

The Democratization of R&D in the U.S.^{†*}

Intellectual Capital for Communities, Paris

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Robert M. Hunt & Leonard Nakamura
Federal Reserve Bank of Philadelphia

*: The views expressed here are the authors', not necessarily those of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

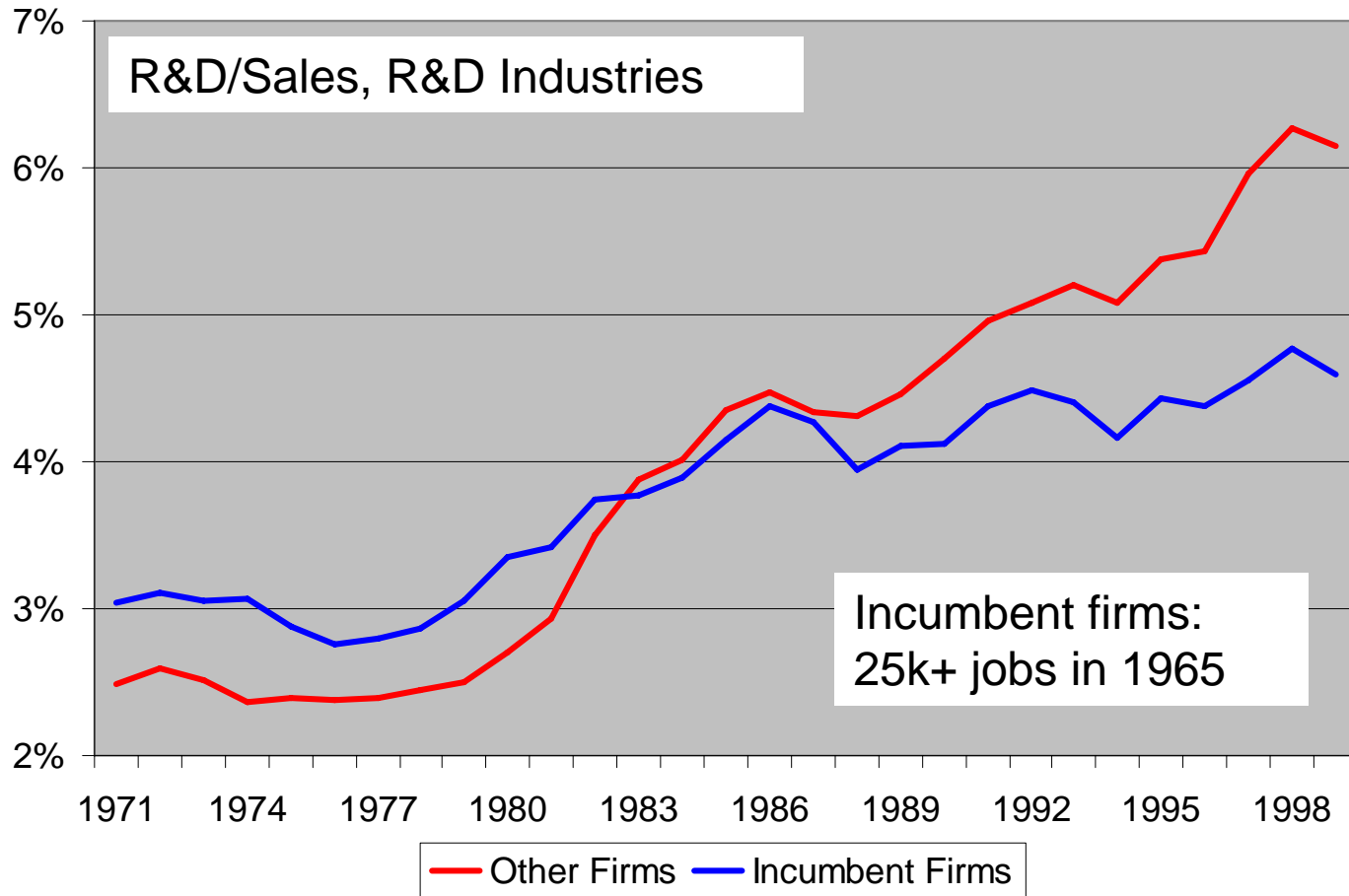


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Motivation

- Prior to 1980, R&D is dominated by large, established firms
 - We call these firms *incumbents*—firms with 25,000+ jobs in 1965
- Over the next 20 years...
 - The R&D intensity of incumbent firms rises a bit
 - But not nearly as much as among smaller, younger firms
 - We call these firms *entrants*
 - Eventually, these entrants are more R&D intensive than incumbents
- The increasing R&D intensity of entrants accounts for nearly all of the secular rise in R&D intensity in the U.S.

R&D Intensity of Incumbents & Other Firms



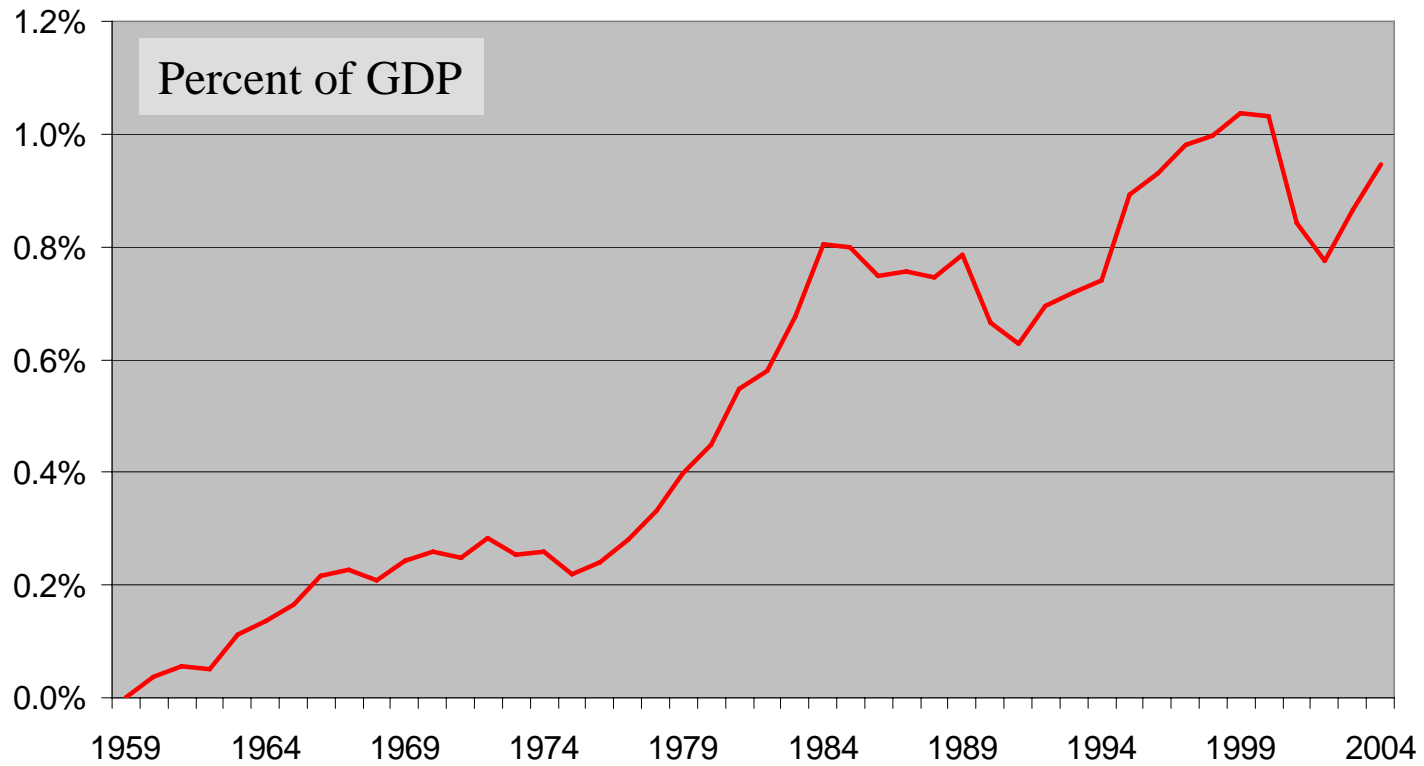
The comparative advantage of big firms has changed

- In addition to well developed R&D labs ...
- Established firms benefited from other barriers to entry
 - Particularly in administration, marketing and distribution...
 - We'll call this barrier the *cost of marketing capital*
- Those barriers declined after 1975 , thanks to
 - Computers... inventory systems, administration
- Claim:
 - The patterns in the data are not simply signs of a productivity shock
 - They are likely a combination of two or more factors including...
 - ...falling costs of marketing capital

Empirical Tests

- We estimate R&D Reaction Functions
 - Regress own R&D intensity on R&D intensity of rest of industry
 - Interact this with our proxy for falling b – *nominal computer investment as a share of GDP*
 - Fixed effects, with a time trend (similar results with year dummies)
- We estimate Market Value
 - Regress own market value on physical assets, own R&D, and own patent stock
 - Each variable is normalized by operating expenses
 - Interact these with our proxy for falling b
 - Fixed effects, with time trend (similar results with year dummies)

Investment in Computers (current \$)



Reaction Function Regressions – Fixed Effects

Dependent Variable: R&D intensity (R&D / Operating Expense)

	All Firms	Non-computer Industries			
		Incumbent Industries			Non-incumbent Industries
		All Firms	Incumbent Firms	Other Firms	
constant	0.3832***	0.4467***	0.0740	0.3160*	0.6114***
time	-0.0002***	-0.0002***	-0.0000	-0.0002*	-0.0003***
Comp_sh	0.0107***	0.0104***	-0.0085**	0.0011	0.0153***
Rival R&D intensity _{t-1}	-0.0725**	-0.1271***	0.1057	0.1841***	-0.2321***
Interaction w/ comp_sh	0.2706***	0.3095***	0.7149***	0.4018***	0.2381***
<i>n</i>	33,793	10,512	1,320	9,192	14,381
Within <i>R</i> ²	.0263	.1034	.3857	.0898	.0172

Market Value Regressions – Demeaned Variables with Selection Correction[#]

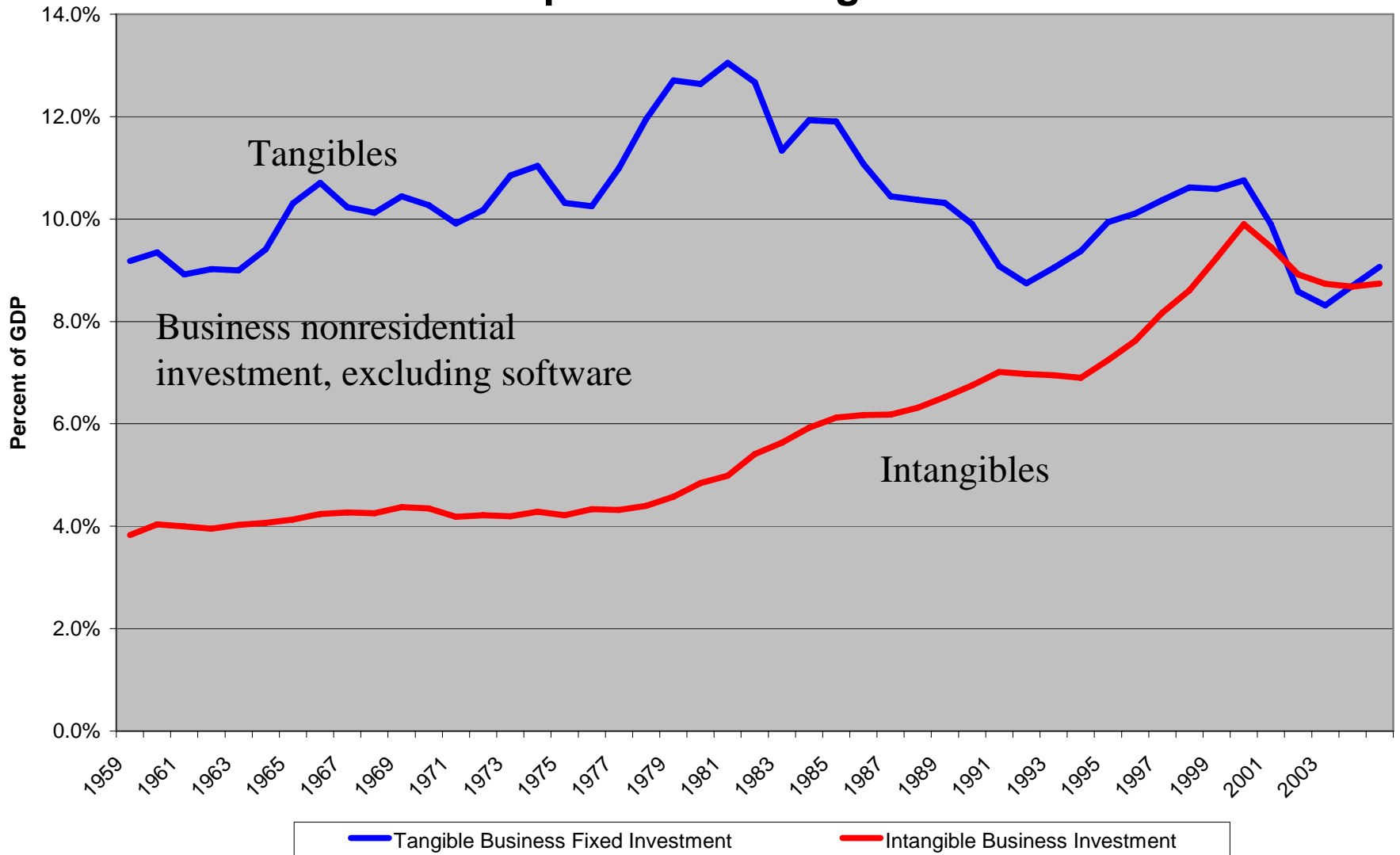
	All Firms	Non-computer Industries			
		Incumbent Industries			Non-incumbent Industries
		All Firms	Incumbent Firms	Other Firms	
Comp_sh	0.4693***	0.1216	-0.4936***	0.0205	0.2639**
Book Value	1.9768***	1.7245***	1.3811***	1.5459***	1.8625***
Interaction	-0.1201***	-0.1078***	-0.1225	0.0065	-0.1617***
R&D	3.6111***	4.9645***	2.1353	1.1254	1.0088
Interaction	-2.3156***	2.1072**	2.5084***	1.4243***	0.5970
Patents	0.0235	0.0693	4.9830***	-0.1400	0.0538
Interaction	0.2133**	0.0976	-5.1352***	0.5048**	0.0618
<i>n</i>	36,688	25,850	1,307	9,313	15,230
Wald Stat.	4,015	2,764	731	1,276	1,351

[#]: All variables normalized by operating expenses. Regressions include a constant and time trend. Patents are sum of past 5 years

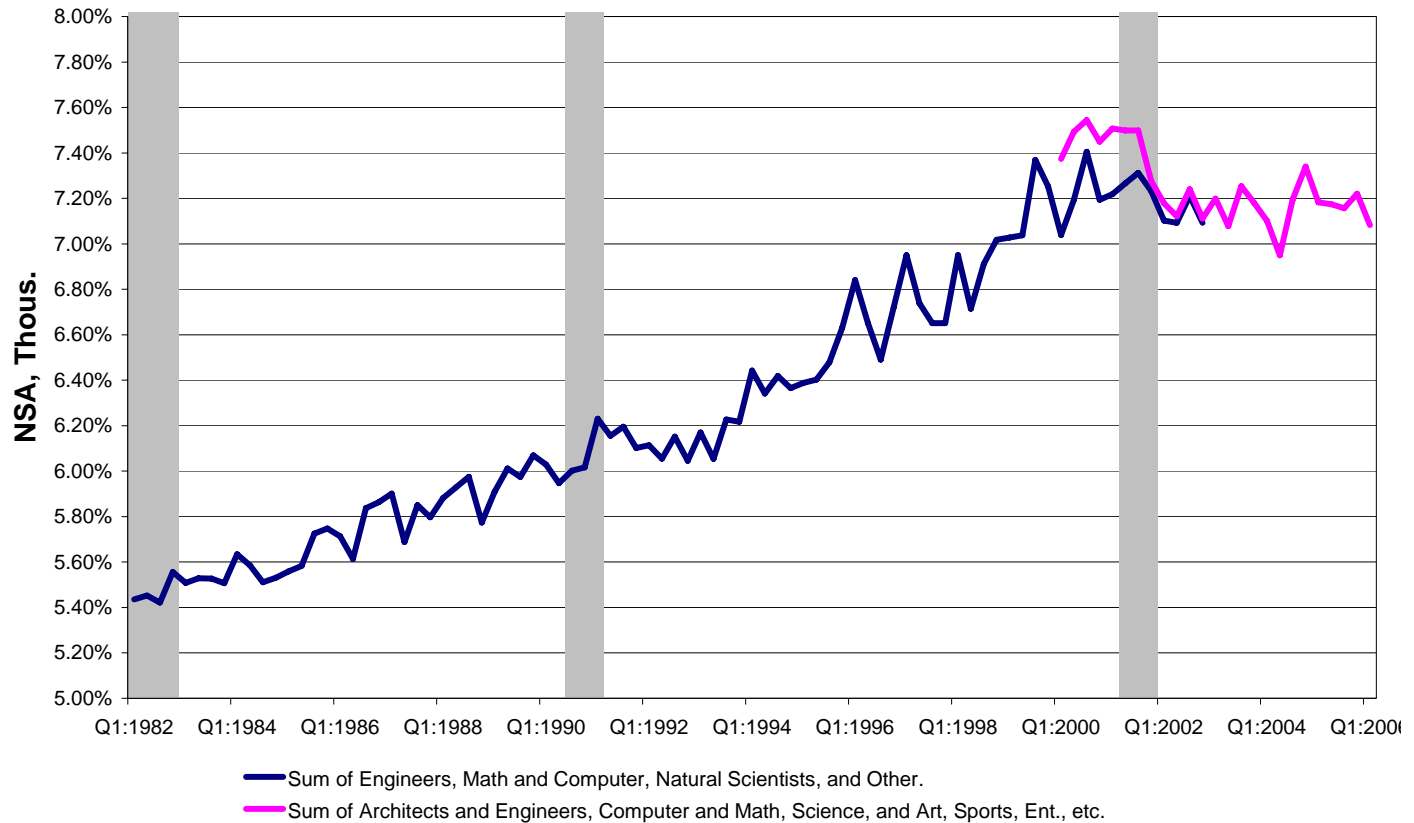
Investment in intangibles in the US rose to 2000

- As computerization made new products more profitable
 - and small firms came to compete in these markets with large firms
- US investment in intangible assets rose relative to GDP
 - R&D, software, advertising, media content, artistic originals
 - professional creative occupations
 - engineers, math and computer science, scientists, artists, designers, writers, entertainers
- Since 2000, intangible investment has grown at the same rate as rest of economy

Investment: In the US, Intangibles are as Important as Tangibles



Workers in creative occupations (Quarterly, percent of total)



Conclusions

- The empirical work shows a complicated story
- Many results are consistent with falling b
 - Higher R&D intensities, movement of reaction function for entrants, and changes in firm market value
- Taken as a whole, the empirical results suggest that declining costs of marketing capital are an essential part of the story
 - There is much more work to do
- From 1977 to 2000, US investment in intangible assets rose under the impetus of computerization
 - But for the past six years, intangible investment has not been rising as a proportion of output