertainty), and the beliefs and strategic withdrawal decisions of other creditors connected to their banks (strategic uncertainty).

When banks are interconnected, creditors of one bank are apprehensive about its counterparty risk, or what proportion of the interbank liabilities its debtor bank will be able to repay. Therefore, creditors' withdrawal decisions depend on how the network structures transmit and propagate these counterparty risks. Therefore, creditors' withdrawal decisions depend on how the network structures transmit and propagate these counterparty risks.

I first consider the case where each bank in the network faces a fixed distribution of liquidity shocks, but no bank is forced to default before outside creditors have made their strategic

withdrawal decisions. Creditors' withdrawal decisions will determine the solvency of banks ex post. This scenario will be referred to as normal times. I restrict my attention to symmetric and regular networks, where each bank's pattern of financial linkages is identical and the total claims and liabilities of all banks are equal.

A financial network is said to be more diversified if each bank makes its financial linkages less dense either by connecting to more counterparties or by distributing its interbank liabilities more evenly across a fixed number of counterparties. From the perspective of panic-based bank runs, I investigate whether more diversified patterns of interbank liabilities could help to make the financial system more stable.

I find a novel mechanism to show that financial networks with more diversified connections will trigger more panics and therefore make the system more fragile. When banks build more diversified financial connections, the distribution of the total interbank repayments becomes less dispersed. For a given distribution of liquidity shocks to each bank, the shift in the distribution of interbank repayments essentially reduces the probability that a bank will have a very low (or high) capability of meeting its obligations and concurrently increases the probability that the bank will have an intermediate ability to meet its liabilities. This will increase depositors' incentives to run. Why? For depositors, as long as the bank can successfully fulfill its obligations, no matter how strong its capability is, the incentive for creditors to resist running on the bank is fixed (i.e., the interest rate is fixed).

By contrast, in the default regime, as discussed in Goldstein and Pauzner (2005), creditors have fewer incentives to run if a bank's capability of rolling over withdrawals is lower (because more creditors will run on the bank and the recovery rate will be lower). Since a less dispersed distribution of the bank's capability will reduce the chance of having a very low capacity in meeting withdrawals, it provides extra incentive for creditors to run, therefore making the system more fragile.

During normal times, I also find that a symmetric and regular interbank network is more fragile either when the liquidity shocks to banks are more correlated or when banks have higher exposures (captured by the total interbank lending) to other banks.

Based on these findings, the provision on "single counterparty exposure limits" in the Dodd-Frank Act, Section 165(e), which attempts to prevent one institution's problems from spreading to the rest of the system by limiting each financial institution's exposure to any single counterparty, could be effective in promoting financial stability by restricting the aggregate exposure of each bank. However, it also provides incentives for financial institutions to build less dense and more diversified linkages, which could endogenously create more panics and undermine financial stability.

Empirical studies suggest that the interbank market has a core-periphery structure, in which large money center banks (the core) have links with each other and with a large number of peripheral banks, whereas the banks in the periphery have links with just a few banks in the core.

In this paper, I also investigate the financial fragility of core periphery networks. The core banks in these networks act as intermediaries for other (periphery) banks with fewer

connections and lower exposures. I find that the core banks with more counterparties and higher total interbank lending will be more prone to panic-based runs than the periphery banks. I also show that that systematic risk increases with the size of the core banks and the volume of their interbank lending.

I next consider the case where one bank in the network receives a shock that is large enough to make it insolvent and default on all of its interbank loans, independent of creditors' reactions. The bank will become distressed even if all creditors stay with it. Other banks are exposed to the standard liquidity shocks as in the baseline model. Due to the complexity of the network, they may not have perfect information about how their bank is linked to the distressed bank, even if they know the structure of network and/or the identity of the distressed bank. Without information about the financial linkages, creditors may hold the neutral belief that each bank in the network has the same probability of being the distressed bank. In this context, I investigate the effects of information disclosure on endogenously generated panics and the extent of financial contagion.

I show that, in a complete network (i.e., a network in which each bank is connected to every other bank) financial contagion is independent of the creditors' beliefs or information about the location of the "bad apple" in the system. Therefore, when the financial network is sufficiently diversified, it is not worthwhile to conduct a costly investigation (e.g., a stress test), to make this information available.

By contrast, in a ring or circle network, where each bank borrows from and makes loans to only one bank in the system, the creditors of the neighboring bank, which is the sole creditor bank of the distressed bank, will run aggressively if they understand how their bank is connected to the distressed one. This is because they understand that the sole counterparty of their bank will default on all interbank liabilities. The negative impact of the panic on one bank will be transmitted to its creditor banks since it increases their counterparty risk, thereby triggering more panics. Therefore, the panic originating from the sole creditor bank of the distressed bank will facilitate financial contagion and have a destabilizing effect on the financial system.

In contrast to the previous literature, which found that voluntary or mandatory information disclosures could reduce uncertainty experienced by outside investors and make the financial system more robust, I find that, from the perspective of panic-based runs, if the size of undiversified network is relatively small, each bank in the system will be more fragile under information disclosure. By a similar argument, I show that a less diversified network of relatively small size could be more fragile under information disclosure.

The conventional wisdom about financial networks—"robust yet fragile"—is that the interconnectedness of banks is robust during normal times, but fragile during bad times. I take a step further and examine the financial fragility of different network structures from the viewpoint of endogenous panics. I show that less diversified networks are more robust during normal times, but could be very sensitive to creditors' information and beliefs about the exact linkage of the distressed bank to their bank when a crisis is under way. Moreover, I find that information disclosure could have a destabilizing effect on the financial market because it triggers contagious panics and facilitates financial contagion.

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Does Increased Noninterest Income Result in Increased Bank Systemic Risk?

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Summary

We consider the relationship between systemic risk and noninterest incomes for a global sample of large banks. We estimate global systemic risk using a global benchmark and find that noninterest income reduces global systemic risk.

The results from our regression models seem to be contrary to the body of evidence reported by Stiroh (2006), Stiroh and Rumble (2006), DeYoung and Rice (2004) and Williams (2016). We find that noninterest income is risk decreasing and our results are closer to those of DeYoung and Torna (2013) and Engle et al. (2014) in more concentrated banking systems. We argue that while single-nation studies find the volatility effect of noninterest income outweighs the portfolio diversification benefits, using a global benchmark (as opposed to local benchmark) to evaluate systemic risk results in the portfolio diversification benefit dominating the volatility effect.

This difference can be explained by the use of different volatility benchmarks in different studies, such as bank revenue volatility (Williams 2016) versus the marginal expected shortfall calculated using a domestic index as a benchmark (Engle et al. 2014, Williams 2016), or this paper's use of a global index as a benchmark. We consider that this result indicates that noninterest income reduces global systemic risk due to its idiosyncratic risk component, which increases volatility and therefore domestic systemic risk, but reduces global interconnectedness. In many ways, these results are compatible with those of Anginer et al. (2014), who find that banks have responded to increased competition by evolving portfolios that have lower correlation with other banks. As argued by Allen and Santomero (2001), increased bank noninterest income is a response to greater competition. This has increased bank domestic risk but decreased global systemic risk. Furthermore, these results support the arguments of Diamond (1984) and Ramakrishnan and Thakor (1984) that increased nontraditional financial activity enhances the relationship aspects of banking.

Little evidence is found that the Global Systemically Important Banks (G-SIBs) as a group represent significantly different risk profiles than the other large banks in our sample. However, we do find that noninterest income increases risk at the margins for the G-SIBs as a group. This would indicate that in the G-SIBs, the revenue volatility effects outweigh the portfolio diversification benefits. Therefore, the globally interconnected nature of G-SIB activities reduces the portfolio diversification benefits from the idiosyncratic nature of noninterest income. Taken with previous results, noninterest income has a cyclical component that differs somewhat from the cyclicality of intermediation income. However, when banks are competing in similar markets the cyclical component of noninterest income

converges, reducing its portfolio diversification benefits. From the perspective of a national regulator, these results pose something of a conundrum, in that increased noninterest income will increase domestic volatility (and therefore potentially domestic systemic risk), especially in less concentrated banking markets (Engle et al. 2014), but reduce global systemic risk. However, the noninterest earning activities of banks classified as G-SIBs should be monitored more closely. In sum, our results do indicate that G-SIBs are more risky than other large banks, however, this risk increase is at the margins due to revenue composition rather than as a main effect.

Our other main results indicate that larger banks and banks with bigger investments in fixed assets (franchise value) have greater global systemic risk. The first result indicates that size dominates G-SIB status in systemic risk. Two possible conclusions follow: (i) that large banks tend to have greater global interconnectedness and G-SIB status alone does not fully reflect this interconnectedness, and (ii) the moral hazard effects of "too-big-to-fail" are apparent when using global benchmarks. In contrast to the argument that franchise value reduces bank risk, we find that franchise value increases global systemic risk. Franchise value is inversely related to bank size (ρ = -0.5092), indicating that "too-big-to-fail" effects are unlikely to explain increased investments in fixed assets resulting in increased systemic risk. Williams (2014) found some evidence that franchise value is associated with increased bank risk in the short run, and argued that the benefits of incumbency ("too-established-to-fail") created risk-seeking in the short run.

As this study uses a different risk measure and is considering global systemic risk, this is an issue that would benefit from further exploration in different settings, such as using S-Risk measures. Following Pathan et al. (2014) we will argue that once franchise value increases past a critical point, the risk-seeking propositions of Martinez-Miera and Repullo (2010) dominate the "skin in the game" effect of Keeley (1990). It is notable that while Williams (2014) finds that increased franchise value tends to increase risk, the same author found that these can be reduced by improved national governance quality.

We also find that banks from nations with large GDP per capita have higher exposure to global systemic risks. We argue that GDP represents increased financial sophistication and nations with more sophisticated financial systems are more globally interconnected. A focus of global regulatory best practice has been in requiring banks to hold more equity capital, while also requiring increasingly sophisticated calculation of the required minimum capital holdings. Given this focus of regulatory attention since the first banks for International Settlements Capital Accord in 1988, it would be expected that increased bank holdings of capital are risk-reducing. However, we find no evidence of a relationship between bank global systemic risk and bank equity holdings.

We tested the robustness of this result in several different ways: (i) by including equity to total assets as one of the variables to be instrumented using its lagged value as an instrument, (ii) by using the alternative variables of Tier 1 capital holdings and total capital adequacy capital ratios as alternative variables, (iii) restricting the sample to those banks with a Tier 1 capital ratio above 4%, and (iv) interacting the G-SIB dummy variable with equity holdings. We found that each of these alternatives did not impact on our results. It is possible that the risk-reducing impact of capital holdings has reached saturation. If this is the case then the implications are that increases in required capital holdings imposed on large banks,

especially the G-SIBs, could result in increased bank risk. Engle et al. (2014, p 51 Table 6) find evidence that increased equity holdings are associated with higher marginal expected shortfall measured against domestic benchmarks. Given the considerable effort and focus on bank capital holdings over the past three decades, the implications of required bank capital holdings for global systemic risk is one that would benefit from further exploration.

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Divergent Emerging Market Economies' Responses to Global and Domestic Monetary Policy Shocks

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Taesu Kang, Bank of Korea
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Summary

This study attempts to measure the impact of United States (US) monetary tightening on emerging market economies (EMEs) and to compare it with the effect of EMEs' own domestic monetary tightening. We apply a panel factor augmented vector autoregression (VAR) model in which global liquidity momenta are used as exogenous variables.

In terms of impact on EMEs, a globally significant interest rate hike outstrips a domestic interest rate hike. A 1 percentage point rise of the federal funds rate costs EMEs a half percent loss in gross domestic product (GDP) for the following 3 years, while EMEs' policy rate hikes have less than one-third of that impact. Global monetary tightening also reduces capital inflows to EMEs. This is true in each component of capital flows and in aggregate. On the other hand, EMEs' own policy tightening is potent only in domestic bond markets. Finally, we tried to link the EMEs' vulnerability to their fundamentals. It turns out that high-inflation EMEs fare worse than their low-inflation counterparts.

The policy implications from this study are that (i) Domestic monetary policy may not be effective enough to counteract global monetary policy shocks in terms of capital flows and effects on growth, and (ii) there is divergence in the policies and macrofinancial responses among EMEs, with inflation drawing a dividing line among them. Stabilizing inflation is not only valid for a domestic economy but also effective against the tightening of global liquidity.

We use an empirical model to obtain the findings. The estimation involves two steps. First, we derive factors from monetary and financial variables of the Group of Five (G5) countries—France, Germany, Japan, the United Kingdom, and the United States. Their data are controlled by their growth and producer-price inflation. These factors are identified by three sign restrictions: policy-driven liquidity momentum, market-driven liquidity momentum, and risk-averseness momentum. For example, an increase in the federal funds rate is associated with a reduction of policy-driven liquidity momentum. These global liquidity momentums are fed into a VAR model of EMEs as exogenous variables.

We choose variables that express the macroeconomic and financial fundamentals of EMEs, such as real GDP growth, consumer-price inflation, nominal effective exchange rate, and policy rate. There are 19 EMEs in the panel and the sample period runs from the first quarter of 1995 to the third quarter of 2014.

Another policy experiment of US monetary tightening entails a one-percentage-point increase in US real interest rate in addition to the hike of the Federal funds rate, because inflation reacts slowly. No prices reactions of other G5 countries are included.

US monetary tightening triggers a reversal in capital inflows into EMEs, as shown by negative capital inflows, weaker stock markets, and depreciation of their currencies. The drainage of liquidity from domestic financial markets reduces aggregate demand, exerting downward pressure on output and inflation. Monetary policymakers seem to react to the incoming shock by raising their policy rates.

EMEs' domestic tightening is found to be less strongly pronounced than US tightening in in its effect on financial flows and prices. That is the case even for real GDP. An interesting observation regards the response of consumer-price inflation. US monetary tightening immediately places a deflationary pressure on EMEs, while domestic tightening slows down inflation, with a delay. This lagged response is the typical response of inflation against domestic policy tightening, and is also observed in the US data. The immediate response of EME inflation can be attributed to both weakened global demand and lower commodity and energy prices.

We also applied the model to each component of EMEs' capital inflows in the International Financial Statistics report compiled by the International Monetary Fund. We found that the story for aggregate capital flows is largely same with flows in each component. Global monetary shocks are more powerful than domestic ones, which are only capable of influencing domestic bond markets.

The last part of this study examines the sources of vulnerability of some EMEs that are expected to experience more severe hardship than others when the Federal Reserve System of the United States starts its tightening cycle. In trying to find the link between vulnerabilities and economic fundamentals, we measure macroeconomic performance by real GDP growth, consumer-price inflation, and exchange rate and capital inflows, relying on a welfare approximation presented in Woodford's book (2003). We split 19 EMEs into four groups according to their average consumer-price inflation for the preceding 3 years. We form a panel from each group and run the panel FAVAR (factor-augmented vector autoregression) model and then measure the performance indicator for each panel against the shock of interest. We repeat the same exercise for other fundamental variables.

From the exercise, we find that the high-inflation group will experience inflation when the United States Fed raises their policy rate. This finding is contrasted with the finding from the whole panel, suggesting a degree of diversity among EMEs in terms of inflation.

We divide all the EME samples into two parts by their average rate of inflation during the sample period. High-inflation EMEs had 14% inflation during the sample period, and low-inflation EMEs had 4%. GDP loss from US monetary tightening is 0.7% for high-inflation EMEs and less than half of that loss for low-inflation EMEs. High-inflation EMEs will experience additional inflation and depreciation of their currencies due to US monetary tightening. High-inflation currencies pay high yields with their bonds and they are found to depreciate more with a tightening of global liquidity. The cause of high inflation can be found in their

monetary policy effectiveness. High-inflation EMEs can reduce their inflation by 0.13% with a domestic policy rate hike of 1%, while their low-inflation counterparts are about four times more effective in controlling their inflation.

The discussant of the paper raised technical issues regarding identification and treatment of US data while the zero lower bound being binding and also suggested to use forecast variance decomposition besides impulse response of the paper and to give more details on sign restrictions in the paper.

The presenter responded that the G5 data include both interest rates and monetary base and other quantitative measure to explicitly take care of the issue of the zero lower bound. Regarding identification of EMEs' monetary shock, the presenter explained that a change of variables within the four categories, which are, macroeconomic variables, capital flows, policy measure and financial prices do not change the results of the study.

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* ADB recognizes "USA" as the United States.

Systemic Risk in a Structural Model of Bank Default Linkages

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Summary

The recent financial crisis highlighted the interconnectedness of financial institutions and invigorated a discussion of this important aspect of systemic risk. So far, the literature has addressed the interconnectedness mainly from two distinct perspectives. The first takes the perspective of network theory; therein, the goal is to build the network of (interbank) asset claims and then determine aggregate measures of network vulnerability. Despite being conceptually appealing, this approach is very difficult to implement: First, it is hard to acquire sufficiently granular data on interbank claims; moreover, even with a given network, the literature lacks a convincing measure of vulnerability. The second perspective on interconnectedness centers on stock markets: based on prices of banks' equity and their associated stock market returns they aim to determine banks' capital shortfall. This is a practical and feasible approach to addressing systemic risk; however, it suffers from two major inherent drawbacks: First, default originates in changes in the balance sheet of financial institutions (their profit and loss statements); second, empirical literature has documented that stock-based measures do not capture systemic risk adequately.

Our paper aims to bridge these two strands by studying so-called structural models that have been successful in the credit risk literature. While they are conceptually rooted in assets and values derived from such claims, they focus on probabilistic aspects of companies; applications to loan portfolios center on probabilistic joint movements in companies' assets. Among others, they characterize the price of the equity claim and so provide a link to an analysis based on stock market returns. Our goal in this paper is to apply structural models to the banking system, where we assume that default of individual banks is linked through correlated changes in asset values across banks. The degree of common risk exposure captures a systematic component of the interconnectivity of financial institutions.

In an initial step, we carry out a theoretical discussion of systemic risk. The paper looks at the fraction of banks that default; based on this it introduces a measure of default risk in the banking system called Conditional Expected Default Frequency (CEDF). Since the paper is concerned with the interconnectedness of banks and this is captured by correlation, the paper studies first the case where bank assets are uncorrelated. Intuitively, this situation boils down to treating banks in isolation, making them safe and sound individually; in short, this may be one justification for microprudential regulation of banks. However, this argument is mathematically correct only for infinitely large banking systems and our CEDF measure picks up the risk within the banking system, even if quantitatively negligible. We then turn to the case where bank assets have strictly positive correlation and use; again, the CEDF is used to assess risk in the banking system. The difference to the CEDF measure with zero correlation (microprudential regulation) has an interesting interpretation: it is the systemic

risk component in the banking system. We document that it is quantitatively sizeable and that it depends non-linearly on a correlation of bank assets with a sensitivity that increases as the correlation increases. This may provide a justification for macroprudential regulation of the banking system.

In a final step, we calibrate our model to the United States banking system. There, we document that interconnectedness has consistently and significantly increased over the past 36 years. We also document four different regimes with structural breaks: they occur in the fourth quarter 1986, at the end of 1995 and at the beginning of 2007. At each of these breaks, the statistical co-movement has increased.

Currently, from a historical perspective, interconnectedness is at record highs. Recent regulatory efforts have been directed at identifying the Systemically Important Financial Institutions (SIFIs), a category created by the Dodd-Frank Act of 2010, and in the requirement for larger capital buffers. However, such efforts have not intended to address the underlying sources of interconnectedness directly, nor did the capital surcharge appear (based on our empirical analysis) to motivate financial institutions to reduce their interconnectedness. In addition, we document that systemic risk has become quantitatively sizeable; the nonlinear nature of our systemic risk measure indicates that it will be hard to set appropriate capital buffers to tackle systemic risk.

Discussion

The ensuing conference discussion after the presentation provided further support to the paper's focus on correlations: the literature documented that correlation in assets is more important as a driver of systemic risk than contagion. In addition, the discussion touched upon the main driver in bank results and the determinants of increased interconnectedness. Further analysis has already been taken up; while preliminary statistical evidence cannot confirm the role of excessive credit growth, it shows that credit growth is among prominent drivers, including gross domestic product growth, lending rates, central bank total assets, and financial institutions' claims on the private sector. This will be reflected in an upcoming revision of the paper.

Securitization, Connectedness, and Shadow Banking

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Summary

The objectives of this paper are to show how risk transfer through securitization changes linkages and systemic risks in the regulated banking system in the presence of the unregulated "shadow" banking system. The theoretical framework analyzes the transfer of idiosyncratic, systematic, and systemic risks, the use of the proceeds from these transfers, and the implications for financial stability. The key findings are (i) risk transfer through securitization is associated with increased connectedness of banks and increased systemic risk exposure of banks, and (ii) risk transfer can lead to lower volatility and a deceptive stability and resilience in the financial system in normal times.

We first show theoretically that diversification of risks within the regulated banking system leads to increased connectedness of banks, which reduces the benefits of both diversification and risk transfer. Therefore, diversification of and the transfer of risks outside the regulated banking system appears to be a superior alternative. Indeed, if the risks are transferred to outside market participants who are not (yet) connected to the banking system, the banking system may be more stable. However, this perspective on the overall stability of the banking system does not explain why individual banks have transferred the risks to entities outside the regulated banking system. The demand for securitized "safe" assets suggests that the entities in the shadow banking system were willing to pay more for the securitized assets than regulated entities were willing to pay. Regulatory arbitrage further incentivized banks to diversify and transfer the risks outside the regulated banking system.

While the diversification of risks among a larger group of entities including the shadow banking system appears to be a dominant strategy for individual banks and from a macro perspective, such a larger system is arguably more difficult to monitor and control. This is particularly true if the risks are (deliberately) hidden, if there are concentrations of risk, or if the interactions of risks with other risk factors are hidden and are not well understood.

Assume that two banks, A and B, face default if all assets are lost with a probability of $p=0.1$. The two banks and their losses are assumed to be independent of each other. The possible losses and probabilities are presented in Table 1 below.

Table 1: Two Banks with No Linkage

		Loss B	
		0	**100**
Loss A	**0**	0.9^2	$0.1 \cdot 0.9$
	100	$0.1 \cdot 0.9$	0.1^2

Source: Authors.

Table 2: Two Banks with Risk-sharing and Linkage

		Loss B		
		0	**50**	**100**
Loss A	**0**	$0.9^2 + \rho \cdot 0.1 \cdot 0.9$		
	50		$2 \cdot 0.1 \cdot 0.9\ (1-\rho)$	
	100			$0.1^2 + \rho \cdot 0.1 \cdot 0.9$

Source: Authors.

If banks A and B transfer risk to each other and therefore share risks, they create a link and become endogenously connected represented by the correlation coefficient ρ. The effects are presented in Table 2 for the case that both banks A and B transfer 50% of their assets to the other bank. Therefore, if bank A suffers a loss of 100 that would have led to a default of bank A without risk sharing, the loss is shared among both banks A and B leading to a loss of 50 for bank A and a loss of 50 for bank B. The probability of this event is given by $0.1 \cdot 0.9\ (1- \rho)$. Since bank B also transfers 50% of its potential losses to bank A, the case (50, 50) occurs with probability $2 \cdot 0.1 \cdot 0.9\ (1-\rho)$. The risk transfer implies a positive correlation ρ since any loss that occurs at either bank A or B is a joint event and not independent, as assumed in Table 1.

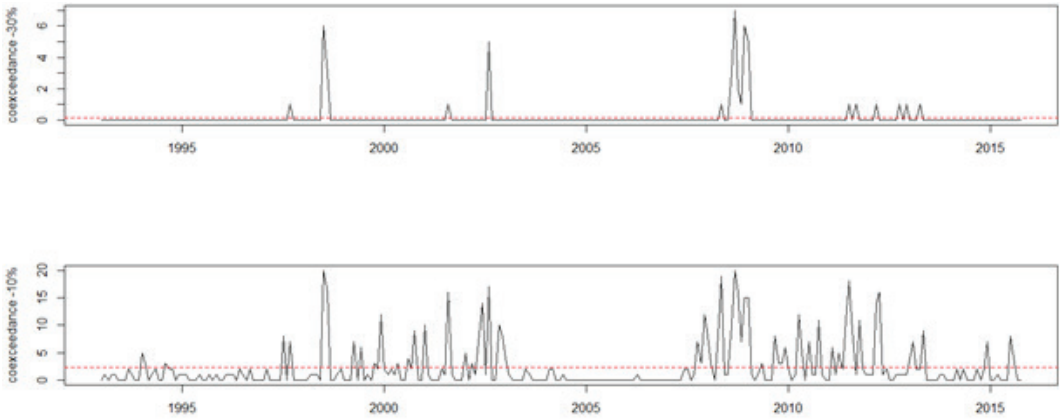
Note that for $\rho=0$, the joint probabilities of "no default" and "default" and associated losses do not change. However, the single events (0/100) and (100/0) in Table 1 are transformed into a joint event (50, 50), an increased set of joint losses (50;50 and 100;100) and a decreased set of individual losses (zero non-joint loss events in Table 2 versus two non-joint loss events in Table 1). For $\rho > 0$, the probabilities of the extreme cases (no default and joint default) increase while the probability of the "intermediate" case (50/50) decreases. For high linkages between banks A and B and $\rho = 1$, the "intermediate" scenario even disappears and there are only two "extreme" events with a positive probability, the events (0/0) and (100/100). The increasing linkages essentially increase the probability mass of the events "no loss" and "joint losses." Note that the correlations are endogenous in the sense that they are the result of the diversification and the transfer of risks.

Figure 1 illustrates what is meant by "hidden." It presents the monthly co-exceedances based on each bank's equity returns for the -30% and -10% return thresholds, that is exceedances are calculated and summed across all banks for each month, resulting in a time-series of monthly co-exceedances.[9] The co-exceedances identify a period of apparent market resilience (2003–2008) in which securitizations and bank linkages increased but the associated rise in systemic risks was not evident, and therefore hidden.

To conclude, the transfer of risk is not the problem *per se,* but the problem is the linkages created by the transfer of risk. If the proceeds of the risk transfers are reinvested in systematic risk and systemic risk, the linkages increase further, and with it the (hidden) severity of extreme losses. Therefore, a key to a more stable and truly resilient system is a system with

[9] The more standard quantile thresholds (e.g., 1%, 5% and 10%) yield similar results but the aggregate losses cannot be directly identified from a visual inspection which is the motivation for the usage of absolute return thresholds such as the -30% and -10% thresholds.

Figure 1: Monthly Co-exceedances



Note: The graphs show estimates of time-varying co-exceedances/joint negative returns below a certain threshold. The time-series plots indicate that the losses can be severe and affect a large number of banks. The largest co-exceedances can be observed for the year 2008. The -30% threshold implies that six banks displayed negative returns of at least -30% in a month in 2008. For the -10% threshold, the number of banks that suffer a 10% loss in their equity increases to 20. Prior to the 2008 spike in co-exceedances, there was a long period without any co-exceedances and therefore a potentially deceptive stability and resilience.
Source: Authors.

weaker linkages, which can be achieved through risk transfers to unconnected entities and without a reinvestment of the proceeds. It is noteworthy that the risks were not necessarily neglected as argued in the literature but hidden.

We argued that the shadow banking system may enhance the stability of the financial system if it shares and diversifies risks in an efficient manner. However, the empirical evidence suggests that the shadow banking system facilitated excess risk transfers and thereby increased the connectedness of the banks involved in the risk transfer.

Discussion

The discussant provided very valuable comments on the paper that will help us to improve the quality of the study substantially.

The subsequent open discussion focused on the connectedness of banks due to the risk transfer through securitization. Participants questioned why risk transfer should lead to increased connectedness of banks, and therefore to stability in normal times and excess volatility in crisis times. I responded that the increased connectedness stems from a reinvestment of the proceeds in systematic risks. In other words, it is not the risk transfer per se but the reinvestment of the proceeds of the risk transfer.

A full revision of the paper is necessary to emphasize the causes of the increased connectedness and the implied systemic risks. The revised version should also stress the role of the different types of risk transferred.

Early Warning Indicators of Systemic Financial Risk in an International Setting

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Chi Truong, Macquarie University (Presenter)
Ben Z Wang, Macquarie University

Summary

We introduce a new top-down approach to measure systemic risk in the financial system, combining information since 1990 on macroeconomic, financial, and ratings factors in four representative countries or regions of the world: Both Australia and the People's Republic of China (PRC) have experienced minimal faults in the sample period. The United States (US) and the European Union are major superpowers that have experienced many and large financial defaults.

One of our aims is to create early warning indicators for systemic financial risk in these "regions." These indicators are the probability for the occurrence and the expected severity of a systemic default event. We register a systemically important event in a region in a month if the accumulated actual defaults to total market capitalization ratio exceeds a threshold. We consider two alternative thresholds—a low one and a high one—and construct a range of models to explain such events. We measure the severity of an event as an integer approximation of the ratio of the event loss to the threshold.

Another aim of the paper is to determine which variables are the key predictors of systemic events, in terms of their probability and expected severity, in a comparative framework of four alternative statistical models—a Poisson (PN), a Negative Binomial (NB), a conditional hurdle (CH) and an unconditional hurdle or zero-inflated Negative Binomial (ZINB) model.

Our data suggests that the CH model is preferred overall for explaining in-sample and predicting out-of-sample systemic events. We allow for different explanatory variables for the two stages of the hurdle models. This distinction in covariates between the zero and non-zero severity counts is important because we find only a world macroeconomic factor helps in explaining the severity of a crisis, while both regional macroeconomic and financial risk factors are important in explaining the occurrence of a systemic crisis (the non-zeros), especially a large one.

These covariate factors give a parsimonious representation of the myriad of information that could help explain systemic risk. Employing these factors in the systemic risk regressions conserves precious degrees of freedom, which is especially important given the large number of zeros in our sample of systemic defaults. The macroeconomic factors are generated from a dynamic factor model using a variety of observed macroeconomic and financial variables in each region, which may be stock or flow variables arriving at mixed frequencies. The financial risk and ratings factors in each region are derived from observed Moody's/KMV expected

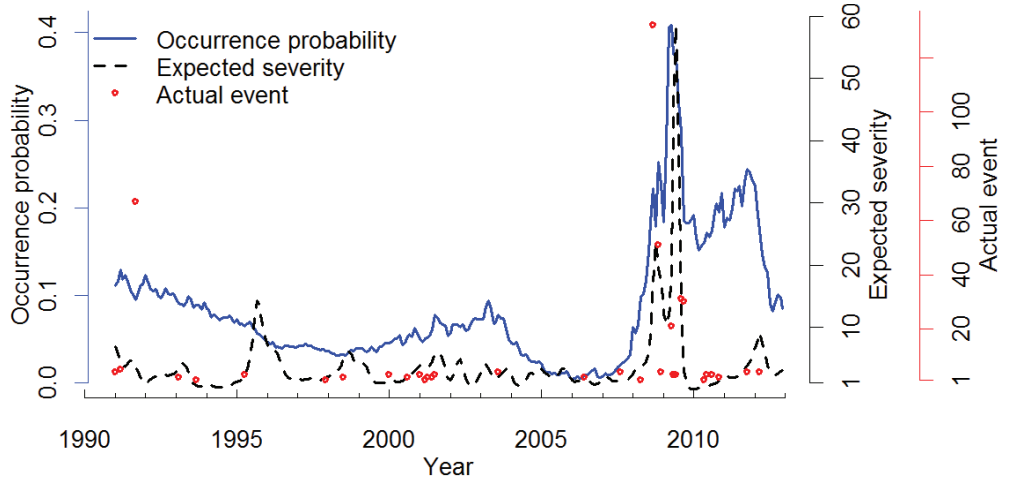
default frequencies for major financial institutions, conditional on actual ratings and the estimated macro factors.

A key result is that lags of the world macroeconomic factor are a good prediction of the severity of both high and low threshold events. Therefore, given that a systemic event occurs, worsening global macroeconomic conditions increase the expected severity of a systemic event in any region. Given the very high persistence of our macroeconomic factors, longer lags of deteriorating world macroeconomic conditions build the necessary conditions for greater systemic severity. Regional macroeconomic factors will be seen to affect the probability of an event, but not its expected severity. This indicates that severity is driven by negative macroeconomic externalities. For the "zero" component of the conditional and unconditional hurdle models, we find that Australia and the PRC have lower risk than the EU and the US for both low and high threshold events. Finally, we find modest evidence of a contagion effect from the lagged US probability of a systemic event to the current probability of systemic risk in the other regions.

These estimates generally show that lagged macroeconomic factors predict the occurrence and severity of systemic crises. They imply that more recent bad regional macroeconomic outcomes admit a possible systemic event, while the expected severity is greater if world macroeconomic conditions have been building up for some time.

Our proposal for systemic risk indicators using the preferred CH model can be thought of as having two components: the probability of a systemic event; and given an event, the expected severity of a systemic event. An unusual spike in these provides an early warning indication of a future systemic event. We present in Figures 1, 2 and 3 the actual number of systemic events, the estimated probability of a systemic event, and the estimated severity of systemic events for the case of a high threshold for Australia, the PRC, and the US. For the US (Figure 1), the probability of observing a high threshold systemic event increased noticeably in 2008, to 40%, up from a medium term average of about 10%. It is important to observe how the probability and expected severity measures for the US in the recent crisis are virtually coincident in timing. For the other regions, the expected severity lags the probability. This is

Figure 1: United States Systemic Index—High Threshold



Source: Authors.

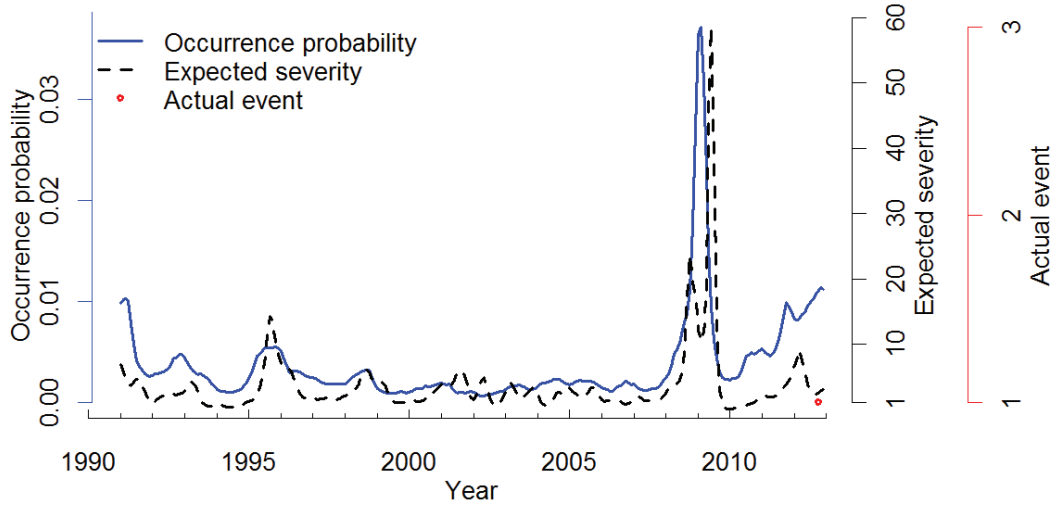
what one might expect since this crisis originated in the US, spreading rapidly in its financial effects, but then spreading later in its real effects on other regions.

Implications for Australia and the People's Republic of China

For Australia, which had only two low threshold systemic events, the inferences have to come largely from the default experiences in the United States and the EU. Figure 2 shows that the probability of a systemic event spiked in 2008, but was about a tenth of that for high events in the United States. The probability very quickly normalized in 2009. A similar pattern is seen for the expected severity measure during the 2008 crisis. When a low threshold event occurred in October 2012—the default of the Brookfield Australian Opportunities Fund with a mere 0.006% of total Australian market capitalization—the probability and expected severity remained small. These results reinforce the wide understanding that the 2008 crisis had minimal impact on Australia. This was because it had both a well-supervised financial system and benign macroeconomic conditions due to its booming commodities trade with Asia and very accommodative fiscal and monetary policy.

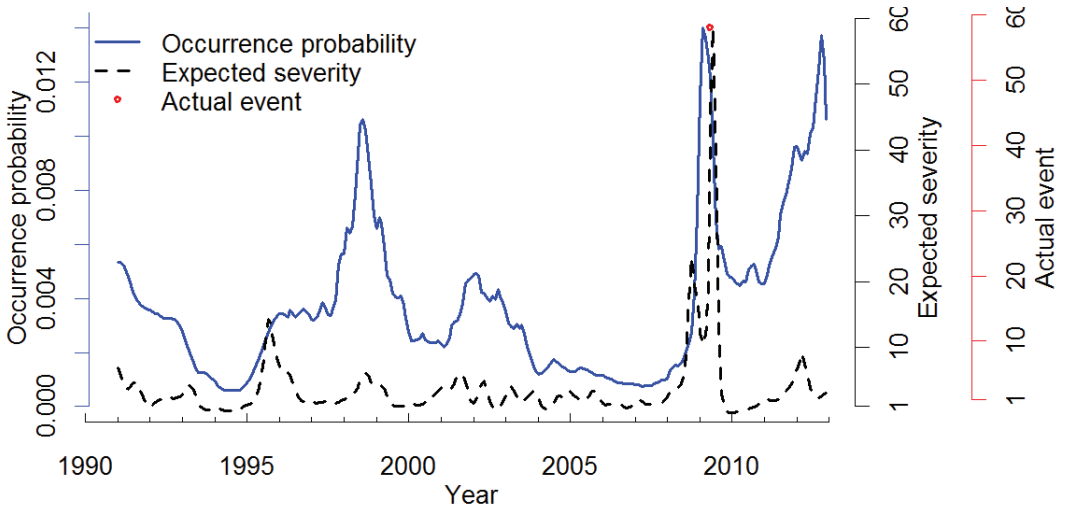
Results for the PRC are illustrated in Figure 3. Throughout the sample period, the PRC experienced only one default—in May 2009, Greentown China Holdings, a real estate developer located in Hong Kong, China, which was a noticeable 0.29% of the total market capitalization in the PRC plus Hong Kong, China. Again, based on inference from the United States and EU, the probability and the expected severity of a high threshold crisis rose somewhat in 2008 (reaching 1.6%, and 58 respectively) and a little less than in Australia, and much less than in the United States. This was probably because of the strong macroeconomic factor in the PRC throughout the crisis period. Approaching 2012, the probability of a systemic crisis increases noticeably, but the scale of the probabilities remained very small. Compared to other countries, the PRC government is more directly involved in the financial

Figure 2: Australia Systemic Index—High Threshold



Source: Authors.

Figure 3: People's Republic of China Systemic Index—High Threshold



Source: Authors.

system, and so the likelihood and severity of a financial crisis remains small. However, the recent escalations are interesting, and indicative of potential financial problems ahead.

In summary, our systemic risk estimates (in probability and expected severity) indicate that the recent crisis emanated from the United States. Our model could have predicted the 2008 crisis in the United States through the rise in our estimates in the previous 2 years. These early warning indications were a result of the significant negative effects of the fall in US house prices on our derived US macroeconomic factor, which in turn significantly increased the probability and intensity of a globalized systemic event in 2008. Though Australia and the PRC experienced very few defaults in the sample period, they still managed to exhibit a jump in the probability and then expected severity of a systemic crisis. Though the risk did escalate, it did remain small and a crisis did not eventuate, which may be a testament to good regulation and supervision of their financial systems and resilient macroeconomic conditions in Australia and the PRC.

Stronger regional macroeconomic conditions will reduce the probability of a systemic event, but if it occurs, its expected severity will be lessened should world macroeconomic conditions be more benign. Policymakers need to ensure macroeconomic stability over the longer term to avoid such systemic crises, and to coordinate policies across countries to reduce the expected severity. Ratings failures were not found to be relevant for systemic events, and therefore we find no evidence that ratings agencies were culpable in the recent crisis. After accounting for ratings, the residual financial risk factor in a region arising out of expected default frequency data are an important indicator of the probability of a future systemic event. Therefore, financial regulators and supervisors need to ensure that such unobserved financial risk factors in their region are not escalating.

Discussion

Juan Miguel Londono-Yarce suggests that understanding of the drivers of systemic events makes a very interesting contribution to the literature, and the paper illustrates a thorough and careful empirical exercise. However, he expressed some concerns about a forward-looking bias in the applied model, and possible measurement errors. He suggested that the forward-looking bias may arise when the set of factors estimated from the full sample are used in the out of sample exercise. The discussant suggested the use a "rolling window" approach for estimating the factors. The issue of measurement error may arise when estimated factors in one model are used as regressors in another model.

Response

We would like to thank the discussant for his comments. With regards to the mentioned forward-looking bias, the out of sample exercise is a test of the derived factors in predicting systemic events. Although the macroeconomic and financial variables in the full sample were used to derive the factors, no information about systemic events was used. Therefore, while we could use filtered factors rather than smoothed factors to avoid the use of "future" macroeconomic and financial risk information, we would not expect much difference in the results. Unfortunately, the suggested "rolling window" approach is rather difficult to implement due to the computational effort of estimating the state-space multifactor model.

The issue of measurement errors has been examined by Pagan (1984) and Bai and Ng (2006). As shown by Pagan (1984), when derived factors are used in another regression model, the coefficient estimates remain consistent, but their variances may not be consistent and may need to be adjusted. We will look into the methods suggested by Pagan (1984) and Bai and Ng (2006) to adjust our estimators' variances.

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International Transmissions of Monetary Shocks: Two-and-a-half Lemma

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Summary

In an interconnected world, foreign monetary shocks are often a key risk for emerging market economies and other developing countries. This paper re-examines the roles of the nominal exchange rate regime and capital flow management in a country's resilience to foreign monetary shocks. There is no shortage of recent reminders of foreign monetary shocks. When the Federal Reserve System of the United States raised the interest rate multiple times in the early 2000s, when it rolled out quantitative easing (QE) after the onset of the global financial crisis, when it talked about "tapering" in May 2013, when the increase in the US interest rate actually took place in December 2015, when the market in March 2016 revised downward its expectations about the number of US interest rate increases that might happen in 2016, and when the Fed further postponed another rate increase in June and August of 2016, we saw that international capital flows to emerging markets reacted and interest rates in many developing countries also appeared to react—often to follow the actual or anticipated changes in US interest rates.

What does it take for a country to have some buffer against foreign monetary shocks? The literature is somewhat split. The textbook notion that a flexible exchange rate regime provides insulation against foreign shocks is said to be supported by the data in Edwards (2012), Klein and Shambaugh (2015), and Obstfeld (2015), among others. On the other hand, using equity prices for firms across emerging market economies, Tong and Wei (2011) find that a flexible nominal exchange rate by itself did not provide much help to an emerging market economy affected by the global financial crisis, but capital flow management encouraging more foreign direct investment (FDI) and less non-FDI capital flows before the crisis tended to provide some cushion during the crisis. Looking at pair-wise correlations among cross-border capital flows, Rey (2015) points out that whether a country has a flexible or a fixed nominal exchange rate regime does not seem to make a difference, but whether it manages capital flows does. The findings of the last two papers are consistent with each other. Rey's (2015) title, "dilemma not trilemma," succinctly highlights a view that capital flow managements appear necessary (whereas a flexible exchange rate regime is not) for a country to be insulated from global financial cycles. Interestingly, neither Tong and Wei (2011) nor Rey (2015) directly examine how combinations of nominal exchange rate regimes and capital flow managements affect a country's conduct of monetary policy in relation to foreign monetary shocks.

In this paper, we investigate the effectiveness of different combinations of exchange rate regimes and capital flow management measures, and we pay special attention to accounting for possible correlations in monetary policies due to common shocks. We will report evidence of "2.5-lemma" or something between a trilemma and a dilemma: a flexible exchange rate regime appears to convey monetary policy autonomy to peripheral countries

when the center country raises its interest rate, but does not do so when the center lowers its interest rate. In other words, "fear of floating" mostly takes the form of "fear of appreciation." Capital flow managements provide insulation to peripheral countries from foreign monetary policy shocks even when the center lowers its interest rate. The "2.5-lemma" pattern is more nuanced than the findings in the existing literature.

The paper makes a number of methodological innovations. First, we use an estimated surprise component of the inflation forecast and an estimated surprise component of the growth forecast, together with the Taylor rule specification, to capture the desired change in a peripheral country's monetary policy, based on its own domestic needs. The Taylor specification includes the stability of real exchange rates as a goal of domestic monetary policy, besides output and price stabilization, as suggested by Engle (2011). Such a framework allows us to control for possible coincidental co-movement of a country's monetary policy with that of the United States. In other words, sometimes the domestic needs of two different central banks may coincide such that their chosen monetary policies are similar even when there is no policy spillover. Therefore, not all co-movements of interest rates in the peripheral and center countries would be interpreted as transmission of monetary policies or lack of monetary policy autonomy.

Second, the paper provides a specification and an estimation method that can include the QE episodes, when we do not observe much change in the US interest rate. We use a likelihood function to incorporate the latent (but censored) changes in the US policy rate. When the US interest rate is above the lower bound, changes in US monetary policy stance can be directly observed from the changes in its interest rate. When the US interest rate is at or near the lower bound, on the other hand, changes in the US policy stance are inferred from changes in the US money supply relative to the US aggregate output. Instead of using a pre-estimated "shadow rate" for the zero-lower-bound period, as done by Wu and Xia (2016) and Krippner (2014), we estimate the parameters jointly with the equation on international transmission of monetary shocks. To our best knowledge, this is among the first attempts in the literature to incorporate the lower-bound episodes in a study of international monetary policy transmissions.

There are important precursors to this paper in the literature. Obstfeld (2015) examines the role of the nominal exchange rate regime but does not explicitly examine the role of capital flow managements in the international transmission of monetary policy shocks. Since many countries with a flexible nominal exchange rate regime also maintain capital flow management, what appears to be the effect of a flexible exchange rate could instead be the effect of capital flow management. Han and Wei (2014) and Klein and Shambaugh (2015) look at both but do not fully account for common shocks that can give the appearance of lack of policy independence of the peripheral country. They also reach opposite conclusions. While Han and Wei (2014) find that a flexible exchange rate by itself does not confer monetary policy autonomy, Klein and Shambaugh (2015) find that a moderately flexible exchange rate does but partial capital flow managements do not. Aizenman et al. (2016) introduced both exchange-rate stability and financial openness in analyzing the sensitivity of peripheral countries' policy rates to core countries' monetary policies. They found that economies that pursue greater exchange-rate stability and financial openness face stronger links with center economies, which is consistent with our conclusion. However, they introduced exchange-rate stability and financial openness separately and not as a policy

combination. In our specification, a policy regime is jointly determined by a combination of capital flow managements and a nominal exchange rate regime.

The paper also differs from the previous papers by explicitly allowing for asymmetric responses by peripheral countries on a flexible exchange rate regime to central country interest rate changes. That is, peripheral countries may or may not feel equally compelled to follow the center country's policy moves depending on whether the center loosens or tightens its monetary policy. In addition, this paper is the first to use estimated surprise components in GDP growth and inflation forecasts in gauging domestic policy need and the first in incorporating the quantitative easing episode in the context of international monetary policy transmission.

In summary, this paper reaches different conclusions from some well-known papers. In particular, neither a dilemma nor a trilemma characterizes the patterns in the data completely. Instead, something in between seems to be the norm: for peripheral countries without capital flow managements, a flexible nominal exchange rate allows them to have some policy autonomy when the center country tightens its monetary policy. On the other hand, when the center country loosens its monetary policy, their "fear of appreciation" takes over and they often pursue similarly looser monetary policy even if the domestic Taylor rule suggests otherwise. In this sense, a flexible exchange rate offers asymmetric or incomplete insulation from foreign monetary policy shocks. In comparison, capital flow managements do offer insulation from foreign monetary policy shocks for peripheral countries on either a fixed or a flexible exchange rate regime. Separately, we do not find robust support for the notion of a global financial cycle that is separate from the spillover of center country monetary policy shocks.

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Session 4 Summary of Papers

Systemic Risk-taking at Banks: Evidence from the Pricing of Syndicated Loans

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Wolf Wagner, Rotterdam School of Management

Summary

Disruptions in the financial system can impose large costs on society. Faced with a situation of general weakness in the financial sector, governments, regulators and central banks undertake extensive measures to support institutions at risk of failing. Besides outright bail-outs, the long list of measures includes guarantees, the purchase of troubled assets and regulatory forbearance. Policymakers also tend to create a more favorable environment for financial institutions in such a situation, be it through blanket guarantees of liabilities, a reduction in interest rates, or direct support of asset prices. While principally less targeted in nature, these interventions particularly benefit institutions at the risk of failure as these have the greatest need for support.

Collectively, the measures amount to significant subsidies to troubled institutions during times of system-wide problems. At the extreme, they can be viewed as an implicit public guarantee not to let an institution fail when other institutions are also weak ("too-many-to fail"). A bank that is at risk of failing in times of good health of the banking system, by contrast, does not benefit from these guarantees. In the case of isolated problems, regulators have plenty of options available. They can seek private sector resolutions, such as mergers or liquidations, which do not require public support.

While desirable from the ex post viewpoint of safeguarding the stability of the financial system, these guarantees are likely to create distortions ex ante. They lower the private cost of risk that tends to materialize across banks and therefore can result in systemic risk-taking. Despite the magnitude of these subsidies, there is however a paucity of evidence for distortions caused by them. Identifying such distortions has proven challenging as there is no clear benchmark of how banks behave without "too-many-to-fail" guarantees.

In this paper we use loan pricing as a setting to study distortions from systemic guarantees. The idea is that public guarantees affect the relative prices of risk. In the absence of guarantees, a lender should require higher compensation for aggregate (economy-wide) risk

than for idiosyncratic risk, as the former is not diversifiable. A financial institution, however, may have a preference for aggregate risk as this makes its exposures more similar to those of other banks, therefore increasing its chances of benefitting from subsidies if it experiences difficulties. In the presence of systemic guarantees, financial institutions are thus expected to underprice aggregate risk relative to idiosyncratic risk.

We examine this question using a large sample of US syndicated loans from 1988 to 2011. Studying individual loans has the advantage that one can control for a large number of factors that may impact pricing, such as borrower and lender characteristics, and the specifics of the lending contract. We decompose a borrower's equity volatility to obtain proxies for aggregate and idiosyncratic risk. Consistent with priors, we first find that banks charge higher loan spreads when borrowers have higher risk overall. The relationship between aggregate risk and loan spreads, however, is a negative one: banks are found to charge lower spreads for borrowers with higher aggregate risk.

An underpricing of aggregate risk, at odds with standard portfolio theory, supports the hypothesis of systemic risk-taking at banks. We provide further evidence for systemic risk-taking exploiting variations in the institutional coverage of public guarantees. Nonbank lenders, such as finance companies, provide a natural control group as systemic guarantees are traditionally perceived as applying to banks only. We find that within this group of lenders, the compensation charged for aggregate risk is not lower than for overall risk, the opposite of the pattern found for banks. The result continues to hold when we consider a matched sample of firms to account for nonbank lenders having a different clientele to traditional banks.

Systemic risk-taking incentives also differ between small and large banks. Large banks are already protected by their size ("too-big-to-fail"); the type of risks they take will not have a primary impact on their likelihood of benefitting from public guarantees. The incentives to increase exposure specifically to aggregate risk are therefore limited. Consistent with this, we find that the underpricing of aggregate risk is much less pronounced at large banks.

Similar to bank size, the extent to which a bank is correlated with the rest of the banking system affects risk-taking incentives. A bank that is fairly correlated with other banks is already protected by "too-many-to-fail" and the incentives to underprice aggregate risk are low. Consistent with this we find that in the group of banks for which systemic risk-taking incentives are lower (correlated banks), the underpricing of aggregate risk is weaker. Likewise, banks that generally enjoy external support in the event of problems have lower additional benefits due to "too-many-to fail". In accordance with this we find the underpricing of aggregate risk to be concentrated among banks with low expectations of outside support.

Last, well-capitalized banks are less likely to fall into distress and therefore systemic risk considerations should matter less for them. In line with this, we find the underpricing of aggregate risk to be more pronounced among banks with high capitalization.

Based on our estimates we can calculate a value for the size of the guarantee. Theory suggests that, without public guarantees, the required compensation for aggregate risk should be at least as high as for idiosyncratic risk (these priors are confirmed for our sample of nonbank lenders); i.e., the coefficient of the aggregate risk ratio should be non-negative.

An estimate of the subsidy at the loan level can therefore be obtained by multiplying the estimated coefficient for the aggregate risk ratio with a firm's aggregate risk ratio. This yields an average subsidy per loan of 23.38 basis points (bps), which is 0.18 x 129.87. In other words, if banks had priced aggregate risk in the same way as idiosyncratic risk, loan spreads would be 23.38 bps higher. This number is only a lower bound for the total subsidy.

By assuming that the pricing of the subsidy into syndicated loans is representative for loans overall, we can calculate the total subsidy. Outstanding loans at US commercial banks were about $6.40 billion at the end of 2014, giving us a total (annual) subsidy of $14.72 billion (=6.400*0.0023), about 0.9% of bank equity ($1.60 billion in 2014). Therefore, the lower bound already suggests a sizeable impact. However, the number is smaller than estimates for "too-big-to-fail" guarantees. For instance, Acharya, Enginer and Warburton (2013) estimate the implicit subsidy provided to large institutions ("too-many-to-fail") to be about $30 billion a year.

The estimated impact on loan pricing points to a considerable moral hazard problem arising from "too-many-to-fail" guarantees. Current macroprudential regulation aiming at mitigating moral hazard from public guarantees does not explicitly take into account too-many-to fail. For instance, the new Basel accord considers capital surcharges for banks that are large, interconnected, and complex. In order to reduce moral hazard arising from too-many-to fail, surcharges for institutions that take on correlated risks may also need to be considered.

The pricing of public guarantees into loans has some further noteworthy implications. First, it suggests that the benefits from such guarantees do not exclusively accrue to banks; the real economy benefits as well. This adds a new angle to the policy debate that has viewed guarantees as private benefits to banks only. Second, our analysis indicates that not all borrowers benefit equally. Systemic guarantees lead to an underpricing of aggregate risk only. Given that borrowers compete with each other for scarce funds, firms that have a larger share of idiosyncratic risk may therefore lose at the cost of firms with predominantly aggregate exposures. This reduces the efficiency of capital allocation in the economy.

Discussion

Christina Bui from UTS business school made a couple of comments. First, as our sample covers the global financial crisis, it would be interesting to distinguish the systemic risk-taking in the normal and crisis periods. Second, VIX as a proxy for global risk aversion could be included to take care of the risk attitude. Third, she discussed the role of relationship lending. Di Gong believed those are important questions and could improve the paper.

Bernard Yeung from BUS business school asked whether it is desirable for regulators to encourage small banks to take on systemic risk for the sake of stimulating lending to real economy. Di Gong's response focused on the trade-off between ex ante distortions versus systemic risk from a social planner's perspective.

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The Transmission of Real Estate Shocks through Multinational Banks

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Summary

Following financial liberalization, consolidation, and integration in many countries, cross-border banking activities have grown dramatically in recent decades.[11] In the pursuit of higher profitability and diversification, many banks extended activities beyond their home countries, opening branches or subsidiaries abroad. The global banking landscape became more international until the global financial crisis when the internationalization trend came to a halt. The share of foreign banks in total number banks in host countries increased from around 25% in 2000 to 33% in 2007. Even though the share of assets owned by foreign banks declined from 13% in 2007 to 10% in 2013, the share of foreign banks in total number of banks was still 36% in 2013 (Claessens and Van Horen 2015).

During the global financial crisis of 2007–2009, many economies including advanced ones experienced negative growth rates for prolonged periods. This deep recessionary period coincided with collapses in real estate prices in some countries, and the souring of real estate-related assets such as mortgage-backed securities and real estate loans has been seen as among fundamental causes of the financial crisis (Acharya et al. 2009). Real estate is a crucial asset class for banks, as they are exposed to real estate markets through their supply of mortgages, the real estate related securities they hold (such as mortgage-backed securities), and the use of real estate as collateral for bank loans to households and firms.

Given the prevalence of foreign banks during the past decade and the importance of real estate markets for the bank business model, a key question is the extent to which the banking system propagates shocks to the pricing of real estate related assets internationally. As complex organizations that offer multiple services in various geographical markets, multinational banks are well suited to study this question. Home countries of these banks exhibit diverse house price histories in both before and after the global financial crisis. Using these different real estate market experiences in home countries of parent banks that own foreign subsidiaries, we investigate the following questions:

- Do multinational banks transmit real estate shocks to local credit supply via their foreign subsidiaries? What are the factors determining the international transmission of real estate shocks?
- Do real estate shocks affect the functioning of internal capital markets? What is the impact on funding structures of foreign subsidiaries?

This study contributes to the literature in several ways. Most importantly, the focus is on a specific type of financial shock, namely real estate market shocks increasing our knowledge

[11] See Claessens and Van Horen (2015), and Bank of International Settlement (BIS) report (2010) for detailed discussions and recent trends.

of how different macroeconomic shocks—including growth in the real economy—the changes in stock markets or real estate market prices are transmitted. Similar to De Haas and Van Lelyveld (2014), we use a large sample including both developed and developing countries. Unlike them, the paper focuses not only on huge banking conglomerates, but also on relatively smaller international and domestic players. The time coverage for the sample is better in the sense that it includes 2010 and 2011. During these years some recovery could be observed in the banking sector, while many countries were still experiencing a banking crisis.

The data include more than 600 foreign bank subsidiaries and their parent banks from an international sample of 53 countries covering 1999–2011. The results suggest that price changes in home country real estate markets have economically and statistically significant effects on credit growth of the foreign bank subsidiaries in host countries. The benchmark regressions 1 and 2 in Table 1 suggest a 1% decrease in real estate prices in home country leads to a 0.2–0.3% decrease in credit growth in the foreign subsidiary. This finding is robust to various alternative specifications and subsamples. Furthermore, the real estate market seems to be special in cross-border transmission—compared to equity markets, whose changes do not seem to be transmitted through international banks. Moreover, regressions 3 and 4 in Table 1 indicate that stricter home country banking regulation of the real estate activities of parent banks reduces the effect of the transmission, indicating the importance of regulation.

Given that price changes in real estate markets are transmitted through multinational banks, it is crucial to determine the factors which affect this transmission. The evidence suggests that the parent banks keep their core subsidiaries, which are larger and rely more on deposits in host countries, from the effects of real estate price changes at home. Furthermore, informational problems are a determining factor in the transmission of real estate prices. Specifically, in response to a negative change in home country real estate prices, foreign bank subsidiaries from neighboring countries or culturally related countries decrease their credit supply less than others. This result suggests that better information or closer relationships (proxied by contiguity and common language) mitigate the cross-border transmission of house prices.

The results do not support the alternative channels, securitization, and moral suasion by national authorities, possibly affecting the transmission of real estate shocks. Securitization enables banks to transfer risks such as mortgage portfolios to third parties, which in theory can handle them. This, in turn, should make banks less responsive to real estate prices, reducing the cross-border transmission. Nevertheless, the aggregate securitization activity at the home country not only fails to mitigate the transmission of real estate price changes, it may even decrease the host country's credit supply, which may be caused by collapses in secondary loan markets during financial crisis.

Countries responded to the recent financial crisis in different ways; supporting their banking systems through recapitalizations, asset purchases, or nationalizations. Some policy responses are bank specific (like a bank nationalization), but there are indirect benefits for the banking system as a whole. How banking system uses this government support is highly political, as the main motivation for governments is to stabilize the credit supply at home. Yet, banks can choose to use it to increase lending abroad, where opportunities may be better. Alternatively, they may use it to curb lending at home. Therefore, national authorities

Table 1: House Price Transmission and Bank Regulation on Real Estate Activities

	Bank FE	System GMM	Bank FE	System GMM
	(1)	(2)	(3)	(4)
Real estate prices	0.066	-0.030	0.091	-0.079
	(0.076)	(0.077)	(0.085)	(0.091)
Home real estate prices	0.257**	0.253**	0.769***	0.657***
	(0.112)	(0.117)	(0.235)	(0.234)
Home real estate activity * Home real estate prices			-0.175**	-0.206***
			(0.077)	(0.078)
Home real estate activity			0.000	0.004
			(0.012)	(0.008)
Lagged gross credit growth		0.166***		0.139***
		(0.031)		(0.035)
N	2345	2338	1786	1811
R-sq	0.181		0.174	
Number of banks	603	880	477	659
AB test AR2		0.222		0.176

FE = fixed effects, GMM = generalized method of moments.
Notes: The dependent variable is *Gross credit growth*, which is the growth rate of real gross loans. *Assets* is the natural logarithm of total assets in constant 2000 US dollars. *Equity* is equity over total assets and *liquidity* is liquid assets over total assets. *GDP growth* is the rate of real per capita GDP growth. *Inflation* is the rate of change in consumer prices. *GDP per capita* is GDP per capita in thousands of constant 2000 dollars. *Equity index* is the change in S&P Global Equity indexes. The same variables are included for parent banks. These benchmark controls are not reported in the table. *Real estate prices* is the lagged growth in real house price index. *Real estate activity* is a categorical variable about under what the conditions banks can engage in real estate activities. It becomes 1 if unrestricted, 2 if permitted, 3 if restricted, 4 if prohibited. Bank-level variables are lagged one period. We estimate all regressions using year fixed effects. In regression 1 and 3, bank fixed effects and robust standard errors are used. In regression 2 and 4, two-step GMM system estimator is used. Regarding the validity of instrumentation, the Arellano and Bond test for autocorrelation of order 2 is provided for the dynamic panel regressions. *, ** and *** denote significance at 10%, 5% and 1%.
Source: Authors' regression estimates.

may put pressure—that is moral suasion—on the parent banks to decrease credit supply to their foreign subsidiaries (Kamil and Rai 2010).

We use the policy responses of home countries to recent financial crisis to proxy the incentives for national authorities. The more recapitalizations and asset purchases or nationalization occur in the home country, higher the probability of national authorities to use moral suasion for parent banks to decrease credit abroad. However, there is no evidence to support that. If anything, the transmission is weaker for the foreign bank subsidiaries, whose parent banks are from countries responding heavily to the recent financial crisis by recapitalizations, asset purchases, and nationalizations.

Finally, the transmission of real estate market prices is asymmetric: negative home country real estate price shocks have a significant impact, which is not the case for positive shocks (Table 2). In addition, the transmission of real estate price changes comes mainly from the

Table 2: Asymmetric Effects of Home Country House Price Shocks

	Bank FE	System GMM	Bank FE with ROA sensitivity
	(1)	(2)	(3)
Real estate prices	0.069	-0.035	-0.073
	(0.076)	(0.077)	(0.118)
Positive Home real estate prices	0.131	0.165	-0.016
	(0.150)	(0.147)	(0.291)
Sensitivity to real estate prices * Positive Home real estate prices			-0.298
			(0.717)
Negative Home real estate prices	0.465**	0.368*	0.942**
	(0.207)	(0.208)	(0.410)
Sensitivity to real estate prices * Negative Home real estate prices			2.479**
			(1.000)
Lagged gross credit growth		0.173***	
		(0.031)	
Sensitivity to real estate prices			0.461***
			(0.082)
N	2345	2338	822
R-sq	0.181		0.282
Number of banks	603	880	249
AB test AR2		0.213	

FE = fixed effects, GMM = generalized method of moments, ROA = return on assets.
Notes: The dependent variable is *Gross credit growth*, which is the growth rate of real gross loans. *Assets* is the natural logarithm of total assets in constant 2000 US dollars. *Equity* is equity over total assets and *liquidity* is liquid assets over total assets. *GDP growth* is the rate of real per capita GDP growth. *Inflation* is the rate of change in consumer prices. *GDP per capita* is GDP per capita in thousands of constant 2000 dollars. *Equity index* is the change in S&P Global Equity indexes. Same variables are included for parent banks. These benchmark controls are not reported in the table. *Positive real estate prices* is the lagged growth in real house price index if positive and zero otherwise. *Negative real estate prices* is the lagged growth in real house price index if negative and zero otherwise. *Sensitivity of ROA* is the sensitivity of ROA of parent bank to real estate price changes prior 2007. Only observations after 2006 are used. Bank-level variables are lagged one period. We estimate all regressions using year fixed effects. In regression 1 and 3, bank fixed effects and robust standard errors are used. In regression 2, two-step GMM system estimator is used. Regarding the validity of instrumentation, the Arellano and Bond test for autocorrelation of order 2 is provided for the dynamic panel regression. *, ** and *** denote significance at 10%, 5% and 1%.
Source: Authors' regression estimates.

later part of the sample. The effect of the capital channel (or parent support), on the other hand, seems to be relevant for the earlier years but not after the recent financial crisis—confirming the results of De Haas and van Lelyveld (2014). More importantly, for the post-2007 period, we find that foreign subsidiaries of parent banks, whose profits are more sensitive to real estate prices before 2007, experienced higher transmission in response to negative real estate price changes in the home country—as shown in regression 3 of Table 2. We take this as evidence for the importance of real estate markets in cross-border transmission. Further, the examination of the funding structure of foreign subsidiaries reveals that the changes in credit supply are mainly due to fluctuations in long-term debt funding and equity in response to house price changes in the home country.

Discussion

Both the discussion and the Q&A session included several helpful points toward the revision of the paper. The focus was mostly on the data section, some of the econometric specifications and eventually the policy implications. The unbalanced nature of the foreign subsidiary panel was mentioned, which can be addressed as an extra robustness check including only banks with long time-series information. Another point regarding the sample was the high presentation of some high-income countries hosting parent banks owning almost half of the subsidiaries. In a related point, the transmission of real estate price changes between North–North, North–South or even South–South international banking can be different and such heterogeneity among various country groups (e.g., income groups or geographical regions) is worth analyzing. The full sample model, which compares domestic banks and foreign bank subsidiaries, is arguably confusing and can be replaced by a more intuitive econometric model, where domestic banks are artificially assigned to random parent banks or home real estate prices variable is replace by the world real estate prices. Finally, shifting the focus from the transmission to factors that determine the transmission, together with more specific policy implications, was suggested.

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Volatility Contagion across the Equity Markets of Developed and Emerging Market Economies

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Ilhyock Shim, Bank for International Settlements (Presenter)
Yoshihiko Sugihara, Bank of Japan

Summary

Using variance risk premiums (VRPs) nonparametrically calculated from equity markets in selected major developed economies and emerging market economies over 2007–2015, we document the correlation of VRPs across them and examine whether equity fund flows work as a path through which VRPs spill over globally. First, we find that VRPs tend to spike during market turmoil, such as the peak of the global financial crisis and the European debt crisis. Second, we find that all cross-equity market correlations of VRPs are positive, and that some economy pairs exhibit high levels of the correlation. For volatility contagion, we find that an increase in VRPs in the United States significantly reduces equity fund flows to other developed economies, but not those to emerging market economies, in the period after the global financial crisis. Two-stage least squares estimation results show that equity fund flows are a channel for spillover of VRPs in the United States to VRPs in other developed economies.

Identifying Contagion in a Banking Network

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Michalis Vasios, Bank of England
Mungo Wilson, Oxford University
Filip Zikes, Federal Reserve Board (Presenter)

Summary

This paper studies the impact of trading profits and losses on bank counterparty borrowing costs using data from a derivatives trade depositary. We use the network of credit-default swaps (CDS) transactions between banks to identify bank CDS returns attributable to counterparty losses. Any bank's exposure to corporate default increases whenever counterparties from whom it has purchased default protection themselves experience losses. In line with this statement, we document an increase in the CDS spreads of a bank. We find no such effect from losses of non-counterparties, nor from counterparties who have bought protection from the bank. We also find that the effect on bank CDS returns through this counterparty loss channel is large relative to the direct effect on a bank's CDS returns from its own trading losses. Our results generate the surprising implication that CDS dealers may have some understanding of their counterparties' exposures.

The Value of Bank Capital Buffers in Maintaining Financial System Resilience

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Harald Scheule, University of Technology Sydney
Eliza Wu, University of Sydney

Summary

This study presents empirical evidence on the role of the voluntary capital reserves of Australian banks in increasing the resilience of the country's financial system. The analysis of the dynamics of loan losses through an extended data set allows for drawing conclusions about the patterns and predictability of the banks' loss rates during crises, and it includes a scenario for economic downturn that helps show that higher capital requirements are essential to avoid financial system failures.

The Financial System Inquiry (FSI) has identified several ways to improve the efficiency and resilience of the Australian banking system. In particular, bank capital levels are expected to be unquestionably strong. However, limited empirical guidance on the size of such buffers exists. We analyze the impact of increased capital buffers on the resilience of the system. Our analysis is based on confidential data for Australian banks from 2002 to 2014, provided by the Australian Prudential Regulation Authority (APRA), and the annual public accounts from 1978 to 2014 of the domestic banks.

This Australian analysis makes three key contributions to the body of knowledge on systemic resilience.

First, we provide empirical evidence on the role of loan-loss dynamics and capital buffers in supporting the resilience of the financial system in Australia. This is important, as the digitalization of data in the Australian banking industry started around 2000. Much of our knowledge is based on the years thereafter, which is a period during which Australia has experienced persistent growth without a severe economic downturn. Nevertheless, since 1981 Australia has experienced three episodes of low GDP growth. These were in 1991, 2000 and 2008, when growth slowed to -1%, 1.1% and 1.5%, respectively. The downturn of 1991 is not included in most existing studies.

To the best of our knowledge, this study is the first that analyzes the systemic loss of the Australian banking system and incorporating the downturn data from that year. The extended data allows us to analyze the patterns and predictability of the banks' loss rates during crises, which could be very different to those in tranquil times. We compare the role of economic downturns on the parameterization of a model that explains future loss rates by contrasting the outcomes based on APRA data starting in 2002 and hand-collected annual data for the Australian banks since 1978. As regulatory capital is reported, the paper analyzes the role of capital buffers more than regulatory capital.

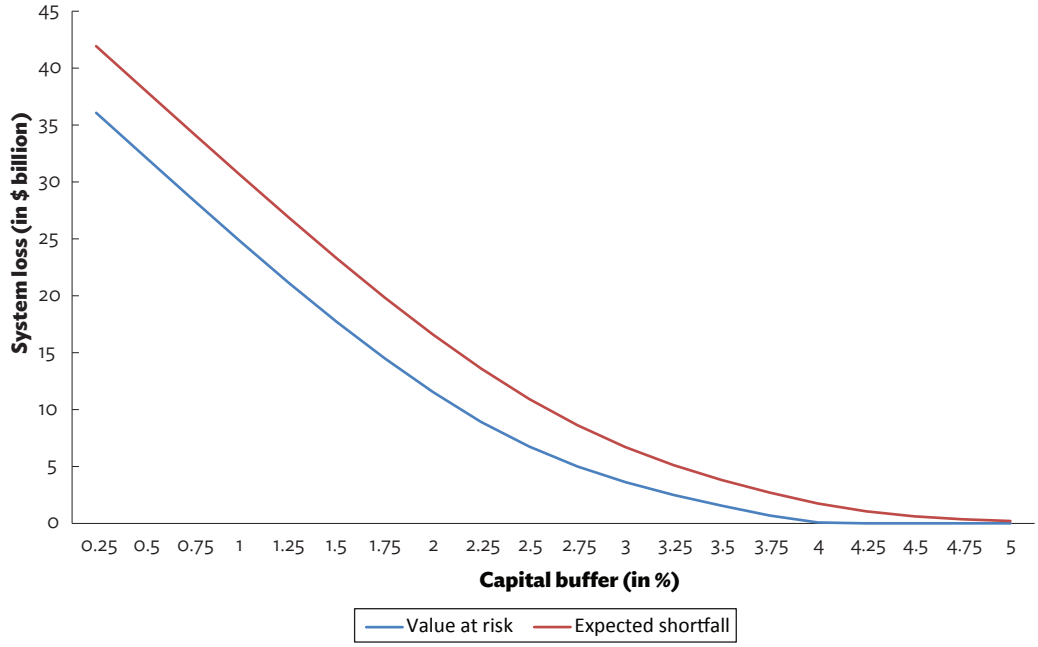
Second, we find that during the stable times, Australian banks' multiyear loss rates are positively related to past loss rates and lagged loan growth, and are negatively related to the deposit ratios, bank size, and the GDP growth rate. Taking economic downturns into consideration, loss rates are negatively related to liquidity, but are positively related to deposit funding and size.

Third, we provide a sensitivity analysis of system resilience by using banks' capital buffers. The size of the Australian financial system protection scheme is measured by computing the absolute losses in excess of capital buffers (the difference between economic capital and regulatory capital) in the system that are not explained by loan provisioning models, and are therefore a reflection of model risk. Specifically, we examine two main loss measures: Value-at-Risk (VaR) and Conditional Value-at-Risk (referred to as Expected Shortfall). These measures are useful for assessing the minimum adequacy and therefore the size of protection schemes necessary for creditors.

The analysis of the systemic losses with regard to banks' capital buffers allows us to assess the impact of the FSI recommendations on the strength of the overall financial system. Financial system protection schemes such as the Australian Financial Claims Scheme can be analyzed in terms of their adequacy and the costs transferred to stakeholders, based on such metrics. The Australian government has recently decided against a transfer of such costs from taxpayers to banks.

Figure 1 shows the sensitivity of systemic loss measures to banks' capital buffers:

Figure 1: Systemic Risk Measures using Annual Data



Source: Authors' estimates.

The findings in this study have two key policy implications.

First, we find that the inclusion of an economic downturn scenario is paramount in modeling systemic losses. It allows us to show that higher capital requirements are essential to avoid financial system failures.

Second, absolute loss levels, based on the likelihood and magnitude of future bank losses after loss mitigation by capital levels proposed by the FSI, are quantified. Bank regulators may apply the developed methodology to assess the adequacy of capital buffers and the likelihood and magnitude of losses exceeding such buffers, and therefore the implied costs to society.

Discussion

Participants in the session concluded that the simulation of banks' future loss rates is interesting and relevant for studying financial system resilience. They suggested that the paper could highlight the variation in the results for periods with and without the economic downturn. Regarding future directions, we would further examine the APRA data and annual data to take advantage of their differences to answer other empirical questions. In addition, we would investigate the implications and effects of raising capital buffers by looking at the bank funding measure.

More Inclusive, More Stable? The Financial Inclusion–Stability Nexus in the Global Financial Crisis

Tania Lopez, Frankfurt School of Finance and Management
Adalbert Winkler, Frankfurt School of Finance and Management (Presenter)

Summary

Over the last decade, policymakers have engaged in considerable efforts to raise the level of financial inclusion, that is the number of individuals and firms using formal financial sector services, in developing and emerging market countries. These efforts have been motivated by the belief that inclusive financial systems provide a contribution to growth and development. However, as demonstrated by the global financial crisis, the formal financial sector is prone to instability. Therefore, it may be regarded as a paradox that a few years after the global financial system had been on the brink of collapse, policymakers have called for action to expand the number of participants in this very system.

According to some financial inclusion advocates this paradox does not exist because financial inclusion contributes to financial stability. This view is based on considerations by which higher levels of financial inclusion are associated with more diversified and therefore more shock-resistant loan portfolios. Inclusive financial systems are also more retail oriented, most importantly in the deposit business of banks. In recent crises episodes retail deposits have been identified as a more stable source of funding than wholesale deposits. Therefore, there is evidence also from the liability side of banking that higher levels of financial inclusion are likely to foster financial stability.

However, some arguments suggest that a rapid rise in financial inclusion might lead to financial instability. Rising inclusion levels mean that new customers with little financial experience and low financial literacy enter the market. These new customers are unknown to financial service providers, i.e., they lack data on default and performance records, and therefore are more risky. There is some anecdotal evidence supporting this view, as rising levels of financial inclusion in Eastern European banking sectors, the United States mortgage market and in selected microfinance markets in the pre-crisis years have been identified as a source of instability. Moreover, this evidence suggests that rising levels of financial inclusion did not mitigate risks that the associated credit booms are followed by credit busts.

Econometric evidence on the inclusion-stability nexus is scarce, mainly because data on financial inclusion is available only the early 2000s. Moreover, any empirical assessment of the nexus faces the challenge of there being no commonly accepted proxies for either financial instability or financial inclusion. Overall results point to positive stability impacts of increased financial inclusion.

This paper contributes to the emerging literature on the inclusion-stability nexus by

- taking into account that financial instability on a systemic level is strongly associated with credit boom-bust patterns,
- distinguishing between the level and the rise of financial inclusion when assessing its impact on financial stability, and
- testing whether financial inclusion itself is subject to a boom-bust cycle.

The analysis is based on data from the IMF's Financial Access Survey (FAS) database. The maximum sample involves 75 countries. The main dependent variable, depicting financial instability, is the depth of the credit crunch during 2007–2009. It is defined as the difference between real credit growth in the last pre-crisis year, 2007, and real credit growth in the crisis, i.e., 2009. When testing for a boom-bust pattern of financial inclusion itself, the drop in the borrower growth rate replaces the drop in credit growth as the variable to be explained. The main independent variables are the level of financial inclusion, depicted by the number of borrowers served by commercial banks (as a percentage of the adult population), and the change in financial inclusion, measured as the average growth rate of borrowers in the pre-crisis period. Moreover, we include interaction terms between pre-crisis credit growth and the pre-crisis level/change of financial inclusion to account directly for moderating effects of financial inclusion on the destabilizing impact of credit booms.

We run cross-country ordinary least squares regressions controlling for the size of the pre-crisis credit boom, that is average real credit growth in 2004–2007, and a range of other indicators depicting the resilience of banking sectors to financial turmoil. In addition, we control for macroeconomic and structural indicators of the respective economies.

The main findings can be summarized as follows:

- First, the level of financial inclusion has no impact on the depth of the credit crunch that followed the collapse of Lehman Brothers investment bank in 2008. However, a higher level of financial inclusion has a moderating effect on the negative impact of the pre-crisis boom on the depth of the credit crunch. This finding echoes the results of other studies on the stability-inclusion nexus, showing that a higher level of financial inclusion is associated with more stability.
- Second, countries with a more rapidly rising financial inclusion in the pre-crisis years do not earn an inclusion dividend in the crisis. Moreover, the stability risks of pre-crisis credit booms are not mitigated by increased financial inclusion.
- Third, financial inclusion itself is subject to boom-bust phenomena. Countries that recorded strong progress in financial inclusion in the pre-crisis years suffer larger setbacks in the crisis years.

These findings are fairly robust to changes in the sample composition and to changes in the financial stability and financial inclusion variables. Moreover, they also hold when running regressions that account for interdependencies between pre-crisis borrower and pre-crisis credit growth. To this end, we orthogonalize pre-crisis borrower (credit) growth by regressing pre-crisis borrower (credit) growth on pre-crisis credit (borrower) growth, and then use the residuals of this regression as the financial inclusion (credit growth) variable. We do not find a significant impact of the pre-crisis borrower growth variable on the drop in credit growth

when accounting only for that part of pre-crisis borrower growth that is unexplained by pre-crisis credit growth. However, if we account only for the part of credit growth that is not explained by borrower growth as a control variable, pre-crisis borrower growth is significantly positively linked to the 2009 drop in credit growth.

Overall, the analysis provides some support for the view that banking sectors serving more borrowers are less prone to financial instability. At the same time, the financial stability risks of credit booms do not decline when accompanied by rising inclusion. Therefore, increased financial inclusion does not mitigate the risks of credit booms. This implies that policymakers should not become complacent about credit booms when they are accompanied by rising financial inclusion.

Our results are subject to several caveats. First, the analysis is based on a limited country sample, as the compilation of data on financial inclusion started only in the early 2000s. Second, our results are subject to endogeneity and omitted variable concerns. For example, credit growth in the pre-crisis period might at least partly be driven by progress in financial inclusion. In addition, the stability-enhancing effect of higher financial inclusion might reflect a stronger political will by governments and central banks to address financial instability, given the high degree of inclusion. Accordingly, more research is needed to disentangle the direct effects of financial inclusion on financial stability from the indirect effects that might arise through various transmission channels.

Discussion

Comment and discussion on the paper focused on the proxies for financial stability and financial inclusion used in the analysis and the appropriate choice and range of control variables. Concretely, it was recommended to normalize the growth rate of financial inclusion in the pre-crisis period by taking into account population growth. As inclusion is mainly an emerging markets and developing countries challenge, it might also be appropriate to exclude mature economies from the sample. Moreover, the paper would benefit from a discussion of possible transmission channels from inclusion to stability. Related to this, control variables should also include the initial levels of financial inclusion, thereby accounting for possible convergence effects, and financial development and bank capitalization. On the endogeneity issue, an instrumental variable approach was recommended. The suggested instrument candidates were population density and terrain ruggedness, since they are likely to influence the level of financial inclusion but are not related to risks to financial stability. Finally, the question was raised about whether a similar analysis could be performed for other financial crisis episodes. This would allow for an assessment on whether the links between stability and inclusion found for the global financial crisis can be generalized.

Measuring Spillovers between the United States and Emerging Markets

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Ka Fai Li, Hong Kong Monetary Authority
Angela Kin Wan Sze, Hong Kong Monetary Authority

Summary

Major advanced economies are commonly regarded as a source of financial spillovers to emerging market economies (EMEs). However, the spillovers from EMEs to advanced economies can be large, given that EMEs have played a major role in global financing flows after years of unconventional monetary policy adopted by major advanced economies. And as EMEs have been net receivers of funds in recent years, their corporate leverage has risen to record levels. Large spillovers also derive from trade and financial linkages, and the integration of EMEs into the global economy and financial system over the past decade. Therefore, any adverse change in fund flows or in EMEs' economic fundamentals could amplify shock transmissions from EMEs to advanced economies and the rest of the world.

This paper studies financial spillovers between the United States and EMEs by answering the following three questions that could potentially provide useful guidance for policymakers in monitoring contagion effects across markets and economies: (i) which asset markets are affected the most by shocks originating in the United States and EMEs? (ii) to what extent can spillovers be attributed to a specific market and region of economies? (iii) has the nature of spillovers changed since the taper tantrum?

Three asset classes, including stocks, sovereign bonds, and foreign exchanges, are first investigated. The study covers both within- and between-economy analysis. In terms of data, weekly returns of the Standard & Poor's 500 Index, the MSCI Emerging Markets Index, the US Treasury index, JPMorgan Government Bond Index-Emerging Markets, and the DXY index are used in estimation. The empirical results show that the spillover between sovereign bond market shocks, regardless of whether the shocks originate in the United States or EMEs, has increased considerably following the tapering tantrum.

Given this growing importance of sovereign bond market spillovers, the second part of this paper focuses on sovereign bond markets only and uses weekly changes in 10-year sovereign bond yields of 19 individual EMEs and 8 advanced economies, including Canada, France, Germany, Italy, Japan, Spain, the United Kingdom, and the United States, in estimation. Consistently, the empirical results show a considerable increase in bond-market spillovers between the United States and EMEs after the taper tantrum. Moreover, contributions of spillovers are greater from economies in Emerging Europe and Africa, than from Latin America and Asia. The fact that sovereign bond yields in the United States and EMEs have

[1] These results remain robust under longer forecasting horizons and more sophisticated model specification.

increasingly synchronized is attributable to (i) low policy rates in many economies has led to search for yield behavior that has manifested into a yield compression globally, and (ii) regulations that require banks and insurers to hold more safe assets such as government securities. From a monetary policy perspective, this analysis implies on one hand that the exit from the zero lower bound in the United States may have potent spillovers on EMEs. On the other hand, any monetary policy shocks originating in EMEs could generate undue pressure on the United States and affect its policy decisions. This two-way interaction between the United States and EMEs, particularly Emerging Europe and Africa, could pose challenges for central banks in formulating monetary policies independently.

Discussion

In this session, the discussant made several major suggestions and comments on the estimation results, which were very useful for further research. Specifically, he suggested measures on the net and directional spillovers based on the estimated mean spillover measures. Although these measures are employed in some studies, the interpretation of these spillover measures seems ambiguous (see details in Q&A below), and so I would interpret these measures cautiously.

He also suggested measures on volatility spillover. I do agree with him that volatility spillover assessment could provide a better understanding on the spillover overall. I actually did a similar analysis when studying this topic; however, the empirical results are not reported in the paper for two reasons. First, a considerable increase in the mean spillover has already provided a strong signal of escalating risk in spillover among the economies. Second, when I conducted the same analysis in the past, I found that the trend of volatility spillover is not consistent with that measured by mean spillover. Although the two spillover measures are not necessarily the same in theory, the economical explanation of their difference remains unclear. A more comprehensive investigation on the issue, covering both the mean and volatility spillovers at the same time, is therefore necessary before incorporating the empirical results in the paper.

Apart from these suggestions, we discussed what contributes to the structural break of the spillover measure in 2006–2007 and why the impact of EME shocks on the United States is different. On the first issue, it appears that the structural break in 2006–2007 arises from the asset bubble effect in the financial markets. On the second issue, based on my further empirical analysis, the impact of EME shocks on the United States may depend on various economic fundamentals and leverage in the banking sector of the EMEs.

Two major questions came from the floor. The first one was about why a forecasting horizon of 10-week is chosen. The 10-week forecasting horizon is chosen because the risk signaled by the spillover measures is considered as a medium-term indicator. If the horizon is too short, the risk can be short-lived only and may not be informative for policymakers to formulate relevant policies. If the horizon is too long, some spillover estimates could be biased, given that some time series are too short to be used in rolling window analysis. The second question was on how these effects, which are measured after controlling for monetary policy outcomes, could be interpreted economically. The estimated spillovers can be viewed as a

kind of financial linkages/correlations free of monetary policy's impact, in other words, such relationship is not completely driven by US monetary policies.

Questions and Answers

Q: Any related literature?

There is no session of literature review in the paper but the paper has discussed several important studies in the literature of financial spillovers (e.g., Diebold and Yilmaz (2009, 2012), Alter and Beyer (2014), Claeys and Vasicek (2014)) and how this paper is related to these existing studies. Some research studies proposed by the discussant, such as Engle and Kelly (2012), Kim et al. (2015), Zhou et al. (2012), are also relevant to this study and a useful reference for the paper.

Q: How to explain the structural break in 2006–2007?

The discussant raises out an interesting observation on the structural break in the overall spillover measure during 2006–2007. The increase in overall spillovers in 2006 and 2007 probably reflects the building up of price bubble in foreign exchange, equity, and sovereign bond markets in the United States and EMEs before the financial crisis in 2008.

Q: Why not assessing volatility spillover?

When studying the topic, I did the volatility spillover analysis based on two approaches: (i) squared returns suggested in Diebold and Yilmaz (2009), and (ii) time varying variances estimated from DCC-GARCH models. However, the two empirical results are not consistent with the one estimated by the mean spillover analysis. Although the two spillover analyzes are not necessarily consistent in theory, how their difference can be explained economically is the key. Moreover, a significant trend in the mean spillover may already provide a strong signal of escalating risk in spillover among the economies. Therefore, the volatility spillover analysis is not reported in this paper.

Q: Why not assessing directional and net spillovers?

When studying the topic, I did the directional and net spillovers for the sovereign bond markets. The estimation results show that the United States has a net spillover impact on EMEs throughout the whole sample period. Although the estimation results look reasonable given the United States' leading position in the sovereign bond market, I am not sure whether the two spillover estimates, that is the spillover effect from the United States to EMEs and that from the EMEs to the United States, can be directly comparable given that their bases (in percentage term) are different. Briefly speaking, consider the spillover between the United States and the PRC as an example. The spillover effect from the PRC to the United States is the contribution of the PRC's shock to the United States forecasting error variance decomposition, while the spillover effect is the contribution of the United States' shock to the PRC's forecasting error variance decomposition. The bases, forecasting error variance decompositions for the PRC and the United States, are not the same, and therefore, their

difference in percentage terms should be interpreted with caution. In view of this, I finally skipped this part of analysis in the paper.

Q: Why different regions impact the United States differently?

The spillover effects to the United States from different EMEs are found to be different because they are largely driven by EMEs' domestic factors. Among all groups of EMEs, the group of Emerging Europe and South Africa have a larger contribution to the impact on US toward the end of 2015 because these economies are considered weaker in economic fundamentals and highly leveraged in their banking sector and so global investors tend to risk off and rebalance their investment portfolios (including financial markets of both the United States and EMEs) when the sovereign credit risk of these EMEs heightens.

Q: Why no descriptive statistics?

I agree that descriptive statistics are useful for understanding the situation overall and should be tabulated in the paper. In the current version of the paper, more charts are plotted because the study focuses on the development of spillover effect over time and line plots are easier for readers to understand the situation in a glance.

Q: Why 10-week?

A forecasting horizon of 10-week is chosen because (i) I am interested in a longer term spillover effect rather than the short term effect; (ii) weekly data could avoid issues like different calendars for different economies (e.g., United States time lags Hong Kong; and holidays for different economies and so on.); and (iii) strong noise/volatility could violate the homoskedastic assumption of Vector Autoregressive models. I did the estimation using daily frequency when studying the topic. The empirical results show that the spillover seems less considerable but exhibits a slowly rising trend (these empirical results are also consistent with IMF's Global Financial Stability Report April 2016 which analyzes spillovers in sovereign bond and equity markets of US and EMEs). From a shorter term perspective, the risk seems less prominent, however, it should not be viewed as no spillover risk from a medium-to-longer-term perspective.

Q: How would these spillover effects, which are measured after controlling for monetary policy outcomes, be interpreted economically?

The estimated spillovers can be viewed as a kind of financial linkages or correlations free of factors of unconventional monetary policy employed by advanced economies. Based on a fixed effect panel regression of the spillover measures on domestic and global risk factors, I found that banking sector's leverage, equity fund flows (which is proxied by EPFR fund flow data), and economic fundamentals are the major domestic factors that contribute to the spillover between US and EMEs significantly. In other words, an EME that has a higher leverage in the banking sector, more equity fund flows, and weaker output tends to have a higher spillover effect. However, these results are not discussed in the paper since they are

not the key focus of the paper. But it is worthwhile to examine this further, which could be useful for understanding the issue more.

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Too Big To Fail: Toward Optimal Incentive Regulation

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Summary

During the 2007–09 financial crisis, government interventions in failing financial institutions, such as American International Group (AIG), fueled a resurgence of interest in the notion of "Too Big To Fail" (TBTF). The notion refers to the idea that some financial institutions are so large and complex that their failures are costlier to society than the required expenses to save them. The idea began to attract public attention in the 1970s when the Federal Deposit Insurance Corporation (FDIC) repeatedly bailed out institutions it deemed "essential" to the community. In 1991, TBTF received an official status in the financial industry when Congress passed the FDIC Improvement Act, authorizing the FDIC to grant special treatments to a number of large banks. Although Congress attempted to abolish the notion of TBTF with the passage of the Dodd-Frank Act in 2010, the Act created a new category—Systemically Important Financial Institutions (SIFIs)—which not only included all previously TBTF institutions but also many new ones. With TBTF continuing to exist, how should it be regulated?

In this paper, we provide a simple framework of banking that enables us to examine a range of possible TBTF policies, including a minimum Tier-1 or Tier-2 capital requirement, tax on size, and cap on size (either via a direct cap or a maximum leverage ratio requirement). In the model, we consider a size-dependent cost of bank resolution, which provides the standard justification for providing assistance to open banks, and a cost of raising public funds to provide such assistance. We find that regulations based both on price and quantity help to improve social welfare; however, to reach the first-best level of social welfare, it is necessary to strengthen incentive bank regulation (i.e. requirements on CoCos, or contingent convertible capital instruments). This is because, under all other policies, our representative banker who has access to cheap deposits also has a strong incentive to expand her investment scale beyond the socially optimal level.

Issues surrounding TBTF have several layers. First, quite literally, banks can be too big to fail. This is because bank failure is typically costly to creditors and depositors, and disruptive to the local and even national economies (see Bernanke 1983, Chabot 2011, and Bernanke 2013). The larger the bank, the more costly and disruptive its failure will be (White and Yorulmazer 2011, McAndrews et al. 2014). When a large bank finds itself on the brink of collapse, the government is inclined to intervene in the form of recapitalization by using public funds (i.e., a bailout).

Second, knowing that the government will intervene, banks have a strong incentive to become TBTF. Naturally, a bank that has received either the implicit or explicit status of TBTF will face less scrutiny from the market and will be able to raise more and cheaper debts

(Jacewitz and Pogach 2011, Strahan 2013, and Santos 2014). Furthermore, TBTF banks will be more willing to gamble with their investments (Davila 2012). Third, on anticipating such intervention and the banks' behavior, authorities have tried to regulate those banks that are (or may become) TBTF. For instance, under the authority of the FDIC Improvement Act, banks that received the TBTF status (implicitly or explicitly) were subject to a broader scope of regulation and supervision. However, TBTF banks continue to get larger in good times and require ever more public assistance in bad times (Strahan 2013).

Regulating TBTF is not a simple task. According to Stern and Feldman (2004), it is difficult to identify and measure the TBTF problem because financial markets have grown not only in size but also in complexity. Furthermore, the benefit that TBTF institutions receive is mostly at the margin, which can vary greatly across firms of different sizes with different portfolio compositions and performance histories (Ennis and Malek 2005). Even considering the negative impacts of TBTF as given, optimal regulation remains debatable. For instance, Johnson and Kwak (2011) argued for a straightforward cap on size and called for division of the largest financial institutions in the United States. Others, however, strongly resisted the idea for fear of inhibiting innovation and economies of scales. Indeed, a number of studies have found evidence of economies of scale in banking (Hughes and Mester 1998; Feng and Serletis 2010; Wheelock and Wilson 2012; and Kovner, Vickery, and Zhou 2014).

Furthermore, another fundamental concern regarding TBTF is the use of public funds to assist open banks. Strahan (2013) provides an excellent survey of the issue, arguing that TBTF is partly due to–and always reinforced by the government's commitment to assist large financial institutions in distress. The justification for an ex post intervention can be traced back to Bagehot (2013), who explained the need and presented the principles for lending of last resort, and to Diamond and Dybvig (1983), whose model provides the rationale for policy actions that prevent widespread contagion of liquidity shocks.

A formal argument for bailouts can also be found in the representation hypothesis by Dewatripont and Tirole (1994), who argue that depositors are too small, and therefore need protection. Based on these reasons, governments have repeatedly provided bailouts to failing institutions throughout history, and they seemingly use more of the taxpayers' money each time. To address this issue, a growing body of literature has advocated for "bail-in" regulation, thereby shifting the burden of saving failing banks from taxpayers to holders of high-yielding bonds. In particular, Sommer (2014) and Flannery (2014) support the use of convertible debts at the largest financial institutions as a counter-measure to the moral hazard of TBTF.

Building on previous findings, we provide a two-period model of banking that focuses on the notion of TBTF. In our model, during the first period, a representative banker who bears a one-time fixed cost of investment borrows to invest in a risky project. If the banker cannot repay her debt in the second period, she declares bankruptcy and liquidates her assets at an increasing and convex cost. As the liquidation cost is a deadweight loss to society, Congress, which is a welfare-maximizing entity, is tempted to bail out the banker via taxation of depositors. While the model considers a fixed marginal cost of taxation, Congress strives to strike a balance between the social benefits and costs of a bailout. Anticipating the bailout, however, the banker excessively increases the size of her investment and worsens the taxpayers' burden. To manage the bailout cost, Congress can impose a minimum capital requirement, size cap, or size tax.

Then, we show that the effectiveness of a minimum capital requirement is limited by the banker's available equity. Meanwhile, a cap on size, while helping to reduce the cost to taxpayers, may inhibit the banker's economies of scale. From a welfare perspective, a tax on size is equivalent to a cap on size. To address the government's bailout incentive, we consider the use of CoCos as an additional layer of regulatory capital. Not only do CoCos eliminate the use of taxpayer money, but they also help to reach the first-best welfare level.

It is noteworthy that, in this paper, we aim to highlight the discussion about TBTF in terms of bank size, and therefore choose to simplify our main model about systemic risk and its associated regulations. As Afonso et al. (2014), Cetorelli et al. (2014), and Laeven et al. (2014) argue, banks tend to become larger, riskier, and more complex simultaneously. Their complexity can generate systemic risk; in other words, the failure of one institution can lead to a wave of asset fire sales and credit flow disruptions in the financial system, such as the case of Lehman Brothers. For this reason, researchers and policymakers have spent a great deal of effort understanding, measuring, and mitigating systemic risk, especially over the last few years (for an exposition, see Acharya et al. 2010).

However, bank size regulation remains a crucial aspect of TBTF. With the failure of Lehman, for instance, the resolution, which happened well after the financial crisis had passed, recovered less than 30 cents on the dollar for creditors, at a cost of more than $9 billion in administrative and other expenses (Fleming and Sarkar 2014). Meanwhile, Brewer III and Jagtiani (2013) examined the data on bank mergers in the United States between 1991 and 2004, finding that banks were willing to pay additional premiums in acquisitions that expanded their size into the TBTF regime. As size continues to play an important role in bankers' business decisions and policymakers' responses, the pros and cons of bank size regulation require more attention.

For the sake of completeness, we also consider a number of extensions to the main model. The extensions includes multiple bankers, their choices in terms of the investment scale and the correlation of their returns, and asymmetric information. Similar to findings in the this papers, we also find that bankers have a strong incentive to concentrate their risk and increase their correlations, while the per-bank cost of bailouts increases at the expense of taxpayers. However, our policy proposal, which combines size regulations and CoCos, is robust to the extensions, because the policy combination forces banks to raise enough CoCos to eliminate both liquidation and bailout outcomes.

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* ADB recognizes "USA" as the United States.

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Does Credit Market Integration Amplify the Transmission of Real Business Cycle During Crises?

Ju Hyun Pyun, Korea University Business School (Presenter)
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Summary

In the light of financial crisis, financial intermediaries or banks tend to repair balance sheets by shedding risky assets or cutting back on new loans. This balance sheet adjustment would dampen investment and consumption through the reduction of external financing, in which households and corporations are forced to deleverage. In the international context, this so-called balance sheet effect warns that higher cross-border debt holdings may amplify the transmission of negative shock by invoking a chain reaction of forced deleveraging.

In that regard, scholars and policymakers suggest that a high priority for research is to understand how different exposures in international credit markets or different debt linkages affect the macroeconomic incidence of the global recession.

How does the balance sheet contraction of financial intermediaries in a country influence the transmission of real business cycles of the other countries? The detailed theoretical mechanism is as follows: a fall in asset values in a country hit by a negative shock forces a large and immediate process of balance sheet contraction for its investors. But the decrease in asset values also leads to balance sheet deterioration in other countries that have internationally diversified asset portfolios, causing a sell-off in assets and a forced deleveraging around the globe. This, in turn, drives a further sell-off in the first country, establishing a chain reaction. Finally, the initial shock is magnified and leads to a large decrease in investment, and highly synchronized business cycles across countries.

Previous empirical studies provide mixed results on the balance sheet effect, especially during the global financial crisis. While one strand of research is accordance with the balance sheet effect since it shows that simultaneous decreases in bank loan supply and subsequent business cycle synchronization across countries during the global financial crisis, another finds that the balance sheet effect was somewhat mitigated in the integrated debt market with the United States during the global financial crisis because the negative shock from the United States did not cause foreign investors to pay off US debt assets and did not cause a chain reaction. Prior studies certainly provide convincing evidence on undiminished demand for US debts, which also hints at the "flight to safety."

This study explores whether there was systematic evidence of the balance sheet effect in international business cycles during the global financial crisis and European sovereign debt crisis. To do so, we investigate the role of cross-border debt holdings in the transmission

of the negative shock to international real business cycles using country pair data for 57 countries during 2001–2013. Our study contributes to the literature by linking the financial market with the real economy and examining the spillover between two during the crisis periods.

We find that international credit (debt) market integration had heterogeneous effects on the transmission of real business cycles: For developed countries, high cross-border debt holdings led to business cycle synchronization during the two crises, which is consistent with the balance sheet effect. However, for a country pair sample including emerging and developing countries, debt market integration buffered against the shock and led to business cycle de-synchronization during the crises.

We also find that short-term debt integration among developed countries drove business cycle synchronization, whereas holdings of long term debts by emerging and developing countries cushioned the transmission of the business cycle. Our results for financial linkages are robust even when including local fundamental factors and other alternative co-movement measures.

Since whether the balance sheet effect occurs through the integrated debt market depends on the extent to which the chain reaction of debt pay-off will take place, our finding suggests that the balance sheet effect certainly dominated among financial intermediaries residing in developed countries during the recent two crises. Yet, investors in emerging and developing countries who tend to hold debt assets issued by developed countries, in particular, the United States did not pay off their debt assets significantly even during the crisis of developed countries because their debt holdings are generally characterized as a safe and risk-free investment. Furthermore, the maturity of debt assets may matter to the chain reaction during the crises. Short-term debts are more convenient to be sold off in the light of the crises and therefore borrowing short term debts would be more vulnerable to the balance sheet effect compared to holding long term debts.

While banking capital flows were at center in the international financial market, this bank financing has been shifted to debt financing since the global financial crisis: A dominant role in US treasury debt assets as a risk free asset has been cemented during the global financial crisis and the international investors have invested in debt markets massively as debt securities were burgeoning in emerging and developing countries since the global financial crisis. In addition, as international capital flows have driven the transmission of financial conditions across borders significantly, it is crucial to understand the role of cross-border debt integration (compared to banking loan integration) in the transmission of real or financial shock across countries in the post crisis era, on which this study sheds light.

After the crises, many policymakers worry about the current status of increased financial integration and its negative consequences on the global economy. However, our finding suggests that financial interconnectedness by especially emerging and developing countries can play a role in buffering the crisis shocks. Therefore, it is important to understand the exact function of cross-border asset holdings (financial integration) in the transmission of real business cycles according to the type and nature of assets, and other parameters.

Analysis of Banks' Systemic Risk Contribution and Contagion Determinants through the Leave-one-out Approach

Stefano Zedda, University of Cagliari (Presenter)
Giuseppina Cannas, European Commission

Summary

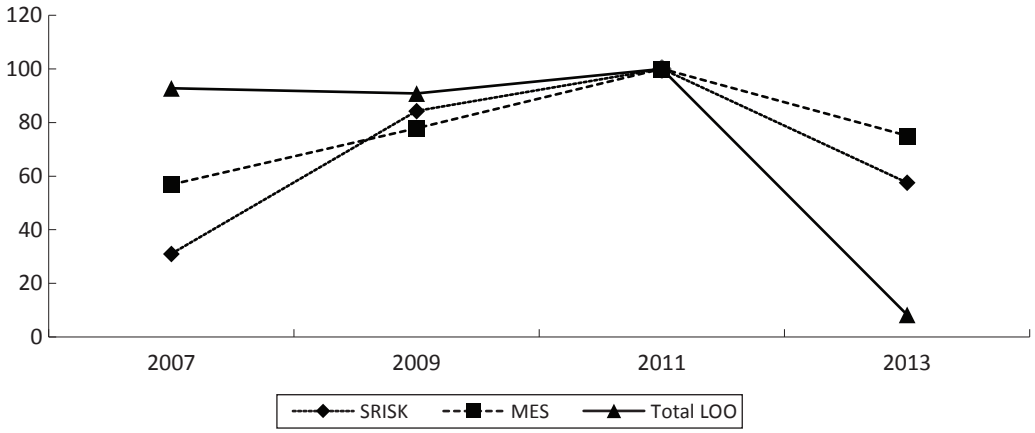
In this paper we develop a strong analysis of the systemic risk and contagion determinants, through the differential effects on the banking system of excluding one bank. The first raw test of comparing the riskiness of a sample of banks by some different risk measures gives some interesting results.

Comparing the "leave one out" (LOO) values with two of the most considered market-based measures, SRISK and marginal expected shortfall (see Figure 1), shows that both SRISK and marginal expected shortfall reported for 2007 a risk level lower than 2013, while the LOO measure reports high risk levels already in 2007, and a system much safer in 2013 than it was before the 2008 crisis. So, this measure was possibly more capable of spotting the 2008 incoming crisis before its start.

This is already an important test, but the main feature of this approach is that it allows splitting the risk into its components, standalone and contagion, and studying each one in detail.

One important evidence coming from our findings is that the stand-alone and contagion components are not strictly linked each other, so one bank that is relatively safe as a single can turn out to be an important contagion vehicle as part of a network, or vice versa.

Figure 1: Evolution of Some Measures of Risk Contribution (2011=100)



LOO = leave one out, MES = marginal expected shortfall, SRISK = systemic risk; a measure to determine the capital needed for a firm to survive during a financial crisis.
Source: Authors.

With reference to contagion, unexpectedly it is not unusual that some banks have a barrier effect, so their presence in the system plays a stabilizing role, reducing the overall system riskiness.

We also showed that the magnitude of the crisis is a key variable when analyzing risk contributions. Some banks can be relatively safe for small crises and quite risky for severe crises (bank 7 in Table 1), or vice versa (bank 8 in Table 1), and also the "barrier" or "contagion vehicle" roles sometimes change depending on the severity of the crisis.

The only one determinant of riskiness clearly assessed in literature, bank dimension, result to be a main driver even in this study, as expected. What we add to the debate is, after neutralizing the size effect, in detailing the linkage of unitary risk contributions (per assets unit) to the unitary balance sheet variables. Regression analyses explain that the assets riskiness and capital coverage are the most relevant variables determining the stand-alone contribution, while interbank exposures (IB_assets and IB_debts) and capital coverage (TRC/TA) mainly determine the contagion risk component in all crises dimensions (see Table 2).

Interestingly, we find that capital affects more the contagion component than the stand-alone one, and that the effects of dimension on contagion are linear, with just a slight effect on larger crises.

In more general terms, the estimations and analyzes developed in this paper give some important contribution to a clearer picture of the banking systems stability determinants, and of their role in systemic crises, so to give important suggestions to regulation and supervision.

The different behavior of the banking systems in different crises severity, coming from our analyzes, suggests a specific targeting of the supervision to the possible crises actually threatening the banking systems stability.

Table 1: Leave One Out Contribution Shares by Crisis Probability (%)

Leave One Out	All	99.900	99.950	99.990	99.999
French Bank 1	0.5	0.4	0.2	0.2	0.2
French Bank 2	-1.0	-1.0	-0.8	-0.8	-0.8
French Bank 3	11.7	11.2	7.5	6.7	8.2
French Bank 4	0.8	0.6	0.3	0.3	0.3
French Bank 5	2.6	2.4	1.4	0.8	0.6
French Bank 6	27.1	27.6	30.9	34.1	34.0
French Bank 7	15.9	16.4	18.8	23.7	28.1
French Bank 8	27.7	27.6	26.3	22.4	18.0
French Bank 9	14.8	14.9	15.3	12.6	11.4
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Authors' estimates.

Table 2: Unitary Contagion Component of Risk Contribution Regression Coefficients and Significance

	99.900%	99.950%	99.990%	99.999%
const	-0.0302	-0.0553	-0.3797	-1.4213*
Ln (TA)	0.0032	0.0058	0.0404	0.1444*
Ln (TA)sqr	-0.0001	-0.0002	-0.0011	-0.0036*
TRC/TA	-0.1074***	-0.1854***	-0.4309***	-0.8289***
RWA/TA	0.0028	0.0043	0.0128	0.0782*
IB_A/TA	0.0625***	0.1113***	0.3078***	0.7512***
IB_D/TA	0.0159**	0.0285**	0.0756**	-0.1720***
R2	0.515	0.525	0.588	0.705

Source: Authors' regression estimates.

The possibility to measure the risk contribution of each single bank to the whole system stability, and the specific quantification of the role of each bank determinant to it (dimension, assets riskiness, capital coverage and interbank linkages), so the capability of this method to assess the macro effects of micro variations, allow for a more accurate targeting of specific supervisory interventions, and possibly for the reduction in the risk of new financial crises.

Next Steps as Outcome of the Conference

Estimation of the system riskiness for Asia. One immediate consequence of this study will be the estimation of the Asian system riskiness. This needs a more complex modeling, as it involves different countries with different regulation and supervision, but it is feasible. Another possibility is to assess the system resilience at single country level that can anyway give important suggestions.

Which net is safer? The paper presented in this conference analyzed the role of interbank exposures for contagion, in terms of its value. The next question to answer is whether the interbank net structure, given the total exposures value, affects the resilience, and this to find the structure assuring the system maximal resilience. Literature is unclear on the interbank role: IB nets are often considered "robust yet fragile". The aim of the next research step is to disentangle this ambiguity and find why and when some interbank configurations help the system safety.

Correlation role and determinants. The model presented has not analyzed in depth the role of correlation among banks. It is an important risk factor, as if banks tend to react to the business cycle and shocks in the same way, the system is exposed to a smaller number of crises, but much more intensive. The aim of this new research step is to analyze if and why banks are increasingly correlated, and give some hints on its effects on riskiness, so to find which possible interventions can smooth this risk.

Dynamic Spillovers between US and BRICS Stock Markets during Financial Crises

Sang Hoon Kang, University of South Australia (Presenter)
Ron McIver, University of South Australia

Summary

This study adds to empirical evidence on the intensity and direction of return and volatility spillover effects, focusing on the relationships between the stock markets of the United States and the BRICS countries (Brazil, the Russian Federation, India, the People's Republic of China, and South Africa). We investigate the intensity of return and volatility spillover indexes by employing the Diebold and Yilmaz (2009, 2012) forecast-error variance decomposition framework of the VAR model. In addition, we use a rolling window approach to capture the time-varying dynamics of the spillover index, and the extent to which recent crises affected the volatility relationships between the US and BRICS stock markets. The recent successive global financial crisis and European sovereign debt crisis provide ideal structural break points to observe sharp changes in market interdependence and volatility transmission. For example, many emerging markets decoupled from developed (US, European) markets during the early stages of the global financial crisis, but recoupled after the crises (Aloui et al. 2011, Kenourgios et al. 2011, Alexakis et al. 2016, Burzala 2016, Mollah et al. 2016).

Our motivations for this study are as follows. While greater global integration of stock markets has facilitated increased capital mobility, it has also been associated with increasing volatility spillovers, particularly between emerging and developed markets. Due to market illiquidity and lesser financial institution and regulatory system development, emerging markets are vulnerable to external shocks from developed markets. In addition, information about spillover effects between emerging markets and developed markets may be useful in a number of applications. This includes those that assess effective portfolio hedge ratios, value-at-risk and optimal portfolio weights (Arouri et al. 2012, Syriopoulos et al. 2015, Mensi et al. 2016), and those that attempt to provide forecasts of the business cycle and early warnings of economic downturns (Chauvet et al. 2015, Choudhry et al. 2016).

Table 1 reports the total spillover index matrices of conditional volatilities. The total volatility spillover index indicates that, on average, 57% of the volatility forecast error variance in all stock markets comes from transmissions. With regard to directional spillover effects, the US market is identified as the largest average contributor of volatility spillovers to the BRICS stock markets. The gross directional volatility spillovers from the United States to all BRICS markets is 108%. In the opposite direction, all the BRICS stock markets spillover to the US stock market is only 53%. The second- and third-largest contributors are Brazil and South Africa, which contribute 86% and 49%, respectively, to other markets. South Africa and Brazil are the largest recipients of volatility spillovers, with the average contributions of all other stock markets estimated at 71% and 61%, respectively. Overall, net volatility spillovers indicate that the United States and Brazil are net transmitters, while the remaining other

Table 1: Directional Volatility Spillovers

	US	Brazil	Russian Federation	India	PRC	South Africa	From others
United States	46.7	23.4	4.3	10.6	4.9	10.1	53
Brazil	29.2	39.4	7.6	5.8	5.7	12.3	61
Russian Federation	15.9	13.0	45.3	6.1	7.1	12.6	55
India	24.5	14.7	2.3	43.4	8.0	7.1	57
People's Republic of China	11.6	13.6	4.6	7.9	54.9	7.4	45
South Africa	26.9	21.5	10.7	7.1	5.2	28.5	71
Contribution to others	108	86	29	38	31	49	341
Contribution including own	155	126	75	81	86	78	57.0%
Net spillovers	55	25	-26	-19	-14	-22	

PRC = People's Republic of China, US = United States.
Notes: The underlying variance decomposition is based upon a weekly VAR of order 2 (as determined by the Schwartz information criterion), identified using a generalized VAR spillover framework by Diebold and Yilmaz (2012). The spillover index (i, j)th value is the estimated contribution to the variance of the 10-week ahead portfolio return forecast error of i coming from innovations to the portfolio of market j.

markets (including the Russian Federation, India, the PRC and South Africa) are net receivers of volatility spillovers.

Directional Spillovers Effects

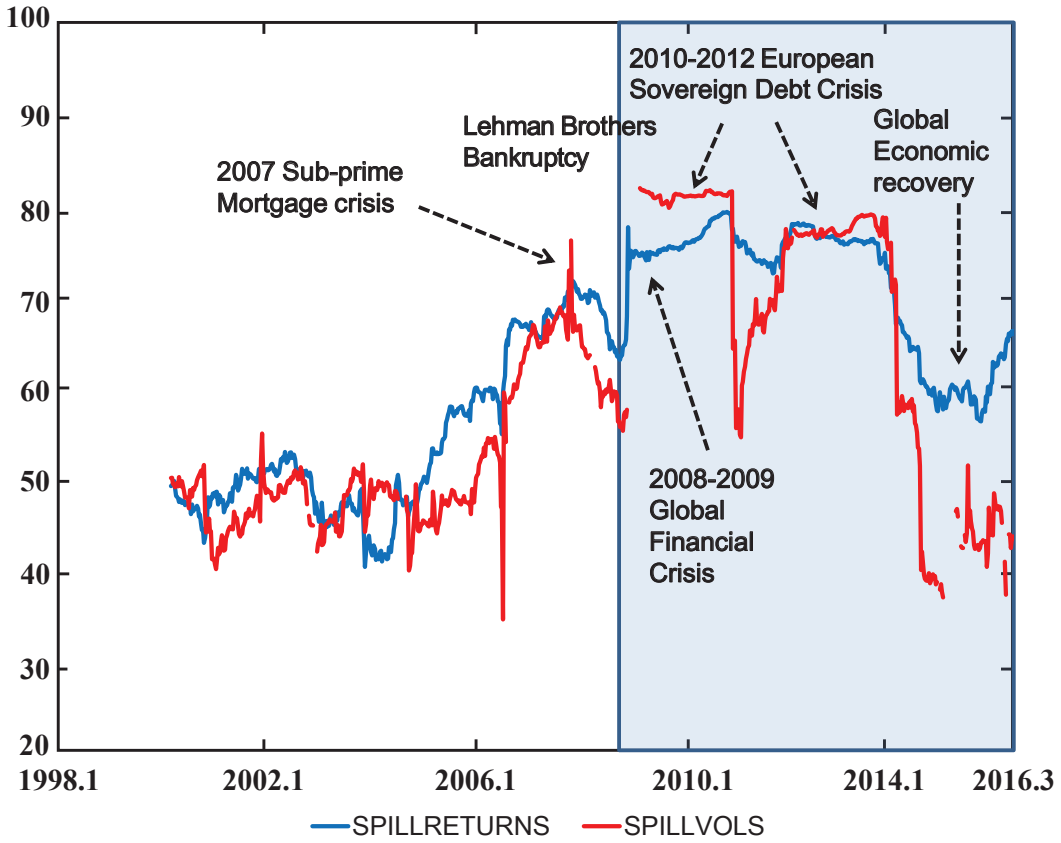
Figure 1 illustrates the time-varying return and volatility spillover indexes across stock markets, respectively. We use 104-week (2 years) rolling window samples, following the methodology of Diebold and Yilmaz (2012).

Starting at values of around 40%, the total return and volatility spillover indexes spike in the third quarter of 2007 subprime mortgage crisis and then rise to their maximum level, approximately 80% (return and volatility), in September 2008 at the time of the Lehman Brothers bankruptcy. More specifically, the bankruptcy provides a starting point for the worldwide spread of the 2007–2008 global financial crisis, and the values of total spillovers persisted until the first phase (2010–2011) of the European sovereign debt crisis. Furthermore, the spread of the crisis throughout the eurozone in the second phase (2011–2012) caused further increases in return and volatility spillovers. In contrast, we see a significant decrease in return and volatility spillovers during 2013–2014, which can be interpreted as a sign of the global economic recovery. Therefore, we conclude that the financial crises intensified both return and volatility spillovers between the US and BRICS stock markets.

Implications

This study provides several important implications for portfolio investors and market policymakers dealing with the US and BRICS stock markets, and suggesting avenues of potential future research for macroeconomic forecasters and policymakers.

Figure 1: The Dynamics of Volatility Spillover Index



Note: Dynamic total volatility (SPILLVOS) spillovers are calculated from the forecast error variance decompositions on 10-step-ahead forecasts. The total spillover indexes are estimated using 104-week rolling windows.
Source: Authors' estimates.

We find trends in the bidirectional return and volatility spillover indexes between the US and BRICS stock markets. These trends are more pronounced in the aftermath of recent financial crises (the global financial crisis and the European sovereign debt crisis). When forecasting portfolio market risk exposures and determining the existence of diversification benefits available from the US and BRICS stock markets, recognition must be given to spill overs' impact in reducing diversification benefits, especially during crisis periods.

From an asset location perspective, the intensity of spillovers provides the need (or opportunity) to build a new diversification strategy. For example, portfolio investors in the US and BRICS stock markets can allocate their funds to a safe haven asset, such as gold, potentially reducing downside risk in the presence of increased intensity in spillovers during periods of turmoil. This is because gold strengthens diversification benefits in equity portfolio risk management (Baur and Lucey 2010, Baur and McDermott 2010).

From a market contagion perspective, the findings of net volatility spillovers helps to understand the direction of information transmission and to classify the net transmitter and net receiver of information in the US and BRICS stock markets. These findings are important for market policymakers in the design of decoupling strategies to protect against contagion risks. The net transmitter plays an important role as a "hub" of information channels, while the

net receiver is a "node" of spillover effects (Diebold and Yilmaz 2014). With regard to market stability, policymakers can use this network connectedness for the information transmission between the US and BRICS stock markets to design strategies to mitigate contagion risks.

Finally, in light of increased interest in the influence of stock market volatility on macroeconomic performance (Chauvet et al. 2015, Choudhry et al. 2016), the identification of the presence and significance of net volatility spillovers between the US and BRICS stock markets suggests avenues for future research from macroeconomic forecasters and policymakers; especially, based on the analysis presented in this paper, those located in the economies of the Russian Federation, India, the People's Republic of China, and South Africa. Extensions include, for example, analysis of the impact of volatility in their home and the US stock markets on real economic activity, and the use of switches between low- and high-volatility regimes as potential early warning signs of economic slowdown or recession.

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Emergency Liquidity Facilities, Signaling and Funding Costs

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Summary

During the recent financial crisis, many solvent banks that experienced a liquidity crunch shied away from using the, the discount window (DW), the main liquidity facility set by the Federal Reserve to help banks in that very situation. Instead, at the height of the crisis (the failure of Lehman Brothers in 2008), some banks were willing to pay up to 150 basis points more (equivalent to $172.6 million in additional costs in just one auction) in an alternative facility, the Term Auction Facility (TAF), which had more stringent and less-flexible lending terms in all dimensions (e.g., loan maturity or the availability of funds) than the DW. We provide a new theoretical explanation and empirical support for the Federal Reserve offering two different liquidity facilities in periods of high asymmetric information and financial distress. The existence of two liquidity facilities with different characteristics allowed banks to signal their level of solvency, which helped to decrease asymmetric information, potentially preventing the failure of financial markets. As a consequence, solvent banks bid aggressively in the TAF, which resulted in lower post-crisis funding costs.

We first propose a signaling model to explain the incentives of banks to use these two facilities. The lower flexibility of the TAF compared with the DW makes the TAF costlier and therefore allows high quality banks to send a credible signal to the market. These different levels of flexibility that create different costs for heterogeneous participants is key for a separating equilibrium to exist in our model. Specifically, we assume that banks need to access a liquidity facility because of a random liquidity shock or because of a "run" caused by concerns about their solvency. Banks can anticipate whether they will be hit by a liquidity shock, but runs are sudden. While good banks experience only the former, bad banks can be hit by both types of shocks.

In the separating equilibrium, good banks that expect a liquidity shock will pay the higher rate to access the less-flexible TAF facility to signal that they do not need the flexibility of the DW to respond to sudden runs. The TAF cannot be accessed instantly, so bad banks do not use the TAF in the hope of not realizing a run, but they need the flexibility of the DW (which can be accessed any time) in case they do experience a run. The funding markets therefore infer that banks that access the TAF are of better quality than banks drawing on the DW, and they price subsequent funding according to these updated beliefs. It is the existence of two facilities with distinct features that allows for separation and a decrease of asymmetric information.

Our empirical analysis tests the predictions of this model. We compare funding costs for different sources before and after the height of the financial crisis for banks that used the DW, TAF, or neither of these facilities. We find that banks that used the TAF to borrow funds at the height of the crisis have lower post-crisis total funding costs (in 2010) than banks that drew from the DW. This difference is about 7 basis points in total funding costs, and 23 basis points for rates paid in the interbank lending market. Additionally, that difference in funding costs is larger for banks that had a more intense usage of the TAF (relative to their size), and for banks that were substantially more risky than others.

To confirm the robustness of our results, we extend our econometric model in two ways. We first use a matching estimator that allows us to control for nonlinearities and selection effects on observables. We then use an instrument to control for potential endogeneity problems related to the decision to use the TAF or the DW.

Membership of banks in the Board of the Federal Reserve (the Fed) is a variable that should be correlated with the decision to use Fed liquidity facilities, but should not be directly related to the funding cost, making it a valid instrument. In both cases, we confirm our initial findings. In addition to our main finding that banks accessing the TAF enjoy lower post-crisis funding costs, we find additional evidence about the higher solvency of banks that used the TAF. Consistent with the predictions of our model, most US banks that failed during the crisis (most of them from 2009 and after), were mainly borrowing from the DW during the period before the Lehman bankruptcy and only a few of them used the TAF as their main source of liquidity from the Fed.

To confirm the robustness of our results, we extend our econometric model in two ways. We first use a matching estimator that allows us to control for nonlinearities and selection effects on observables. We then use an instrument to control for potential endogeneity problems related to the decision to use the TAF or the DW.

Membership of banks in the Fed is a variable that should be correlated with the decision to use Fed liquidity facilities, but should not be directly related to the funding cost, making it a valid instrument. In both cases, we confirm our initial findings.

In addition to our main finding that banks accessing the TAF enjoy lower post-crisis funding costs, we find evidence about the higher solvency of banks that used the TAF.

Conference Overview and Summary of Papers

International Conference on Financial Cycles, Systemic Risk, Interconnectedness, and Policy Options for Resilience

Jointly organized by the Asian Development Bank Economic Research and Regional Cooperation Department and the Institute of Global Finance – University of New South Wales, the conference gathered leading academics, central bankers and financial regulators, and international financial organizations and discussed the theory, practices, and policy implications of financial interconnectedness for systemic risk and financial stability.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to a large share of the world's poor. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

About the Institute of Global Finance

Based at the University of New South Wales, Sydney, the Institute of Global Finance (IGF) is housed at Australia's leading business school: the UNSW Business School. The IGF has collaborated and published joint research with a number of international institutions, such as the BIS, the IMF and the World Bank. The IGF collaborates with New York University's Volatility Institute. The IGF's work with the NYU Volatility Institute focuses on banks' systemic risk, global financial stability and financial institutions. The IGF is currently working with business and finance organizations such as PwC, KPMG and BlackRock and collaborates with international institutions such as the Asian Development Bank and the World Bank, with the aim of providing cutting edge research with policy applications for the finance industry and policymakers. Another objective of the IGF is the promotion of global financial prosperity through financial policies which contribute to greater global financial and regional resilience and enhancement of the process of regional and global financial integration.

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