Johnson
Cornell
SC Johnson College of Business

Accrual Accounting and Resource Allocation: A General Equilibrium Analysis

Jung Ho Choi

Presented by Felipe Bastos G Silva

10/17/2017

Overview

Motivation: What is the value of accrual accounting systems (accounting performance measures) to real production decisions?

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Unobservable / Construct

Real economic performance (fundamentals)

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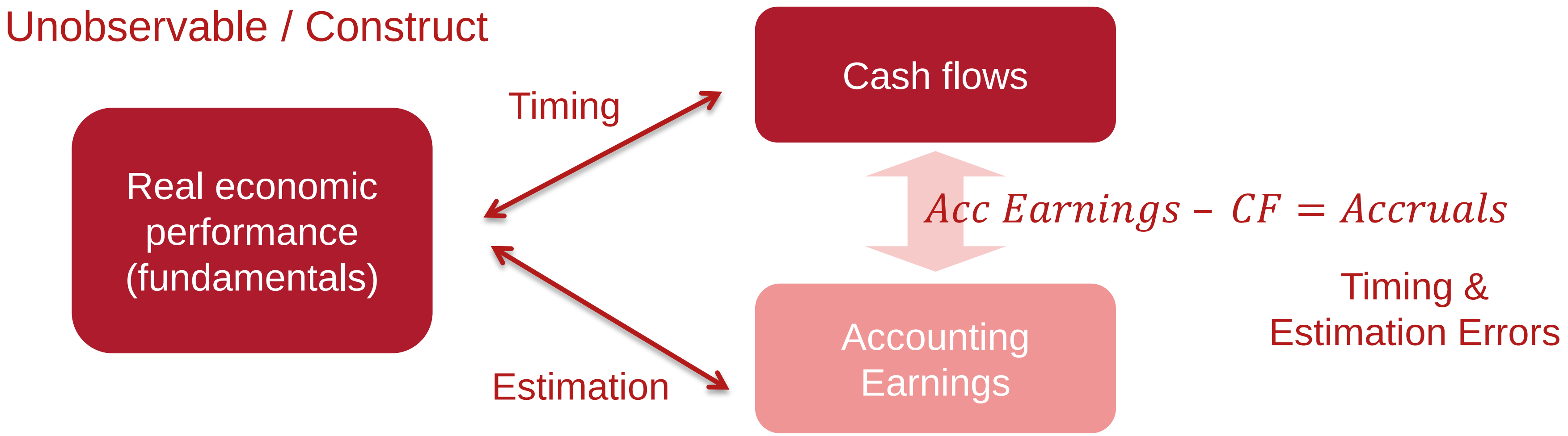

Unobservable / Construct

Real economic performance (fundamentals)

Timing

Cash flows

Estimation

Accounting Earnings

$Acc\ Earnings - CF = Accruals$

Timing & Estimation Errors

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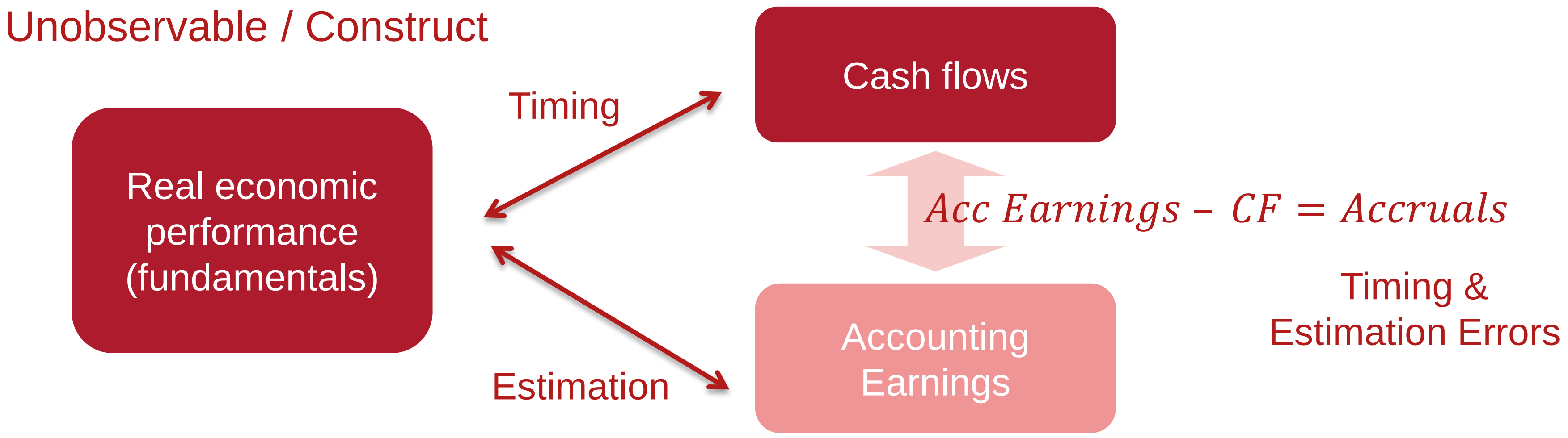

Unobservable / Construct

Real economic performance (fundamentals)

Timing

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$Acc\ Earnings - CF = Accruals$

Timing & Estimation Errors

The relative magnitude of timing and estimation errors determines whether accrual accounting systems provide managers with a better measure of fundamentals than cash accounting systems

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Empirical Challenge:

- Firms production decisions are inherently endogenous
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Approach:

- Build a GE model (variant of David et al. 2016)
  - Single (representative HH); Multiple heterogeneous firms
  - Resources allocated to firms through product and input markets
  - Production functions using Labor and Capital as inputs but varying in productivity
  - Key friction: managers' information of *current* and future productivity.

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- The role of accruals:
  - help measure firm performance more accurately, hence improving managerial production decisions (Kaplan, 1984, Hopper et al. 1992, Hemmer and Labro, 2008; Feng et al. 2009; Dichev et al. 2013, Shroff, 2016)
  - consequently, accounting information can directly affect resource allocation and aggregate productivity by *reducing information frictions*.

$$Future\ Productivity = F(Cash\ Flows, Accounting\ Earnings, Everything\ Else)$$

- Structural estimation with data from the US, China and India

Outline

(1) GE Model

(2) Data and Identification

(3) Quantitative Analysis

(4) Robustness Tests

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1. **GE Model**

2. Data and Identification

3. Quantitative Analysis

4. Robustness Tests

General Equilibrium Model

GE model with accounting systems by adapting David et al's (2016) GE model and Nikolaev's (2016) accrual accounting model.

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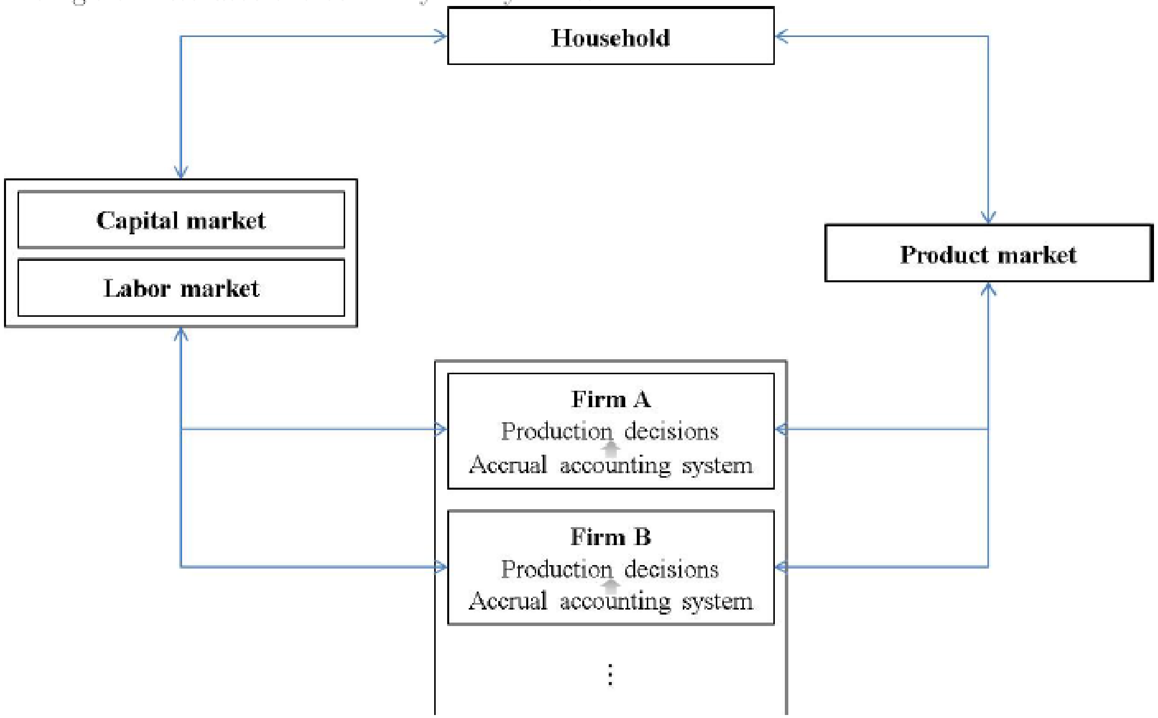
Figure 1: Economy

This figure illustrates the economy in my model.



General Equilibrium Model

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Representative HH:

Maximizes her utility from consumption $\sum_{t=0}^{\infty} \beta^t u(C_t),$

subject to budget constrain: $C_t + K_{t+1} \leq (1 + R_t - \delta)K_t + W_t L_t + \Pi_t, \ \forall t \geq 0,$

K_t is the aggregate capital stock (owned by the representative HH)

L_t is labor (inelastically supplied)

Π_t total profit from the operation of all firms

Technology:

There is a continuum of intermediate-good producers (indexed by *i*) with fixed measure of 1.

Each intermediate-good producer has a Cobb-Douglas production technology

$Y_{it} = K_{it}^{\alpha_1} L_{it}^{\alpha_2}, \ \alpha_1 + \alpha_2 = 1,$

General Equilibrium Model

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Market Structure and Revenue:

Market structure: monopolistic competition with heterogeneous firms with CES aggregator for the final good.

$$Y_t = \left(\int A_{it} Y_{it}^{\frac{\theta-1}{\theta}} di\right)^{\frac{\theta}{\theta-1}}, \ \theta \in (1, \infty),$$

(log) Productivity follows an AR(1) process: $a_{it} = (1-\rho)\overline{a} + \rho a_{it-1} + \epsilon_{it}, \ \epsilon_{it} \sim N(0, \sigma^2), \ \sigma_a^2 \equiv \frac{1}{1-\rho^2}\sigma^2,$

Product market competition: each firm faces a downward-sloping demand: $P_{it} = A_{it}\left(\frac{Y_{it}}{Y_t}\right)^{-\frac{1}{\theta}}.$

Revenue of firm *i*: $P_{it}Y_{it} = Y_t^{\frac{1}{\theta}} A_{it} K_{it}^{\hat{\alpha}_1} L_{it}^{\hat{\alpha}_2}, \ \hat{\alpha}_j \equiv \left(1 - \frac{1}{\theta}\right)\alpha_j, \ \hat{\alpha} \equiv \hat{\alpha}_1 + \hat{\alpha}_2.$

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Input Choices with Imperfect Information

Firms makes input choices under imperfect information about future productivity

Conditional expectation of future productivity $E_{it-1}[A_{it}]$ affects labor and capital investment decisions

The firm's PMP is

$$\max_{K_{it},L_{it}} E_{it-1}[P_{it}Y_{it} - W_t L_{it} - R_t K_{it}]$$

$$= \max_{K_{it},L_{it}} Y_t^{\frac{1}{\theta}} E_{it-1}[A_{it}] K_{it}^{\hat{\alpha}_1} L_{it}^{\hat{\alpha}_2} - W_t L_{it} - R_t K_{it},$$

Optimal capital investment decision: $$K_{it} = \frac{E_{it-1}[A_{it}]^{\theta}}{\int E_{it-1}[A_{it}]^{\theta} di} \int K_{it} di.$$

(a firm consider average capital and average expected productivity to determine the level of its capital investment)

FOC of the PMP: $\hat{\alpha}_1 K_{it}^{\hat{\alpha}_1 - 1} Y_t^{\frac{1}{\theta}} E_{it-1}[A_{it}] L_{it}^{\hat{\alpha}_2} = R_t,\ \hat{\alpha}_2 L_{it}^{\hat{\alpha}_2 - 1} Y_t^{\frac{1}{\theta}} E_{it-1}[A_{it}] K_{it}^{\hat{\alpha}_1} = W_t.$

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Information Structure

Accounting systems affect firms' production decisions by shaping managers information about future productivity

Information frictions arise from the uncertainty in the change in future productivity $(A_{it} - A_{it-1})$ but also from uncertainty about current productivity (A_{it-1}).

$$E_{it-1}[A_{it}] = E_{it-1}[A_{it} - A_{it-1}] + E_{it-1}[A_{it-1}].$$

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$$E_{it-1}[A_{it}] = E_{it-1}[A_{it} - A_{it-1}] + \underset{\uparrow}{E_{it-1}[A_{it-1}]}.$$

Accrual accounting systems improve expectations of future productivity through this term

Key difference between this paper and David et al. (2016), which assumes $E_{t-1}[A_{it-1}] = A_{it-1}$

General Equilibrium Model

GE model with accounting systems by adapting David et al's (2016) GE model and Nikolaev's (2016) accrual accounting model.

Introducing Accounting Systems

The paper builds on Nikolaev's accrual accounting model because it models an accrual system that improves an imperfect measure of firm performance by explicitly introducing true earnings into accounting systems

$$\Pi_{it} = \underbrace{Y_t^{\frac{1}{\theta}} A_{it} K_{it}^{\hat{\alpha}_1} L_{it}^{\hat{\alpha}_2}}_{Revenue} - \underbrace{(W_t L_{it} + R_t K_{it})}_{Cost}.$$

CFs and Acc Earnings:

$$\begin{aligned} CF_{it} &= \Pi_{it} + \epsilon_{it}^{c} \quad \text{(Timing error)} \\ &= \Pi_{it} + \underbrace{(A_{it}^{ac} - 1) Y_t^{\frac{1}{\theta}} A_{it} K_{it}^{\hat{\alpha}_1} L_{it}^{\hat{\alpha}_2}}_{\epsilon_{it}^{c}} \\ &= Y_t^{\frac{1}{\theta}} \underbrace{A_{it} A_{it}^{ac}}_{A_{it}^{c}} K_{it}^{\hat{\alpha}_1} L_{it}^{\hat{\alpha}_2} - W_t L_{it} - R_t \end{aligned}$$

$$\begin{aligned} AE_{it} &= CF_{it} + AC_{it} \\ &= \Pi_{it} + \epsilon_{it}^{e} \quad \text{(est. error)} \\ &= \Pi_{it} + \underbrace{(A_{it}^{ae} - 1) Y_t^{\frac{1}{\theta}} A_{it} K_{it}^{\hat{\alpha}_1} L_{it}^{\hat{\alpha}_2}}_{\epsilon_{it}^{e}} \\ &= Y_t^{\frac{1}{\theta}} \underbrace{A_{it} A_{it}^{ae}}_{A_{it}^{e}} K_{it}^{\hat{\alpha}_1} L_{it}^{\hat{\alpha}_2} - W_t L_{it} - R_t K_{it}, \end{aligned}$$

A_{it}^{c} and A_{it}^{e} are accounting cash- and earnings-based productivity measures
a_{it}^{ac} and a_{it}^{ae} are iid and follow normal distributions

Accruals: $AC_{it} = \epsilon_{it}^{e} - \epsilon_{it}^{c}.$ (as the size of timing errors becomes large relative to est. errors, accrual acc. systems do more to improve the measure of fundamentals)

$$E[\epsilon_{it}^{c}] = E[\epsilon_{it}^{e}] = 0, \; E[CF_{it} | A_{it}] = E[AE_{it} | A_{it}] = \Pi_{it}.$$

General Equilibrium Model

GE model with accounting systems by adapting David et al's (2016) GE model and Nikolaev's (2016) accrual accounting model.

Managers' Information

Three sources of info: CFs'; Accounting Earnings and all other info: $a_{it}|\mathbb{I}_{it-1} \sim N(E_{it-1}[a_{it}], V_{it-1}[a_{it}]),$

$$\mathbb{I}_{it-1} = \{a^c_{it-1}, \cdots, a^c_{i0}, a^e_{it-1}, \cdots, a^e_{i0}, s_{it-1}, \cdots, s_{i0}\}$$

The conditional variance of fut. Productivity $V_{it-1}[a_{it}]$, is what defines informational frictions for managers. Stationarity means $V_{it-1}[a_{it}] = \overline{V}$.. Managers form $E_{it-1}[a_{it}]$ from imperfect measures (Kalman filter)

All other information is another signal with information about future productive shocks $s_{it} = a_{it+1} + a^s_{it},$ a^s_{it} is noise and follows an iid normal distribution with mean 0 and variance σ^2_s

Accrual accounting systems reduce the conditional variance of future productivity by improving an imperfect measure of current productivity.

$$\overline{V} = \rho^2\left(\frac{\sigma_s^2}{\sigma^2+\sigma_s^2}\right)^2 \frac{\overline{V}\sigma_{ae}^2\sigma_{ac}^2(\sigma^2+\sigma_s^2)}{\overline{V}(\sigma_{ae}^2+\sigma_{ac}^2)(\sigma^2+\sigma_s^2)+\sigma_{ae}^2\sigma_{ac}^2(\sigma^2+\sigma_s^2+\rho^2\overline{V})} + \frac{\sigma^2\sigma_s^2}{\sigma^2+\sigma_s^2}.$$

IFT shows that $\frac{d\overline{V}}{d\sigma_{ae}^2} \geq 0.$

General Equilibrium Model

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Equilibrium Definition

A steady-state equilibrium in this economy consists of a wage rate W, capital rental rate R, intermediate-good price and quantity $(\{P_{it}, Y_{it}\}_{i \in I})$, optimal input choices $(\{K_{it}, L_{it}\}_{i \in I})$ and aggregate levels of output, capital, labor and consumption such that

1. A representative household's optimization implies $R = \frac{1}{\beta} - 1 + \delta$, where β is the discount factor and δ is the depreciation rate;
2. Given R and W, an intermediate-good producer maximizes its profits by choosing $\{P_{it}, Y_{it}\}$, K_{it}, and L_{it};
3. All markets are cleared: $C + \delta K = Y = \int P_{it} Y_{it} di$, $\int K_{it} di = K$, and $\int L_{it} di = L$.

General Equilibrium Model

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Equilibrium

Aggregate Productivity

Market clearing: $Y = \int P_{it} Y_{it} di = K^{\hat{\alpha_1}} L^{\hat{\alpha_2}} Y^{\frac{1}{\theta}} \frac{\int A_{it}(E_{it-1}[A_{it}])^{\frac{\hat{\alpha}}{1-\hat{\alpha}}} di}{(\int E_{it-1}[A_{it}]^{\frac{1}{1-\hat{\alpha}}} di)^{\hat{\alpha}}}.$

Aggregate output expressed in a log form

$$y \;=\; \frac{1}{\theta} y + \hat{\alpha_1} k + \hat{\alpha_2} l + log \int A_{it}(E_{it-1}[A_{it}])^{\frac{\hat{\alpha}}{1-\hat{\alpha}}} di - \hat{\alpha} log \int (E_{it-1}[A_{it}])^{\frac{1}{1-\hat{\alpha}}} di.$$

$$\begin{pmatrix} a_{it} \\ E_{it-1}[a_{it}] \end{pmatrix} \sim N\left(\begin{bmatrix} \overline{a} \\ \overline{a} \end{bmatrix}, \begin{bmatrix} \sigma_a^2 & \sigma_a^2 - \overline{V} \\ \sigma_a^2 - \overline{V} & \sigma_a^2 - \overline{V} \end{bmatrix} \right),$$

$$y \;=\; \alpha_1 k + \alpha_2 l + \underbrace{\frac{\theta}{\theta - 1}\overline{a} + \frac{1}{2}(\frac{\theta}{\theta - 1})\frac{\sigma_a^2}{1 - \hat{\alpha}} - \frac{1}{2}\theta\overline{V}.}_{a}$$

Aggregate productivity

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Equilibrium

Rental Rate of Capital and Wage Rate

Euler Equation of the representative HH: $1 = \beta(1 - \delta + R).$

Wage rate $w = \frac{1}{1-\hat{\alpha_1}} log\hat{\alpha_2}(\frac{\hat{\alpha_1}}{\hat{\alpha_2}R})^{\hat{\alpha_1}} L^{\hat{\alpha}-1} + \frac{1}{1-\hat{\alpha_1}}(\overline{a} + \frac{1}{2}\frac{\sigma_a^2 - \overline{V}}{1-\hat{\alpha}} + \frac{1}{2}\overline{V} + \frac{1}{\theta}y).$

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Equilibrium

Aggregate Capital and Output

Relationship between capital and labor is expressed at the aggregate level $K = \frac{\hat{\alpha}_1 L}{\hat{\alpha}_2 R} W.$

Then a log change in capital is the same as a log change in wages with respect to informational frictions

$$\frac{dk}{d\bar{V}} = \frac{dw}{d\bar{V}}.$$

Then we can characterize the relation between aggregate output and informational frictions

$$\begin{aligned}\frac{dy}{d\bar{V}} &= \alpha_1 \left(\frac{dk}{d\bar{V}}\right) - \frac{1}{2}\theta \\ &= -\frac{1}{2}\theta \frac{1}{1-\alpha_1}.\end{aligned}$$

Informational frictions reduce aggregate output. Capital share α_1 strengthens the negative relation because the economy accumulates less aggregate capital if aggregate productivity is lower

General Equilibrium Model

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Equilibrium - Analysis

Quality of accrual accounting systems improves firm’s input choices and, in turn, facilitates resource allocation across firm’s through the input and product market.

Each individual firm I makes more informed investment decisions if accrual accounting systems improve managers’ information about future productivity by providing a better measure of fundamentals than cash accounting systems.

Individual firms decisions ➔ aggregate effects:

Firms access the same capital and labor market to purchase inputs, so one firm’s more efficient input choice translates into better resource allocation across firms.

If one firm is wiling to purchase more resources at the same price of resources than another firm due to its high expected productivity, resources are allocated from the potentially low-productivity firm to the potentially high-productivity firm through prices in the input markets.

Product market competition determines how strongly firms’ input choices respond to their understanding of future productivity. Potentially high-productivity firms are going to take moremarket share than potentially low-productivity ones because the HH substitutes high-productivity goods for low-productivity goods more aggressively.

HH provides aggregate capital depending on aggregate productivity, which depends on the distribution of productivity and resource allocation across firms. Economy accumulates more capital

Outline

(1) GE Model

(2) Data and Identification

(3) Quantitative Analysis

(4) Robustness Tests

Data and Identification

Data

Compustat + Compustat Global (estimation of model parameters using SMM)

Exclude US firms listed in OTC markets (different information environment)

Productivity A_{it} and investment I_{it} are the two key variables in the paper

Estimate accruals using the B/S approach (Leuz et al. 2003)

$$AC_{it} = (\Delta CA_{it} - \Delta Cash_{it}) - (\Delta CL_{it} - \Delta STD_{it} - \Delta TP_{it}) - Dep_{it},$$

Cash flows and accounting earnings are transformed into imperfect measures of productivity

$$Y_t^{\frac{1}{\theta}} \underbrace{A_{it} A_{it}^{ac}}_{A_{it}^{c}} K_{it}^{\hat{\alpha}_1} L_{it}^{\hat{\alpha}_2} - W_t L_{it} - R_t K_{it}, \qquad = Y_t^{\frac{1}{\theta}} \underbrace{A_{it} A_{it}^{ae}}_{A_{it}^{e}} K_{it}^{\hat{\alpha}_1} L_{it}^{\hat{\alpha}_2} - W_t L_{it} - R_t K_{it},$$

$VA_{it}^{c} = VA_{it}^{e} - AC_{it}$ (Value-added cash flows and accounting earnings)

Imperfect measures of productivity estimated by the following equations

$$a_{it}^{c} + Constant = va_{it}^{c} - \hat{\alpha} k_{it},\ a_{it}^{e} + Constant = va_{it}^{e} - \hat{\alpha} k_{it}.$$

Capital stock measured by gross PP&E. Net investment measured by the variation in capital stock $i_{it} = k_{it} - k_{it-1}.$

Data and Identification

Identification

Challenge: having only noisy measures of productivity makes it difficult to identify the actual productivity process and the variance of the noise in cash flows and accounting earnings.

Vector of parameters that govern the process of firm's productivity and the quality of different information sources $\Psi = \{\rho, \sigma^2, \sigma^2_{ac}, \sigma^2_{ae}, \sigma^2_s\}$.

Moment conditions to identify σ_a^2, σ_{ac}^2 and σ_{ae}^2

$$cov(a^c_{it}, a^e_{it}) = cov(a_{it} + a^{ac}_{it}, a_{it} + a^{ae}_{it}) = var(a_{it}) = \sigma^2_a,$$

$$var(a^c_{it}) = var(a_{it} + a^{ac}_{it}) = var(a_{it}) + var(a^{ac}_{it}) = \sigma^2_a + \sigma^2_{ac},$$

$$var(a^e_{it}) = var(a_{it} + a^{ae}_{it}) = var(a_{it}) + var(a^{ae}_{it}) = \sigma^2_a + \sigma^2_{ae}.$$

An investment-optimality condition provides identification assumptions for the quality of unobservable information σ_s^2

Also choose the correlation between capital stock and a key moment condition to consider the existence of other frictions correlated with productivity.

Data and Identification

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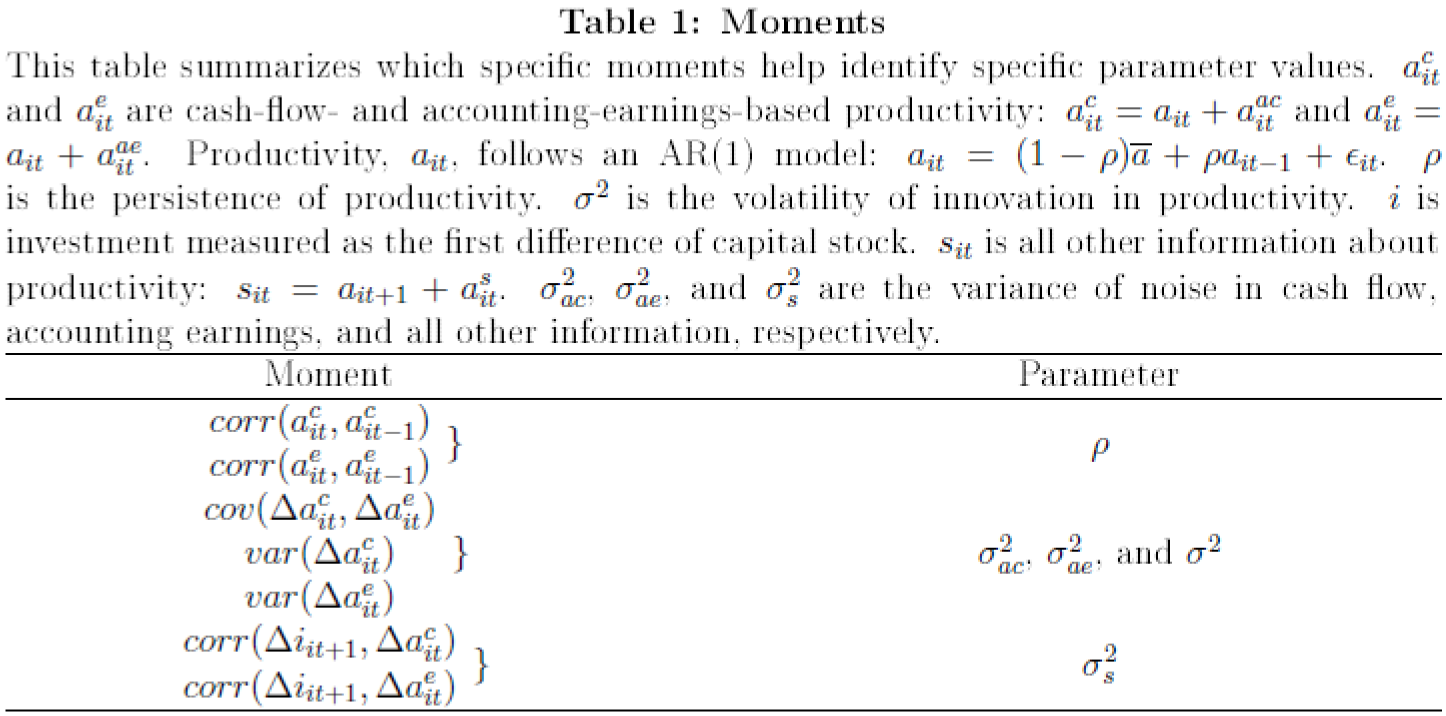

Table 1: Moments

This table summarizes which specific moments help identify specific parameter values. a^c_{it} and a^e_{it} are cash-flow- and accounting-earnings-based productivity: $a^c_{it} = a_{it} + a^{ac}_{it}$ and $a^e_{it} = a_{it} + a^{ae}_{it}$. Productivity, a_{it}, follows an AR(1) model: $a_{it} = (1-\rho)\overline{a} + \rho a_{it-1} + \epsilon_{it}$. ρ is the persistence of productivity. σ^2 is the volatility of innovation in productivity. i is investment measured as the first difference of capital stock. s_{it} is all other information about productivity: $s_{it} = a_{it+1} + a^s_{it}$. σ^2_{ac}, σ^2_{ae}, and σ^2_s are the variance of noise in cash flow, accounting earnings, and all other information, respectively.

Moment	Parameter
$corr(a^c_{it}, a^c_{it-1})$ $corr(a^e_{it}, a^e_{it-1})$	ρ
$cov(\Delta a^c_{it}, \Delta a^e_{it})$ $var(\Delta a^c_{it})$ $var(\Delta a^e_{it})$	σ^2_{ac}, σ^2_{ae}, and σ^2
$corr(\Delta i_{it+1}, \Delta a^c_{it})$ $corr(\Delta i_{it+1}, \Delta a^e_{it})$	σ^2_s

Data and Identification

SMM

Use SMM – search for the set of parameter values that statistically satisfy the moment conditions derived from the model, assuming $\theta = 6$ and $\alpha_1 = 0.33$

Two Counterfactual Analysis

(1) Estimate the impact of accrual accounting systems on aggregate productivity by comparing them with a hypothetical economy without accrual accounting systems.

Manager's information set only has cash flows and other info: a_{it}^{c} and s_{it}

(2) Estimate the potential gains for China and India if these countries had the same quality of accrual accounting systems as the US – i.e., estimation keeping $\sigma_{ae,US}^{2}$

Keeping the process of productivity in China and India intact, this counterfactual analysis examines how changing the quality of accrual accounting information would affect firms' input choices and, eventually, resource allocation across firms in these countries

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Quantitative Analysis

Descriptive Statistics

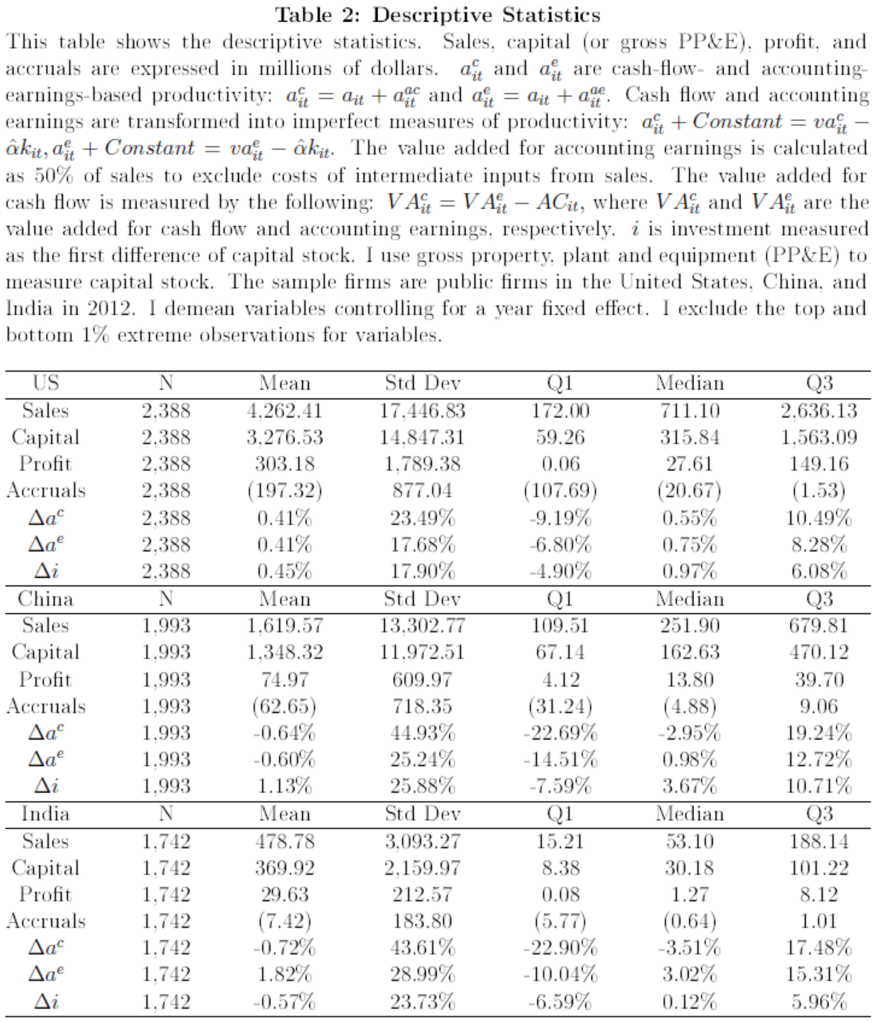


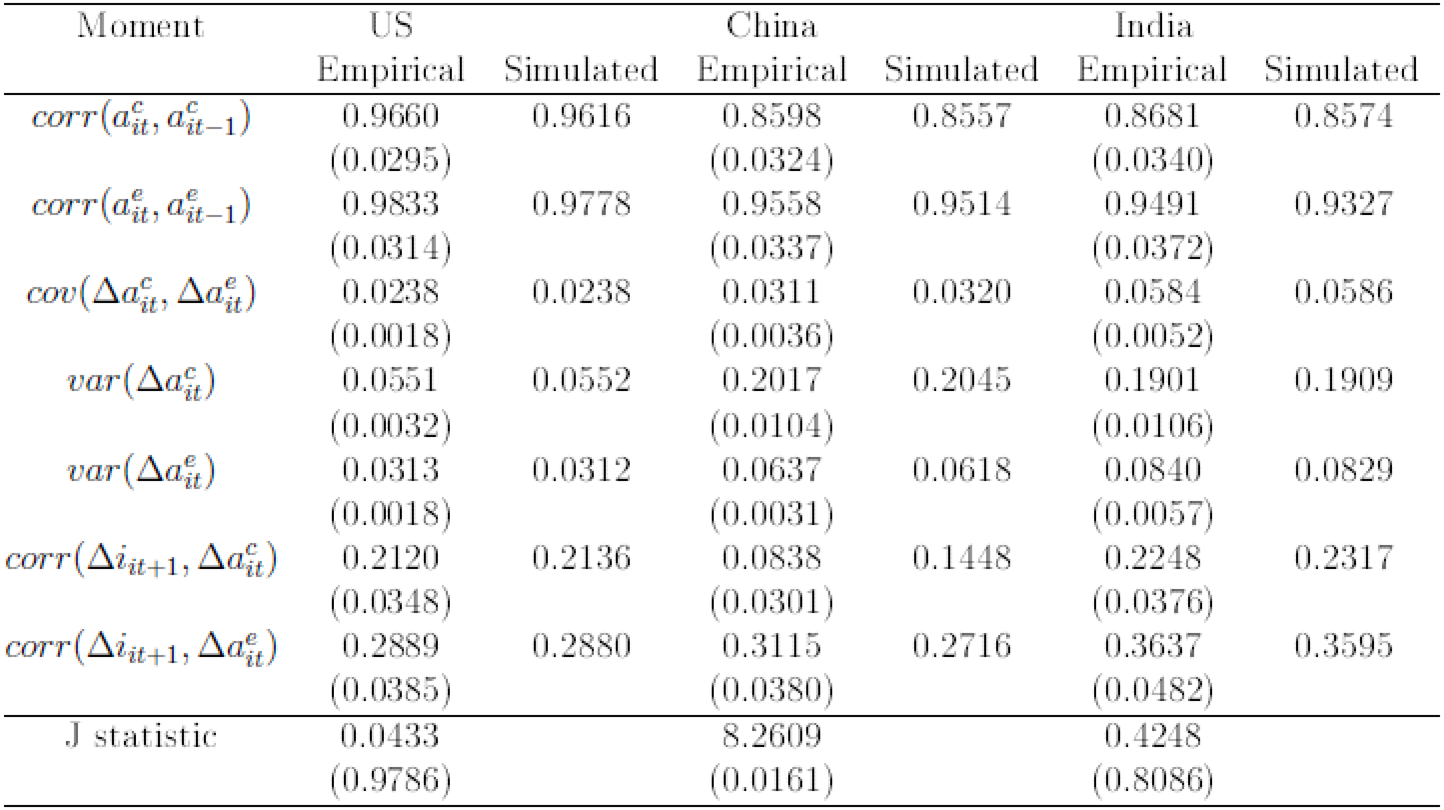
Table 2: Descriptive Statistics

This table shows the descriptive statistics. Sales, capital (or gross PP&E), profit, and accruals are expressed in millions of dollars. a_{it}^{c} and a_{it}^{e} are cash-flow- and accounting-earnings-based productivity: $a_{it}^{c} = a_{it} + a_{it}^{ac}$ and $a_{it}^{e} = a_{it} + a_{it}^{ae}$. Cash flow and accounting earnings are transformed into imperfect measures of productivity: $a_{it}^{c} + Constant = va_{it}^{c} - \hat{\alpha}k_{it}, a_{it}^{e} + Constant = va_{it}^{e} - \hat{\alpha}k_{it}$. The value added for accounting earnings is calculated as 50% of sales to exclude costs of intermediate inputs from sales. The value added for cash flow is measured by the following: $VA_{it}^{c} = VA_{it}^{e} - AC_{it}$, where VA_{it}^{c} and VA_{it}^{e} are the value added for cash flow and accounting earnings, respectively. i is investment measured as the first difference of capital stock. I use gross property, plant and equipment (PP&E) to measure capital stock. The sample firms are public firms in the United States, China, and India in 2012. I demean variables controlling for a year fixed effect. I exclude the top and bottom 1% extreme observations for variables.

US	N	Mean	Std Dev	Q1	Median	Q3
Sales	2,388	4,262.41	17,446.83	172.00	711.10	2,636.13
Capital	2,388	3,276.53	14,847.31	59.26	315.84	1,563.09
Profit	2,388	303.18	1,789.38	0.06	27.61	149.16
Accruals	2,388	(197.32)	877.04	(107.69)	(20.67)	(1.53)
Δa^{c}	2,388	0.41%	23.49%	-9.19%	0.55%	10.49%
Δa^{e}	2,388	0.41%	17.68%	-6.80%	0.75%	8.28%
Δi	2,388	0.45%	17.90%	-4.90%	0.97%	6.08%
China	N	Mean	Std Dev	Q1	Median	Q3
Sales	1,993	1,619.57	13,302.77	109.51	251.90	679.81
Capital	1,993	1,348.32	11,972.51	67.14	162.63	470.12
Profit	1,993	74.97	609.97	4.12	13.80	39.70
Accruals	1,993	(62.65)	718.35	(31.24)	(4.88)	9.06
Δa^{c}	1,993	-0.64%	44.93%	-22.69%	-2.95%	19.24%
Δa^{e}	1,993	-0.60%	25.24%	-14.51%	0.98%	12.72%
Δi	1,993	1.13%	25.88%	-7.59%	3.67%	10.71%
India	N	Mean	Std Dev	Q1	Median	Q3
Sales	1,742	478.78	3,093.27	15.21	53.10	188.14
Capital	1,742	369.92	2,159.97	8.38	30.18	101.22
Profit	1,742	29.63	212.57	0.08	1.27	8.12
Accruals	1,742	(7.42)	183.80	(5.77)	(0.64)	1.01
Δa^{c}	1,742	-0.72%	43.61%	-22.90%	-3.51%	17.48%
Δa^{e}	1,742	1.82%	28.99%	-10.04%	3.02%	15.31%
Δi	1,742	-0.57%	23.73%	-6.59%	0.12%	5.96%

Quantitative Analysis

Moment Conditions



Moment	US		China		India	
	Empirical	Simulated	Empirical	Simulated	Empirical	Simulated
$corr(a^c_{it}, a^c_{it-1})$	0.9660	0.9616	0.8598	0.8557	0.8681	0.8574
	(0.0295)		(0.0324)		(0.0340)	
$corr(a^e_{it}, a^e_{it-1})$	0.9833	0.9778	0.9558	0.9514	0.9491	0.9327
	(0.0314)		(0.0337)		(0.0372)	
$cov(\Delta a^c_{it}, \Delta a^e_{it})$	0.0238	0.0238	0.0311	0.0320	0.0584	0.0586
	(0.0018)		(0.0036)		(0.0052)	
$var(\Delta a^c_{it})$	0.0551	0.0552	0.2017	0.2045	0.1901	0.1909
	(0.0032)		(0.0104)		(0.0106)	
$var(\Delta a^e_{it})$	0.0313	0.0312	0.0637	0.0618	0.0840	0.0829
	(0.0018)		(0.0031)		(0.0057)	
$corr(\Delta i_{it+1}, \Delta a^c_{it})$	0.2120	0.2136	0.0838	0.1448	0.2248	0.2317
	(0.0348)		(0.0301)		(0.0376)	
$corr(\Delta i_{it+1}, \Delta a^e_{it})$	0.2889	0.2880	0.3115	0.2716	0.3637	0.3595
	(0.0385)		(0.0380)		(0.0482)	
J statistic	0.0433		8.2609		0.4248	
	(0.9786)		(0.0161)		(0.8086)	

Quantitative Analysis

Parameter Values

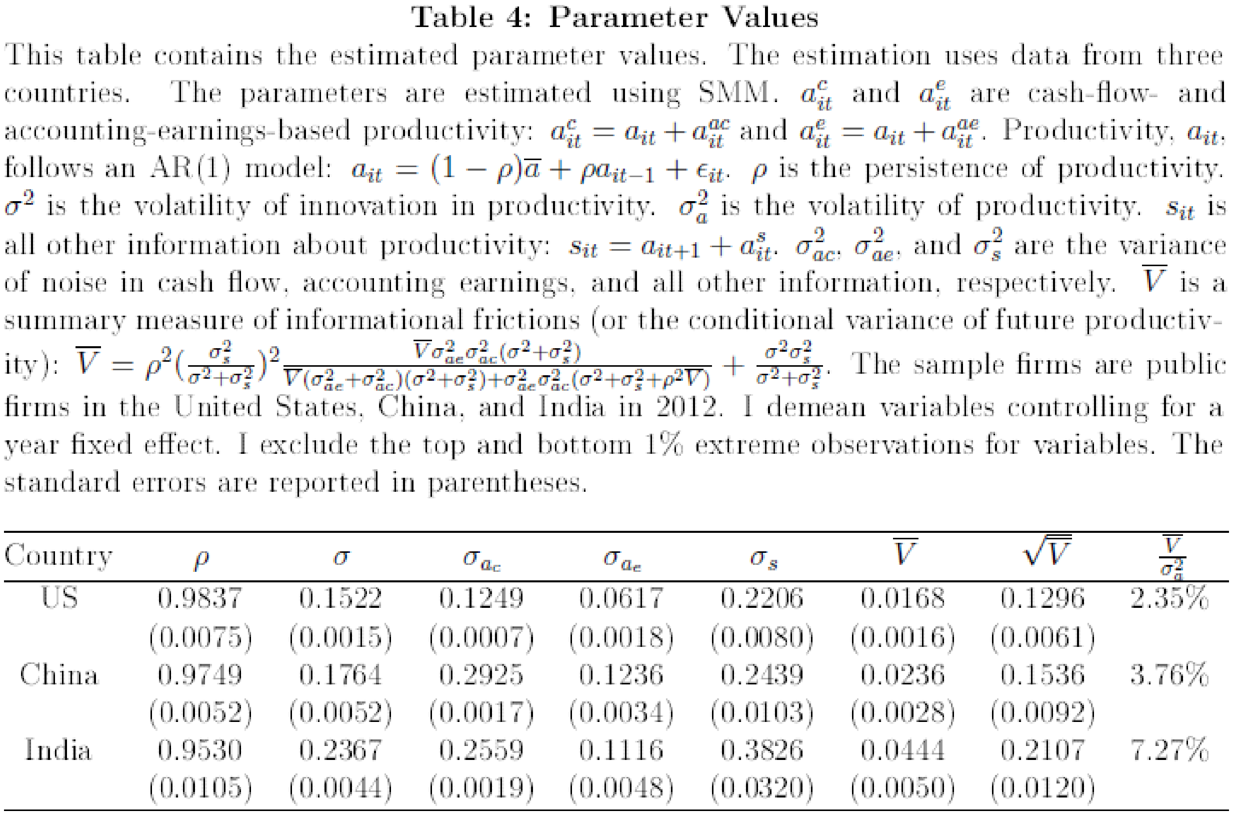


Table 4: Parameter Values

This table contains the estimated parameter values. The estimation uses data from three countries. The parameters are estimated using SMM. a_{it}^c and a_{it}^e are cash-flow- and accounting-earnings-based productivity: $a_{it}^c = a_{it} + a_{it}^{ac}$ and $a_{it}^e = a_{it} + a_{it}^{ae}$. Productivity, a_{it}, follows an AR(1) model: $a_{it} = (1-\rho)\overline{a} + \rho a_{it-1} + \epsilon_{it}$. ρ is the persistence of productivity. σ^2 is the volatility of innovation in productivity. σ_a^2 is the volatility of productivity. s_{it} is all other information about productivity: $s_{it} = a_{it+1} + a_{it}^s$. σ_{ac}^2, σ_{ae}^2, and σ_s^2 are the variance of noise in cash flow, accounting earnings, and all other information, respectively. $\overline{V}$ is a summary measure of informational frictions (or the conditional variance of future productivity): $\overline{V} = \rho^2(\frac{\sigma_s^2}{\sigma^2+\sigma_s^2})^2 \frac{\overline{V}\sigma_{ae}^2\sigma_{ac}^2(\sigma^2+\sigma_s^2)}{\overline{V}(\sigma_{ae}^2+\sigma_{ac}^2)(\sigma^2+\sigma_s^2)+\sigma_{ae}^2\sigma_{ac}^2(\sigma^2+\sigma_s^2+\rho^2\overline{V})} + \frac{\sigma^2\sigma_s^2}{\sigma^2+\sigma_s^2}$. The sample firms are public firms in the United States, China, and India in 2012. I demean variables controlling for a year fixed effect. I exclude the top and bottom 1% extreme observations for variables. The standard errors are reported in parentheses.

Country	ρ	σ	σ_{a_c}	σ_{a_e}	σ_s	$\overline{V}$	$\sqrt{\overline{V}}$	$\frac{\overline{V}}{\sigma_a^2}$
US	0.9837	0.1522	0.1249	0.0617	0.2206	0.0168	0.1296	2.35%
	(0.0075)	(0.0015)	(0.0007)	(0.0018)	(0.0080)	(0.0016)	(0.0061)	
China	0.9749	0.1764	0.2925	0.1236	0.2439	0.0236	0.1536	3.76%
	(0.0052)	(0.0052)	(0.0017)	(0.0034)	(0.0103)	(0.0028)	(0.0092)	
India	0.9530	0.2367	0.2559	0.1116	0.3826	0.0444	0.2107	7.27%
	(0.0105)	(0.0044)	(0.0019)	(0.0048)	(0.0320)	(0.0050)	(0.0120)	

Quantitative Analysis

Impact of Accrual Accounting Information on Aggregate Productivity and Output

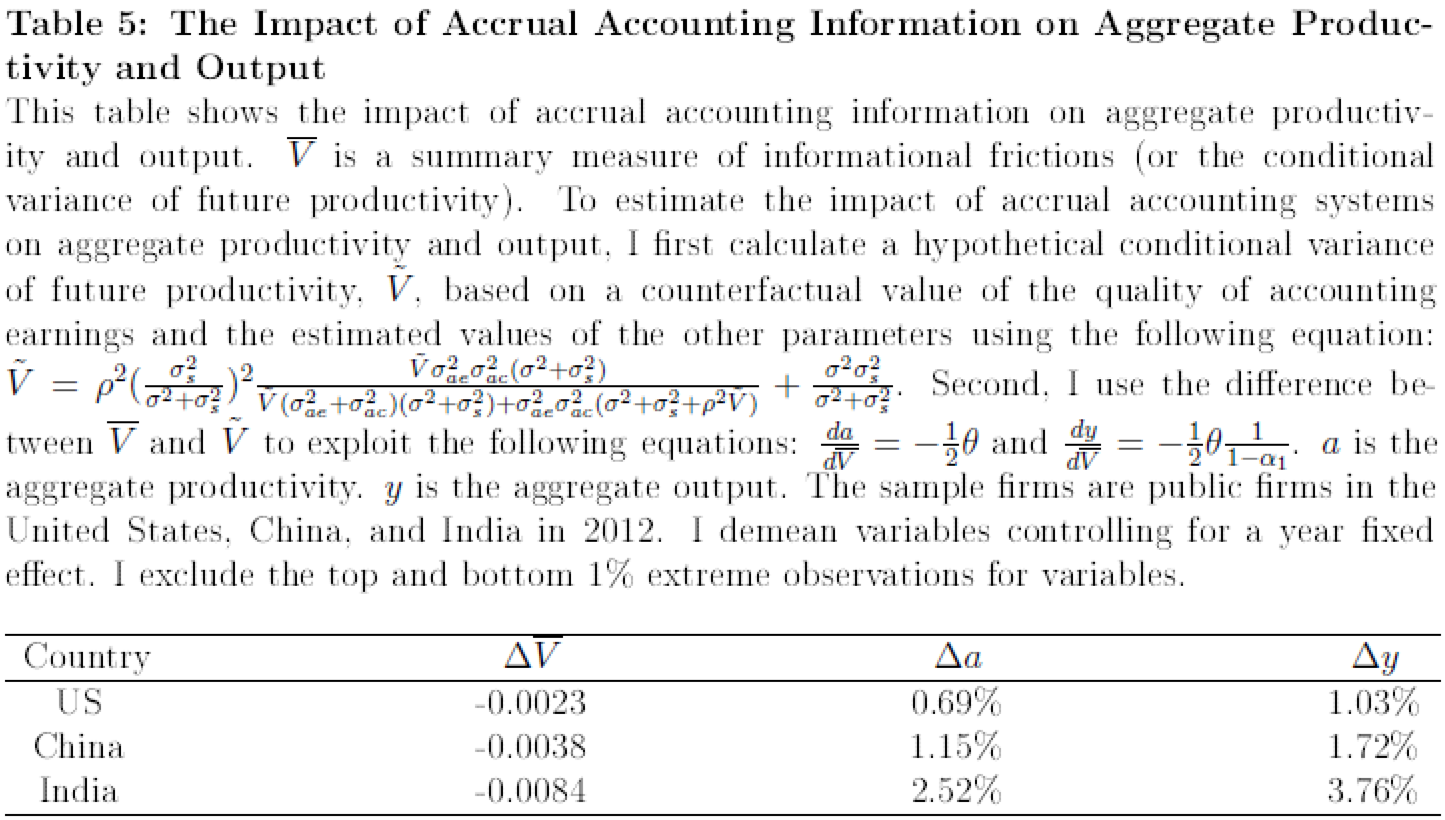


Table 5: The Impact of Accrual Accounting Information on Aggregate Productivity and Output

This table shows the impact of accrual accounting information on aggregate productivity and output. $\overline{V}$ is a summary measure of informational frictions (or the conditional variance of future productivity). To estimate the impact of accrual accounting systems on aggregate productivity and output, I first calculate a hypothetical conditional variance of future productivity, $\tilde{V}$, based on a counterfactual value of the quality of accounting earnings and the estimated values of the other parameters using the following equation: $\tilde{V} = \rho^2(\frac{\sigma_s^2}{\sigma^2+\sigma_s^2})^2 \frac{\tilde{V}\sigma_{ae}^2\sigma_{ac}^2(\sigma^2+\sigma_s^2)}{\tilde{V}(\sigma_{ae}^2+\sigma_{ac}^2)(\sigma^2+\sigma_s^2)+\sigma_{ae}^2\sigma_{ac}^2(\sigma^2+\sigma_s^2+\rho^2\tilde{V})} + \frac{\sigma^2\sigma_s^2}{\sigma^2+\sigma_s^2}$. Second, I use the difference between $\overline{V}$ and $\tilde{V}$ to exploit the following equations: $\frac{da}{d\overline{V}} = -\frac{1}{2}\theta$ and $\frac{dy}{d\overline{V}} = -\frac{1}{2}\theta\frac{1}{1-\alpha_1}$. a is the aggregate productivity. y is the aggregate output. The sample firms are public firms in the United States, China, and India in 2012. I demean variables controlling for a year fixed effect. I exclude the top and bottom 1% extreme observations for variables.

Country	$\Delta\overline{V}$	Δa	Δy
US	-0.0023	0.69%	1.03%
China	-0.0038	1.15%	1.72%
India	-0.0084	2.52%	3.76%

Quantitative Analysis

Impact of “US Quality” Accrual Accounting Information on Aggregate Productivity and Output in India and China

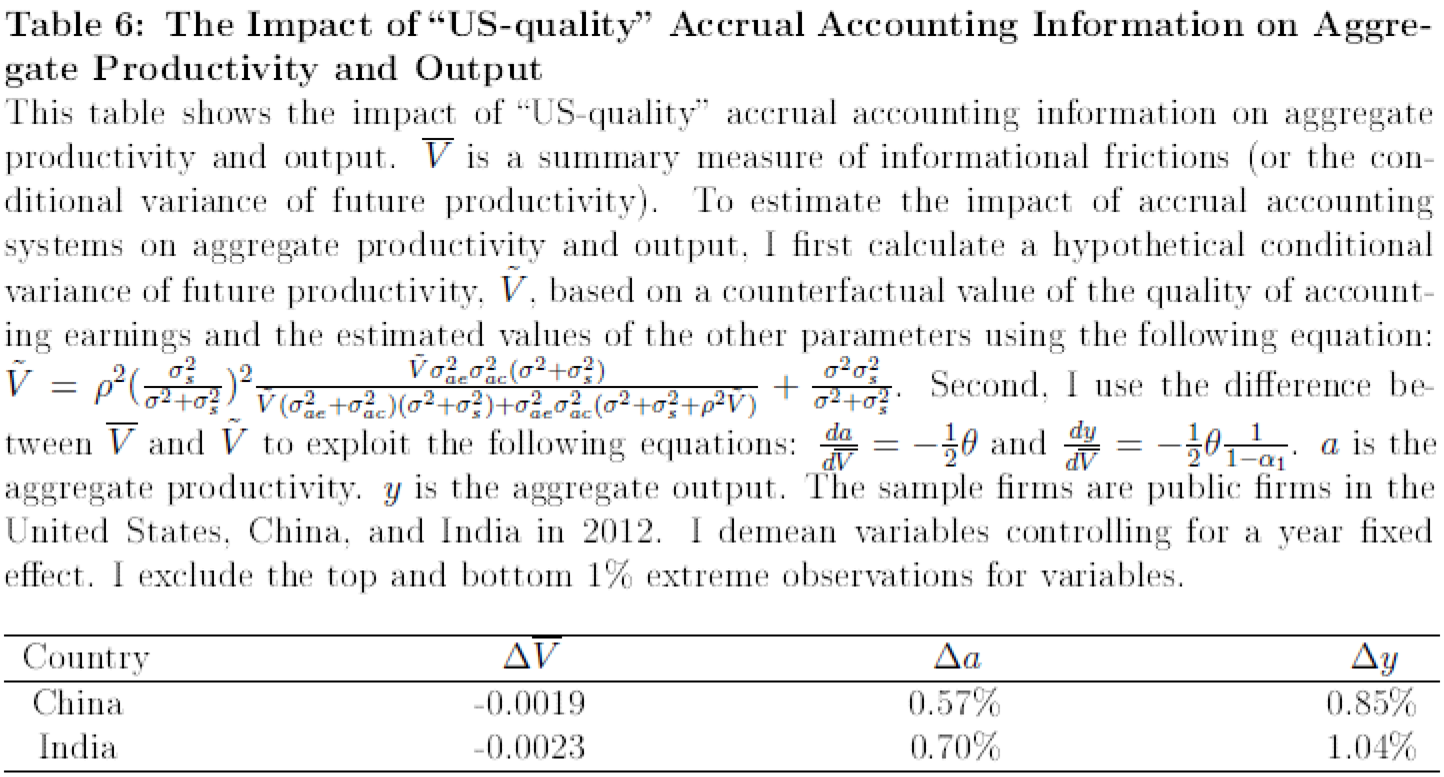


Table 6: The Impact of “US-quality” Accrual Accounting Information on Aggregate Productivity and Output

This table shows the impact of “US-quality” accrual accounting information on aggregate productivity and output. $\overline{V}$ is a summary measure of informational frictions (or the conditional variance of future productivity). To estimate the impact of accrual accounting systems on aggregate productivity and output, I first calculate a hypothetical conditional variance of future productivity, $\tilde{V}$, based on a counterfactual value of the quality of accounting earnings and the estimated values of the other parameters using the following equation: $\tilde{V} = \rho^2(\frac{\sigma_s^2}{\sigma^2+\sigma_s^2})^2\frac{\tilde{V}\sigma_{ae}^2\sigma_{ac}^2(\sigma^2+\sigma_s^2)}{\tilde{V}(\sigma_{ae}^2+\sigma_{ac}^2)(\sigma^2+\sigma_s^2)+\sigma_{ae}^2\sigma_{ac}^2(\sigma^2+\sigma_s^2+\rho^2\tilde{V})} + \frac{\sigma^2\sigma_s^2}{\sigma^2+\sigma_s^2}$. Second, I use the difference between $\overline{V}$ and $\tilde{V}$ to exploit the following equations: $\frac{da}{d\overline{V}} = -\frac{1}{2}\theta$ and $\frac{dy}{d\overline{V}} = -\frac{1}{2}\theta\frac{1}{1-\alpha_1}$. a is the aggregate productivity. y is the aggregate output. The sample firms are public firms in the United States, China, and India in 2012. I demean variables controlling for a year fixed effect. I exclude the top and bottom 1% extreme observations for variables.

Country	$\Delta\overline{V}$	Δa	Δy
China	-0.0019	0.57%	0.85%
India	-0.0023	0.70%	1.04%

Outline

(1) GE Model

(2) Data and Identification

(3) Quantitative Analysis

(4) Robustness Tests

Robustness Tests

Different specifications of Accounting Properties $a^{c}_{it} = a_{it} + \xi^{c}\epsilon_{it} + a^{ac}_{it}, a^{e}_{it} = a_{it} + \xi^{e}\epsilon_{it} + a^{ae}_{it},$

Other frictions $\max_{K_{it},L_{it}} E_{it-1}[Y_t^{\frac{1}{\theta}}(1-\tau_{Y_{it}})A_{it}K_{it}^{\hat{\alpha}_1}L_{it}^{\hat{\alpha}_2} - W_tL_{it} - (1+\tau_{K_{it}})R_tK_{it}],$

(Affect the optimal capital rule)

Different values of the elasticity of substitution θ

Industry Analysis Accrual accounting systems reduce informational frictions, V , more in an industry with a longer operating cycle:

collections and payments more likely to be misaligned with the timing of business transactions

Thank you