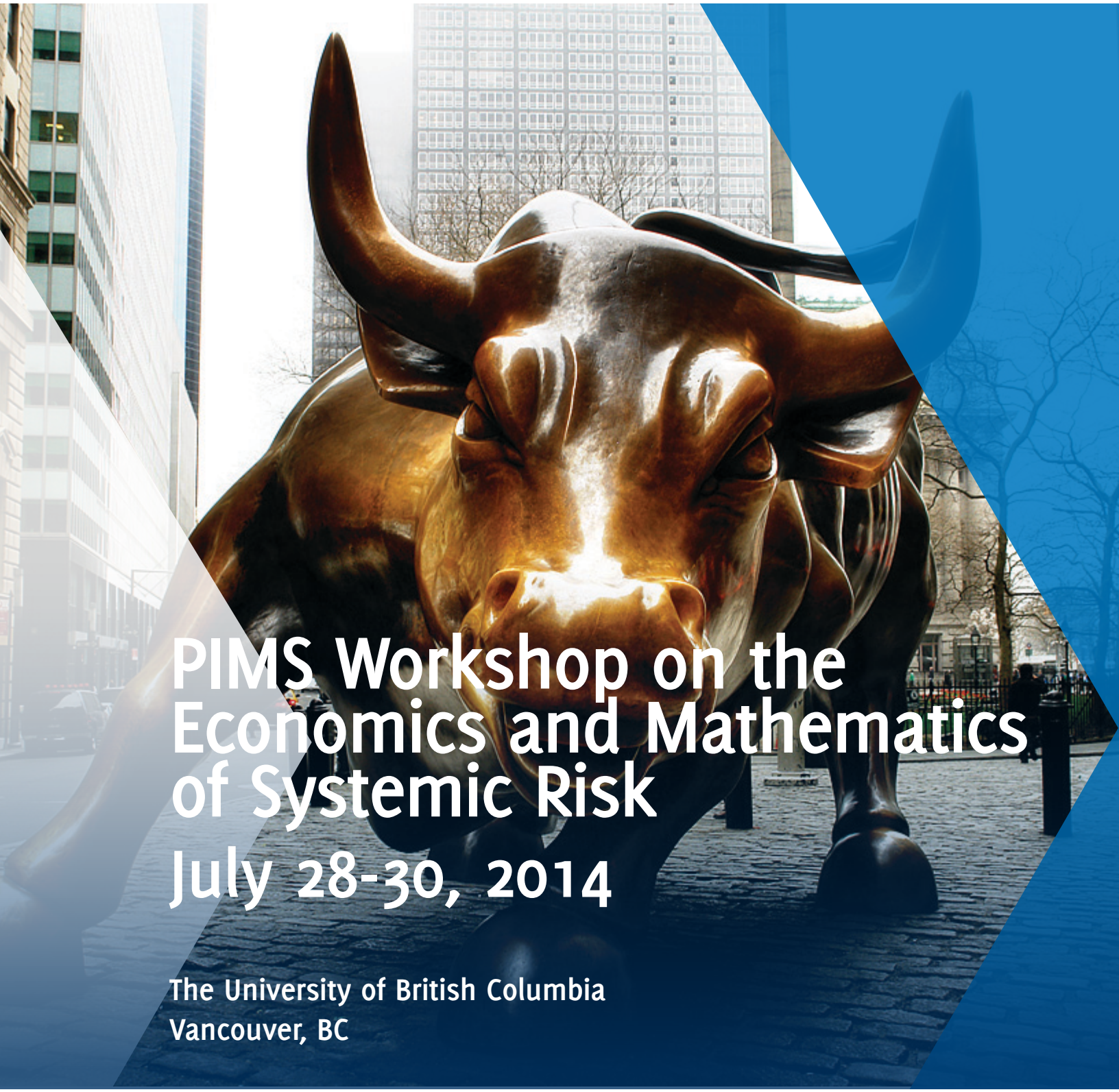
Pacific Institute *for the* Mathematical Sciences



PIMS Workshop on the Economics and Mathematics of Systemic Risk

July 28-30, 2014

The University of British Columbia
Vancouver, BC

PIMS

GLOBAL RISK INSTITUTE

IPAM

CMM Center for Mathematical Modeling

SAUDER School of Business
UNIVERSITY OF BRITISH COLUMBIA

HOW DO FINANCIAL MARKETS GENERATE RISK?

HOW CAN REGULATIONS MITIGATE RISK?

Workshop Schedule

Monday, July 28th

Earth Sciences Building

8:30am- 8:50am:	Registration and check in (ESB Atrium)
8:50am- 9:00am:	Welcome message from PIMS' Director
9:00am-9:50am:	Thaleia Zariphopoulou (University of Texas)
	Risk Sharing Among Heterogeneous Investors
9:50am-10:40am:	Tom Hurd (McMaster University)
	Contagion Channels for Financial Systemic Risk
10:40am-11:10am:	Break (ESB Lobby)
11:10am-12:00pm:	Olivier Gossner (London School of Economics)
	Dynamic Bank Runs Under Public and Private Information
12:00pm-2:00pm:	Lunch (Magma Café)
2:00pm-2:50pm:	AlirezaTahbaz-Salehi (Columbia University)
	Systemic Risk and Stability in Financial Networks
2:50pm-3:40pm:	Alejandro Jofre (University of Chile)
	Systemic Risk in Energy Market and Mining
3:40pm-4:10pm:	Break (ESB Lobby)
4:10pm-5:00pm:	Matheus Grasselli (McMaster University and Fields Institute)
	Asset Price Dynamics in a Stock-Flow Consistent Macroeconomic Model

Tuesday, July 29th

Earth Sciences Building

9:00am-9:50am:	Agnes Sulem (INRIA Paris-Rocquencourt)
	Optimal Control of Interbank Contagion
9:50am-10:40am:	Mark Flood (Office of Financial Research- OFR)
	Measuring Counterparty Networks
10:40am-11:10am:	Break (ESB Lobby)
11:10am-12:00pm:	Andrew W. Lo (Massachusetts Institute of Technology)
	Big Data, Big Brother, and Systemic Risk Measurement and Management
12:00pm-2:00pm:	Lunch (Magma Café)

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2:00pm-4:00pm:	Panel Discussion: Christine Cumming (Federal Reserve Bank of New York); Joe Langsam (University of Maryland); Andrew W. Lo (Massachusetts Institute of Technology); Bernd Schwaab (European Central Bank)
4:00pm-6:00pm:	Break (at participants' leisure)
6:00pm-8: 30pm:	Workshop Dinner (Sage Bistro [see map])

Wednesday, July 30th

Earth Sciences Building

9:00am-9:50am:	Bernd Schwaab (European Central Bank) *Conditional Euro Area Sovereign Default Risk*
9:50am-10:40am:	Xavier Vives (IESE Business School) *Strategic Complementarity, Fragility, and Regulation*
10:40am-11:10am:	Break (ESB Atrium)
11:10am-12:00pm:	Tobias Adrian (Federal Reserve Bank of New York) *Intermediary Leverage Cycles and Financial Stability*
12:00pm-2:00pm:	Conclusion (& Lunch)

WORKSHOP TOPICS

Intermediary Leverage Cycles and Financial Stability

Tobias Adrian, Federal Reserve Bank of New York

We present a theory of financial intermediary leverage cycles within a dynamic model of the macroeconomy. Intermediaries face risk-based funding constraints that give rise to procyclical leverage and a procyclical share of intermediated credit. The pricing of risk varies as a function of intermediary leverage, and asset return exposure to intermediary leverage shocks earns a positive risk premium. Relative to an economy with constant leverage, financial intermediaries generate higher consumption growth and lower consumption volatility in normal times, at the cost of endogenous systemic financial risk. The severity of systemic crisis depends on intermediaries' leverage and net worth. Regulations that tighten funding constraints affect the systemic risk-return trade-off by lowering the likelihood of systemic crises at the cost of higher pricing of risk. (Joint work with Nina Boyarchenko - FRBNY).

Measuring Counterparty Networks

Mark Flood, Office of Financial Research- OFR

This paper examines the growing literature on counterparty networks in financial markets, and extracts a set of requirements that should be satisfied by a robust measurement framework. In other words, how should we measure counterparty networks, if our aim is to support conveniently the broadest collection of useful analytical tools? We survey the implementation considerations in measuring counterparty networks and draw three broad conclusions. First, measurement of financial networks must be a supervisory exercise. Individual market participants naturally have a limited view of the network beyond their immediate counterparties. As (relatively) disinterested and legally empowered observers, supervisors can provide this potentially powerful perspective. Second, there is a network-system "duality" of modeling perspectives on the counterparty network. While researchers historically have concentrated on system-level characteristics—such as liquidity, the price of risk, complexity, and stability—significant new transaction-level datasets are now appearing, permitting important new insights into the detailed inner workings of financial networks. Third, the current central challenge in measuring counterparty networks is to improve data capture and data modeling for financial contracts. Low-level details that populate transaction orders, trade confirmations, and other messages are highly standardized, but this level of formalization is only beginning to extend to higher-level abstractions. For example, the introduction of the legal entity identifier (LEI), which enables consistent and reliable node identification in the counterparty network, exemplifies the data infrastructure that has been missing at the systemic level.

Systemic Risk in Energy Market and Mining
Alejandro Jofre, University of Chile

In this talk we describe some open problems on risk analysis for electricity markets and mining. We connect some of the fundamental and natural constraints in these problems with reliability, risk assessment and pricing.

Dynamic Bank Runs Under Public and Private Information
Olivier Gossner, London School of Economics

In a dynamic model of bank runs with public information, we show that agents tend to preempt runs, thus destabilizing the bank earlier than in static models. On the other hand, when information is private, agents believe that others have less extreme signals than their own, a phenomenon we call “mean reversion of beliefs”. This mitigates incentives to act on information, and makes the banks survive for much longer. (Joint work with Kyna Fong, Johannes Hörner and Yuliy Sannikov.)

Asset Price Dynamics in a Stock-Flow Consistent Macroeconomic Model
Matheus Grasselli, McMaster University and Fields Institute

The currently dominant school of macroeconomic modelling - namely microfounded Dynamic Stochastic General Equilibrium (DSGE) - has a hard time dealing with even the most basic empirical facts pertaining financial markets. Its tenets include the role of financial intermediation as merely a way to channel household savings into investment by firms, the multiplier theory of money supply, and stable equilibria occasionally perturbed by exogenous shocks - none of which are remotely true in practice. In this talk I present a simple macroeconomic model for asset price dynamics based on Tobin's theory of investment and portfolio balances. The model incorporates realistic aspects of financial intermediation, including credit creation for both investment and speculative purposes, endogenous growth cycles, and Minskyan financial instability.

Contagion Channels for Financial Systemic risk
Tom Hurd, McMaster University

There are many distinct channels of systemic risk (SR) including correlated asset shocks, default contagion, funding liquidity contagion and market illiquidity effects. My talk will focus on computational methods, both Monte Carlo and analytic, for the contagion channels of SR that lead to cascading chains of defaulted and illiquid financial institutions. A number of deliberately simplified modelling frameworks, beginning with the Eisenberg-Noe 2001 model, aim to reveal pure contagion effects in isolation from other SR channels. It turns out there is a large amount of commonality amongst these contagion models, which means that similar computational algorithms work even as their financial mechanisms differ. Towards the end we will explore what can happen in networks when two separate contagion mechanisms intertwine to create a "double cascade."

Big Data, Big Brother, and Systemic Risk Measurement and Management
Andrew W. Lo, Massachusetts Institute of Technology

A recurring theme among the many narratives of the Financial Crisis of 2008 is the complexity of the financial system and the failure of private- and public-sector policies to anticipate and attenuate the Crisis. This failure may be a symptom of the emergence of a new type of risk to the financial system—systemic risk—and the growing mismatch between rapidly evolving financial technologies and increasingly antiquated regulations that were never designed to address these challenges. However, technology can also be used to improve regulation. In this talk, Prof. Lo will provide an overview of new challenges to macroprudential policy such as the "refinancing ratchet effect" and the potential for big data analytics to transform financial regulation, including self-stabilizing capital requirements, machine-learning models for consumer credit risk management, and aggregate risk measures that guarantee individual privacy.

Conditional Euro Area Sovereign Default Risk
Bernd Schwaab, European Central Bank

We propose an empirical framework to assess the likelihood of joint and conditional sovereign default from observed CDS prices. Our model is based on a dynamic skewed-t-distribution that captures all salient features of the data, including skewed and heavy-tailed changes in the price of CDS protection against sovereign default, as well as dynamic volatilities and correlations that ensure that uncertainty and risk dependence can increase in times of stress. We apply the framework to euro area sovereign CDS spreads during the euro area debt crisis. Our results reveal significant time-variation in distress dependence and spill-over effects for sovereign default risk. We investigate market perceptions of joint and conditional sovereign risk around announcements of Euro-system asset purchases programs, and document a strong impact on joint risk. (Joint work with André Lucas- University of Amsterdam, Xin Zhang- Sveriges Riksbank).

Optimal Control of Interbank Contagion
Agnès Sulem, INRIA Paris-Rocquencourt

We consider a financial network described as a weighted directed graph, in which nodes represent financial institutions and edges the exposures between them. Distress propagation in a financial system may be modeled as an epidemic on this graph. We study a preferred equity infusion government program set to mitigate interbank contagion. Financial institutions are prone to insolvency risk channeled through the network of interbank debt and to funding liquidity risk. When the government has complete information on interbank debt, the problem of quantifying the optimal amount of infusions can be expressed as a convex combinatorial optimization problem, tractable when the set of banks eligible for intervention (core banks) is sufficiently, yet realistically, small. The incomplete information case is studied by combining stochastic control theory with the random graph representation of the financial system. Finally we investigate a model in which funding liquidity is endogenous and depends on the way an institution is exposed to insolvency risk, through the financial network. (Joint work with Andreea Minca, Cornell University).

Systemic Risk and Stability in Financial Networks
Alireza Tahbaz-Salehi, Columbia University

We provide a framework for studying the relationship between the financial network architec- ture and the likelihood of systemic failures due to contagion of counterparty risk. We show that financial contagion exhibits a form of phase transition as the extent of interbank interconnectivity increases: as long as the magnitude and the number of negative shocks affecting financial institutions are sufficiently small, a more equal distribution of interbank obligations enhances the stability of the system. However, beyond a certain point, such dense interconnections start to serve as a mechanism for the propagation of shocks and lead to a more fragile financial system. Our results thus highlight the "robust-yet-fragile" nature of financial networks: the same features that make the system more resilient under certain conditions may function as significant sources of systemic risk and instability under another. (Joint work with Daron Acemoglu and Asuman Ozdaglar).

Strategic Complementarity, Fragility, and Regulation
Xavier Vives, IESE Business School

Fragility is affected by how the balance sheet composition of financial intermediaries, the precision of information signals, and market stress parameters all influence the extent of strategic complementarity among investors' strategies. A solvency and a liquidity ratio are required to control the likelihood of insolvency and illiquidity. The solvency requirement must be strengthened in the face of increased competition, whereas the liquidity requirement must be strengthened under more conservative fund managers and higher penalties for fire sales. Greater disclosure may aggravate fragility and require an increase in the liquidity ratio, so regulators should establish prudential and disclosure policies in tandem.

Risk sharing among heterogeneous investors
Thaleia Zariphopoulou, University of Texas

This talk is on risk sharing among heterogeneous investors who invest under forward investment optimality criteria. In this framework, explicit stochastic representations are obtained for the individual optimal investments as well as for the allocations across different utilities. Using these representations, questions on, among others, risk sharing, aggregate risk, and portfolio sensitivities are addressed. (Joint work with P. Monin (OFR)).

About the Organizers

Pacific Institute for Mathematical Sciences (PIMS) The PIMS mandate is to promote excellent research and applications of the mathematical sciences, to facilitate the training of highly qualified personnel, to enrich public awareness of and education in mathematics and to create partnerships with similar organizations around the world.

René Carmona is Professor of Engineering and Finance at Princeton University. He is Director of Graduate Studies of the Bendheim Center for Finance, where he oversees the masters in finance program. Dr. Carmona's publications include over 100 articles and seven books on probability, statistics and financial mathematics. He is recognized worldwide as a leading researcher and consultant in the commodity and energy markets.

George Papanicolaou is Professor of Mathematics at Stanford University. He is a member of the US National Academy of Sciences, won the SIAM von Neumann Prize in 2006 and the William Benter Prize in Applied Mathematics in 2010. One of his recent interests is the use of asymptotics for stochastic equations in analyzing complex models of financial markets and in data analysis.

Ivar Ekeland is a former President of Université Paris-Dauphine, and held the Canada Research Chair in Mathematical Economics at the University of British Columbia until his retirement in 2011. He has also written numerous books and papers in mathematics, economics and finance. He is a Fellow of the Royal Society of Canada, and has made substantial contributions to mathematics in a variety of areas.

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