Risk-Taking Channel of Monetary Policy: A Global Game Approach

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“Participants also reviewed indicators of financial vulnerabilities that could pose risks to financial stability and the broader economy. These indicators generally suggested that such risks were moderate, in part because of the reduction in leverage and maturity transformation that has occurred in the financial sector since the onset of the financial crisis.”
Issues for Consideration

• Is the absence of leverage sufficient to disregard financial developments for monetary policy?

• What role for long-only investors?
  – Asset side: Vayanos and Woolley (2013)
  – Liabilities side: Chen, Goldstein, Jiang (2010)

• To what extent can micro- and macroprudential policies address financial market disruptions due to long-only investors?
Fund Flows

Figure 1

Total Net Flows, January 2008 - April 2013
Fund Flows

Source: Lipper
Monetary Policy and Risk Premiums

- Monetary policy working through shifts in risk premium
  - Hanson and Stein (2012), Gertler and Karadi (2013)

- How does risk premium depend on monetary policy?

- Why do we see abrupt jumps in risk premium to apparently small monetary shocks?
  - What is the amplification mechanism?
  - How does the answer depend on size of asset management sector?
  - Why do price changes and quantity changes reinforce each other?

- How does QE work?
Investors

- Asset managers
  - Risk-neutral, no subjective discounting
  - Rewarded with constant fraction of terminal asset value and consume only at terminal date
  - But suffers from “last place aversion”

- Households
  - Risk-averse, no subjective discounting
  - Consume only at terminal date
Long and Short Assets

• Long asset
  – Zero coupon bond that pays at terminal date
  – But payoff is risky due to credit risk or exchange rate risk
  – Expected terminal value $v$, variance $\sigma^2$
  – Total stock is $S$, of which asset managers hold $A$

• Short asset
  – Floating rate
  – Investors have precise information about rate over short interval of time, but not common knowledge
  – Supplied elastically by central bank
Benchmark Three Period Model

Trading date
- $p$ common knowledge;
- $r$ known but not common knowledge;
- Switching strategy around threshold $r$

$\bar{v}$ realized

$1 + r$

Figure 2. Time line for three period model
Last Place Aversion of Asset Managers

Penalty for being last (including equal last)

If fund manager FM is last and proportion \( x \) of fund managers has strictly higher portfolio values, then FM’s assets under management declines by factor of \( \phi x \).

In other words, if fund manager’s assets under management is \( a \), comes last and \( x \) has strictly higher portfolio value then the fund manager’s assets under management becomes

\[
a(1 - \phi x)
\]
Passive Traders with Mean-Variance Preferences

Households behave competitively from mean-variance preferences:

\[ U = vy - \frac{1}{2\tau}y^2\sigma^2 + (e - py) \]

\( y \) is long asset holding, \( e \) is endowment, \( \tau \) is risk tolerance

Summing across households, aggregate demand for long asset is

\[ p = v - \frac{\sigma^2}{\sum_h \tau_h} y \]
\[ = v - cy \]

where \( c = \frac{\sigma^2}{\sum_h \tau_h} \)
Figure 3. **Market clearing of the long asset.** The price of the long asset at date 1 is $p$. Asset managers hold $A$ units and households hold $S - A$ units.
Global Game

• Asset managers initially hold \( A \) units of long asset

• At date 1
  – Each asset manager observes a precise, but noisy signal of \( r \)
  – Based on signal of \( r \), allocates portfolio between long and short asset

• If proportion \( x \) sell the long asset,
  – Each seller is matched with household buyer
  – Asset manager \( i \) has equal chance of being placed in queue \([0, x]\)
  – Therefore, if \( x \) asset managers sell the long asset, the expected revenue from sale is
    \[
    p - \frac{1}{2} cx
    \]
  – Sale proceeds are held at floating rate \( r \)
Global Game Payoffs

Expected payoff from holding the long asset when proportion $x$ sell the long asset is

$$ u(x) = v (1 - \phi x) $$

Although asset manager is risk-neutral and has long horizon, the short-term friction from last place aversion generates element of short-termism.

Expected payoff from selling the long asset when proportion $x$ sell the long asset is

$$ w(x) = (1 + r) \left( p - \frac{1}{2} c x \right) $$

The payoff is the product of the expected proceeds from sale and return from floating rate $r$
Figure 4. Payoff functions from holding long-dated security and switching to floating rate
Global Game Solution

Payoff difference $u(x) - w(x)$ is monotonic in $x$, so that the global game is dominance solvable (Morris and Shin (2003))

There is unique threshold $r^*$ for the floating rate so that the unique (dominance solvable) equilibrium is of the form:

\[
\begin{aligned}
\text{Sell} & \quad \text{if } r > r^* \\
\text{Hold} & \quad \text{if } r \leq r^*
\end{aligned}
\]

At the switching point, players’ beliefs are “Laplacian” - hold uniform density over $x \in [0, 1]$
Laplacian Beliefs

We need an answer to:

“My signal is $\rho^*$. What is the probability that $x$ is less than $z$?” \(Q\)

Answer to \(Q\) gives the c.d.f of $x$ evaluated at $z$, denote by $G(z|\rho^*)$. 
Figure 5. Deriving the subjective distribution over $x$ at switching point $\rho^*$
Laplacian Beliefs

When the true interest rate is \( r \), the signals \( \{\rho_i\} \) are distributed uniformly over the interval \( [r - \varepsilon, r + \varepsilon] \). Investors with signals \( \rho_i > \rho^* \) are those who sell. Hence,

\[
x = \frac{r + \varepsilon - \rho^*}{2\varepsilon}
\]

When do we have \( x < z \)? This happens when \( r \) is low enough, so that the area under the density to the right of \( \rho^* \) is squeezed. There is a value of \( r \) at which \( x \) is precisely \( z \). This is when \( r = r_0 \), where

\[
\frac{r_0 + \varepsilon - \rho^*}{2\varepsilon} = z
\]

or

\[
r_0 = \rho^* - \varepsilon + 2\varepsilon z
\]

See the top panel of Figure 5. We have \( x < z \) if and only if \( r < r_0 \). We
need the probability of $r < r_0$ conditional on $\rho^*$.

Player $i$’s posterior density over $r$ conditional on $\rho^*$ is uniform over $[\rho^* - \varepsilon, \rho^* + \varepsilon]$, as in the lower panel of Figure 5. Probability that $r < r_0$ is then the area under the density to the left of $r_0$, which is

$$\frac{r_0 - (\rho^* - \varepsilon)}{2\varepsilon} = \frac{(\rho^* - \varepsilon + 2\varepsilon z) - (\rho^* - \varepsilon)}{2\varepsilon} = z$$

Thus, the probability that $x < z$ conditional on $\rho^*$ is exactly $z$. $G(z|\rho^*) = z$ and density over $x$ is uniform. For any sequence $(\varepsilon_n)$ where $\varepsilon_n \to 0$, the density over $x$ is uniform.
Global Game Solution

Given linearity of $u(.)$ and $w(.)$, the switching point $r^*$ satisfies

$$u\left(\frac{1}{2}\right) = w\left(\frac{1}{2}\right)$$

Or

$$v\left(1 - \phi \cdot \frac{1}{2}\right) = (1 + r^*) \left( p - \frac{1}{2}c \cdot \frac{1}{2}A \right)$$

Therefore

$$1 + r^* = \frac{v\left(1 - \phi/2\right)}{p - \frac{1}{4}cA}$$

$$= \frac{v\left(1 - \phi/2\right)}{v - cS + \frac{3}{4}cA}$$

(5)
Critical Risk Premium

Although asset managers are risk-neutral, the risk premium does not get driven down to zero due to the friction of last-place aversion.

At switching point $r^*$, the risk premium at which asset managers switch from holding the long asset to selling the long asset comes from (5)

$$\text{Critical risk premium} = \left. \frac{v}{p} \right|_{r^*} = \left( \frac{1 - \frac{1}{4} [v - cS] + cA}{\frac{\phi}{1 - \frac{2}{2}}} \right) (1 + r^*)$$

Asset manager foregoes a risk-premium due to last place aversion.

Critical risk premium is increasing in last place aversion $\phi$. 
Feasible Size of Asset Management Sector

In order for the asset managers to be content to hold the long asset, the holding of the asset management sector cannot be too large.

If asset managers hold the long asset

\[ 1 + r < 1 + r^* = \frac{v (1 - \phi/2)}{v - cS + \frac{3}{4} cA} \]

Solving for \( A \),

\[ A < \frac{4}{3c} \left( \frac{v (1 - \phi/2)}{1 + r} - v + cS \right) \]

There is a negative relationship between feasible \( A \) and interest rate \( r \).
Figure 6. Risk premium and critical threshold $r^*$ as a function of the size of asset management sector.
Multi-Period Model

- Time indexed by $\{0, 1, 2, \cdots, T, T + 1\}$

- $T + 1$ is terminal date (interpreted as “long run”)
  - Long asset is zero coupon bond with terminal payment, expected value of payment is $v$
  - Late resolution of uncertainty; uncertainty in long asset payoff resolved between $T$ and $T + 1$

- Asset managers and mean-variance households
  - Both groups consumer only at $T + 1$
  - Neither discounts the future
  - Asset manager risk-neutral but with last place aversion
- \( T \) trading periods \( \{1, 2, \cdots, T\} \)
  - Asset manager chooses between holding long asset or short asset
  - Short asset is floating rate \( r_t \)
  - Asset managers have precise information on \( r_t \) but not common knowledge

In multi-period model, selling and then buying back the long asset is new feature

Buying back the long asset entails “riding back up” the demand curve of the household, which acts as a supply curve for the long asset

Interest rate shocks then have persistent impact; at the higher interest rate \( r \), feasible asset management sector holding \( A \) is lower
Multi-Period Model

\( W_t(x_t) \) is value function for an asset manager who sells the risky bond holding at date \( t \) when proportion \( x_t \) of asset managers sell.

Expected proceed is \( p_t - \frac{1}{2}cx_tA_t \), which earns the floating rate \( 1 + r_t \) between dates \( t \) and \( t + 1 \).

At date \( t + 1 \), asset managers who sold in the previous period buy back the risky bond by “riding back up” the household demand curve.

\[
W_t(x_t) = \int_{p_t - \frac{1}{2}cA_{t+1}}^{p_{t+1}} \frac{v}{q} (1 + r_t) \left( p_t - \frac{1}{2}cx_tA_t \right) dq
\]

\[
= (1 + r_t) \left( p_t - \frac{1}{2}cx_tA_t \right) \cdot v \ln \left( \frac{p_{t+1}}{p_{t+1} - \frac{1}{2}cA_{t+1}} \right)
\]  

(6)
Value function at date $t$ of an asset manager who holds the risky bond when proportion $x_t$ sell the risky bond is identical to that in the three period model and is given by

$$V_t (x_t) = v (1 - \phi x_t) \quad (7)$$

Laplacian beliefs at $r_t^*$ imply

$$V_t \left( \frac{1}{2} \right) = W_t \left( \frac{1}{2} \right) \quad (8)$$

so $r_t^*$ satisfies:

$$1 + r_t^* = \frac{1 - \frac{\phi}{2}}{\left( p_t - \frac{1}{4}cA_t \right) \ln \left( \frac{p_{t+1}}{p_{t+1} - \frac{1}{2}cA_{t+1}} \right)} \quad (9)$$
Figure 7. Persistent impact of increase in interest rate above threshold $r^*$
Implications for Monetary Policy

- Monetary policy has impact on risk premiums
  - Risk premium can jump abruptly with small monetary shock

- Quantities matter
  - Asset management sector size interacts with monetary policy
  - QE can absorb supply and allow asset management sector to grow; but exit may be painful
  - With free entry, asset management sector always grows until it reaches the knife-edge size $A^*$
  - With endogenous $A$, the economy always positions itself at the knife-edge point whereby even a small tightening shock to monetary policy entails big sell-offs and jumps in risk premiums
Empirical Implications

- Asset manager holdings and price changes move in an amplifying direction
  - Sell-offs are larger when asset manager positions have grown for longer
- Sales and price falls go together
- Evidence from VAR exercises