A Theory of Blind Trading

Cyril Monnet\textsuperscript{1} and Erwan Quintin\textsuperscript{2}

\textsuperscript{1}University of Bern and Study Center Gerzensee
\textsuperscript{2}Wisconsin School of Business

June 21, 2014
Motivation

- Opacity is ubiquitous in financial markets, often by design.
- This suggests that opacity plays an essential role.
- What fundamental frictions does opacity help mitigate?
- We propose a simple answer:
  1. Expert investors are needed to address moral hazard issues.
  2. But it is costly to produce experts, so it is optimal to economize on their number.
  4. Opacity mitigates that problem.
- Put another way, transparent markets would feature a suboptimal fraction of unsophisticated investors.
The market for Mortgage Pass-Through Securities

- Most agency MBS’ are issued in TBA markets (see Vickery, 2013)
- Investors buy pools before they exist with the GSE having only committed to a few pool-wide characteristics
- The market also features a “specified market” where existing pools with favorable characteristics are sold
- In other words, primary MBS markets feature an opaque end and a more transparent end
- The more transparent market features investors that can process finer pool information
- This creates a “cheapest-to-deliver” problem
Literature

▶ Dang, Holmstrom and Gorton (2012), Andolfatto, Berentsen and Waller (2012), Monnet and Quintin (2014)
▶ Rock (1986), Pagano and Volpin (2012)
▶ Di Maggio and Pagano (2014)
The model

- $t = 0, 1$, one good
- Mass one of investors with one unit of good at $t = 0$
- They can store any fraction of that endowment at a zero net return
- Large mass of prospectors with no endowment characterized by a prospection cost $k_0 \sim H$
- Provided they incur an additional diligence/effort cost $k$, the project yields payoff $r > 0$ at date 1 with probability $\lambda \sim F$
- We assume
  \[ \int \lambda r dF > k \]
  but
  \[ H \left( \int \lambda r dF - k \right) \int \lambda r dF < 1 \]
Informed investors

- Investors can become experts at a utility cost $\gamma$
- They can see and interpret project types ($\lambda$)
- Uninformed investors can’t learn from expert bids
- Formally, we assume that prospectors meet non-experts first, then they meet expert investors
Consider a planner who wants to maximize total welfare by choosing:

1. How many prospectors to activate (\(\Leftrightarrow\) a threshold \(\overline{k}_0\))
2. A fraction \(\mu\) of investors to inform
3. Consumption profiles: \(c^u \geq 0\), \(c^i \geq 0\) and \(c^p \geq 0\)
4. Storage amounts: \(s^u\), \(s^i\)

Assume the planner can observe whether prospectors bore the effort cost \(k\) . . .

. . . but does observe prospector types
First-best

\[
\max \ (1 - \mu)c^u + \mu(c^i - \gamma) + \int_{0}^{\bar{k}_0} (c^p - k_0 - k)dH(k)
\]

subject to:

\[
\int_{0}^{\bar{k}_0} c^p dH(k_0) + (1 - \mu)s^u + \mu s^i \leq 1 \quad (1)
\]

\[
c^i - \gamma, c^u \geq 1 \quad (2)
\]

\[
(1 - \mu)(c^u - s^u) + \mu(c^i - s^i) = H(\bar{k}_0) \int \lambda r dF \quad (3)
\]
No need for experts at the first-best

Proposition

The first best allocation satisfies $\mu = 0$, $s^u = 1 - H(k^*_0)(k^*_0 + k)$, $c^u = 1$, and $c^p = k + k^*_0$ where

$$\int \lambda r dF = k^*_0 + k.$$
Assume that effort is private information.

Now the planner needs a positive mass of informed agents.

Informed agents can make $\lambda$–dependent transfers, $q^i(\lambda)$, while other agents only make blind transfers $q^u$ to active prospectors.

IC requires

$$\int c^p(\lambda) dF - k - k_0 \geq c^p(0) - k_0$$

Feasibility requires

$$H(\bar{k}_0) q^u \leq (1 - \mu)(1 - s^u)$$

and

$$H(\bar{k}_0) \int q^i(\lambda) dF \leq \mu(1 - s^i).$$
Proposition

With unobservable effort, the optimal allocation satisfies 
\[ \mu = kH(\bar{k}_0), \ s^i = 0, \text{ where } \bar{k}_0 \text{ solves} \]

\[ \int \lambda r dF = \bar{k}_0 + k + \gamma k. \]
Two Walrasian markets

All investors can participate in the first one, only informed investors participate in the second one

Projects sell for $p^u$ on uninformed market, $p^i(\lambda)$ on informed market

Let $V(\lambda) = \max [p_u, p^i(\lambda)]$

Active prospectors exert effort provided

$$\int V(\lambda)dF(\lambda) - k \geq p_u$$

Prospectors become active provided

$$\max \left\{ \int V(\lambda)dF(\lambda) - k, p_u \right\} \geq k_0$$
Uninformed investors form expectations about the set $\Lambda_u$ of projects sold in the first market.

In equilibrium, $\Lambda_u = \{\lambda : p_u \geq p_i(\lambda)\}$.

Then uninformed investors solve

$$V_u = \max_{s^u \in [0,1]} s^u + \theta^u \int_{\Lambda_u} \lambda r \frac{dF(\lambda)}{F(\Lambda_u)}$$

subject to

$$1 - s^u = \theta^u p_u.$$
Informed investors

- Informed agents solve the following problem

\[ V_i = \max_{s^i, \theta^i(\lambda)} s^i + \int_{\Lambda_i} \theta^i(\lambda) \lambda r d\lambda \]

subject to

\[ 1 - s^i = \int_{\Lambda_i} \theta^i(\lambda) p_i(\lambda) d\lambda. \]
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subject to

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- In any equilibrium, on \( \Lambda_i \),

\[ \frac{\lambda r}{p_i(\lambda)} \equiv R_i. \]
Informed investors

- Informed agents solve the following problem

\[
V_i = \max_{s^i, \theta^i(\lambda)} s^i + \int_{\Lambda_i} \theta^i(\lambda) \lambda r d\lambda
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subject to

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\]

- In any equilibrium, on \( \Lambda_i \),

\[
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\]

- Since investors can choose whether to become informed, \( \mu \in (0, 1) \) if and only if

\[
V_i - \gamma = V_u
\]
A market equilibrium is a set of beliefs and strategies for all agents such all agents behave optimally and beliefs are borne out.
Market equilibrium

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Remark

1. A market equilibrium where all investors are informed always exists
2. A market equilibrium with both types of investors may exist
3. No market equilibrium with only uninformed agents exists
Markets vs. second-best

Lemma

In any equilibrium where a positive mass of projects is activated, prices are given by

\[ p_u \geq E(\lambda|\lambda \in \Lambda_u)r \text{ and } R_i = \frac{\lambda r}{p_i(\lambda)} = 1 + \gamma \text{ for all } \lambda \in \Lambda_i. \]

Furthermore, \( p_u = E(\lambda|\lambda \in \Lambda_u)r \) whenever \( s_u < 1 \).
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Furthermore, \( p_u = E(\lambda | \lambda \in \Lambda_u)r \) whenever \( s_u < 1 \).

Proposition

At a market equilibrium, fewer projects are activated and the ratio of informed to uninformed is higher than at the second best.
In an equilibrium with both types of investors, a threshold $\tilde{\lambda}^M$ exists with

$$E(\lambda|\lambda \leq \tilde{\lambda}^M)r = \frac{\tilde{\lambda}^M r}{1 + \gamma}$$
Intuition

\[
\int_0^{\tilde{\lambda}^M} E(\lambda|\lambda \leq \tilde{\lambda}^M) \, rdF + \int_{\tilde{\lambda}^M}^1 \frac{\lambda r}{1 + \gamma} \, dF = k_0^M + k.
\]
Intuition

\[
\int_{0}^{\tilde{\lambda}^M} E(\lambda | \lambda \leq \tilde{\lambda}^M) \, dF + \int_{\tilde{\lambda}^M}^{1} \frac{\lambda r}{1 + \gamma} \, dF = k_0^M + k.
\]

But

\[
\int_{0}^{\tilde{\lambda}^M} E(\lambda | \lambda \leq \tilde{\lambda}^M) \, dF + \int_{\tilde{\lambda}^M}^{1} \frac{\lambda r}{1 + \gamma} \, dF = \int \lambda r \, dF - \int_{\tilde{\lambda}^M}^{1} \frac{\gamma \lambda r}{1 + \gamma} \, dF
\]
Intuition

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\int_0^{\bar{\lambda}^M} E(\lambda|\lambda \leq \bar{\lambda}^M) \, rdF + \int_{\bar{\lambda}^M}^1 \frac{\lambda r}{1 + \gamma} \, dF = k_0^M + k.
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\]

and

\[
\int_{\bar{\lambda}^M}^1 \left( \frac{\lambda r}{1 + \gamma} - E(\lambda|\lambda \leq \bar{\lambda}^M) r \right) \, dF \geq k.
\]
Intuition

\[ \int_0^{\tilde{\lambda}^M} E(\lambda|\lambda \leq \tilde{\lambda}^M) r dF + \int_{\tilde{\lambda}^M}^1 \frac{\lambda r}{1 + \gamma} dF = k_0^M + k. \]

But \[ \int_0^{\tilde{\lambda}^M} E(\lambda|\lambda \leq \tilde{\lambda}^M) r dF + \int_{\tilde{\lambda}^M}^1 \frac{\lambda r}{1 + \gamma} dF = \int \lambda rdF - \int_{\tilde{\lambda}^M}^1 \frac{\gamma \lambda r}{1 + \gamma} dF \]

and \[ \int_{\tilde{\lambda}^M}^1 \left( \frac{\lambda r}{1 + \gamma} - E(\lambda|\lambda \leq \tilde{\lambda}^M)r \right) dF \geq k. \]

so \[ \int_{\tilde{\lambda}^M}^1 \frac{\gamma \lambda r}{1 + \gamma} dF > k\gamma. \]
Intuition

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\int_0^{\tilde{\lambda}^M} E(\lambda|\lambda \leq \tilde{\lambda}^M)rdF + \int_{\tilde{\lambda}^M}^1 \frac{\lambda r}{1 + \gamma}dF = k_0^M + k.
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so

\[
\int_{\tilde{\lambda}^M}^1 \frac{\gamma \lambda r}{1 + \gamma}dF > k\gamma.
\]

hence

\[
\int \lambda rdF > k_0^M + k(1 + \gamma).
\]
Intuition

\[
\int_{0}^{\bar{\lambda}^M} E(\lambda | \lambda \leq \bar{\lambda}^M) r dF + \int_{\bar{\lambda}^M}^{1} \frac{\lambda r}{1 + \gamma} dF = k_0^M + k.
\]

But

\[
\int_{0}^{\bar{\lambda}^M} E(\lambda | \lambda \leq \bar{\lambda}^M) r dF + \int_{\bar{\lambda}^M}^{1} \frac{\lambda r}{1 + \gamma} dF = \int \lambda r dF - \int_{\bar{\lambda}^M}^{1} \frac{\gamma \lambda r}{1 + \gamma} dF
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and

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\int_{\bar{\lambda}^M}^{1} \left( \frac{\lambda r}{1 + \gamma} - E(\lambda | \lambda \leq \bar{\lambda}^M) r \right) dF \geq k.
\]

so

\[
\int_{\bar{\lambda}^M}^{1} \frac{\gamma \lambda r}{1 + \gamma} dF > k\gamma.
\]

hence

\[
\int \lambda r dF > k_0^M + k(1 + \gamma).
\]

whereas

\[
\int \lambda r dF = k_0^{SB} + k(1 + \gamma).
\]
Optimal opacity

- Assume that the planner can set up a technology that sends a public message $m$ once $\lambda$ is realized.
- The planner can choose any message function in the following set:

$$\{ m : [0, 1] \mapsto B([0, 1]) : \lambda \in m(\lambda) \text{ for almost all } \lambda \in [0, 1] \}$$
Optimal opacity

- Assume that the planner can set up a technology that sends a public message \( m \) once \( \lambda \) is realized.
- The planner can choose any message function in the following set:

\[
\{ m : [0, 1] \mapsto B([0, 1]) : \lambda \in m(\lambda) \text{ for almost all } \lambda \in [0, 1]\}
\]

**Proposition**

The optimal message function is binary and partitions the set of types in two subsets \( \Lambda^*_u = [0, \lambda^B] \) and \( \Lambda^*_i = [\lambda^B, 1] \) where

\[
\int_{\lambda^B}^{\lambda^B} \left( \frac{\lambda r}{1 + \gamma} - E(\lambda|\lambda \leq \lambda^B) \right) dF = k.
\]

Projects in \( \Lambda^*_u \) are sold to uninformed investors while projects in \( \Lambda^*_i \) are sold to informed investors.
Key consequences

With opacity:

1. An equilibrium with both types of investors always exists
2. Welfare can only improve . . .
3. . . . and generally does
Implementation

- Implementation by delegation: ex-post agency conflicts
- Implementation via forward markets
Testable implications vs. IPO markets

1. IPOs tend to be “underpriced”
2. IPOs that feature more representation from institutional investors tend to be more underpriced and institutional investors earn higher returns on IPOs than do retail investors
3. Underpricing rises with “valuation uncertainty.”
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Our model’s distinguishing prediction:

- More information should cause the fraction of experts to go up, hence average underpricing to rise
Financial markets naturally feature a juxtaposition of expert and non-expert investors...
which makes opacity essential
Imposing transparency, in our model, is a bad idea