DYNAMIC INCENTIVES FOR BUY-SIDE ANALYSTS

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August 2019
Analyst research plays an important role in modern capital markets.

Analysts obtain information from public records, corporate filings, and other sources.

Institutions and investors rely on this research to aid in investment decisions.

Our goal is to try to understand some of the incentives at play in these environments.
**MOTIVATION**

We focus on **buy-side analysts** that gather and provide information to **fund managers** for their *exclusive* use within the firm.

Fund managers rely on these analysts for investment ideas, advice, and recommendations.

These buy-side analysts differ in their ability and access to information.

They behave strategically to enhance the **perception** of their ability.

⇒ The manager may be operating on biased or misleading advice!

How should a fund manager incentivize analysts and maximize fund profits?

1. In the short term ⇔ maximize the value of information.
2. In the long term ⇔ maximize the human capital of her fund.

BASIC MODEL: ENVIRONMENT

Players:
▶ Single principal (fund manager) and single agent (analyst).

Horizon:
▶ Principal commits to a retention/promotion policy (no transfers).
▶ Analyst observes and communicates information over $T$ periods.
▶ An event is publicly realized in period $T + 1$, and the principal implements policy.

State:
▶ Persistent state of the world $\omega \in \Omega$, $|\Omega| = n$; each state is equally likely.

Outcome:
▶ A public outcome $r \in \Omega$ is realized in period $T + 1$.
▶ The outcome is noisy but informative: $\Pr(r | \omega) = \begin{cases} \gamma & \text{if } r = \omega, \\ \frac{1-\gamma}{n-1} & \text{if } r \neq \omega. \end{cases}$

BASIC MODEL: AGENT

Types:
- Analyst’s private type $\theta \in \{h, l\}$.
- Both types are equally likely.

Signals:
- At each $t \leq T$, agent privately observes a signal $s_t \in S := \Omega \cup \{\phi\}$.
- Learning is an “all-or-nothing” Bernoulli arrival process:
  $$\Pr(s_t \mid \omega, s_{t-1}) = \begin{cases} 
  1 & \text{if } s_t = \omega \text{ and } s_{t-1} = \omega, \\
  \alpha_\theta & \text{if } s_t = \omega \text{ and } s_{t-1} \neq \omega, \\
  1 - \alpha_\theta & \text{if } s_t = \phi \text{ and } s_{t-1} \neq \omega, \\
  0 & \text{otherwise.}
\end{cases}$$
- The high type is a faster learner: $0 < \alpha_l < \alpha_h < 1$.

BASIC MODEL: PREFERENCES

Agent’s preferences:
- The analyst has reputationally motivated career concerns.
- Her payoff is $\begin{cases} 1 & \text{if retained/promoted}, \\ 0 & \text{otherwise}. \end{cases}$

Principal’s preferences:
- The fund manager has dual concerns $\Pi(V, W)$, increasing in both.
- Ex post value of information (i.e., “trading profits”) is $V(\pi_1, \ldots, \pi_T, r)$, where $\pi_t$ is the period-$t$ belief about $\omega$.
- Value of human capital is $W :\begin{cases} 1 & \text{if type } h \text{ is retained}, \\ -1 & \text{if type } l \text{ is retained}, \\ 0 & \text{otherwise}. \end{cases}$
TWO CRITICAL ASSUMPTIONS

1. Analyst cares only about probability of retention/promotion; no transfers.
   ▶ Evidence shows substantial heterogeneity in the use of high-powered incentives; concentrated at the top end of the tenure/fund hierarchy.
   ▶ Compensation driven primarily by promotions (eventually to fund manager).
   ▶ Also: “skin in the game” only makes things easier for the manager.

2. Analyst ability is reflected in speed (and not quality) of learning.
   ▶ “Analysts exhibit heterogeneous skill—some are high-type, and some are low-type.... The heterogeneity stems from differential ability to produce new information.” (Crane and Crotty, forthcoming JF)
   ▶ That said, differential quality of information may be natural. See Deb-Pai-Said (2018) for difficulties with high-dimensional state spaces.
In our setting, a *direct mechanism* is a policy \( X(\tilde{\theta}, \tilde{s}^T, r) \in [0, 1] \).

- The agent reports a private type \( \tilde{\theta} \) at time 0.
- She then reports a signal \( \tilde{s}_t \) at each \( t \).
- The public outcome \( r \) is realized at \( T + 1 \).

The revelation principle applies, so the principal can do no better than the payoff she gets from an optimal *incentive compatible* direct mechanism.

- Agent must be incentivized to report all private information truthfully.
- It requires an agent to truthfully report that she is unskilled!
In our employment/organizational setting, this is *prima facie* impractical.

- Even if the commitment to promote a self-admitted low-skill type was credible, managers talk to each other and to research firms.
- External reputational hit is a costly impediment to career mobility.
- May also face legal/regulatory prohibitions (e.g., EEO).

We therefore assume the fund manager’s contracting/commitment power is limited.

- We rule out the use of full direct revelation mechanisms.
- Instead we focus on a class of “indirect” contracts.
- Key restriction: the manager does not solicit information about types.
At each $t = 1, \ldots, T$, the agent sends a message $\tilde{s}_t \in S$.

**Agent histories:** The set of agent histories is $\mathcal{H}^A = \bigcup_{t=1}^{T} S^t \times S^{t-1}$. A typical period-$t$ element is $h^A_t = (s^t, \tilde{s}^{t-1})$.

**Principal histories:** The set of relevant public histories is $\mathcal{H}^P = S^T \times \Omega$. A typical element is $h^P = (\tilde{s}^T, r)$.

**Agent’s strategy:** $\sigma^\theta : \mathcal{H}^A \to \Delta(S)$ determines the distribution of messages at each history.

**Principal’s strategy:** $\chi(\tilde{s}^T, r) \in [0, 1]$ is the decision to retain/promote the agent (or not).

- The principal fully commits to $\chi$.
- We explicitly consider stochastic mechanisms.
RECAP

Principal commits to retention policy \( \chi(\tilde{s}^T, r) \in [0, 1] \);

Nature draws state \( \omega \in \Omega \);
Agent learns type \( \theta \in \{h, l\} \);

Agent observes private signal \( s_1 \in S \) and reports \( \tilde{s}_1 \in S \);

Outcome \( r \in \Omega \) publicly realized;
Policy \( \chi(\tilde{s}^T, r) \) implemented; payoffs realized.

MAIN QUESTIONS OF INTEREST

How much information can the principal elicit?

How much screening is possible?

What exactly is the tradeoff between learning and screening?

What does the optimal mechanism look like?
With a nonstrategic analyst, the principal uses a deterministic test that relies only on speed.

- But with a strategic analyst, rewarding speed alone is not optimal.
- It is too easy to “manufacture” information.

Instead, the principal screens using accuracy, with stochastic penalties for slow learning.

Despite not using a DRM, the principal can induce the analyst to immediately and truthfully reveal all signals.

The principal provides incentives for reporting no learning, and also for providing risky or contrarian advice.

Forecasters: Ottaviani-Sørensen (2006a,b,c), Marinovic-Ottaviani-Sørensen (2013).


Dynamic mechanism design: Battaglini (2005), Pavan-Segal-Toikka (2014).

Consider the “first-best” benchmark where the agent’s signals are public.

- No private information about the state $\implies$ retention decision is decoupled from portfolio decision.
- Principal can maximize $V$ without worrying about incentives.
- And principal can maximize $W$ without worrying about information.
- Therefore, principal’s payoff is $\Pi^{FB} := \Pi(V^{FB}, W^{FB})$.

The measure of type separation for any retention rule $\chi$ is

$$W = \sum_{r \in \Omega} \sum_{s^T \in S^T} \Pr(r, s^T) \chi(s^T, r) \left[ \Pr(\theta = h \mid r, s^T) - \Pr(\theta = l \mid r, s^T) \right]$$

$$= \frac{1}{2} \sum_{r \in \Omega} \sum_{s^T \in S^T} \left[ \Pr(r, s^T \mid \theta = h) - \Pr(r, s^T \mid \theta = l) \right] \chi(s^T, r).$$

In the public signal benchmark, the optimal retention policy $\chi^{FB}$ is characterized by a cutoff $\bar{k} := 1 + \ln \left( \frac{\alpha_h}{\alpha_l} \right) / \ln \left( \frac{1-\alpha_l}{1-\alpha_h} \right)$ such that the analyst is retained if, and only if, an informative signal arrives in some period $t \leq \bar{k}$.

The first-best screens purely on the speed of learning:

- Only the arrival time of the first informative signal (if any) matters.
- There is no benefit to randomization.
- The analyst is not penalized for events out of her control.
- But she is never retained/promoted if information doesn’t arrive.
Now suppose signals are privately observed by the agent.

The principal cannot achieve first-best separation $W^{FB}$:

- Suppose the principal commits to $\chi^{FB}$.
- The agent can guarantee retention by “guessing” and reporting the arrival of an arbitrary informative signal in any period $t \leq \bar{k}$.
- This also has a negative impact on the fund’s trading profits $V$.

But the principal can achieve first-best value of information $V^{FB}$:

- Suppose the principal commits to $\chi(\tilde{s}^T, r) = 0$.
- Truthful reporting is a (trivial) best-response for the agent.
- But this essentially gives up on any sort of screening.
The fund manager’s expected payoff from the optimal mechanism is

$$\Pi^* := \max_X \{ \Pi(V, W) \} = \Pi(V^{FB}, W^*), \text{ where } W^* := \max_{X \in DRM} \{ W \}$$

is the maximal separation of types possible using direct mechanisms.

Despite not being able to use a direct mechanism:

- The principal’s ability to separate types is unaffected.
- She elicits exactly as much information as when signals are public.

Note: for many (but not all) natural $V$, $\Pi^* = \max_{X \in DRM} \{ \Pi(V, W) \}$. 

SEPARATING TYPES

Why can the principal achieve $W^*$ without a DRM?

Lemma

For any incentive compatible direct mechanism $X(\theta, s^T, r)$, there is an indirect mechanism $\chi(s^T, r)$ such that:

1. the separation $W$ generated by $\chi$ is (weakly) greater than from $X$;
2. the type-$h$ agent has an incentive to report her signals truthfully; and
3. the type-$l$ agent is free to misreport optimally.

Proof.

$\blacktriangleleft$

$X$ is a menu with one option for $h$ and one for $l$; $\chi(s^T, r) := X(h, s^T, r)$ forces both types into $h$’s option.

IC $\implies l$ prefers “her” option, so forcing a misreport decreases $l$’s payoff.

But $W$ is simply $\Pr(\text{retain} | \theta = h) - \Pr(\text{retain} | \theta = l)$.

$\blacksquare$

SEPARATING TYPES

So to achieve $W^*$ without DRM\(s\), the principal needs to ensure IC for type $h$.

Three types of IC constraints:

(NM) No misreporting once the state is known.
(ND) No delay once the state is known.
(NG) No guessing the state if it still unknown.

Both (NM) and (ND) are type-independent:

- If they are satisfied for type $h$ $\implies$ they are satisfied for type $l$.

But (NG) is not!

- The option value of waiting for more information depends on the likelihood of information arriving.
- Since $\alpha_h > \alpha_l$, type $h$ may be willing to wait even though $l$ is not.

Lemma

Constraint (NG) holds for the type-l analyst in the optimal mechanism.

Proof.

- Suppose not \( \implies \) there is some period \( \bar{t} \) where type \( h \) is content to wait but type \( l \) strictly prefers to guess.
- This means that only type \( h \) will report an informative signal after \( \bar{t} \).
- So the principal can increase \( \chi \) by \( \epsilon > 0 \) at all such histories.
- For \( \epsilon \) small enough, this does not break type \( l \)'s strict preference to guess.
- No effect on \( V \), but strict increase in \( W = \Pr(\text{retain} \mid \theta = h) - \Pr(\text{retain} \mid \theta = l) \).  
\[ h's \text{ payoff} - l's \text{ payoff} \]

\[ \square \]

Implication: the optimal retention mechanism yields \( V = V^{FB} \).
THE OPTIMAL MECHANISM

So what does this optimal mechanism look like?

Some preliminaries:
1. Since learning is “all-or-nothing,” we need only condition on the analyst’s first reported non-null signal \( s_t \neq \phi \).
2. Since the underlying states and signals are symmetric, it is without loss to symmetrize the manager’s mechanism.

Therefore, a mechanism \( \chi(s^T, r) \) can be summarized by

\[
(p_t, q_t)_{t=1}^T \text{ and } p_{\infty},
\]

where

- correctly reporting \( \omega \) at \( t \) \( \implies \) retained with probability \( p_t \);
- incorrectly reporting \( \omega \) at \( t \) \( \implies \) retained with probability \( q_t \); and
- never reporting a non-null signal \( \implies \) retained with probability \( p_{\infty} \).
THE OPTIMAL MECHANISM

Theorem

The fund manager’s optimal mechanism is characterized by a cutoff period $t^*$ such that

$$p_t = \begin{cases} 
1 & \text{if } t \leq t^*, \\
(1 + \alpha_l(\gamma n - 1))^{t^* - t} & \text{if } t > t^*;
\end{cases}$$

$$q_t = \begin{cases} 
1 - \left(\frac{\alpha_l(\gamma n - 1)}{n-1}\right)^{t^* - t} & \text{if } t \leq t^*, \text{ and} \\
0 & \text{if } t > t^*;
\end{cases}$$

$$p_\infty = \frac{1}{n} (1 + \alpha_l(\gamma n - 1))^{t^*-T}.$$

This mechanism satisfies constraints (NM), (ND), and (NG) for both types.

$(p_t, q_t)_{t=1}^{T}$ and $p_\infty$ are such that constraint (NG) always binds for type $l$. 

The fund manager’s optimal mechanism contrasts sharply with the public-signal benchmark:

- Randomization is necessary.
- Screening is based on speed (but now “continuously”).
- Screening also relies on accuracy.
- The analyst is willing to say “I don’t know.”
The underlying intuitions apply broadly in this class of models.

Our results continue to hold if we allow:

- perfectly informative outcomes (i.e., $\gamma = 1$);
- differential costs/benefits of retaining different types;
- asymmetric priors about types; or
- asymmetry in states and outcomes.
Easiest to see with two states: $\omega \in \{a, b\}$ with prior $\pi_a > \pi_b$.

The public-signal benchmark remains unchanged, but with private learning, a mechanism is now probabilities

$$(p^\omega_t, q^\omega_t)_{t=1}^T$$

and $p^\omega_\infty$ for each $\omega \in \{a, b\}$,

where the superscript $\omega$ denotes the realized outcome.

Main difference from basic model: an uninformed analyst may now have a preference to bias any guesses towards the more likely outcome (here, $a$).
Main difference from basic model: an uninformed analyst may now have a preference to bias any guesses towards the more likely outcome (here, $a$).

This can never be optimal: (NG) must bind (for type $l$) for both $a$ and $b$.

- Earlier argument implies that (NG) holds for each $\omega \in \{a, b\}$.
- But if (NG) is slack for $\omega$ at time $\bar{t}$, the principal can push down $p_t^\omega$ and $q_t^\omega$ for $t > \bar{t}$.
- Since type $l$ is more likely to “stick around,” this increases $W$.

Implication: optimal to reward “risky” or “contrarian” advice more than “safe” or “conventional” advice.
We study the dynamic mechanism design problem of incentivizing and evaluating analysts.

We show that screening does not need to be in conflict with information revelation, even with limited instruments.

Part of a broader agenda of:

- Studying dynamic strategic learning environments without money.
- Exploring the nature and role of expertise in organizations.

Next steps:

- How should we be thinking about incentives for sell-side analysts?
- Where does information come from? Can we endogenize information acquisition?