2
Accounting choice

Accounting is an information system design problem. An objective in the study of accounting is to understand its nature and its utility for helping organizations manage uncertainty and private information. As one of many information sources, accounting has many peculiar properties: it's relatively late, it's relatively coarse, it's typically aggregated, it selectively recognizes and reports information (or, equivalently, selectively omits information), however accounting is also highly structured and well disciplined against random errors, and frequently audited. Like other information sources accounting competes for resources. The initial features cited above may suggest that accounting is at a competitive disadvantage. However, the latter features (integrity) are often argued to provide accounting its comparative strength and its integrity is reinforced by the initial features (see Demski [1994, 2008] and Christensen and Demski [2003]).

Demski [2004] stresses endogenous expectations, that is, emphasis on microfoundations or choices (economic and social psychology) and equilibrium to tie the picture together. His remarks sweep out a remarkably broad path of accounting institutions and their implications beginning with a fair game *iid* dividend machine coupled with some report mechanism and equilibrium pricing. This is then extended to include earnings management, analysts' forecasts, regulation assessment studies, value-relevance studies, audit judgement studies, compensation studies, cost measurement studies, and governance studies. We continue this theme by focusing on a modest subset of accounting choices.

In this chapter we begin discussion of four prototypical accounting choice settings. We return to these examples repeatedly in subsequent chapters to illustrate and explore their implications for econometric analysis and especially endogenous causal effects. The first accounting choice setting evaluates equilibrium earnings

management. The second accounting choice setting involves the ex ante impact of accounting asset revaluation regulation on an owner's investment decision and welfare. The third accounting choice setting involves the impact of the choice (discretionary or regulated) of costly accounting report precision on an owner's welfare for assets in place (this example speaks to the vast literature on "accounting quality").[1] A fourth accounting choice setting explores recovery of recognized transactions from reported financial statements.

2.1 Equilibrium earnings management

Suppose the objective is to track the relation between a firm's value P_t and its accruals z_t.[2] To keep things simple, firm value equals the present value of expected future dividends, the market interest rate is zero, current period cash flows are fully paid out in dividends, and dividends $\widetilde{d}$ are Normal *iid* with mean zero and variance σ^2. Firm managers have private information $\widetilde{y}_t^p$ about next period's dividend $\widetilde{y}_t^p = \widetilde{d}_{t+1} + \widetilde{\varepsilon}_t$ where $\widetilde{\varepsilon}$ are Normal *iid* with mean zero and variance σ^2.[3] If the private information is revealed, ex dividend firm value at time t is

$$P_t \equiv E\left[\widetilde{d}_{t+1} \mid \widetilde{y}_t^p = y_t^p\right]$$
$$= \frac{1}{2}y_t^p$$

Suppose management reveals its private information through income I_t (cash flows plus change in accruals) where fair value accruals

$$z_t = E\left[\widetilde{d}_{t+1} \mid \widetilde{y}_t^p = y_t^p\right] = \frac{1}{2}y_t^p$$

are reported. Then, income is

$$I_t = d_t + (z_t - z_{t-1})$$
$$= d_t + \frac{1}{2}\left(y_t^p - y_{t-1}^p\right)$$

and

$$P_t \equiv E\left[\widetilde{d}_{t+1} \mid \widetilde{d}_t = d_t, I_t = d_t + \frac{1}{2}\left(y_t^p - y_{t-1}^p\right)\right]$$
$$= E\left[\widetilde{d}_{t+1} \mid \widetilde{z}_t = \frac{1}{2}y_t^p\right]$$
$$= z_t$$

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[1] An additional setting could combine precision choice and investment (such as in Dye and Sridar [2004, 2007]). Another could perhaps add accounting asset valuation back into the mix. But we leave these settings for later study.

[2] This example draws from Demski [2004].

[3] For simplicity, there is no other information.

There is a linear relation between price and fair value accruals.

Suppose the firm is owned and managed by an entrepreneur who, for intergenerational reasons, liquidates his holdings at the end of the period. The entrepreneur is able to misrepresent the fair value estimate by reporting, $z_t = \frac{1}{2}y_t^p + \theta$, where $\theta \geq 0$. Auditors are unable to detect any accrual overstatements below a threshold equal to $\frac{1}{2}\Delta$. Traders anticipate the entrepreneur reports $z_t = \frac{1}{2}y_t^p + \frac{1}{2}\Delta$ and the market price is

$$P_t = z_t - E[\theta] = z_t - \frac{1}{2}\Delta$$

Given this anticipated behavior, the entrepreneur's equilibrium behavior is to report as conjectured. Again, there is a linear relationship between firm value and reported fair value accruals.

Now, consider the case where the entrepreneur can misreport but with probability α; the probability of misreporting is common knowledge. Investors process the entrepreneur's report with misreporting in mind. The probability of misreporting given an accrual report of z_t is

$$\Pr(D \mid \widetilde{z}_t = z_t) = \frac{\alpha \phi \left(\frac{z_t - 0.5\Delta}{\sqrt{0.5}\sigma} \right)}{\alpha \phi \left(\frac{z_t - 0.5\Delta}{\sqrt{0.5}\sigma} \right) + (1 - \alpha) \phi \left(\frac{z_t}{\sqrt{0.5}\sigma} \right)}$$

where $\phi(\cdot)$ is the standard normal density function and $D = 1$ if there is misreporting ($\theta = \frac{1}{2}\Delta$) and $D = 0$ otherwise. In turn, the equilibrium price for the firm following the report is

$$P_t = E\left[\widetilde{d}_{t+1} \mid \widetilde{z}_t = z_t\right] = \frac{\alpha (z_t - 0.5\Delta) \phi \left(\frac{z_t - 0.5\Delta}{\sqrt{0.5}\sigma} \right) + (1 - \alpha) z_t \phi \left(\frac{z_t}{\sqrt{0.5}\sigma} \right)}{\alpha \phi \left(\frac{z_t - 0.5\Delta}{\sqrt{0.5}\sigma} \right) + (1 - \alpha) \phi \left(\frac{z_t}{\sqrt{0.5}\sigma} \right)}$$

Again, the entrepreneur's equilibrium reporting strategy is to misreport the maximum whenever possible and the accruals balance is $\alpha \left(\frac{1}{2}\Delta \right)$, on average. Price is no longer a linear function of reported fair value.

The example could be extended to address a more dynamic, multiperiod setting. A setting in which managers report discretion is limited by audited "cookie jar" accounting reserves. We leave this to future work.

2.1.1   Implications for econometric analysis

Econometric analysis must carefully attend to the connections between theory and data. For instance, in this setting the equilibrium behavior is based on investors' perceptions of earnings management which may differ from potentially observed (by the analyst) levels of earnings management. This creates a central role in our econometric analysis for the propensity score (discussed later along with discrete choice models). The evidence or data helps us distinguish between

various earnings management propositions. In the stochastic or selective manipulation settings, manipulation likelihood is the focus.

Econometric analysis of equilibrium earnings management is pursued in chapters 3 and 13. Chapter 3 focuses on the relation between firm value and reported accruals. The discussion in chapter 13 first explores accruals smoothing in both valuation and evaluation contexts then focuses on separation of signal from noise in stochastically and selectively manipulated accruals. Informed priors and Bayesian analysis are central to these discussions in chapter 13.

2.2   Asset revaluation regulation

Our second example explores the ex ante impact of accounting asset revaluation policies on owners' investment decisions (and welfare) in an economy of, on average, price protected buyers.[4] Prior to investment, an owner evaluates both investment prospects and the market for resale in the event the owner becomes liquidity stressed. The payoff from investment I is distributed uniformly and centered at $\hat{x} = \frac{\beta}{\alpha} I^\alpha$ where $\alpha, \beta > 0$ and $\alpha < 1$. Hence, support for investment payoff is $x = \hat{x} \pm f = [\underline{x}, \overline{x}]$. A potential problem with the resale market is the owner will have private information — knowledge of the asset value. However, since there is some positive probability the owner becomes distressed, π, the market will not collapse (as in Dye [1985]). The equilibrium price is based on distressed sellers being forced to pool potentially healthy assets with non-distressed sellers' impaired assets. Regulators may choose to prop-up the price to aid distressed sellers by requiring certification of assets at cost k with values below some cutoff x_c.[5,6] The owner's ex ante expected payoff from investment I and certification cutoff x_c is

$$
\begin{aligned}
E\left[V \mid I, x_c\right] \;=\;& \pi \frac{1}{2f}\left[\frac{1}{2}\left(x_c^2 - \underline{x}^2\right) - k\left(x_c - \underline{x}\right) + P\left(\overline{x} - x_c\right)\right] \\
& + (1-\pi)\frac{1}{2f}\left[\frac{1}{2}\left(x_c^2 - \underline{x}^2\right) + P\left(P - x_c\right) + \frac{1}{2}\left(\overline{x}^2 - P^2\right)\right] \\
& - I
\end{aligned}
$$

The equilibrium uncertified asset price is

$$
P = \frac{x_c + \sqrt{\pi}\,\overline{x}}{1 + \sqrt{\pi}}
$$

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[4]This example draws heavily from Demski, Lin, and Sappington [2008].

[5]This cost is incremental to normal audit cost. As such, even if audit fee data is available, k may be difficult for the analyst to observe.

[6]Owners never find it ex ante beneficial to voluntarily certify asset revaluation because of the certification cost. We restrict attention to targeted certification but certification could be proportional rather than targeted (see Demski, et al [2008] for details). For simplicity, we explore only targeted certification.

This follows from the equilibrium condition

$$P = \frac{1}{4fq} \left[\pi \left(\overline{x}^2 - x_c^2 \right) + (1 - \pi) \left(P^2 - x_c^2 \right) \right]$$

where

$$q = \frac{1}{2f} \left[\pi \left(\overline{x} - x_c \right) + (1 - \pi) \left(P - x_c \right) \right]$$

is the probability that an uncertified asset is marketed. Further, the regulator may differentially weight the welfare $W \left(I, x_c \right)$ of distressed sellers compared with non-distressed sellers. Specifically, the regulator may value distressed seller's net gains dollar-for-dollar but value non-distressed seller's gains at a fraction, w, on the dollar.

$$\begin{aligned} W \left(I, x_c \right) &= \pi \frac{1}{2f} \left[\frac{1}{2} \left(x_c^2 - \underline{x}^2 \right) - k \left(x_c - \underline{x} \right) + P \left(\overline{x} - x_c \right) \right] \\ &\quad + w \left(1 - \pi \right) \frac{1}{2f} \left[\frac{1}{2} \left(x_c^2 - \underline{x}^2 \right) + P \left(P - x_c \right) + \frac{1}{2} \left(\overline{x}^2 - P^2 \right) \right] \\ &\quad - I \left[\pi + \left(1 - \pi \right) w \right] \end{aligned}$$

2.2.1 Numerical example

As indicated above, owners will choose to never certify assets if it's left to their discretion. Consider the following parameters

$$\left\{ \alpha = \frac{1}{2}, \beta = 10, \pi = 0.7, k = 20, f = 150 \right\}$$

Then never certify $\left(x_c = \underline{x} \right)$ results in investment $I = 100$, owner's expected payoff $E \left[V \mid I, x_c \right] = 100$, and equilibrium uncertified asset price $P \approx 186.66$.

However, regulators may favor distressed sellers and require selective certification. Continuing with the same parameters, if regulators give zero consideration ($w = 0$) to the expected payoffs of non-distressed sellers, then the welfare maximizing certification cutoff $x_c = \overline{x} - \frac{\left(1 + \sqrt{\pi} \right) k}{\left(1 - \sqrt{\pi} \right) \left(1 - w \right)} \approx 134.4$.[7] This induces investment $I = \left[\frac{\beta \left(2f + \pi k \right)}{2f} \right]^{\frac{1}{1 - \alpha}} \approx 109.6$, owner's expected payoff approximately equal to 96.3, and equilibrium uncertified asset price $P \approx 236.9$ (an uncertified price more favorable to distressed sellers).

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[7]This is optimal for k small; that is, $k < Z \left(w \right)$ where

$$Z \left(w \right) = \frac{2f \left(1 - \sqrt{\pi} \right) \left(1 - w \right)}{\left(1 + \sqrt{\pi} \right) \pi} \left[\pi - \sqrt{\frac{\pi \left(1 + \sqrt{\pi} \right) c}{f \left(1 - \sqrt{\pi} \right) \left(1 - w \right)}} \right]$$

and

$$c = \left[\pi + w \left(1 - \pi \right) \right] \left[\frac{1 - \alpha}{\alpha} - \left(\frac{2f}{\alpha \left(2f + \pi k \right)} - 1 \right) \left(1 + \frac{\pi k}{2f} \right)^{\frac{1}{1 - \alpha}} \right] \beta^{\frac{1}{1 - \alpha}}$$

2.2.2   Implications for econometric analysis

For econometric analysis of this setting, we refer to the investment choice as the treatment level and any revaluation regulation (certification requirement) as policy intervention. Outcomes Y are reflected in exchange values[8] (perhaps less initial investment and certification cost if these data are accessible) and accordingly (as is typical) reflect only a portion of the owner's expected utility.

$$Y = P\left(I, x_c\right) = \frac{x_c + \sqrt{\pi x}}{1 + \sqrt{\pi}}$$

Some net benefits may be hidden from the analysts' view; these may include initial investment and certification cost, and gains from owner retention (not selling the assets) where exchange prices represent lower bounds on the owner's outcome. Further, outcomes (prices) reflect realized draws whereas the owner's expected utility is based on expectations. The causal effect of treatment choice on outcomes is frequently the subject under study and almost surely is endogenous.

This selection problem is pursued in later chapters (chapters 8 through 12). Here, the data help us distinguish between various selection-based propositions. For instance, is investment selection inherently endogenous, is price response to investment selection homogeneous, or is price response to investment selection inherently heterogeneous? Econometric analysis of asset revaluation regulation is explored in chapter 9.

2.3   Regulated report precision

Our third example explores the impact of costly report precision on owner's welfare in an economy of price protected buyers.[9] Suppose a risk averse asset owner sees strict gains to trade from selling her asset to risk neutral buyers. However, the price the buyer is willing to pay is tempered by his perceived ability to manage the asset.[10] This perception is influenced by the reliability of the owner's report on the asset $s = V + \varepsilon_2$ where $\varepsilon_2 \sim N\left(0, \sigma_2^2\right)$. The gross value of the asset is denoted $V = \mu + \varepsilon_1$ where $\varepsilon_1 \sim N\left(0, \sigma_1^2\right)$ and ε_1 and ε_2 are independent. Hence, the price is

$$\begin{aligned} P &= E\left[V \mid s\right] - \beta Var\left[V \mid s\right] \\ &= \mu + \frac{\sigma_1^2}{\sigma_1^2 + \sigma_2^2}\left(s - \mu\right) - \beta \frac{\sigma_1^2 \sigma_2^2}{\sigma_1^2 + \sigma_2^2} \end{aligned}$$

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[8]This may include a combination of securities along the debt-equity continuum.

[9]This example draws heavily from Chistensen and Demski [2007].

[10]An alternative interpretation is that everyone is risk averse but gains to trade arise due to differential risk tolerances and/or diversification benefits.

The owner chooses σ_2^2 (inverse precision) at a cost equal to $\alpha \left(b - \sigma_2^2\right)^2$ (where $\sigma_2^2 \in [a, b]$) and has mean-variance preferences[11]

$$E\left[U \mid \sigma_2^2\right] = E\left[P \mid \sigma_2^2\right] - \gamma Var\left[P \mid \sigma_2^2\right]$$

where

$$E\left[P \mid \sigma_2^2\right] = \mu - \beta \frac{\sigma_1^2 \sigma_2^2}{\sigma_1^2 + \sigma_2^2}$$

and

$$Var\left[P \mid \sigma_2^2\right] = \frac{\sigma_1^4}{\sigma_1^2 + \sigma_2^2}$$

Hence, the owner's expected utility from issuing the accounting report and selling the asset is

$$\mu - \beta \frac{\sigma_1^2 \sigma_2^2}{\sigma_1^2 + \sigma_2^2} - \gamma \frac{\sigma_1^4}{\sigma_1^2 + \sigma_2^2} - \alpha \left(b - \sigma_2^2\right)^2$$

2.3.1   Public precision choice

Public knowledge of report precision is the benchmark (symmetric information) case. Precision or inverse precision σ_2^2 is chosen to maximize the owner's expected utility. For instance, the following parameters

$$\left\{\mu = 1,000, \sigma_1^2 = 100, \beta = 7, \gamma = 2.5, \alpha = 0.02, b = 150\right\}$$

result in optimal inverse-precision $\sigma_2^{2*} \approx 128.4$. and expected utility approximately equal to 487.7. Holding everything else constant, $\alpha = 0.04$ produces $\sigma_2^{2*} \approx 140.3$. and expected utility approximately equal to 483.5. Not surprisingly, higher cost reduces report precision and lowers owner satisfaction.

2.3.2   Private precision choice

Private choice of report precision introduces asymmetric information. The owner chooses the Nash equilibrium precision level; that is, when buyers' conjectures $\bar{\sigma}_2^2$ match the owner's choice of inverse-precision σ_2^2. Now, the owner's expected utility is

$$\mu - \beta \frac{\sigma_1^2 \bar{\sigma}_2^2}{\sigma_1^2 + \bar{\sigma}_2^2} - \gamma \frac{\sigma_1^4 \left(\sigma_1^2 + \sigma_2^2\right)}{\left(\sigma_1^2 + \bar{\sigma}_2^2\right)^2} - \alpha \left(b - \sigma_2^2\right)^2$$

For the same parameters as above

$$\left\{\mu = 1,000, \sigma_1^2 = 100, \beta = 7, \gamma = 2.5, \alpha = 0.02, b = 150\right\}$$

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[11]Think of a *LEN* model. If the owner has negative exponential utility (*CARA*; contstant absolute risk aversion), the outcome is linear in a normally distributed random variable(s), then we can write the certainty equivalent as $E[P(s)] - \frac{\rho}{2}Var[P(s)]$ as suggested.

the optimal inverse-precision choice is $\sigma_2^{2**} \approx 139.1.$ and expected utility is approximately equal to 485.8. Again, holding everything else constant, $\alpha = 0.04$ produces $\sigma_2^{2**} \approx 144.8.$ and expected utility is approximately equal to 483.3. Asymmetric information reduces report precision and lowers the owner's satisfaction.

2.3.3   Regulated precision choice and transaction design

Asymmetric information produces a demand or opportunity for regulation. Assuming the regulator can identify the report precision preferred by the owner σ_2^{2*}, full compliance with regulated inverse-precision $\hat{b}$ restores the benchmark solution. However, the owner may still exploit her private information even if it is costly to design transactions which appear to meet the regulatory standard when in fact they do not.

Suppose the cost of transaction design takes a similar form to the cost of report precision $\alpha_d \left(\hat{b} - \sigma_2^2 \right)^2$; that is, the owner bears a cost of deviating from the regulatory standard. The owner's expected utility is the same as the private information case with transaction design cost added.

$$
\mu - \beta \frac{\sigma_1^2 \bar{\sigma}_2^2}{\sigma_1^2 + \bar{\sigma}_2^2} - \gamma \frac{\sigma_1^4 \left(\sigma_1^2 + \sigma_2^2 \right)}{\left(\sigma_1^2 + \bar{\sigma}_2^2 \right)^2} - \alpha \left(b - \sigma_2^2 \right)^2 - \alpha_d \left(\hat{b} - \sigma_2^2 \right)^2
$$

For the same parameters as above

$$
\left\{ \mu = 1,000, \sigma_1^2 = 100, \beta = 7, \gamma = 2.5, \alpha = 0.02, \alpha_d = 0.02, b = 150 \right\}
$$

the Nash equilibrium inverse-precision choice, for regulated inverse-precision $\hat{b} = 128.4$, is $\sigma_2^{2***} \approx 133.5.$ and owner's expected utility is approximately equal to 486.8. Again, holding everything else constant, $\alpha_d = 0.04$ produces $\sigma_2^{2***} \approx 131.7.$ and owner's expected utility is approximately equal to 487.1. While regulation increases report precision and improves the owner's welfare relative to private precision choice, it also invites transaction design (commonly referred to as earnings management) which produces deviations from regulatory targets.

2.3.4   Implications for econometric analysis

For econometric analysis of this setting, we refer to the report precision choice as the treatment level and any regulation as policy intervention. Outcomes Y are reflected in exchange values[12] and accordingly (as is typical) reflect only a portion of the owner's expected utility.

$$
Y = P \left(\bar{\sigma}_2^2 \right) = \mu + \frac{\sigma_1^2}{\sigma_1^2 + \bar{\sigma}_2^2} \left(s - \mu \right) - \beta \frac{\sigma_1^2 \bar{\sigma}_2^2}{\sigma_1^2 + \bar{\sigma}_2^2}
$$

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[12]This may include a combination of securities along the debt-equity continuum.

In particular, cost is hidden from the analysts' view; cost includes the explicit cost of report precision, cost of any transaction design, and the owner's risk premia. Further, outcomes (prices) reflect realized draws from the accounting system s whereas the owner's expected utility is based on expectations and her knowledge of the distribution for (s, V). The causal effect of treatment choice on outcomes is frequently the subject under study and almost surely is endogenous. This selection problem is pursued in later chapters (chapters 8 through 12). Again, the data help us distinguish between various selection-based propositions. For instance, is report precision selection inherently endogenous, is price response to report precision selection homogeneous, or is price response to report precision selection inherently heterogeneous? Econometric analysis of regulated report precision is explored in chapters 10 and 12. Chapter 10 employs classical identification and estimation strategies while chapter 12 employs Bayesian analysis.

2.4   Inferring transactions from financial statements

Our fourth example asks to what extent can recognized transactions be recovered from financial statements.[13] Similar to the above examples but with perhaps wider scope, potential transactions involve strategic interaction of various economic agents as well as the reporting firm's and auditor's restriction of accounting recognition choices.

We denote accounting recognition choices by the matrix A, where journal entries make up the columns and the rows effectively summarize entries that change account balances (as with ledgers or T accounts). The changes in account balances are denoted by the vector x and the transactions of interest are denoted by the vector y. Then, the linear system describing the problem is

$$Ay = x$$

2.4.1   Implications for econometric analysis

Solving for y is problematic as A is not invertible — A is typically not a square matrix and in any case doesn't have linearly independent rows due to the balancing property of accounting. Further, y typically has more elements than x. Classical methods are stymied. Here we expressly lean on a Bayesian approach including a discussion of the merits of informed, maximum entropy priors. Financial statement data help us address propositions regarding potential equilibrium play. That is, the evidence may strongly support, weakly support, or refute anticipated equilibrium responses and/or their encoding in the financial statements. Evidence supporting either of the latter two may resurrect propositions that are initially considered unlikely. Econometric analysis of financial statements is explored in chapter 13.

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[13]This example draws primarily from Arya et al [2000].

2.5   Additional reading

Extensive reviews and illuminating discussions are found in Demski [1994, 2008] and Christensen and Demski [2003]. Demski's American Accounting Association Presidential Address [2004] is particularly insightful.