

# Default Risk Mitigation in Derivatives Markets and Its Effectiveness

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When you can *measure* what you are speaking about, and express it in *numbers*, you *know* something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind: it may be the beginnings of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science.

—William Thomson (Lord Kelvin)



# Background

- Growing importance of derivatives for banks and other financial institutions
- High concentration of derivatives markets
- Large players have significant leverage ratios
- OTC derivatives markets have experienced several large credit events
- Collateral usage in OTC markets has grown significantly



# Research Questions

- 1) What are the differences in the mechanisms for default risk mitigation observed in derivatives markets?
- 2) How do these mechanisms affect the wealth of market participants, market liquidity, and default risk?



# Different Perspectives on Collateral

Market  
Risk

Price

Liquidity  
Risk

“Spread”, quantity

Credit  
Risk

PD, LGD



# Credit Risk Perspective

- Credit risk: expected loss due to changes in counterparty credit quality
- Traditional perspective on collateral:  
Reduces LGD → Reduces credit risk



# Credit Risk Perspective (cont'd)

*The mechanisms by which collateral provides benefit is through improvement of the recovery rate. Collateral **does not** make it more or less likely that a counterparty will default and **does not** change the value of a defaulted transaction.*



*What I tell you three times is true.*

—Lewis Carroll



# Credit Risk Perspective (cont'd)

- Credit risk: expected loss due to changes in counterparty credit quality
- Traditional perspective on collateral:  
Reduces LGD → Reduces credit risk
- But what about PD?



# Liquidity Risk Perspective

- Liquidity risk: expected loss due to trading costs (market) or funding needs (funding liquidity)
- Collateral imposes funding constraint on trader (funding liquidity)
- As a consequence, it might reduce market liquidity
- Both might affect a trader's ability to hedge, and might thus adversely affect her probability of default as well as loss given default

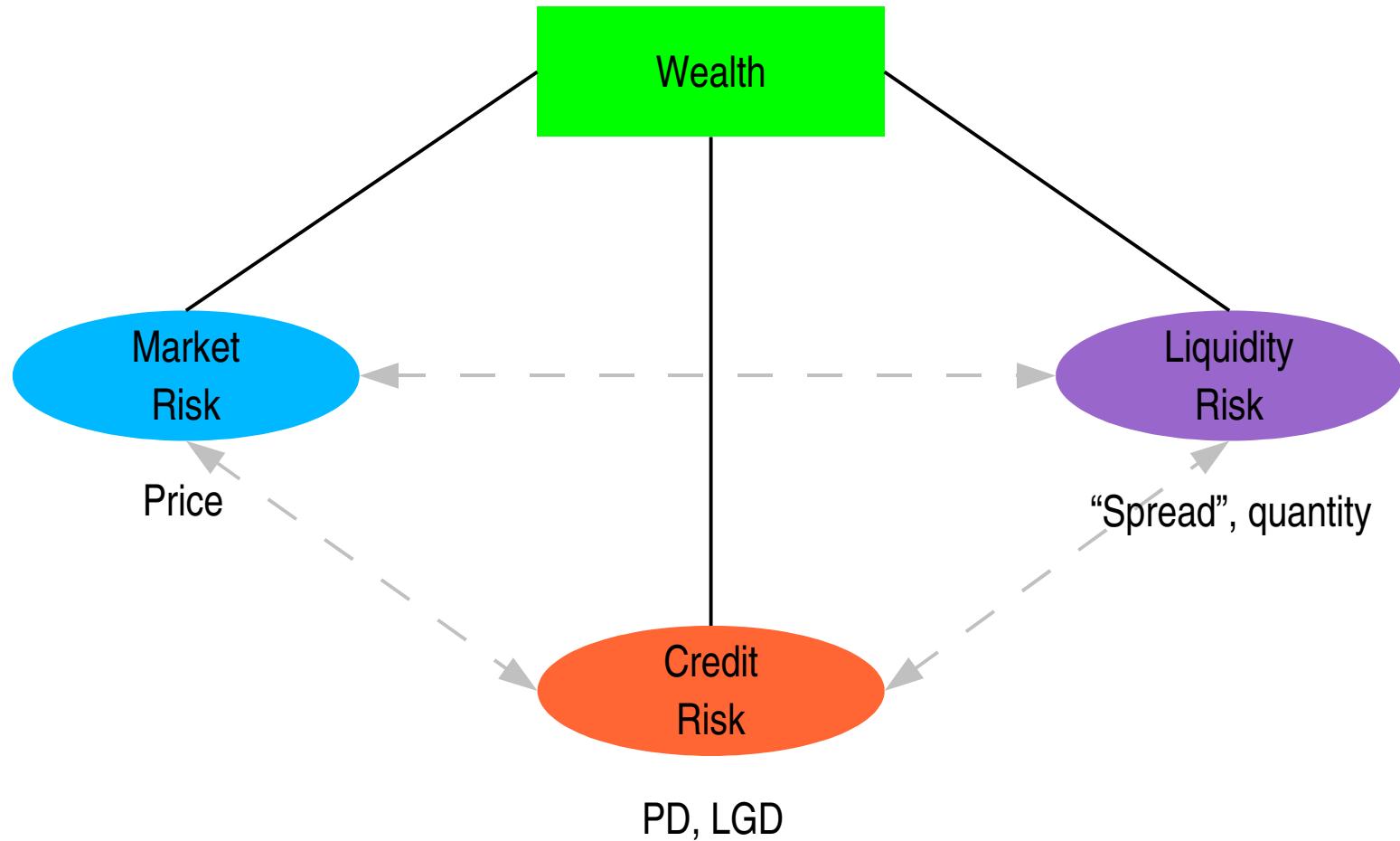


# Market Risk Perspective

- Market risk: expected loss due to price changes
- Price reflects value of contract → function of credit and liquidity risk
- Effects of collateral on prices ambiguous
- Challenge: feedback effects



# “Holistic” Perspective on Collateral





# Modeling Challenges

- Heterogeneity of agents
- Non-linearity of wealth
- Path-dependence
- Dynamics



# Model

- 25 banks
- Exogenous demand and supply for bond, subject to both price and default risk
- Fixed-floating v. floating-fixed exposure
- Solvency and funding constraint
- Asset-based insolvency



## Model (cont'd)

- Banks trade swap contract to hedge price risk
- Swap contracts subject to default risk
- Three sets of default risk mitigation mechanisms:
  - Initial margin
  - Initial & variation margin
  - Initial & variation margin, CCP

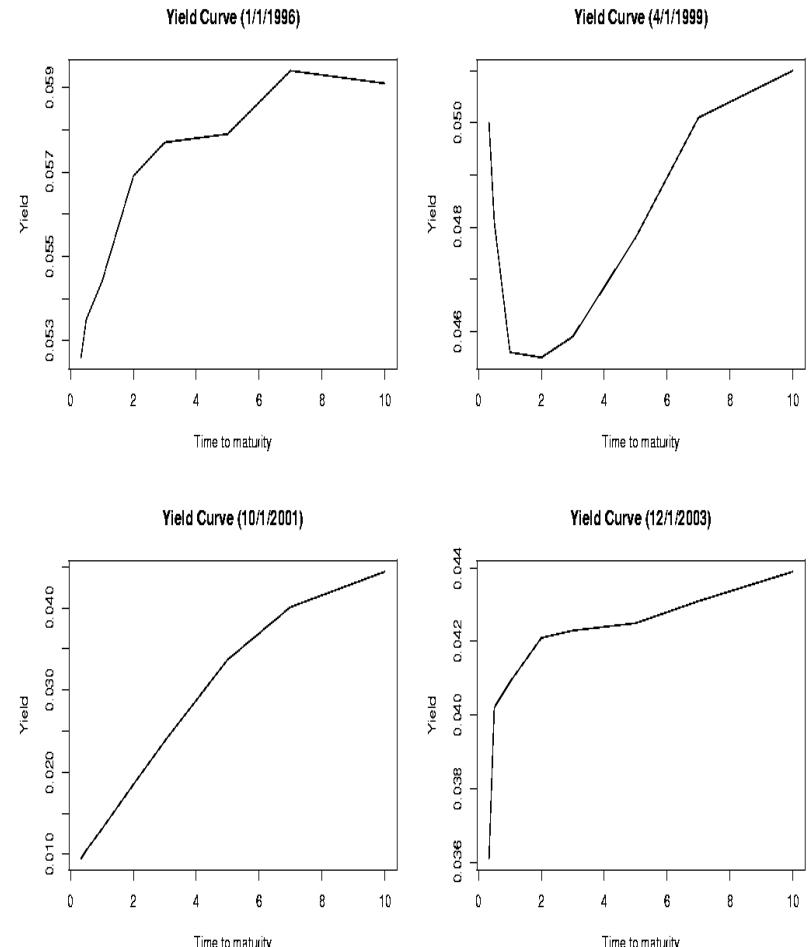
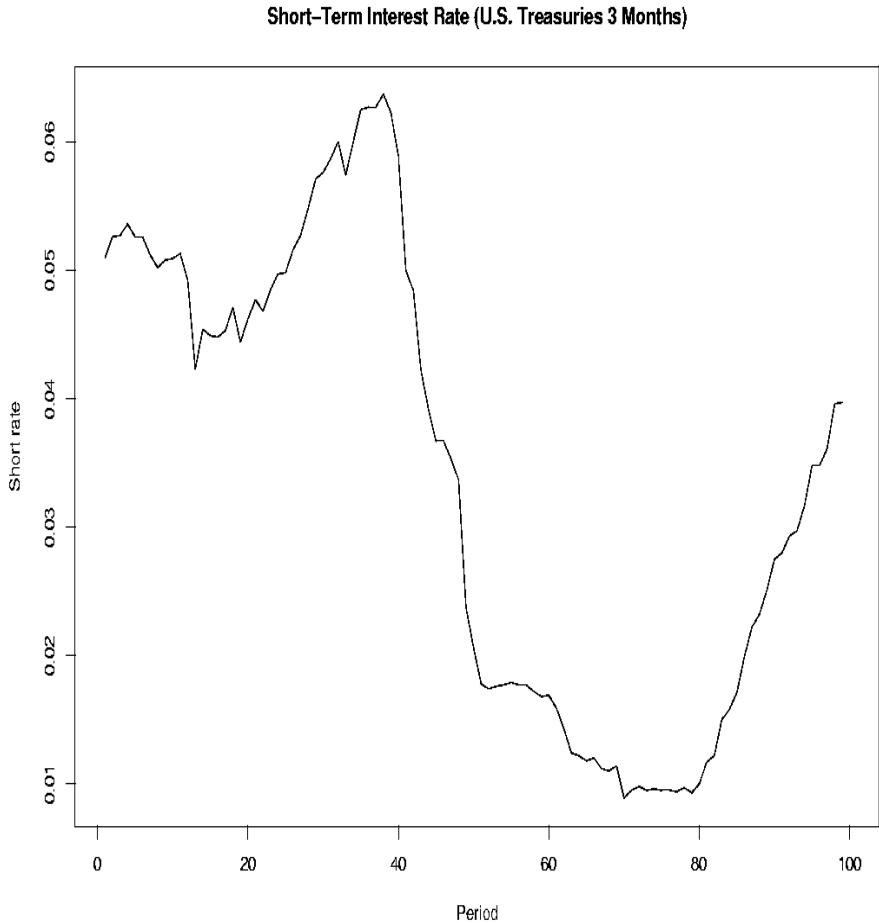


# Model Parameters

Type	Parameter	Description	Values
Market	T	Time horizon	100
	N	Number of agents	25
	$r, u, \sigma_r$	Term structure of interest rate	Empirical term structure
	$T_D$	Maturity of bonds	48
	$T_S$	Maturity of swaps	48
Real sector	$h, v, \rho_{h,r}, \sigma_h$	Term structure of hazard rate	
Banks	m	Initial amount of money	Empirical distribution



# Interest-Rate Environment





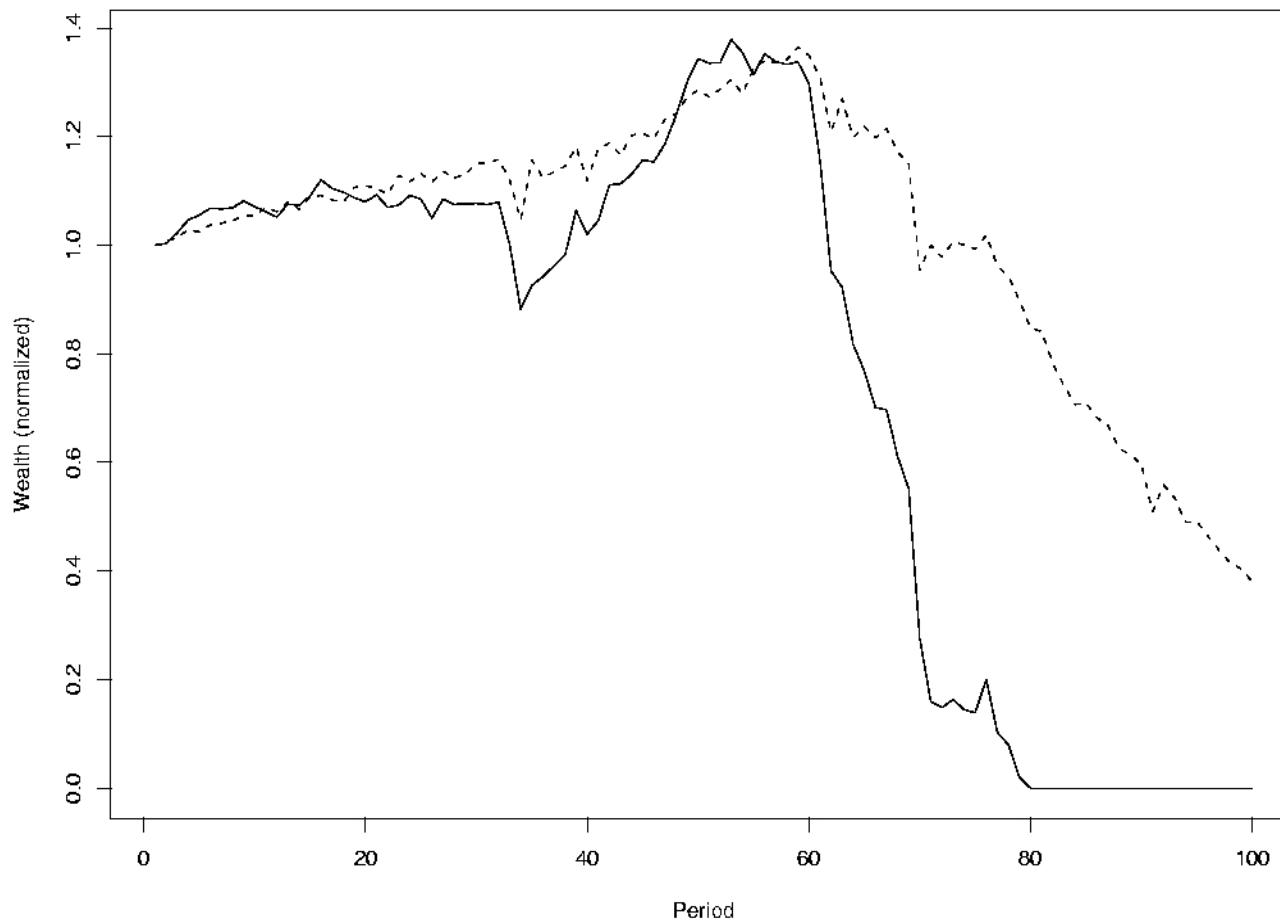
# A Sample Run

- Banks receive endowment in money
- At the beginning of every period, banks receive random client demand (function of wealth) and enter into a position
- Submit order for swap contract (constrained by solvency and by funding liquidity)
- Interest rate is revealed
- Positions are settled



# A Sample Path of Wealth

Sample Path of a Bank's Wealth





# Overall Effects of Mitigation Mechanisms

Simulation results for generic parameter configuration

	BC	0	IM	IM & VM	CCP
$\sigma_w$	0.492	0.397	0.401	0.498	0.498
$W_T$	166.0	174.7	169.8	162.2	161.4
$d$	0.176	0.112	0.140	0.240	0.240
LGD	n/a	0.227	9.94	5.74	5.62
$V$	n/a	19.0	18.6	15.4	15.4
$\theta$	0.0	0.812	0.814	0.802	0.802



# Model Limitations

- Assumption that banks try to hedge completely
- Derivatives market with hedgers only
- Information effects of collateral and CCP
- Externalities of derivatives markets



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*If you can look into the seeds of time,  
And say which grain will grow and which will not,  
Speak.*

—Shakespeare, *Macbeth*