Discussion of "Self-fulfilling Fire Sales: Fragility of Collateralised, Short-Term, Debt Markets," by J. C.-F. Kuong

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Coordination games

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- ▶ Schelling (1960).
- ▶ Bryant (1980), Diamond and Dybvig (1983)
- ▶ Cole and Kehoe (1996, 2000).
- ▶ Carlsson and van Damme (1990), Morris and Shin (1998), Burdzy, Frankel and Pauzner (2001).
- ▶ What is new in this paper: moral hazard and fire sales.
- ▶ The model is simple, but rich.
- ▶ It illustrates the role of pecuniary externalities in generating (a) inefficiency and (b) multiplicity of equilibria

A risk-shifting game

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- ▶ An entrepreneur needs one unit to invest in a project, which can be risky (R) or safe (S).
- ▶ A safe project yields a return X_S for sure; a risky project yields X_R with probability $0 < p < 1$ and nothing with probability $1 - p$.
- ▶ There are two (or more) potential investors for the project, who engage in Bertrand competition:
    - ▶ In the first stage, investors simultaneously offer contracts $(1, r)$, where 1 is the size of the loan and r is the interest rate.
    - ▶ At the second stage, the entrepreneur either (i) accepts an offer and chooses the type of project or (ii) rejects all offers.

Payoffs

- All agents are risk neutral and there is no discounting
- If the contract $(1, r)$ is accepted, the investor's payoff is

$$\begin{array}{ll} 1 + r & \text{if } S \text{ is chosen} \\ p(1 + r) & \text{if } R \text{ is chosen} \end{array};$$

the entrepreneur's payoff is

$$\begin{array}{ll} X_S - (1 + r) & \text{if } S \text{ is chosen} \\ p(X_R - (1 + r)) & \text{if } R \text{ is chosen} \end{array}.$$

- **Assumptions**:

$$X_R > X_S > 1,$$
$$pX_R < X_S.$$

Unique SPE outcome

Theorem

If

$$p\left(X_R - 1\right) < X_S - 1,$$

the game has unique subgame perfect equilibrium outcome in which the entrepreneur accepts the offer $(1,0)$ and chooses the safe project. The payoff to the investor is 1 and the payoff to the entrepreneur is $X_S - 1$.

Alternative game form

- In the first stage, the entrepreneur chooses the type of project he wants to have funded, unobserved by the investors.
- In the second stage, the investors simultaneously make offers to the entrepreneur.
- In the third stage, the entrepreneur either (i) accepts one of the offers or (ii) rejects all offers.
- The payoffs are as before.

Multiple SPE outcomes

Theorem
If

$$p\left(X_R - 1\right) < X_S - 1$$

and

$$p\left(X_R - \frac{1}{p}\right) > X_S - \frac{1}{p},$$

there are two subgame perfect outcomes. One is the same as the in the previous game. In the other, the entrepreneur chooses the risky project and the investors offer the contract $(1, r)$ such that $p\left(1 + r\right) = 1$.

Competitive equilibrium

- ▶ Suppose there is a continuum of entrepreneurs and investors.
- ▶ The number of investors is greater than the number of entrepreneurs.
- ▶ An equilibrium consists of an interest rate r, a decision by investors to supply one unit at that rate, a decision by entrepreneurs to borrow one unit at that rate and a decision about the type of contract.
- ▶ The equilibrium interest rate equates the demand and supply of loans (investors are indifferent).

Multiple CE outcomes

Theorem

If

$$p\left(X_R - 1\right) < X_S - 1$$

and

$$p\left(X_R - \frac{1}{p}\right) > X_S - \frac{1}{p},$$

there are two competitive equilibrium outcomes. In one, the interest rate is $r = 0$ and entrepreneurs choose the safe project. In the other, entrepreneurs choose the risky project and the market-clearing interest rate r satisfies $p\left(1 + r\right) = 1$.

Collateral

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▶ Suppose the entrepreneur has one unit of an asset that can be used as collateral for the loan. The asset is worth 1 to the entrepreneur and $\ell < 1$ to the investors.

▶ The use of collateral is inefficient, but it may make the safe project incentive compatible where it would not be without collateral.

▶ A contract is now a triple $(1, k, r)$.

Theorem
Under the maintained assumptions, there is a unique outcome if the investors move first, and two outcomes if entrepreneurs move first.

▶ If the risky project is chosen, it is optimal to set $k = 0$. If the safe project is chosen, the use of collateral is efficient.

Lessons learned

- Self-fulfilling expectations arise naturally in games with moral hazard: an expectation of risk-shifting causes lenders to demand higher nominal rates, which encourages risk shifting.
- But the multiplicity of equilibria is sensitive to the extensive form of the game: when lenders move first, they internalize the effect of low rates on risk taking, resulting in a unique equilibrium.
- In the present paper, firms are first movers: by choosing an incentive efficient contract, they in effect choose the equilibrium of the contracting game.
- Multiplicity of equilibria requires something else: fire sales in the asset market on which collateral is sold.

Fire sales

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- ▶ One does not need collateral to have fire sales.
- ▶ Shleifer and Vishny (1993), Allen and Gale (1994, 1998).
- ▶ Geanakoplos and Zame (2014), Geanakoplos (1997).
- ▶ Gale and Gottardi (2011, 2014).
- ▶ Dang, Gorton and Holmstrom (2014) argue adverse selection rather than moral hazard is the important feature of wholesale funding markets.
- ▶ When there are pecuniary externalities, inefficiency does not require multiplicity (Geanakoplos and Polemarchakis, 1986).
- ▶ Solutions include capital regulation, liquidity regulation, dealer of last resort.

Collateral and fire sales

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- ▶ There is a large number of firms and lenders, matched in pairs.
- ▶ Each firm chooses a contract $(1, r, k)$ to maximize its expected profit subject to participation and incentive constraints.
- ▶ The contract is incentive efficient, given the equilibrium in the market for collateral assets.
- ▶ The inefficiency and multiplicity of equilibrium arises from the pecuniary externality in the asset markets.
- ▶ Anticipating low asset prices, lenders demand high interest rates, and firms choose risky projects.
- ▶ Why don't firms simply offer more collateral? The use of collateral as an incentive has become more inefficient as the spread between valuations increases.

New approaches

- ▶ He and Xiong, "Dynamic Bank Runs."
    - ▶ overlapping generations of lenders.
    - ▶ value of firm follows Brownian motion.
    - ▶ liquidity guarantee may fail randomly.
    - ▶ inertia leads to unique equilibrium *à la* Burdzy, Frankel and Pauzner
    - ▶ option value of withdraw raises the cutoff of each cohort

- ▶ Tourre "Debt Runs and the Value of Liquidity Reserves"
    - ▶ adds liquid asset to the portfolio of each bank
    - ▶ assumes illiquid asset sold in fire sale
    - ▶ rollover boundary trades off liquidity and solvency

- ▶ Cf. Morris and Shin "The Liquidity Component of Insolvency"

Observations

- ▶ What stylized facts or moments of the data does the model fit?
- ▶ In most wholesale funding markets, the collateral and the "project" are *one and the same*.
- ▶ Interest rates were not very high during the years leading up to the financial crisis?
- ▶ Haircuts were adjusted ex post as prices fell or markets froze.
- ▶ Did lenders anticipate fire sales when the securities (repo, ABS, ABCP, SIVs, CDOs, etc.) were created or only afterwards?
- ▶ Why are we interested in multiplicity?
- ▶ Multiple equilibria are not necessary for inefficiency.
- ▶ And fire sales are neither necessary nor sufficient for multiplicity.