Comments to the Paper

Cross-Country Income Differences Revisited: Accounting for the Role of Intangible Capital

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Background

- Increasingly recognized importance of intangible capital.

  American Do it Better: U.S. MNCs vs. non-U.S. MNCs and U.K. Firms in U.K. (Bloom et al., 2015)

  Management as Technology (Bloom et al., 2016)

- Country-specific growth accounting studies (CHS, 2009; Fukao et al., 2009)
- Positive relationship between intangible and TFP & labor productivity

Problem

- Lack a consistent and internationally comparable database to incorporate key intangibles into development accounting framework

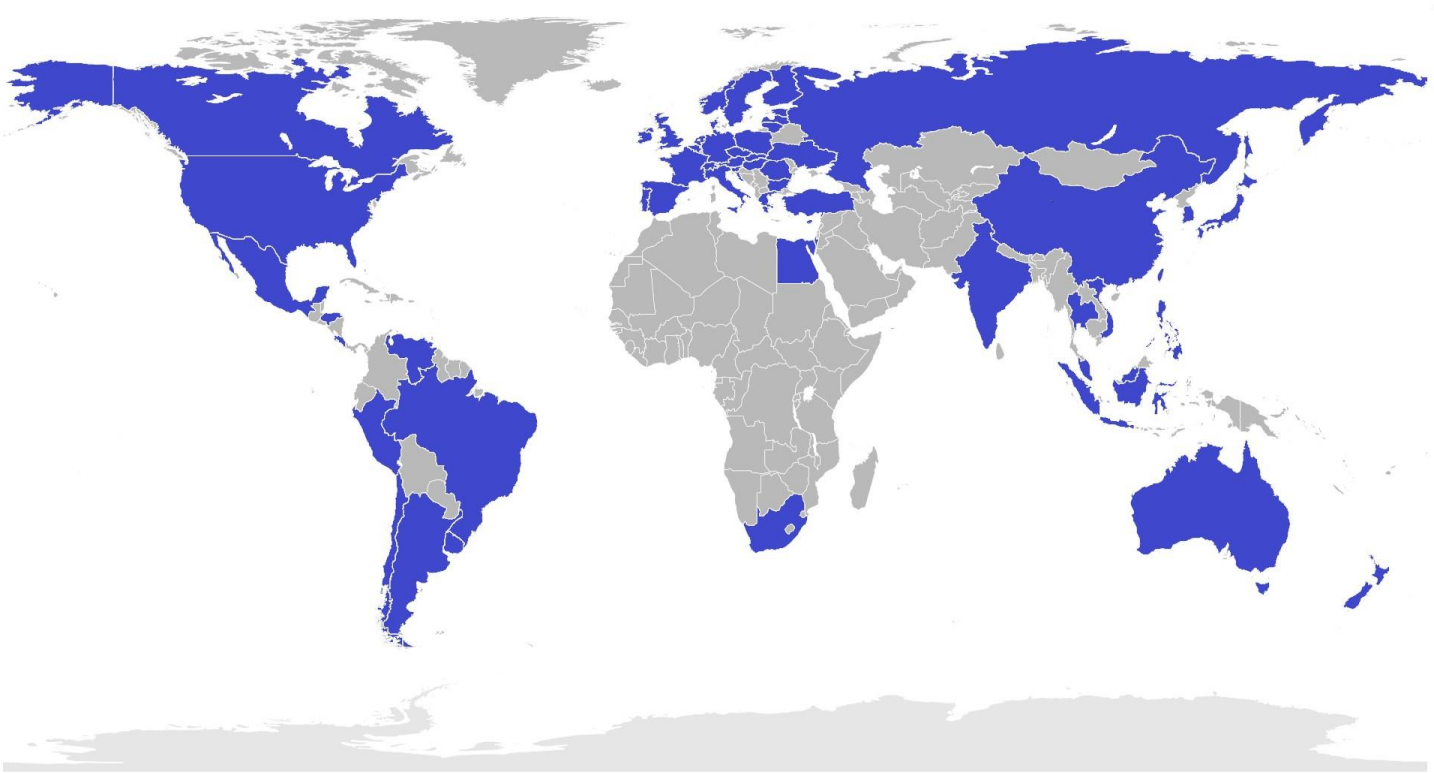
Main Results from the Paper

- Constructed a new intangible investment database for 60 countries during the period of 1995 to 2011.

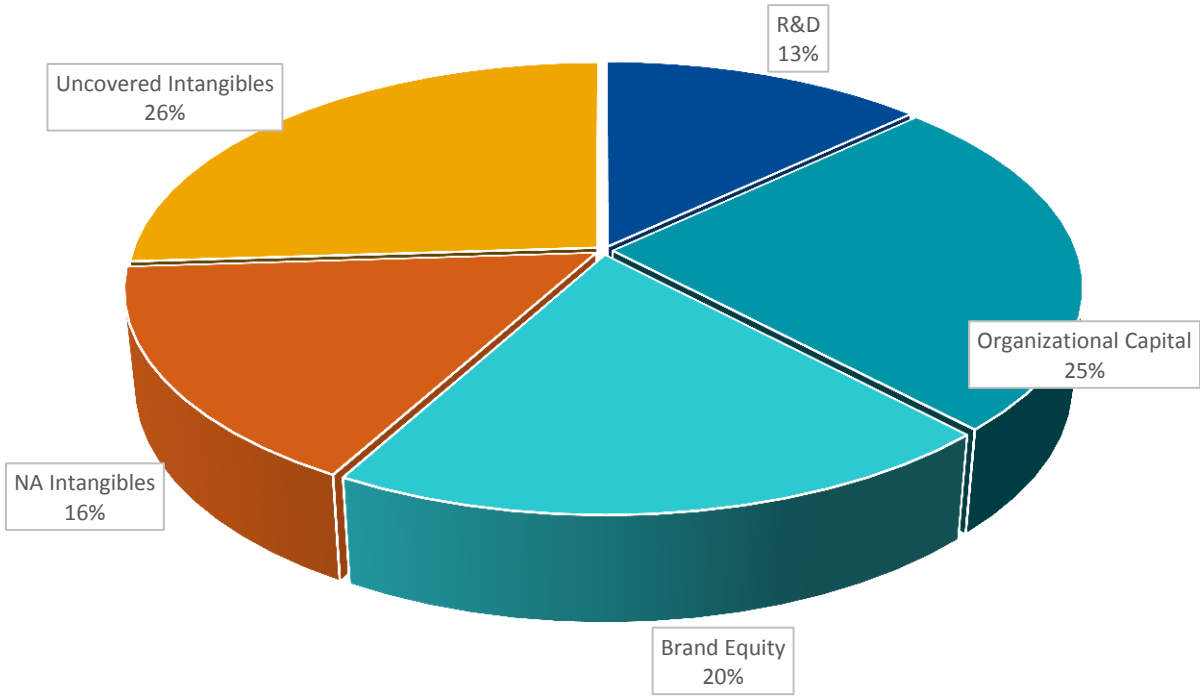
- Intangible investment has become increasingly important over time and it is positively associated with income levels.

- In all variants of the model considered, differences in intangible capital systematically increases the VAF. In the baseline specification, it may help account for another 16 percentage points of income variation, significantly diminishing the role of TFP.

Coverage of the Newly Constructed Database



Coverage of the Types of Intangibles



Data Source: INTAN-Invest

Measurement of Intangibles (I)

- Exclude public sectors: Public Administration (L), Education (M), and Health and Social Work (N).

Asset Type	Measured by	Depreciation Rate
Brand Equity	Spending on Advertising and market research	60%
R&D	Business R&D expenditures	20%
Organizational Capital	20% of wage compensation of managers	40%

Price Index of Intangibles: Assume the relative price between intangibles and tangibles are the same across countries.

$$R^N_{j,t,US} = \frac{P^N_{j,t,US}}{P^I_{t,US}} \qquad P^N_{j,c,t} = P^I_{c,t} \times R^N_{j,t,US}$$

Stock: Perpetual inventory method.

Measurement of Intangibles (II)

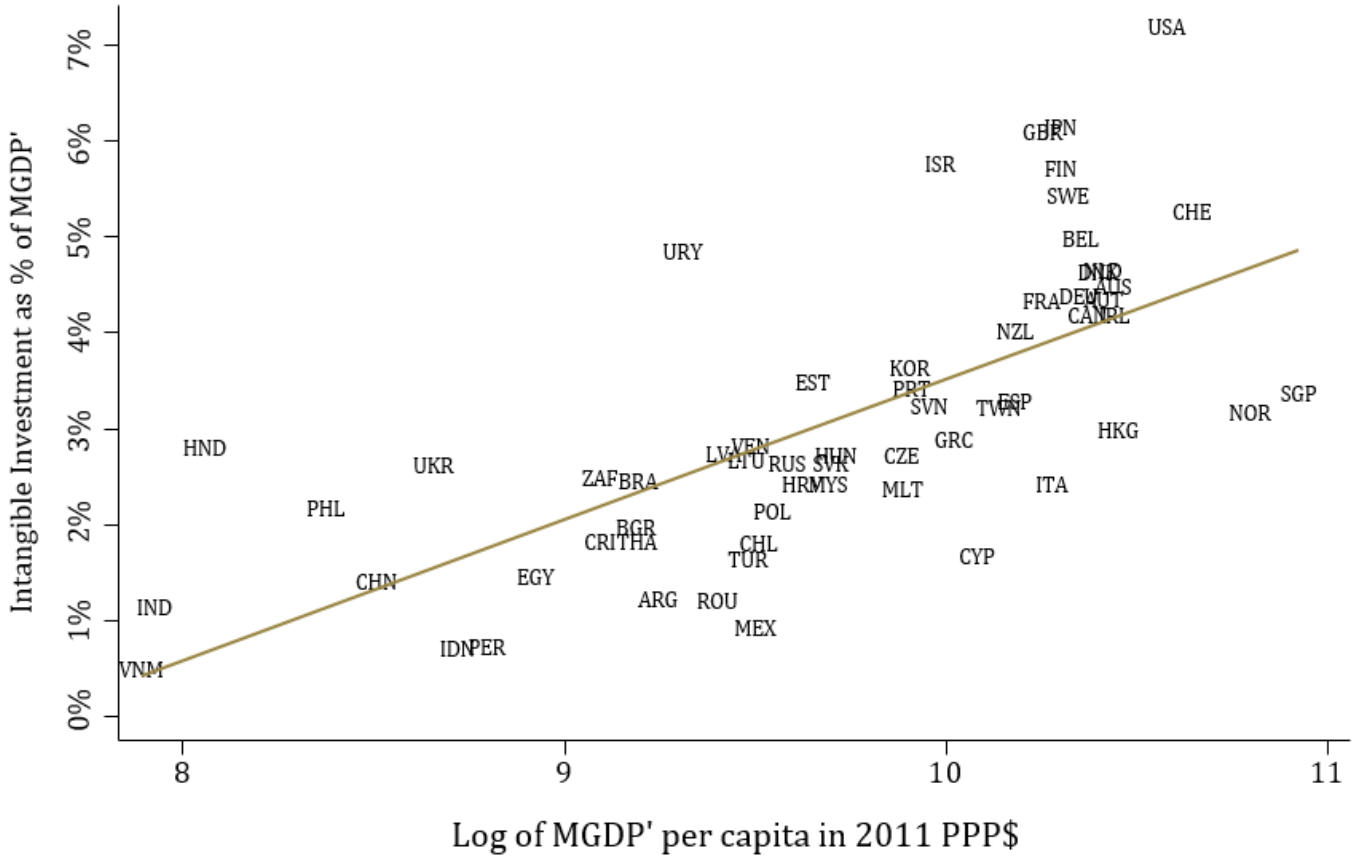
- Expenditure-based Approach:

$$\mathrm{N} = N^{RD} + N^{OC} + N^{BE}$$

$$Y' = S^{M} GDP + N;$$

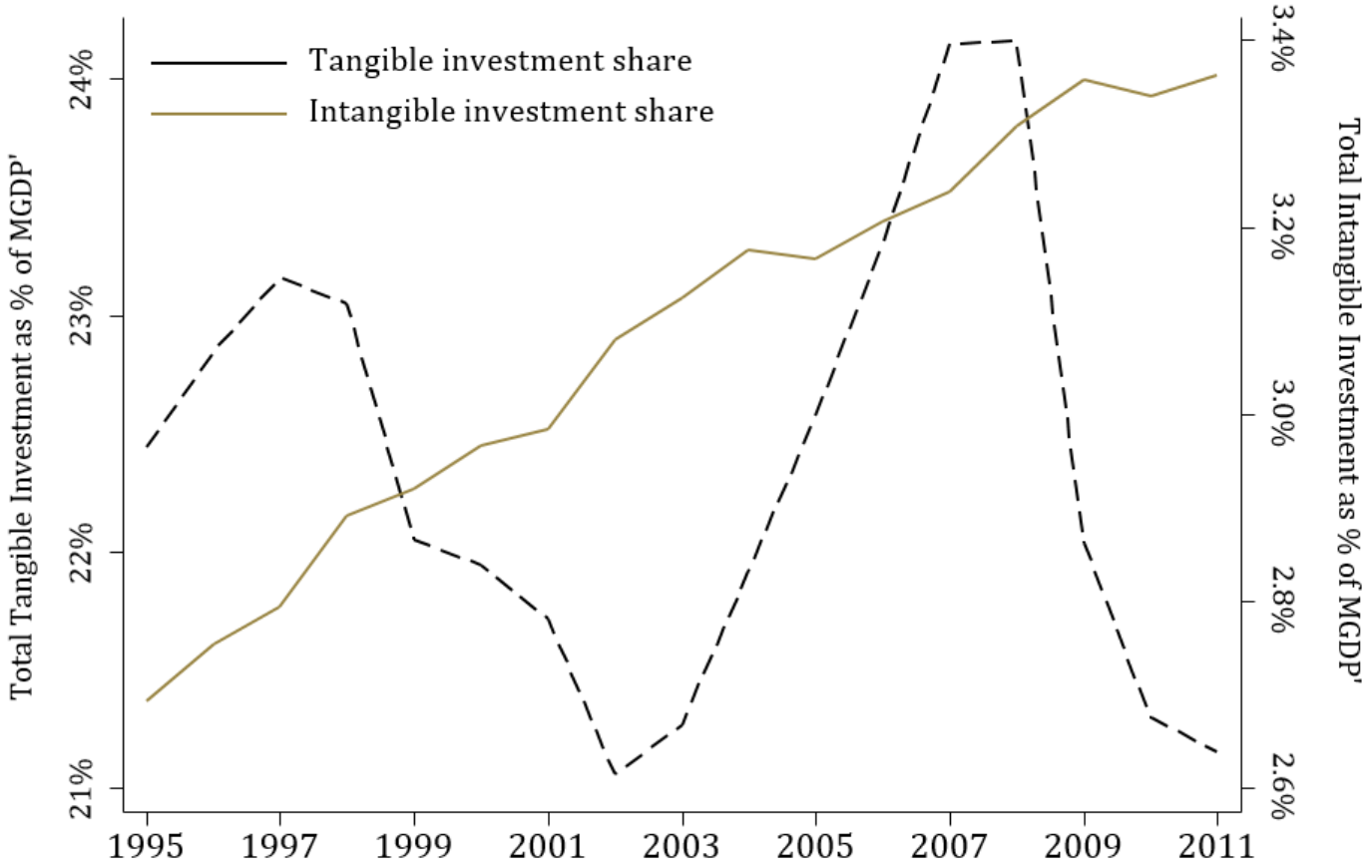
where GDP (and I) are based on SNA 1993 (retrieved from UN NA)

Intangible investment positively associated with per capita income



Notes: Author's calculation. The line shown in the figure is OLS regression line. The shares of intangible investment are averaged over time.

Cross-country Average Investment Trend of Intangibles and Tangibles



Notes: Author's calculation. The shares of tangible and intangible investments are averaged across countries.

Basic Setup of Development Accounting

- **Benchmark production function (Hall and Jones, 1999):**

$$Y = A \cdot K^{\alpha} (Lh)^{\gamma}$$

- **per worker & CRS:**

$$y = A \cdot k^{\alpha} (h)^{1-\alpha}$$

- **Rewrite as follows:**

$$y = A \cdot y_{KH}; \qquad y_{KH} \equiv k^{\alpha} h^{1-\alpha}$$

- **Variance decomposition ($y = A \cdot y_{KH}$):**

$$var[log(y)] = var[log(A)] + var[log(y_{KH})] + 2cov[log(A), log(y_{KH})]$$

- **Following Caselli (2005):**

$$\text{VAF} = \frac{var[log(y_{KH})]}{var[log(y)]}$$

Extended Model

- **Adding intangible capital:**

$$Y' = A \cdot K^{\alpha} R^{\beta} (Lh)^{1-\alpha-\beta}$$

$$y' = A \cdot k^{\alpha} r^{\beta} (h)^{1-\alpha-\beta}$$

- **Rewrite as follows:**

$$y' \equiv A \cdot y_{K\,RH}$$

- **Using variance decomposition:**

$$VAF' = \frac{var[log(y_{K\,RH})]}{var[log(y')]}$$

Data Construction

$$\text{VAF} = \frac{k^{\alpha} h^{1-\alpha}}{y} \qquad \text{VAF}^{t} = \frac{k^{\alpha^{t}} r^{\beta} h^{1-\alpha^{t}-\beta}}{yt}$$

- $\underset{I}{k}$: PIM ($\delta^{K} = 0.06$; 1960-2011; $P_{c,t}$ from UN NA)
- r: PIM (δ^{R}_{j}; 1995-2011; $P^{N}_{j,c,t}$ imputed)
- h: standard procedure as function of the average years of schooling s
- α: 1/3 (e.g. Caselli, 2005)
- $\alpha' = 0.25$; $\beta = 0.15$, following CHS (2009)

Results from Basic Model

$$\text{VAF} = \frac{k^{\alpha} h^{1-\alpha}}{y}$$

Table: Variance Accounted For of the Basic Model for 2011

	Coverage	var[log(y)]	var[log(y_{KH})]	VAF
Own data	Total Economy (60)	0.387	0.088	22.7%
Own data (excl. F.USSR)	Total Economy (51)	0.432	0.101	23.4%
Data from PWT 8.1	Total Economy (60)	0.452	0.109	24.1%
Own data	Market Economy (60)	0.432	0.101	23.3%

Results from Extended Model

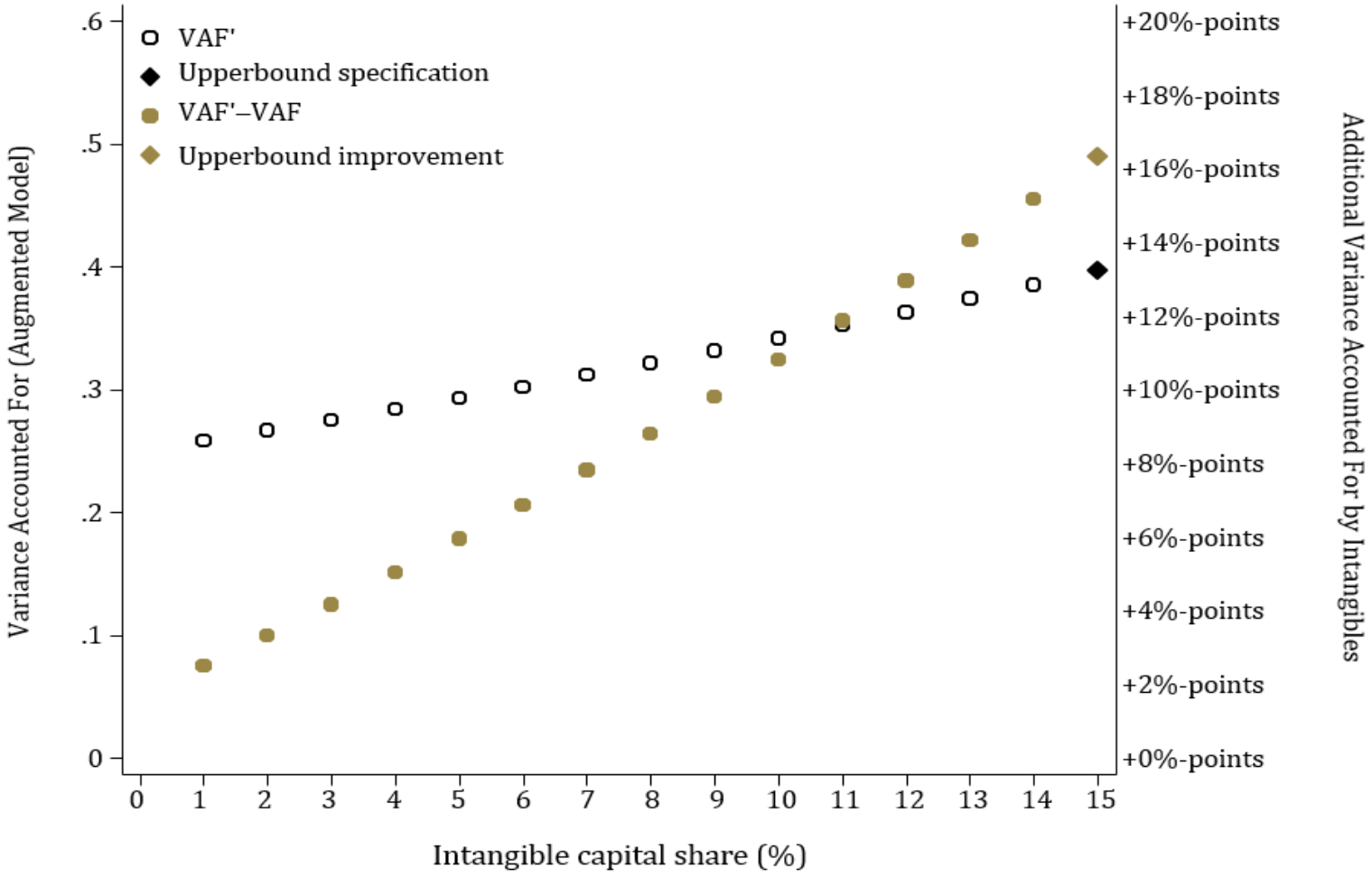
$$\mathrm{VAF}' = \frac{k^{\alpha'}\gamma^{\beta}h^{1-\alpha'-\beta}}{y'}$$

Table: VAF of the Augmented Model for 2011 (Market Economy)

	Output elasticities	var[log(y_t)]	var[log(y_{KRH})]	VAF	Δ
Lower-bound	α = .33 & β = .05	0.445	0.124	27.9%	*+5%-points*
Mid-range	α = .33 & β = .10	0.445	0.166	37.2%	*+14%-points*
Upper-bound (Baseline)	α = .25 & β = .15	0.445	0.177	39.8%	*+16%-points*

Δ: denotes the difference in the explanatory power of the augmented model as compared to the basic model (i.e. VAF^t-VAF) in percentage points.

Varying Intangible Capital Share



Robustness Check

	$\mathbf{var[\log(y')]}$	$\mathbf{var[\log(y_{KRH})]}$	$\mathbf{VAF'}$	$\mathbf{\Delta}$
Baseline result	0.445	0.177	39.8%	*+16%-points*
(1) Alternative OC	0.443	0.171	38.6%	*+15%-points*
(2) Dropping GRC&ESP	0.456	0.181	39.7%	*+16%-points*
(3) Dropping sample	0.403	0.160	39.7%	*+16%-points*
(4) Alternative δ_j	0.445	0.183	41.1%	*+18%-points*
(5) Alternative K_0 & R_0	0.445	0.177	39.8%	*+16%-points*
(6) Alternative price P^{BS}	0.445	0.173	38.9%	*+15%-points*
(7) Alternative price P^{GDP}	0.445	0.172	38.6%	*+15%-points*
(8) Alternative price P^{I}	0.456	0.173	38.9%	*+15%-points*

Ex. δ of Intangibles: Eisfeld & Papanikolaou (2013), Hall (2007) – 15%?

Comments and Questions

- An important topic: more research is needed
- In general, the qualitative aspect of the conclusion is consistent with several country specific studies.
- However, issues associated with the methodology of estimating intangible stock do not justify the study to estimate the effects accurately.

Comments and Questions

Key: Stock of Intangibles – (1) P, (2) δ, (3) gestation lag, and (4) investment data

- **(1) Price Index of Intangibles** – Measurement errors can be very high!

Ratio of price index of intangibles to price index of tangibles is constant across assets and across countries? Can the ratio for the U.S. apply to every country?

Ex. Why assumes all countries, no matter developed or developing, having similar R&D productivity growth rates?

- **(2) Depreciation rates of Intangibles** (Li and Hall, 2016; Li, 2016; Diewert and Huang 2011; Warusawitharana 2010; Berstein and Mamuneas 2006)

- No rigorous study supports the assigned depreciation rates.

Ex. R&D depreciation rate

- Why assumes all industries across countries have the same pace of technology progress and the degree of market competition?
- Developing countries have much higher R&D depreciation rates than developed countries.

δ_RD, China in motor = 52% vs. δ_RD, Germany in motor = 19% (Li, 2016)

→ Countries are different in technology.

- Robustness check is incomplete.

Comments and Questions

- **(3) Gestation lags** for three intangible assets:

- No information in the paper
- Should vary with countries and industries
- Developing countries should have longer gestation lags: absorption capacity (Cohen and Levinthal, 1990)

⇒ 1. **Likely to substantially overestimate the stock of intangibles for developing countries**

2. **Likely to substantially underestimate the stock of intangibles for leading countries**

δ_OC, US in motor = 16% (Li, 2016) vs. 40% for the U.S. (this paper)

Note: Bloom et al. (2016) δ_management capital = 13.3%

⇒ **Likely to underestimate the explanation power of intangibles**

- (4) Measurement of the investments of organizational capital:

- Proxy for investment: "20%" of manger compensations -- an ad hoc approach (Diewert, 2014 IARIW)

- Human-embodied or Firm-embodied? (Bloom et al., 2015; Bryjolfsson and Hitt, 2002)