Understanding Credit Spreads: The role of systematic variation in liquidity and expected loss

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Introduction

- Two burgeoning, and somewhat distinct, literatures in financial economics

- Effect of Liquidity and Liquidity Risk on Asset Prices

- (In)Ability of structural models of credit risk to explain levels of credit spreads

Our Proposal…

- Bridge the gap between these literatures
  - Use ideas from asset-pricing literature on how liquidity and liquidity risk should be priced
  - To understand how large, if any, is the liquidity premium contained in credit spreads
  - I will mainly focus on this aspect of the proposal

- Also re-examine some of the systematic risk factors driving credit spreads
  - In particular, the systematic risk of expected loss given the new evidence on recovery-rate risk

Liquidity and Asset Pricing

- Liquidity co-moves with market liquidity
  - Huberman-Halka (1999), Hasbrouck-Seppi (2000), Chordia, Roll, Subrahmanyam (2000)
- Liquidity comoves with returns (negatively), and predicts future returns
  - Jones (2001), Amihud (2002)
- Expected illiquidity is priced
  - Amihud and Mendelson (1986)
- Liquidity risk is also priced
  - Pastor-Stambaugh (2001), Acharya-Pedersen (2002)

Credit Spread Modeling

- Merton (1974)-based models seem unable to match the level of credit spreads
- CAN, however, match well the hedge ratios – Schaefer and Strebulaev (2003)
- Nevertheless, residual variability is high – Collin-Dufresne, Goldstein, Martin (2000)
  - Failure is highest for high-rated bonds
- CGM find that this residual variability is correlated across ALL bond types
- Some recent contributions (discussed later) suggest liquidity may be playing a role

Acharya-Pedersen model

- Expected Return =

  Expected (%)Trading-cost times Holding Period

  +

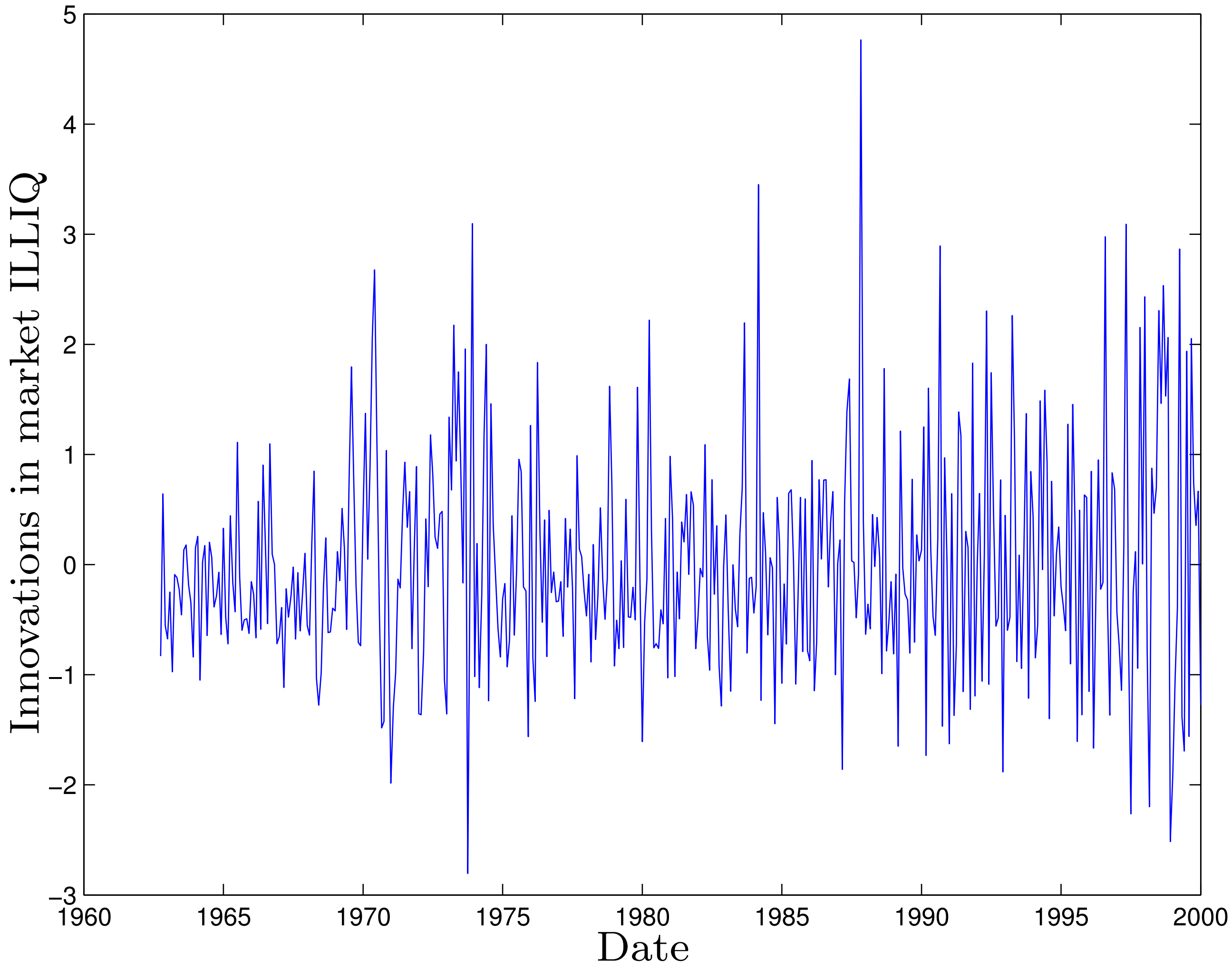
  Risk-premium times Net Beta

- Net Beta = Covariance ($r^i - c^i$, $r^M - c^M$)

- Risk-premium = Expected ($r^M - c^M - r^f$)

Estimation Approach

- NYSE/AMEX 1963-2000
- Amihud (2002) ILLIQ measure: A proxy for price-impact using daily data
  - Monthly average of $|R^i| / DV^i$ for stock i
  - Highly correlated with Kyle's (1985) λ (Hasbrouck, 2004)
  - ILLIQ is higher for illiquid stocks and in periods where the markets are illiquid
  - Shown by Amihud (2002) to affect stock prices in both cross-section and time-series analysis
- Average across stocks for market ILLIQ c^M (see plot)
- Construct market beta and liquidity betas
- Test the asset-pricing model for liquidity-sorted portfolios



Standardized innovations in market illiquidity from 1962-1999.

Results

- E(r) = 0.04 * Expected (%)Trading-cost +
  1.449 * Net Beta

- 0.04 = Holding period of 25 months
- 1.5 = Net market risk-premium per month (a bit too high)
- Does not allow for separate liquidity premium

- E(r) = 0.04 * Expected (%)Trading-cost +
  1.150 * Market Beta + 4.334 * Liquidity Beta

Why is this useful?

- Provides estimate of liquidity risk-premium from a simple yet well-founded economic model
- Researchers can compare liquidity and liquidity risk of alternative asset classes to those of stock portfolios
- Use estimated risk-premium to come up with preliminary (suggestive) estimates of how large might the effect of illiquidity be in credit spreads

Application to Credit Spreads

	AAA	BBB	BB	B	CCC
(Bid-asks from Chen, Lesmond, Wei, WP 2004)					
Short Mat					
Bid-Ask	27	24	42	54	82
Yield	850	954	981	1163	1767
%cost	3.18	2.52	4.28	4.64	4.64
Medium Mat					
Bid-Ask	50	38	49	61	60
Yield	850	954	981	1163	1767
%cost	5.88	3.98	4.99	5.25	3.40
Long-term Mat					
Bid-Ask	56	52	64	82	100
Yield	850	954	981	1163	1767
%cost	6.59	5.45	6.52	7.05	5.66
Spread over rf	76	178	322	486	970

Comparison to AP Portfolios

- Based on trading costs:
  Short-maturity bonds = Portfolio 23
  Medium-maturity bonds = Portfolio 24
  Long-maturity bonds = Portfolio 25

- Three most illiquid stock portfolios
  - Smallest market cap (20-40 mln USD)
  - Most volatile (40-60% annualized)
  - Most liquidity-risky (0.75-1.5% vol of trading costs)
  - Highest average returns (13.2% annualized)

Calibrating Liquidity Effects

Effect of expected liquidity:					
	AAA	BBB	BB	B	CCC
Short	0.1271	0.1006	0.1713	0.1857	0.1856
Medium	0.2353	0.1593	0.1998	0.2098	0.1358
Long	0.2635	0.2180	0.2610	0.2820	0.2264
cov(r,ILLIQ)	-0.0008	-0.0012	-0.0021	-0.0021	-0.0040
Effect of liquidity risk:					
	AAA	BBB	BB	B	CCC
Low risk-premium					
lambda=1.5	0.1203	0.1757	0.3110	0.3140	0.6029
High risk-premium					
lambda=4.5	0.361	0.527	0.9329	0.9419	1.8086

Calibration (Cont'd)

Liquidity + Liquidity risk (Medium maturity instruments)					
	AAA	BBB	BB	B	CCC
Low RP	0.36	0.33	0.51	0.52	0.74
% of Yield	4.18	3.51	5.21	4.50	4.18
% of Spread	46.79	18.82	15.86	10.78	7.62
High RP	0.6	0.69	1.13	1.15	1.94
% of Yield	7.06	7.23	11.52	9.89	10.98
% of Spread	78.95	38.76	35.09	23.66	20.00

- Based on reasonable risk-premium estimates, the effect of expected illiquidity and liquidity risk on bonds can be 20-50% of yield spreads

Supporting Findings

- Existing literature has found the SMB (small minus big size) portfolio to explain
  - The part of credit spreads not related to expected loss
    - Elton, Gruber, Agrawal and Mann (2001)
  - The part of credit spreads not related to Merton-model predicted variation
    - Schaefer and Strebulaev (2003)
- AP find that liquidity and liquidity risk explain SMB effect completely
  - A well-accepted fact in literature by now

Obvious Caveats…

- Our aggregate liquidity measure does not include bond-market liquidity
  - The liquidity-risk effect may in fact be greater
  - There may be liquidity risk “local” to bond markets
- Need to check that liquidity, liquidity-risk are actually priced in the cross-section of bonds
- Need to appropriately eliminate credit-risk determinants before studying any liquidity effects in cross-section as well as time-series

Some Recent Contributions

- Since our proposal, we have discovered some useful, interesting papers
- Chen, Lesmond, Wei (2004)
  - Use % of zero returns (and implied) measures of bond illiquidity based on daily data
  - Show illiquidity is priced in the cross-section
  - Also provide some time-series evidence
- Goyenko (2005)
  - Uses similar measure to show that both stock and bond market illiquidities are priced

Recent Contributions (Cont'd)

- Houweling, Mentink, Vorst (2005)
  - Study bonds denominated in Euros
  - Show that nine different measures of liquidity are related, almost all are priced (individually)
  - Overall effect of liquidity of 13-23 bps
- Gebhardt, Hvidkjaer, Swaminathan (2005)
  - Use Term Spread and Default Spread as systematic variables based on Fama and French (1993)
  - Find significant explanatory power in the cross-section of bond returns (by rating categories)

Our Proposed Methodology

- Study cross-section as well as time-series of individual corporate bond returns
  - Effect of expected illiquidity
  - Effect of liquidity risk [NEW] (a la Acharya-Pedersen)
- In light of recent progress, it seems important to
  - Study the time-series of credit spreads in particular
    - Is liquidity an important determinant of variations in
      - Default Spread?
      - Term Spread?
  - Study both equity and bond-market liquidity
    - The latter implies significant data-collection effort

Proposal (Cont'd)

- As an illustration of time-series analysis, we have done some preliminary tests

- Relate the time-series variation in Default Spread and Term Spread to
  - Stock-market Illiquidity
  - Stock-market return
    - For both, focus on smallest portfolios given earlier discussion
  - Other determinants often insignificant: for example, broad market return and market volatility

Hypotheses for Default Spread

- Decreasing in stock-market returns
  - Market-return: value-weighted or equal-weighted?
  - Small stock-portfolio return?
- Increasing in stock-market illiquidity
  - Commonality in liquidity
    - Chordia, Sarkar and Subrahmanyam (2003)
    - Brunnermeier and Pedersen (2005)
  - Bonds like small-stock portfolios
- Increase in stock-market volatility
  - Value-weighted or equal-weighted?

Preliminary Results (Cont'd)

- Monthly data are over 40 years, 1963-2002
- Default spread in month t:

  $DEF_t = BAA_t - AAA_t$

  $DDEF_t = DEF_t – DEF_{t-1}$

  OR DEF_t / DEF_{t-1}

  OR $\log(DEF_t / DEF_{t-1})$
- $DILLIQ_t = \log(ILLIQ_t/ILLIQ_{t-1})$
- The small stocks' portfolios are where the liquidity effects are particularly pronounced.
- DILLQSML = average DILLIQ for size portfolios 2, 3 & 4
- RSML = average returns for size portfolios 2, 3 & 4

Dependent Variable: $DDEF_t$

Variable	Coefficient	*t*-statistic
$DILLIQSML_{t-1}$	0.013	0.77
$DILLIQSML_{t-2}$	**0.038**	**2.70*** **
$RSML_{t-1}$	**-0.263**	**-3.44*** **
$RSML_{t-2}$	-0.020	-0.02
$DDEF_{t-1}$	0.189	3.08***
$DDEF_{t-2}$	-0.106	-1.98***
$R^2 = 0.108$, DW = 2.03		

Dependent Variable: $DDEF_t$

Variable	Sub-period I		Sub-period II	
	Coefficient	*t*-statistic	Coefficient	*t*-statistic
$DILLIQSML_{t-1}$	0.046	1.25	-0.002	0.12
$DILLIQSML_{t-2}$	**0.056**	**1.85***	**0.032**	**2.10****
$RSML_{t-1}$	**-0.199**	**-1.86***	**-0.315**	**-3.26*****
$RSML_{t-2}$	-0.043	-0.34	0.057	0.040
$DDEF_{t-1}$	0.128	1.58	0.264	4.42***
$DDEF_{t-2}$	-0.140	-1.68*	-0.141	2.17**
	R^2 = 0.111, DW = 2.01		R^2 = 0.130, DW = 2.04	

Hypotheses for Term Spread

- Trickier…
- Flight to quality and liquidity (short-end treasuries)
    - Holmstrom and Tirole's LAPM (2001)
    - Longstaff (2002)

- Decreasing in stock-market returns
- Increasing in stock-market illiquidity
- Decreasing in inflation growth

Preliminary Results (Cont'd)

- Term Spread (TS_t) =
  Log (10-yr Tsy $Yield_t$ / 3-mo TBill $Yield_t$)
- $DTS_t = TS_t - TS_{t-1}$
- $INF_t = \log(CPI_t / CPI_{t-1})$
  - CPI_t is seasonally adjusted, all items
- $DINF_t = INF_t - INF_{t-1}$
- Market illiquidity and return appear to be more important than small stock portfolio measures

Dependent Variable: DTS_t

Variable	Coefficient	*t*-statistic
$DILLIQ_t$	0.0080	2.87***
$DILLIQ_{t-1}$	0.0061	2.12
RM_{t-3}	-0.315	-2.78***
RM^2_{t-3}	3.465	2.77***
$DINF_{t-1}$	-2.851	-2.45**
DTS_{t-1}	0.313	5.45***
$R^2 = 0.140$ DW = 1.93		

Dependent Variable: DTS_t

Variable	Coefficient	*t*-statistic
$DILLIQ_t$	0.0080	2.85***
$DILLIQ_{t-1}$	0.0062	2.09**
RM_{t-3}	-0.266	-2.24**
RM^2_{t-3}	3.272	2.47**
DI_{t-1}	-2.507	-2.38**
DTS_{t-1}	0.304	5.29***
$DDEF_{t-1}$	0.729	2.13
$R^2 = 0.161$ DW = 1.94		

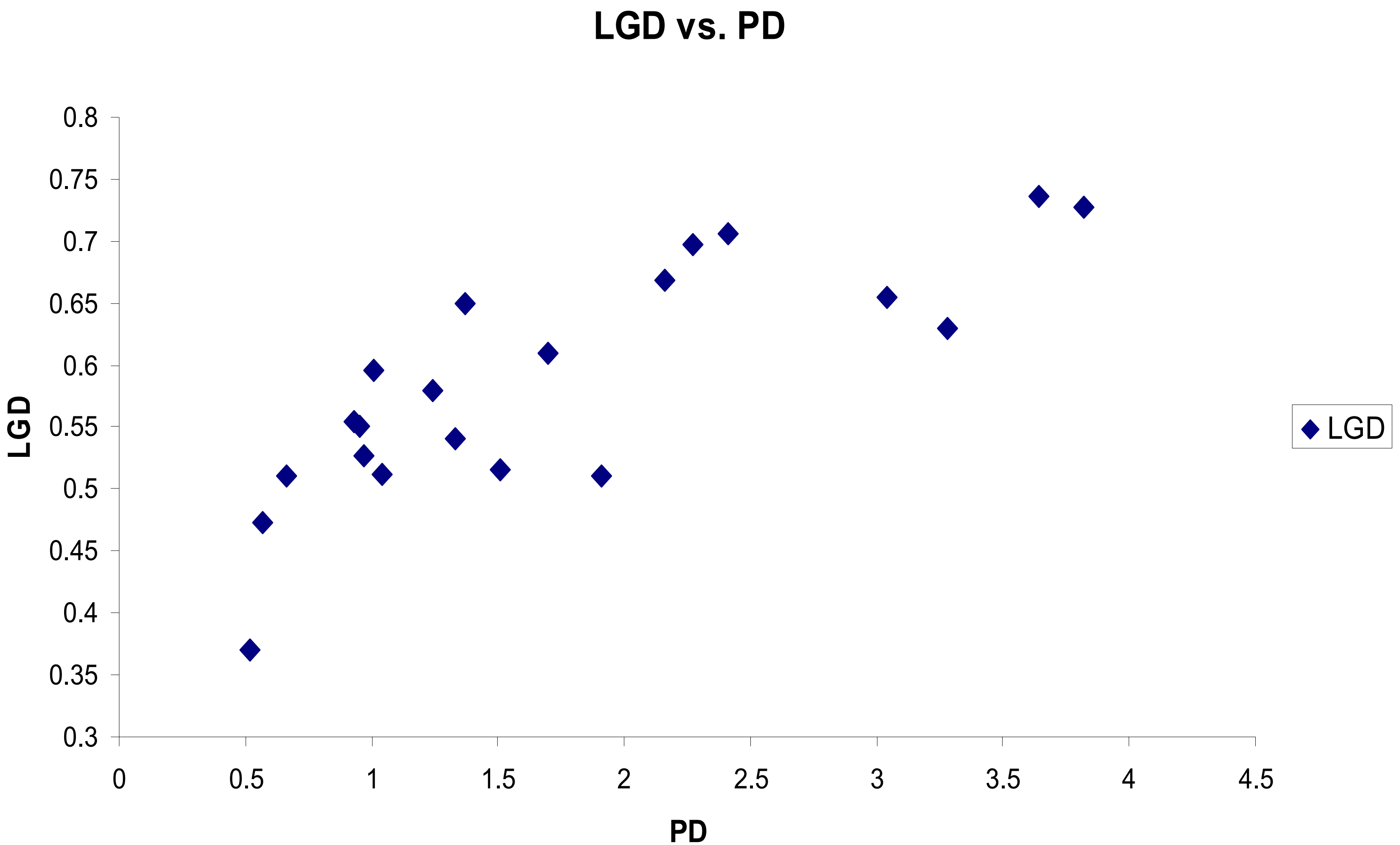
Systematic Expected Losses

- Recent evidence shows that not just default likelihood (PD), but loss given default (LGD) is also systematic
  - Altman, Brady, Resti, Sironi (2003)
    - "Bad things happen in pairs"
    - PD and LGD are correlated
  - Acharya, Bharath, Srinivasan (2004)
    - Recovery is lower for "asset-specific" industries
    - Effect is at industry level, not just macro level

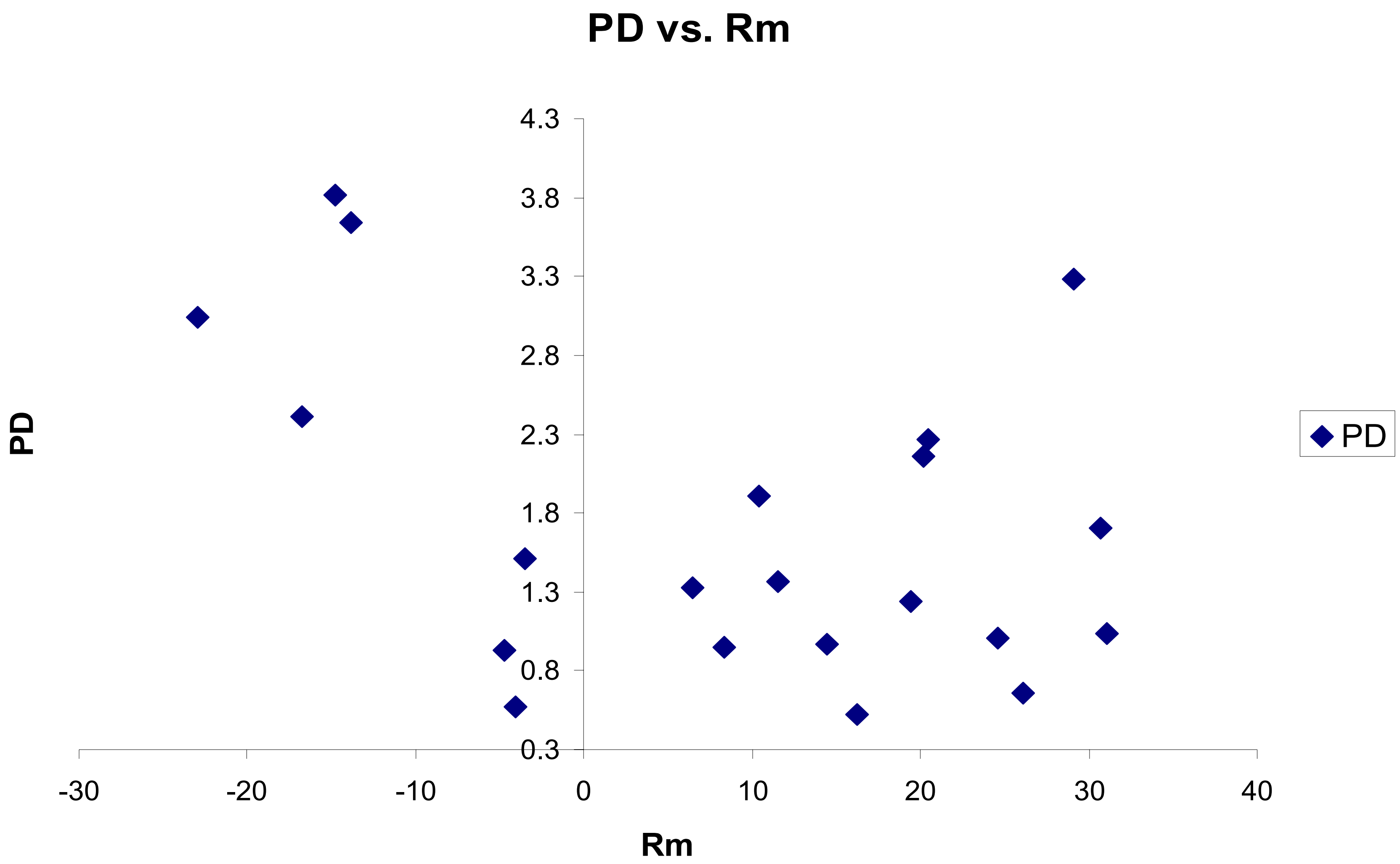
Expected Losses (Cont'd)

- Why is this "recovery risk" important?
  - Expected losses contain a "multiplier" systematic effect
- Traditional way of thinking about systematic risk of expected losses
  - Cov (PD * Avg LGD, Rm)
- But Cov (PD, LGD) > 0 …
- Correct way
  - Cov (PD * LGD, Rm)

LGD vs. PD Plot



PD vs. Rm Plot



Expected Losses (Cont'd)

- Calibration (again!)…
- Cov (PD, Rm) = -0.040%
- Statistically, LGD is well-described by

  LGD = 0.4572 + 0.075 * PD
- Cov (PD * LGD, Rm)

= 0.46 Cov(PD,Rm) + 0.075 Cov (PD^2,Rm)

= -0.056%

- True systematic risk is about 40% greater

Expected Losses (Cont'd)

- Recent efforts at explaining rating-AAA spreads have focused on
  - Asset-pricing models with time-varying risk-premium (Habit models)
    - Chen, Collin-Dufresne, Goldstein (2004)
  - Risk-premium is higher in "bad" times
- Thus, there may be triple multiplier at work
  - PD, LGD, Risk-premium all go up at the same time
- Credit spreads may be of their size partly due to this multiplier effect
  - Not yet modeled in the literature
  - We hope to quantify the effect

Summary

- Liquidity, liquidity risk and recovery risk appear to be promising dimensions to pursue to explain
  - Level of credit spreads
  - Dynamics of credit spreads
- Preliminary results on liquidity risk suggest
  - Equity-market based measures of liquidity may themselves succeed in this endeavour
  - But bond-market liquidity measures may be necessary to obtain conclusive evidence
  - We plan to pursue both, subject to data constraints

Proposed Timeline and Budget

- Data acquisition/cleaning: end of Summer 2005
- Pilots: Fall 2005
- Empirical investigation: Summer 2006
- Paper(s) for circulation: Fall 2006

- Research assistants: €15,000
- Computing equipment: €4,000
- Travel expenses: €4,500
- Overheads: €1,500
- Data: €5,000