

A Global Liquidity Factor for Fixed Income Pricing

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- 1 Motivation
- 2 Liquidity and Asset Pricing
 - Relation to the Existing Literature
 - Methodology
- 3 Data & Results
 - Proxying Liquidity
 - Estimation Results
 - Robustness to other Liquidity Proxies
 - Maturity & Rating
- 4 Concluding Remarks

Outline



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Motivation for Paper



- Liquidity squeeze documented dramatic consequences of evaporating liquidity
- Premiums widely documented in equity markets, but systematic analysis for FI markets limited
- SEC press release on FASB Statement No. 157
- Obtain observable measure for price of liquidity: non-default component of corporate bond spreads (Longstaff et al., 2005)
 - Interpreted as liquidity component, it is evidently priced in the market; it is a spread!
- **Main idea:** Liquidity factor for bonds allows identification of liquidity effect even for bonds where no CDS is traded

Important Implications



- **Liquidity premiums**
 - Reaping of liquidity premium for long-term investors
 - Identification of liquidity sensitive assets for optimizing portfolio transition
- **Valuation**
 - Accomodate accounting standard setters' demand of adjusting market values for liquidity effects using market inputs
 - Probably preferable to DCF with notoriously difficult to obtain risk-adjusted discount rate
- **Risk Management**
 - Improves risk assessment by avoiding use of “level 3” inputs

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Focus on Equities



- Extensive survey of the literature on asset pricing and liquidity in Amihud et al. (2005)
- Influential contributions dealing with liquidity and (US) equities:
 - Amihud and Mendelson (1986): Theoretical framework justifying work on liquidity
 - Amihud (2002), Pastor and Stambaugh (2003), or Sadka (2006): Significant effect of liquidity on expected returns
 - Martinez et al. (2005) P&S analysis on international level using Spanish data
 - Korajczyk and Sadka (2008): Combination of various liquidity measures using a PCA to back out latent liquidity factor
- Chordia et al. (2005): Linkages of bond and stock market data due to liquidity (Further motivates to take a closer look at bond market liquidity)

Focus on Fixed Income



- Huang and Huang (2003): Corporate spreads too high to be solely explained by credit risk
- Longstaff et al. (2005): Non-default component of corporate spreads (backed out using CDS spreads) related to typical market microstructure measures of liquidity
- De Jong and Driessen (2005): Liquidity risk is priced using the factor of Amihud (2002)
- Recently bond market illiquidity also documented by Chen et al. (2007), Edwards et al. (2007), and Goldstein et al. (2007)
- Mahanti et al. (2008) and Nashikkar et al. (2007): Latent liquidity factor based on investor holdings

Liquidity Component backed out from CDS Market



- No-arbitrage idea for a CDS:
 - **Portfolio I**
 - Defaultable bond \bar{C} with interest payments \bar{c} and maturity T_N
 - CDS on that bond with spread \bar{s}
 - **Portfolio II**
 - Default-free coupon bond C with the same face value and payment dates, and coupon $\bar{c} - \bar{s}$
- **BUT: Actual and synthetic government w/ different liquidity**
- Analytical models follow along the lines of Duffie (1999) or Hull and White (2000)
- Empirically investigated by **Longstaff et al. (2005): non-default component b/w CDS and corporate spread attributed to liquidity!**

At the Repo Window



- Difference in liquidity b/w government and synthetic government bond not surprising when looking at a central bank's repo window
- Different haircuts applied to synthetic and true government bond

Res. Mat.	Cat. I (govt bonds)		Cat. II (reg. gov. ..)		Cat. III (bank & corp.)		Cat. IV (unsec. bank)		Cat. V ABS
	Fixed C	Zero	Fixed C	Zero	Fixed C	Zero	Fixed C	Zero	all Coupons
0-1	0.5	0.5	1	1	1.5	1.5	6.5	6.5	12
1-3	1.5	1.5	2.5	2.5	3	3	8	8	12
3-5	2.5	3	3.5	4	4.5	5	9.5	10	12
5-7	3	3.5	4.5	5	5.5	6	10.5	11	12
7-10	4	4.5	5.5	6.5	6.5	8	11.5	13	12
>10	5.5	8.5	7.5	12	9	15	14	20	12

Source: ECB (2008)

Measuring the Liquidity Premium



- Even if government bond not easy to buy or sell, repoing ability renders it near cash equivalent
- Government bond as reference for measuring liquidity
 - Yield purely compensation for time value of money
- **Corporate yield** w/ at least three components:
 - Time value of money
 - Default risk
 - *Illiquidity*
- **Interested in price** discount *not* due to changes in *interest rate* or *default risk*

The Model



- Decomposing the corporate yield, bond yields compensate for
 - Time value of money
 - Credit risk
 - Liquidity risk
 } *Here: Same for all assets*

i.e. \exists a **liquidity factor** that is relevant \forall bonds

- Controlling for equity performance, as motivated by Chen et al. (2007), the empirical model considered is:

$$R_{i,t} = \alpha_i + \beta_i^{(1)} \Delta \text{Rates}_t + \beta_i^{(2)} \Delta \text{Default}_t + \beta_i^{(3)} \Delta \text{Liqui}_t + \beta_i^{(4)} R_t^{\text{MSCIw}} + \epsilon_{i,t} \quad (1)$$

- Coefficients have an interpretation of scaled duration
 - Scaling of sensitivities by duration in line with Jarrow (1978)

The Liquidity Factor



- **Idea:** Liquidity component backed out from corporate and CDS spreads of senior financials contains systematic information for all bond returns
- Main interest: Liquidity loading $\beta_i^{(3)}$ for the numerous bonds considered
⇒ Does Liqui help pricing assets?
- If liquidity components for single corporates/financials have a price and they help explaining other returns (non-zero liquidity loading), Elton et al. (2001) interpret this as evidence for the economic significance of the factor.

Outline

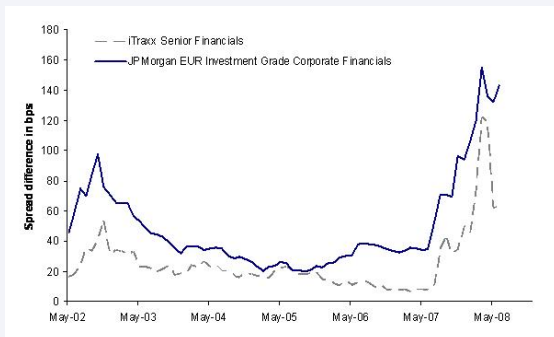


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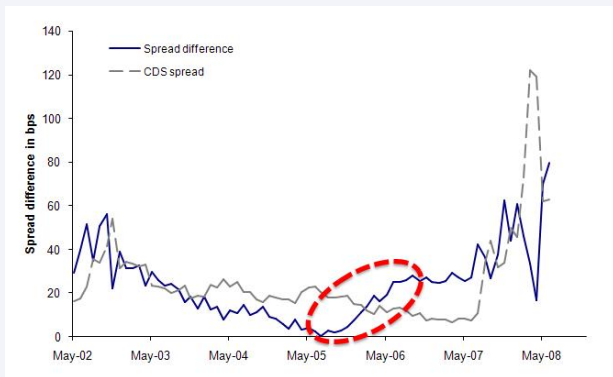
Base Proxy for the Liquidity Premium



- $Liqui_{Fin}$: Difference between
 - Government **Spread of the JPMorgan EUR Investment Grade Corporate Financials Index**; Avg spread: 50bps
 - **CDS spread of the iTraxx Europe Senior Financials**; Avg spread: 26bps



CDS Spread and Spread Difference



- Spread difference > 0 w/ avg = 24 bps
- Liquidity price rose long before CDS spreads increased
- Evidence of illiquidity in CDS market toward end of sample

Estimation Methodology



$$R_{i,t} = \alpha_i + \beta_i^{(1)} \Delta \text{Rates}_t + \beta_i^{(2)} \Delta \text{Default}_t + \beta_i^{(3)} \Delta \text{Liqui}_t \\ + \beta_i^{(4)} R_t^{\text{MSCIw}} + \epsilon_{i,t}$$

- Equation (1) w/ cross-equation restrictions (rates included depend on currency denomination of asset i)
- TS regression for each i not efficient
- SUR using first step covariance matrix as estimate for the correlation structure

Assets under Investigation



- Fixed income (JPMorgan Indices):
Corporate Bond Index (All Industries) USD, High Yield US,
Corporate Bond Index (All Industries) EUR, Pfandbriefe EUR,
Subordinated Financial EUR, Corporate Bond Index (All
Industries) GBP, Senior Financials GBP, Corporate Bond
Index (All Industries) JPY, Emerging Markets Global
Diversified, Corporates Emerging Markets,
- Other:
Commodities Index, MBS Index, ABS Index USD, CMBS
Index, Munis, Hedge Funds, Loans
- Sample period: June 2002 - July 2007

Estimation Results $Liqui_{Fin}$



	1	R_{MSCIw}	Coefficients of				R^2
			$\Delta Rate$	$\Delta Liqui_{Fin}$	ΔDef_{Fin}		
CorpIG USD	0.0040 *	0.0636 *	-5.4712 *	-8.4055 *	-7.5330 *		94.67%
HY US	0.0069 *	0.1592 *	-1.7145 *	-17.8235 *	-16.0749 *		65.71%
CorpIG EUR	0.0039 *	0.0037	-4.1176 *	-4.8266 *	-4.0157 *		90.48%
Collateralized EUR	0.0031 *	-0.0151	-4.4629 *	-1.2829 *	-0.5213		94.83%
FinSub EUR	0.0044 *	-0.0115	-5.5412 *	-7.1393 *	-6.6085 *		91.71%
CorpIG GBP	0.0044 *	0.0454 *	-6.5186 *	-4.6568 *	-5.8772 *		91.92%
FinSen GBP	0.0043 *	0.0103	-5.5198 *	-4.7719 *	-6.1825 *		95.17%
CorpIG JPY	0.0007 *	0.0013	-1.9189 *	-2.1348 *	-1.7226 *		63.14%
EMBIGlobDiv USD	0.0070 *	0.3717 *	-6.1014 *	-10.8285 *	-8.5150 *		70.14%
CorpEM USD	0.0064 *	0.1002 *	-6.5743 *	-7.9745 *	-9.2069 *		88.56%
Commodities USD	0.0181 *	0.0278	-1.38445	-5.2105	-14.6472		2.40%
GNMAMortgages USD	0.0033 *	0.0246	-2.2911 *	-0.3356	1.5272		73.84%
ABS USD	0.0033 *	-0.0041	-1.6394 *	1.0604 *	1.1193 *		89.21%
CMBS USD	0.0039 *	0.0246	-4.9613 *	-1.0670	-1.4887		93.95%
Munis USD	0.0043 *	0.0094	-4.8031 *	-3.7824 *	-5.8674 *		88.29%
HedgeFunds USD	0.0063 *	0.3228 *	-0.60219	-1.9831	-7.1210 *		68.13%
Loans USD	0.0045 *	0.0107	0.06897	-9.3315 *	-14.0000 *		66.25%

- Liquidity statistically and economically significant
- **Negative coefficient** \Rightarrow **Return goes down as liquidity premium increases** (i.e. liquidity dries up)
- Wald-Test: Reject joint equality of Liqui and Def coefficients

Explanatory Power of Liquidity



- Variance Decomposition

$$Var(R_i) = \sum_{j=1}^4 \left(\beta_i^{(j)} \sigma_j \right)^2 + 2 \sum_{j=1}^3 \sum_{k=j+1}^4 \beta_i^{(j)} \beta_i^{(k)} \sigma_j \sigma_k \rho_{jk} + \sigma_i^2 \quad (2)$$

- Incremental R^2 due to liquidity (avg $\approx 9\%$):

CorpIG USD	CorpIG GBP	EMBIGlobDiv USD	HY US	FinSub EUR	CorpEM USD
8.89%	4.56%	6.87%	32.31%	12.42%	5.53%
CorpIG EUR	GNMAMortgages USD	HedgeFunds USD	FinSen GBP	CMBS USD	
10.43%	0.06%	0.61%	6.72%	0.19%	
CorpIG JPY	Collateralized EUR	Munis USD	ABS USD	Loans USD	
11.15%	0.67%	2.01%	1.16%	39.59%	

- HY or GNMAMortgages hint at “flight to quality” phenomenon

Alternative Liquidity Proxies



- $Liqui_{Corp}$: Difference between
 - Gov **Spread JPMorgan EUR IG Corp**; Avg spread: 58bps
 - **CDS spread of the iTraxx Europe Main**; Avg spread: 45bps
- $Liqui_{Swap}$: Difference in yields between
 - **Interest rate swap**
 - Corresponding **government bond**
- $Liqui_{PCA}$: Latent liquidity
 - Principal component analysis (PCA) using Fin, Corp, Swap
- $Liqui_{Exact}$: Exact match (but data only from Jan '05)
 - US IG Corporate CDS spreads and **corresponding** treasury spreads
- **Estimation results** of eqn (1) qualitatively **similar**
- Inclusion of market fear gauge ΔVIX (Bao et al., 2008) not altering results

Maturity



- Analyzing impact of *maturity* on sensitivity to liquidity
- ECB haircuts (increasing in maturity) \Rightarrow Expecting bigger liquidity effect for longer maturities

Maturity	$\beta_T^{(3)}$		
	EUR	GBP	USD
1-3	-2.5860 *	-0.4085 *	-0.5581 ⁺
3-5	-3.4812 *	-0.6537 *	-1.0466 *
5-7	-5.1421 *	-1.6851 *	-2.1539 *
7-10	-4.1691 *	-2.7080 *	-3.3929 *
10+	-7.7848 *	-4.3314 *	-3.2713 *

- E.g. change from 3-5 to 5-7 years category corresponds almost exactly to change in ECB haircut (Category III assets)
- USD market less affected by liquidity than EUR market

Rating



- Analyzing impact of *rating* on sensitivity to liquidity
- Better rating \Rightarrow Smaller effect of liquidity changes

Rating	EUR		ΔLiqui_{PCA} Coefficient		USD	
	'02 - '07	'02 - '08	GBP '02 - '07	'02 - '08	'02 - '07	'02 - '08
AAA	-	-	-1.3900 *	-1.5429 *	-0.5288 +	-0.7240
AA	-2.8053 *	-3.8979 *	-1.8680 *	-2.8971 *	-0.9067 *	-1.2340 *
A	-2.6965 *	-4.3233 *	-2.1652 *	-3.2325 *	-1.1326 *	-2.3844 *
BBB	-6.8641 *	-6.5974 *	-3.3608 *	-3.1099 *	-3.6986 *	-4.1414 *

- Flight to quality

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Concluding Remarks



- Liqui component from CDS and bond indices significantly relates to bond returns
 - Returns negatively affected by increasing illiquidity (as intuition suggests)
- Central bank haircuts fully reflected in market data
- Flight to quality
- Important implications
 - Long-term investors who reap a liquidity premium
 - Accomodate accounting standard setters demand for liquidity adjusted prices
 - Market-based approach for liquidity risk management

- Amihud, Y. (2002). Illiquidity and stock returns: cross-section and time-series effects, *Journal of Financial Markets* **5**(1): 31–56.
- Amihud, Y. and Mendelson, H. (1986). Asset pricing and the bid-ask spread, *Journal of Financial Economics* **17**(2): 223–249.
- Amihud, Y., Mendelson, H. and Pedersen, L. H. (2005). *Liquidity and Asset Prices*, now, Boston.
- Bao, J., Pan, J. and Wang, J. (2008). Liquidity of Corporate Bonds, *SSRN eLibrary* .
- Chen, L., Lesmond, D. A. and Wei, J. (2007). Corporate yield spreads and bond liquidity, *Journal of Finance* **62**(1): 119–149.
- Chordia, T., Sarkar, A. and Subrahmanyam, A. (2005). An empirical analysis of stock and bond market liquidity, *Review of Financial Studies* **18**(1): 85–129.
- De Jong, F. and Driessen, J. (2005). Liquidity Risk Premia in Corporate Bond Markets, *SSRN eLibrary* .
- Duffie, D. (1999). Credit Swap Valuation, *Financial Analyst Journal* pp. 73–87.
- ECB (ed.) (2008). *Outcome of the biennial review of the risk control measures in Eurosystem credit operations*.
- Edwards, A., Harris, L. and Piwowar, M. (2007). Corporate Bond Market Transparency and Transaction Costs, *Journal of Finance* **62**(3): 1421–51.
- Elton, E. J., Gruber, M. J., Agrawal, D. and Mann, C. (2001). Explaining the rate spread on corporate bonds, *Journal of Finance* **56**(1): 247 – 277.

- Goldstein, M., Hotchkiss, E. and Sirri, E. (2007). Transparency and Liquidity: A Controlled Experiment on Corporate Bonds, *Review of Financial Studies* **20**(2): 235.
- Huang, J.-Z. J. and Huang, M. (2003). How Much of Corporate-Treasury Yield Spread Is Due to Credit Risk?: A New Calibration Approach, *SSRN eLibrary*.
- Hull, J. C. and White, A. (2000). Valuing Credit Default Swaps I: No Counterparty Default Risk, *Journal of Derivatives* **8**: 29–40.
- Jarrow, R. (1978). The relationship between yield, risk, and return of corporate bonds, *Journal of Finance* **33**(4): 1235–1240.
- Korajczyk, R. A. and Sadka, R. (2008). Pricing the commonality across alternative measures of liquidity, *Journal of Financial Economics* **87**(1): 45–72.
- Longstaff, F. A., Mithal, S. and Neis, E. (2005). Corporate Yield Spreads: Default Risk or Liquidity? new Evidence from the Credit-Default Swap Market, *Journal of Finance* **60**(5): 2213–2253.
- Mahanti, S., Nashikkar, A., Subrahmanyam, M., Chacko, G. and Mallik, G. (2008). Latent liquidity: A new measure of liquidity, with an application to corporate bonds, *Journal of Financial Economics* **88**(2): 272–298.
- Martinez, M. A., Nieto, B., Rubio, G. and Tapia, M. (2005). Asset pricing and systematic liquidity risk: An empirical investigation of the spanish stock market, *International Review of Economics and Finance* **14**(1): 81–103.
- Nashikkar, A., Subrahmanyam, M. and Mahanti, S. (2007). Latent Liquidity and Corporate Bond Yield Spreads, *Technical report*.

- Pastor, L. and Stambaugh, R. F. (2003). Liquidity risk and expected stock returns, *Journal of Political Economy* **111**(3): 642–685.
- Sadka, R. (2006). Momentum and post-earnings-announcement drift anomalies: The role of liquidity risk, *Journal of Financial Economics* **80**(2): 309–349.