The Economic Consequences of Discrete Recognition and Continuous Measurement

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Chicago Booth Workshop

November 8, 2018
Recognition as a long-standing accounting practice

- Accounting produces information
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- Recognition is the first step in the accounting process
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  - determines whether a transaction is admitted
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  - fundamental accounting concept
Recognition as a long-standing accounting practice

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- Recognition is the first step in the accounting process
  - determines whether a transaction is admitted
  - fundamental accounting concept
- Recognition entails discreteness
An example: revenue recognition

- the transaction:

  \[ p_2 \] is the likelihood that the customer will pay.

- The accounting issue: whether to recognize revenue?

  \[ s = 0 \text{ if } p < P \]

  \[ s = 1 \text{ or } s = p \text{ if } p \geq P \]

- A more continuous approach:

  \[ s = p \]

  Two problems with recognition:

  - the discrete classification suppresses information
  - the discreteness induces evidence management around the threshold
An example: revenue recognition

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  - products worth $1 are delivered to a customer on credit
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The tides towards a more continuous approach

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...
The research questions

- What could be the benefit of the long-standing practice of recognition?
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- What could be the benefit of the long-standing practice of recognition?
- What are the consequences of moving away from a discrete recognition regime towards a more continuous regime?
Answer: frictions in the production process

- A two-step representation of the accounting process

\[
\text{state } (\omega) \rightarrow \text{ evidence } (t) \rightarrow \text{ report } (s) \rightarrow \text{ decision } (d)
\]

- manager's influence
- standard design
Answer: frictions in the production process

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- While we want report s to be informative about state ω, standards can only be written on evidence t
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- While we want report \( s \) to be informative about state \( \omega \), standards can only be written on evidence \( t \)

- Main result: recognition is more efficient if and only if evidence management is a severe threat
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  - fixing evidence, continuous regime conveys more evidence
  - manager can influence accounting evidence (EM)
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  - the equilibrium informativeness is the product of these two steps
Timeline

- At date 0, the standard setter chooses either a discrete or a continuous regime;
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- At date 2, the evidence is jointly determined by the state and EM, and converted to a report according to the prevailing standard;
Timeline

- At date 0, the standard setter chooses either a discrete or a continuous regime;
- At date 1, the manager engages in evidence management (EM);
- At date 2, the evidence is jointly determined by the state and EM, and converted to a report according to the prevailing standard;
- At date 3, the investor receives the report and makes a decision. Payoffs are determined by both the decision and the state.
Revenue recognition example revisited

\[
\text{state } (\omega) \rightarrow \text{evidence } (t) \rightarrow \text{report } (s) \rightarrow \text{decision } (I)
\]

standard design
Revenue recognition example revisited

\[ \text{state} (\omega) \rightarrow \text{evidence} (t) \rightarrow \text{report} (s) \rightarrow \text{decision} (I) \]

- state: whether the cash will be collected from the customer
Revenue recognition example revisited

state ($\omega$) — evidence ($t$) — report ($s$) — decision ($I$)

- state: whether the cash will be collected from the customer
- evidence: the customer’s credit score, payment history, financial conditions, macroeconomic conditions ...
Revenue recognition example revisited

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\text{state } (\omega) \rightarrow \text{evidence } (t) \rightarrow \underbrace{\text{report } (s)}_{\text{standard design}} \rightarrow \text{decision } (I)
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- **state**: whether the cash will be collected from the customer
- **evidence**: the customer’s credit score, payment history, financial conditions, macroeconomic conditions ...
- **report**
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- **state** \((\omega)\) — evidence \( (t) \) — report \( (s) \)— decision \( (I) \)
  
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  - evidence: the customer’s credit score, payment history, financial conditions, macroeconomic conditions ...
  - report
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- decision: how much to invest
Formalizing accounting recognition

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\text{state } (\omega) - \text{ evidence } (t) - \text{ report } (s) - \text{ decision } (I)
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standard design
Formalizing accounting recognition

\[ \text{state} (\omega) \rightarrow \text{evidence} (t) \rightarrow \text{report} (s) \rightarrow \text{decision} (I) \]

- state: \( \omega \in \{H = 1, L = 0\} \) with prior: \( \Pr(\omega) = q_\omega \)
Formalizing accounting recognition

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- state: \( \omega \in \{H = 1, L = 0\} \) with prior: \( \Pr(\omega) = q_\omega \)

- evidence \( t \sim f^\omega(t) : \frac{f^H(t)}{f^L(t)} \) is increasing in \( t \).
Formalizing accounting recognition

state \( (\omega) \) — evidence \( (t) \) — report \( (s) \) — decision \( (I) \)

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\begin{align*}
\text{standard design} \\
\text{state: } \omega \in \{H = 1, L = 0\} \text{ with prior: } P_r(\omega) = q_\omega \\
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\text{report}
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  - discrete regime \( s \in \{h, l\} \) \( s = h \) iff \( t \geq T \)
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**report**
- discrete regime \( s \in \{h, l\} \) \( s = h \) iff \( t \geq T \)
- continuous regime \( s = t \)

**decision:** \( I \in R \)
The main friction: evidence management (EM)

\[
\text{state } (\omega) \quad \text{evidence } (t) \quad \text{report } (s) \quad \text{decision } (d)
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- manager's influence
- standard design

\[
m_{im}(t) = m_{H}(t) + (1-m)m_{\omega}(t)
\]

The improvement is larger for the bad type.

Private cost of \( \kappa K(m) \) for the manager.
The main friction: evidence management (EM)

\[ \text{state} (\omega) \rightarrow \text{evidence} (t) \rightarrow \text{report} (s) \rightarrow \text{decision} (d) \]

- EM \( m \): influence evidence distribution (without changing the state)
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- The distribution of the manipulated evidence is

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f^\omega_m(t) = mf^H(t) + (1 - m)f^\omega(t)
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$$f_m^\omega(t) = mf^H(t) + (1 - m)f^\omega(t)$$

- $m$ improves the distribution of evidence
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Payoffs and the efficiency

- investor wants to make accurate investment decisions:

\[ v(\omega, I) = \omega I - \frac{1}{2}I^2 \]
Payoffs and the efficiency

- investor wants to make accurate investment decisions:
  \[ v(\omega, I) = \omega I - \frac{\lambda}{2} I^2 \]

- manager prefers higher investment level:
  \[ u(\omega, I, m) = \beta I - \kappa K(m) \]
Payoffs and the efficiency

- investor wants to make accurate investment decisions:
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- manager prefers higher investment level:
  \[ u(\omega, I, m) = \beta I - \kappa K(m) \]

- the efficiency is a weighted average
  \[ W = \alpha V + (1 - \alpha) U \text{ with } \alpha \in (0, 1] \]
The equilibrium: investment and manipulation

- the investor’s decision is increasing in \( s \)

\[
l^*(s) = \frac{1}{\lambda} E[\omega|s; \hat{m}]
\]
The equilibrium: investment and manipulation

- the investor’s decision is increasing in $s$

$$I^*(s) = \frac{1}{\lambda} E[\omega|s; \hat{m}]$$

- given $\hat{m}$, the manager’s gross payoff is increasing in manipulation $m$:

$$\text{constant} + \beta q_L m (\Pi_H - \Pi_L)$$
The equilibrium: investment and manipulation

- the investor’s decision is increasing in $s$

\[ I^*(s) = \frac{1}{\lambda} E[\omega | s; \hat{m}] \]

- given $\hat{m}$, the manager’s gross payoff is increasing in manipulation $m$:

\[ \text{constant} + \beta q_L m(\Pi_H - \Pi_L) \]

- the equilibrium first-order condition for $m$

\[ \beta q_L (\Pi_H - \Pi_L) = \kappa K'(m^*) \]
The reports’ informational properties (Lemma 1)

Two reports $\tilde{s}_C$ and $\tilde{s}_D$
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1. rational expectations: $E[E[\omega|s_i; m^*]] = q_H$;
The reports’ informational properties (Lemma 1)

Two reports $\tilde{s}_C$ and $\tilde{s}_D$

1. rational expectations: $E[E[\omega|s_i; m^*]] = q_H$;
2. given $m^*$, recognition reduces information
The reports’ informational properties (Lemma 1)

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   - $\tilde{s}_C$ is more informative than $\tilde{s}_D$ in Blackwell sense
Two reports $\tilde{s}_C$ and $\tilde{s}_D$

1. rational expectations: $E[E[\omega|s_i; m^*]] = q_H$;
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3. EM reduces information
The reports’ informational properties (Lemma 1)

Two reports $\tilde{s}_C$ and $\tilde{s}_D$

1. rational expectations: $E[E[\omega|s_i; m^*]] = q_H$;
2. given $m^*$, recognition reduces information
   - $\tilde{s}_C$ is more informative than $\tilde{s}_D$ in Blackwell sense
3. EM reduces information
   - the informativeness of $\tilde{s}_i(m^*)$ decreases in $m^*$ in integral precision sense.
A weaker criterion than Blackwell finess
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- $X$ is more integral precise than $Y$ iff $E[\omega|Y]$ second-order stochastically dominates $E[\omega|X]$
A weaker criterion than Blackwell finess

X is more integral precise than Y iff $E[\omega|Y]$ second-order stochastically dominates $E[\omega|X]$

Intuition: information is useful because it moves posterior away from prior.
A weaker criterion than Blackwell finess

$X$ is more integral precise than $Y$ iff $E[\omega|Y]$ second-order stochastically dominates $E[\omega|X]$

Intuition: information is useful because it moves posterior away from prior.

The more informative a report is, the more dispersed the posterior is.
The main result

**Theorem**

*Recognition is more efficient than continuous measurement if and only if EM cost $\kappa$ is sufficiently low.*
The main result

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1. fixing evidence, recognition reduces efficiency (Proposition 2)
The main result

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1. fixing evidence, recognition reduces efficiency (Proposition 2)
2. EM reduces efficiency (Proposition 3)
The main result

**Theorem**

*Recognition is more efficient than continuous measurement if and only if EM cost $\kappa$ is sufficiently low.*

1. fixing evidence, recognition reduces efficiency (Proposition 2)
2. EM reduces efficiency (Proposition 3)
3. EM is lower in recognition regime (Proposition 4)
The main result

Theorem

Recognition is more efficient than continuous measurement if and only if EM cost \( \kappa \) is sufficiently low.

1. fixing evidence, recognition reduces efficiency (Proposition 2)
2. EM reduces efficiency (Proposition 3)
3. EM is lower in recognition regime (Proposition 4)
4. the trade-off yields a unique threshold \( \bar{\kappa} \) (Theorem)
Recognition directly reduces efficiency

- fixing manipulation \( m^* \), \( W_C(m^*) > W_D(m^*) \).
Recognition directly reduces efficiency

- fixing manipulation $m^*$, $W_C(m^*) > W_D(m^*)$.
  - the manager is indifferent: $U_C = U_D$
Recognition directly reduces efficiency

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Recognition directly reduces efficiency

- fixing manipulation $m^*$, $W_C(m^*) > W_D(m^*)$.
  - the manager is indifferent: $U_C = U_D$
  - the investor prefers continuous regime: $V_C > V_D$
- without EM, $W_C > W_D$. 
EM reduces efficiency

- given a regime, EM reduces efficiency: \( \frac{\partial W}{\partial m^*} < 0 \)
EM reduces efficiency

- given a regime, EM reduces efficiency: \( \frac{\partial W}{\partial m^*} < 0 \)
  - the manager incurs a larger EM cost: \( \frac{\partial U}{\partial m^*} < 0 \)
EM reduces efficiency

- given a regime, EM reduces efficiency: \( \frac{\partial W}{\partial m^*} < 0 \)
  - the manager incurs a larger EM cost: \( \frac{\partial U}{\partial m^*} < 0 \)
  - the investor makes a less-informed decision: \( \frac{\partial V}{\partial m^*} < 0 \)
EM is lower in the recognition regime

- given EM, the investor is more sensitive to evidence in the continuous regime
EM is lower in the recognition regime

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- in an extreme as \( \kappa \to 0 \)
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  - \( m^*_C \to 1 \): deviation from \( m^* = 1 \) may reveal the bad type
EM is lower in the recognition regime

- given EM, the investor is more sensitive to evidence in the continuous regime
- in an extreme as $\kappa \to 0$
  - $m^*_C \to 1$: deviation from $m^* = 1$ may reveal the bad type
  - $m^*_D < 1$: deviation does not lead to full revelation
The trade-off

- both accounting standards and EM affect the report’s informativeness
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\text{state } (\omega) \quad \text{— evidence } (t) \quad \text{— report } (s) \quad \text{— decision } (d)
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Manager’s influence
Standard design
The trade-off

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\end{align*}
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- continuous regime maximizes the second step
The trade-off

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- recognition regime improves the first step
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- continuous regime maximizes the second step
- recognition regime improves the first step
- recognition is more efficient when the first step is more important
The trade-off

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- manager’s influence
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- continuous regime maximizes the second step
- recognition regime improves the first step
- recognition is more efficient when the first step is more important
- the first step becomes more important as EM cost is lower
The trade-off

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- continuous regime maximizes the second step
- recognition regime improves the first step
- recognition is more efficient when the first step is more important
- the first step becomes more important as EM cost is lower
- the trade-off generates a partition point \( \tilde{\kappa} \)
The trade-off

- both accounting standards and EM affect the report’s informativeness

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- recognition is more efficient when the first step is more important
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- the trade-off generates a partition point \( \bar{\kappa} \)

- as \( \kappa \to \infty, W_C > W_D \)
The trade-off

- both accounting standards and EM affect the report’s informativeness

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Comparative statics

- recognition is more efficient ($\bar{\kappa}$ is larger) if
  1. the primary agency problem is severe ($\beta$)
  2. the capital market functions better ($\lambda$)
  3. standard setters put less weight on investors ($\alpha$)
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Empirical and policy implications

- continuous approach leads to more EM.
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Empirical and policy implications

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- provide a rationale and comparative statics for discrete recognition.
The production of accounting information

- how does the accounting process produce information?
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- how does the accounting process produce information?
  - long-standing accounting practice: recognition, conservatism
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  - positive accounting theory

- a formalization of the positive accounting theory
  - primary vs. secondary agency problems
  - accounting produces information
    - information is used to address the primary agency on actions (e.g., accounting-based bonus)
    - such use induces agent’s secondary agency on the accounting process (e.g., EM)
  - accounting practice arises as an equilibrium response

- separate the two agencies to focus on the accounting process
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- open the black box to understand the accounting process
The implications

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  - recognition and thresholds
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- better understand the use of accounting information
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- historical cost vs. fair value
- better understand standard setting: independence and expertise
- connect to incomplete contracting literature
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Takeaways

- Discrete recognition is more efficient than continuous measurement if and only if manipulation threat is sufficiently severe.
- Ex-post (conditional on evidence), recognition suppresses evidence.
- Ex-ante, recognition could be efficient in the shadow of evidence management.
Thank you!