Demand for Crash Insurance, Intermediary Constraints, and Stock Returns

Hui Chen, Scott Joslin, Sophie Ni

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Options market and risk sharing

- Options market is huge (global exchange-traded derivatives market in 2012: $56 trillion notional).
- Does it play a role in facilitating risk sharing in the aggregate economy? Or is it just a "sideshow"?
  - **Deep out-of-the-money (OTM) puts on the market ⇒ crash insurance**
- What are the roles of financial intermediaries?
  - Sellers: agency (Lo 2001, Makarov and Plantin 2011, Malliaris and Yan 2011)
  - Buyers: if intermediaries themselves become constrained

Quantities are informative as well

When there is little trading in crash insurance, does it mean

- No one cares about crash risk?
- Everyone is constrained/worried and no one is willing to provide the insurance.

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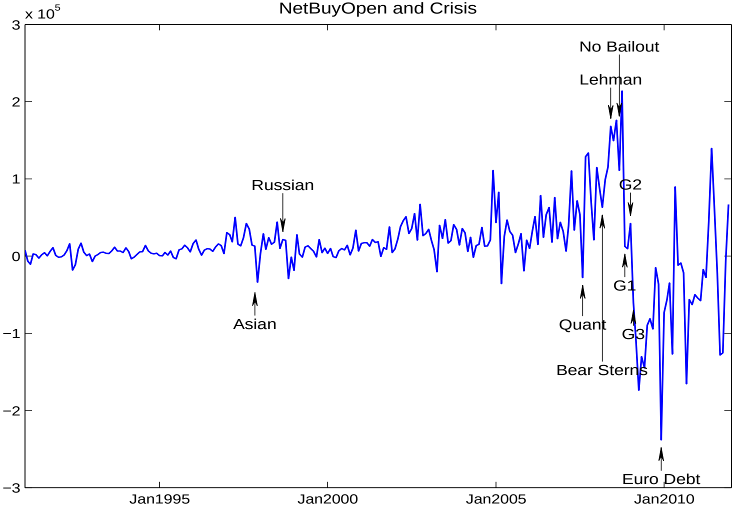
Options market and risk sharing



Public investors are net buyers of crash insurance on average, until the financial crisis.

Overview of results

- A model in which the risk-bearing capacity of dealers falls as crash risk rises.
  - Due to a tighter funding constraint or tighter VaR constraint.
  - As a result, equilibrium net public demand becomes informative about dealer constraints.
  - As crash risk rises $\Longrightarrow$ a negative relation between net public demand for crash insurance and market risk premium.
- Empirically, we find that public demand for deep OTM SPX put option predicts market return
  - NetBuyOpen $\Downarrow$ 1-STD $\Longrightarrow R_{t \to t+3m} \uparrow 3.6\%$, $R^2 = 18.4\%$
  - Distinct from other predictors: P/D, CAY, IVRV, Tail, ...
  - Unique for deep OTM puts
  - Low NetBuyOpen linked to deleveraging by broker-dealers

The model

Key feature

Quantity of crash insurance demanded by public is determined **endogenously**. When risk increases:

- Public demand curve shifts up;
- Market maker's supply curve shifts down due to constraint.

The net effect may be that in time of high crash risk (and high risk premium), equilibrium demand for crash insurance is low.

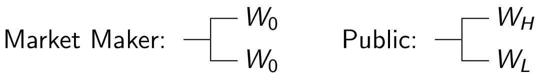
This is opposite to the demand pressure theory (Garleanu, Pedersen, Poteshman 2009):

- With risk averse market makers, **exogenous** demand pressure increases option prices.

A simple 2-period model

Two agents: pubic investor and market maker, who both have CRRA utility (relative risk aversion γ) over terminal wealth.

The public investor has background risk over a future random state, with state L occurring with probability λ.



The market maker sells insurance against state L to the public investor.

- Insurance pays off 1 unit of wealth in state L; price today: p; number of contracts traded: N.
- Riskfree rate is normalized to 0.

A simple 2-period model

We suppose that the market maker faces a Conditional Value-at-Risk constraint (CVaR):

$$\begin{aligned} ES_q &= \text{expected shortfall at level } q \\ &= E[\text{loss}|\text{being in worst } q\% \text{ tail}] \\ &= \frac{1}{q}\int_0^q VaR_\gamma d\gamma \\ &\leq \alpha_0 W_0 \end{aligned}$$

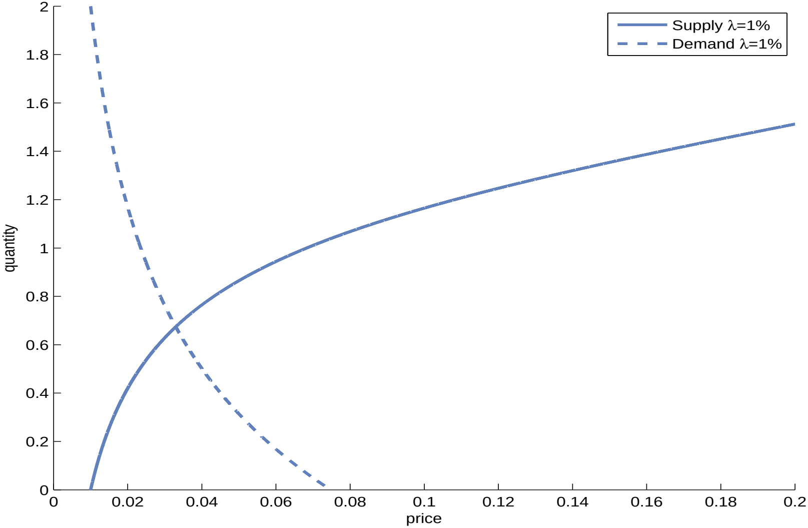
In this model:

$$ES_q = \frac{\lambda}{q}(1-p)N \quad \Rightarrow \quad \mathbf{N} \leq \frac{\mathbf{q}\alpha_\mathbf{0}\mathbf{W_0}}{\lambda(\mathbf{1}-\mathbf{p})}$$

Effect of CVaR constraint

As the amount of risk rises, this constraint binds so that the market maker provides less insurance. This is equivalent to having higher risk aversion when there is more risk.

A simple 2-period model



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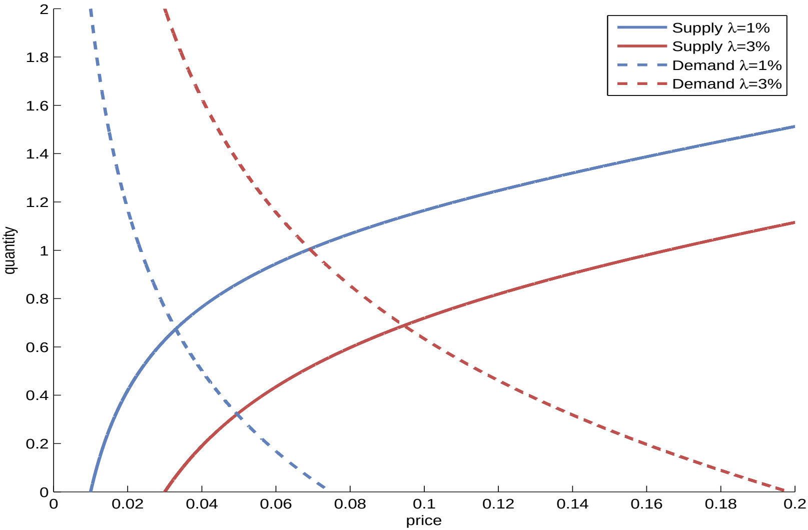

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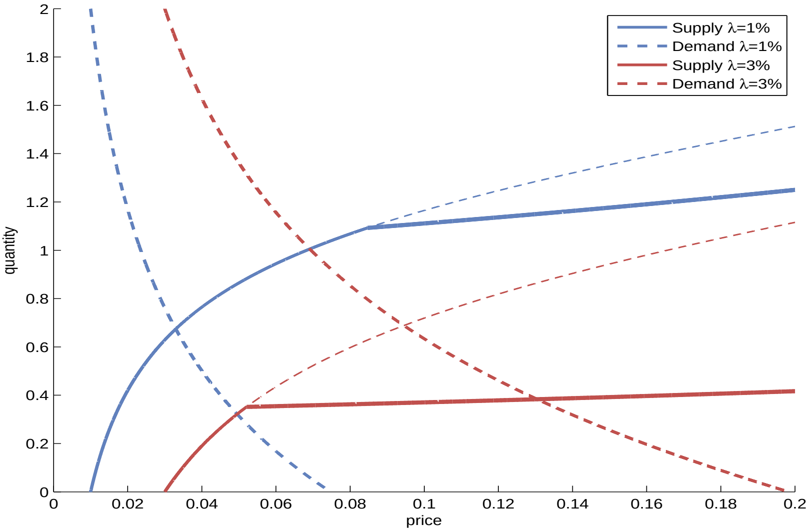


Data

We use options data obtained from the CBOE

- SPX options daily volume data January 1991 to December 2011
- CBOE separates option volumes into:
  - buy/sell transactions initiated by "public" and "firms"
  - open/close transactions

Consider monthly public demand for SPX puts with $K/S \leq 0.85$ (deep OTM):

$$\text{NetBuyOpen} = \text{OpenBuy} - \text{OpenSell}$$

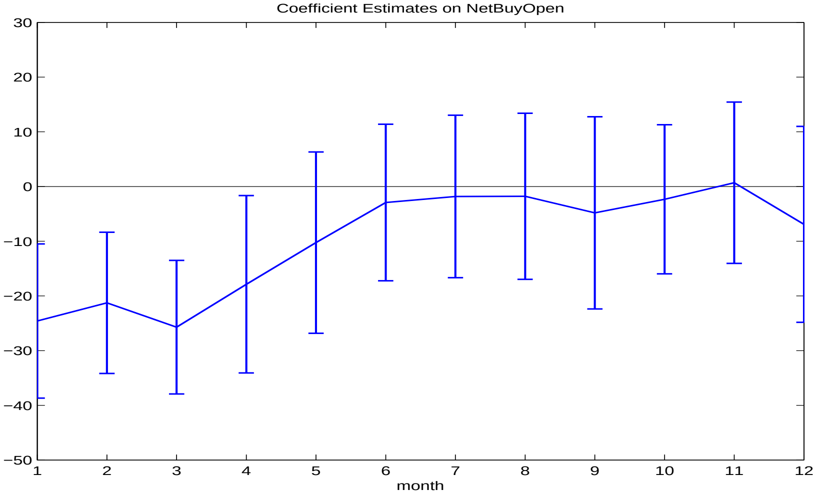
Return predictability

3-month market excess return ($Rm_{t \to t+3}$)

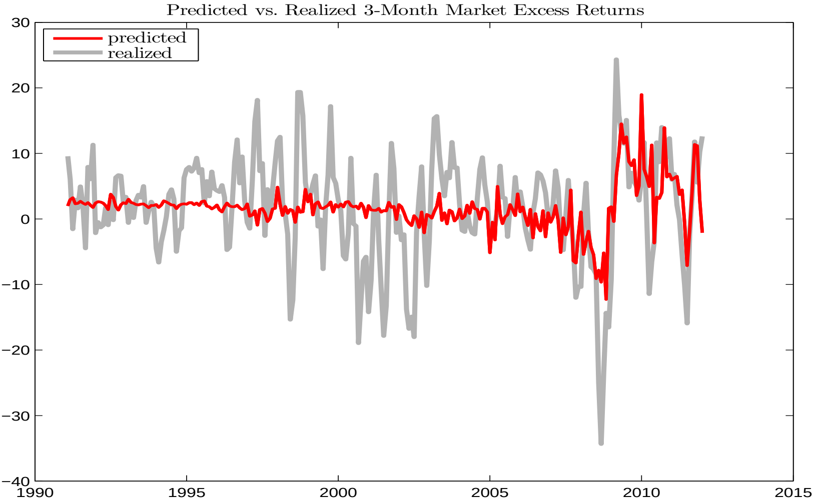
NetBuyOpen	-70.62					-55.57
	(-4.52)					(-2.78)
Open Interest		0.38				
		(0.41)				
IVRV			0.14			0.11
			(5.00)			(2.53)
P/E ratio				0.06		-0.05
				(1.10)		(-1.20)
Div Yield					244.14	189.22
					(2.10)	(1.75)
R^2	0.184	-0.003	0.119	0.010	0.030	0.243
Obs	252	252	252	252	252	252

IVRV: Variance premium (Bollerslev, Tauchen, and Zhou 2009)

Predictability at different horizons



Predicted returns



Predictability is unique for deep OTM puts

Moneyness	Puts	Calls
$K/S < 0.85$	-70.62 (-4.52)	52.18 (0.57)
$0.85 < K/S < 0.99$	-4.33 (-0.31)	5.29 (1.01)
$0.99 < K/S < 1.01$	-0.27 (-0.05)	-6.07 (-1.20)
$K/S > 1.01$	23.69 (1.12)	5.47 (1.04)

Is the information already in prices?

3-month market excess return ($Rm_{t \to t+3}$)

NetBuyOpen	-70.59	-68.36	-70.72	-68.31	-70.71	-62.75
	(-4.53)	(-4.03)	(-4.44)	(-4.49)	(-4.57)	(-4.18)
Tail	0.07					-1.09
	(0.10)					(-0.97)
Slope ($K/S < 0.85$) $- 0.85$		0.12				0.27
		(0.34)				(0.72)
Slope $0.85 - 0.90$			0.00			-0.19
			(0.01)			(-0.25)
Slope $0.90 - 0.95$				1.48		3.40
				(1.30)		(2.54)
Slope $0.95 - 1.0$					-0.65	-3.35
					(-0.46)	(-2.09)
R^2	0.180	0.189	0.188	0.202	0.190	0.213

Option demand and dealer leverage

NetBuyOpen

Model	1	2	3
ΔLeverage	0.0009 (5.72)	0.0010 (3.90)	0.0008 (2.65)
IVRV		-0.0007 (-2.14)	-0.0007 (-1.88)
Slope			-0.0017 (-1.92)
IP		0.0003 (1.42)	0.0008 (1.95)
Unemploy		-0.0055 (-2.01)	-0.0053 (-1.57)
Lag	0.7653 (10.37)	0.5572 (4.22)	0.4921 (3.53)
R^2	0.592	0.685	0.685
Obs	84	84	64

A real time measure of dealer constraint?

Quarterly market excess return (Rm_{t+1})

NetBuyOpen	-93.52			-79.38
	(-4.21)			(-3.29)
IVRV		0.24		0.19
		(4.52)		(3.29)
ΔLeverage			-8.41	-3.10
			(-2.89)	(-1.11)
DV				194.14
				(1.24)
CAY				20.98
				(0.48)
R^2	0.199	0.178	0.10	0.28
Obs	84	84	84	83

ΔLeverage: Adrian and Shin (2010)

Conclusion

- A model in which the equilibrium demand for crash insurance is informative about the dealers' risk sharing capacity.
- As a result, equilibrium public demand for crash insurance is negatively related to market returns when crash risk is high.
- Empirically, we find that public demand for deep OTM put option predicts future stock return negatively.
    - Periods of low demand correspond to deleveraging by dealers.
- Next step: Use equilibrium demand for crash insurance to measure the stress of financial intermediaries.
    - Compared to leverage: forward-looking, higher frequency
    - Unique information relative to price-based measures