Organizational Capital, R&D Assets, and Outsourcing

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Motivation and Challenge

- Motivation:
  * BEA now recognizes expenditures on R&D as fixed investment.
  * Organizational capital as a business expense.
  * If assume R&D expenditures and organizational capital were **both** treated as investment, want to examine the relationship between these intangible assets of U.S. industries and:

  1) their global competence
  2) their outsourcing patterns

- Challenge:
  * dearth of data and measurement difficulties

- Latest efforts by NSF, Census, and NBER – new pilot survey on U.S. management practices in 2011.

This Study

- A forward-looking intangible investment model (2012, 2013, Li)

- Two intangibles: R&D Assets and Organizational Capital

- Dataset: use Compustat (company-based) for the consistency of the measurement of the two intangibles.

  1) R&D expenditures, SG&A expenditures (Lev and Radhakrishnan, 2002), and other data including the market value of common equity at the end of fiscal year.

  2) Nine R&D intensive industries

  3) Period: 1987-2010.

Depreciation Rates of R&D Assets and Organizational Capital

Industry	$\delta_{R\&D}$ with 2-year gestation lag	δ_{OC} with 1-year gestation lag
Aerospace	21%	11%
Communication	31%	20%
Computer System Design	43%	8%
Computer & peripherals	41%	6%
Motor	28%	6%
Navigational	26%	4%
Pharmaceutical	10%	2%
Scientific R&D	16%	10%
Semiconductor	27%	16%
Software	24%	7%

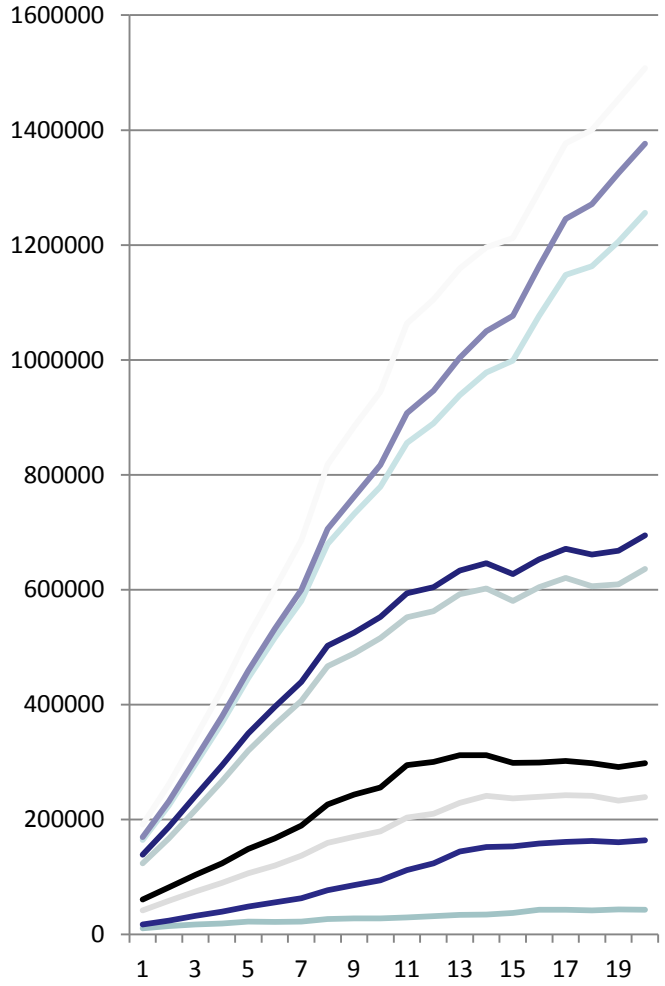
Note:

- The R&D depreciation rates are estimated based on BEA's R&D dataset.
- The depreciation rates of organization capital are estimated based on Compustat dataset.
- Both datasets cover the period of 1987-2011.

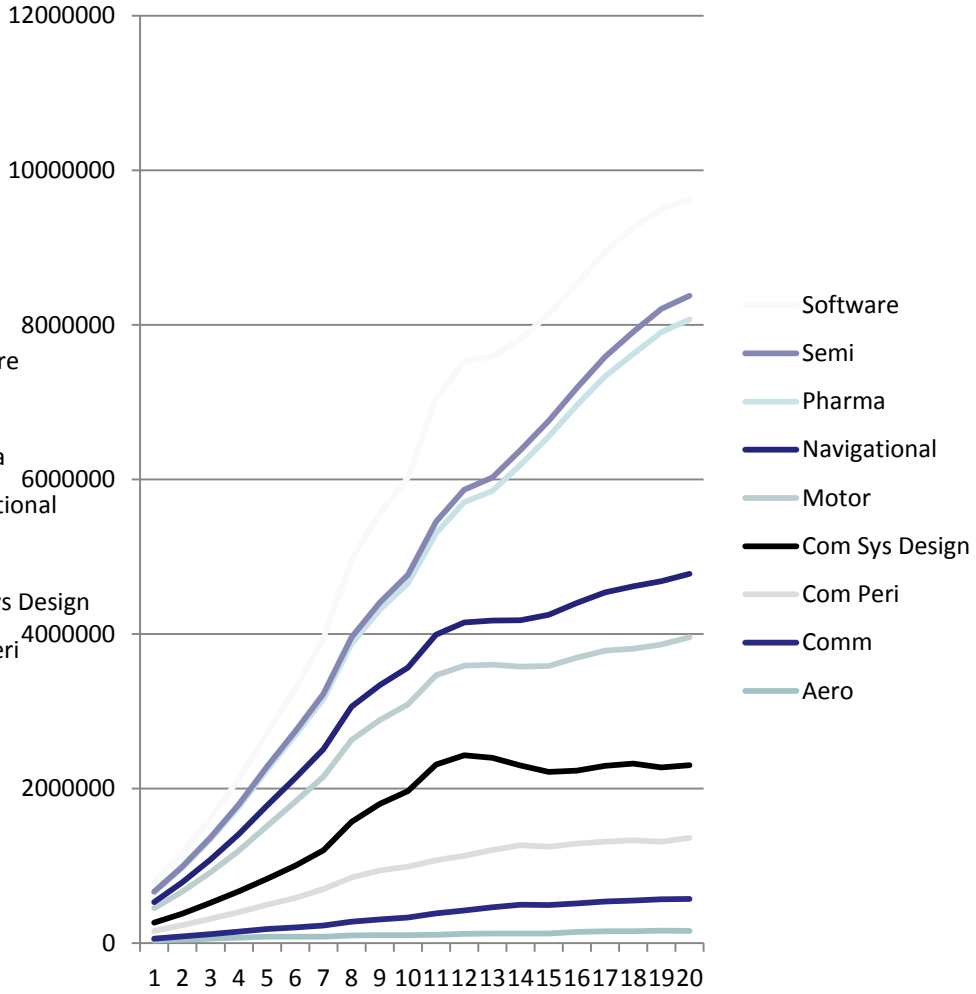
Market Leaders vs. Followers: Depreciation Rates of R&D Assets and Organizational Capital

Industry	$\delta_{R\&D,\ Leader}$	$\delta_{R\&D,\ Follower}$	$\delta_{OC,\ Leader}$	$\delta_{OC,\ Follower}$
Aerospace	29%	28%	13%	18%
Communication	29%	27%	17%	15%
Computer System Design	17%	23%	1%	13%
Computer & peripherals	26%	27%	3%	15%
Motor	21%	23%	5%	8%
Navigational	27%	34%	3%	7%
Pharmaceutical	9%	39%	2%	20%
Semiconductor	26%	26%	16%	19%
Software	21%	29%	2%	13%

Ranking of Annual Stock Size of R&D Assets and Organizational Capital



Annual Stock of R&D Assets



Annual Stock of Organizational Capital

Global Top Ten Public Companies in Software, Semiconductor, and Pharmaceutical Industries

Rank	Software Co.	Country	Semi. Co.	Country	Pharmaceutical Co.	Country
1	Microsoft	U.S.	Samsung Electronics	South Korea	Pfizer	U.S.
2	Oracle	U.S.	Intel	U.S.	Novartis	Switzerland
3	SAP	Germany	Qualcomm	U.S.	Sanofi	France
4	Symantec	U.S.	Taiwan Semiconductor	Taiwan	Merk & Co	U.S.
5	VMware	U.S.	Texas Instrument	U.S.	Roche Holding	Switzerland
6	CA	U.S.	ASML Holding	Netherlands	GlaxoSmithKline	U.K.
7	Adobe Systems	U.S.	Broadcom	U.S.	Abbott Laboratories	U.S.
8	Intuit	U.S.	SK Hynix	South Korea	Astra Zeneca	U.K.
9	Fiserv	U.S.	Applied Materials	U.S.	Eli Lilly & Co	U.S.
10	Amadeus Holdings	Spain	Tokyo Electron	Japan	Tera Pharmaceutical Inds	Israel

Source: Forbes, 2013. http://www.forbes.com/global2000/

Global Top Ten Public Companies in the Auto and Computer Systems Design Industries

Rank	Auto Co.	Country	Com Sys Design	Country
1	Volkswagen Group	Germany	IBM	U.S.
2	Toyota Motor	Japan	Accenture Ireland	Ireland
3	Daimler	Germany	Tencent Holdings	China
4	Ford Motor	U.S.	Tata Consultancy Services	India
5	BMW Group	Germany	Infosys	India
6	General Motors	U.S.	Wipro	India
7	Nissan Motor	Japan	Cognizant Technology	U.S.
8	Honda Motor	Japan	Capgemini	France
9	Hyundai Motor	South Korea	Computer Sciences	U.S.
10	SAIC Motor	China	Atos	France

Source: Forbes, 2013. http://www.forbes.com/global2000/

Relationship between R&D and Organizational Capital vs. Offshore Outsourcing Pattern

In-house RD x OC		Industry	RD
Organizational Capital	+	Non IT-Hardware Industries	Lower degree of offshore outsourcing
		Ex. pharmaceuticals, motor, and computer systems design	
	-	IT Hardware Industries	Higher degree of offshore outsourcing
		Ex. computer & peripherals and communication equipment	

The Impacts of Treating R&D Expenditures and SG&A Expenditures as Investment on Each Industry's 2011 CFC

Industry	CFC due to RD	CFC due to OC	Total Increase in CFC
Computer and electronics products	0.53%	0.92%	1.45%
Motor	3.5%	5.6%	9.1%
Chemical	0.97%	1.44%	2.41%
Publishing (includes software)	0.16%	0.37%	0.53%
Computer system design	0.37%	1.08%	1.45%

Notes: 1. The values shown here underestimate the true impacts on the industry and the economy. The calculations of stocks only include firms that are in the Compustat dataset, which only cover publically traded firms. 2. To calculate the percentage increase in CFC in each industry, we use the GDP by industry value added numbers posted on BEA's website.

Conclusions

1. Organizational capital depreciates slower than R&D assets.
2. Market leaders have smaller depreciation rates of both intangibles than their followers.
3. U.S. industries with higher rankings in intangibles generally have greater global competitiveness.
4. Outsourcing decision on R&D activities is related to the interaction relationship between R&D assets and organizational capital.
5. During the sample period, the estimated impact of incorporating organizational capital on GDP is at least 1.5 times of that of incorporating R&D.

Summary of Impacts of R&D Assets, Organizational Capital, Physical Assets, and Their Relationship on Profitability

Industry	RD	OC	Tangible	RD*OC	RD*Tangible	OC*Tangible
Aerospace	-/*	-/	+/**	+/**	-/**	+/*
Communication	+/*	+/*	+/*	-/*	+/**	-/
Computer and Peripherals	+/*	+/*	+/	-/*	+/	+/*
Computer Systems Design	-/*	+/*	+/	+/*	+/*	-/*
Motor	-/**	+/**	+/*	+/*	+/	-/
Navigational	-/	+/*	+/*	+/	+/	-/**
Pharmaceutical	-/*	+/*	+/*	+/*	+/*	-/*
Semiconductor	-/	+/	+/*	+/*	-/*	-/
Software	-/*	+/*	+/*	-/	+/*	-/*

Note: * 10% significant level. ** 5% significant level. (Panel Regression Analysis)