The Real Effect of Accounting for Software Development Costs on Corporate Innovation

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Research Questions

Whether the adoption of SFAS-86 (Accounting for the Costs of Computer Software to Be Sold) affects US public software firms'

- quantity of innovation outputs,
- scientific and economic quality of innovation, and
- innovation strategies

as compared with other high-tech firms?

Accounting for R&D

IAS 38	SFAS-86 (ASC 985-20)	SFAS-2 (ASC 730)
Capitalization regime	Capitalization regime	Expense regime
R&D	Software development	R&D
Distinguish research and development	-	-
Technical feasibility and probable future economic benefits	Technical feasibility and probable future economic benefits	-
-	How to establish technical feasibility	-
Amortization	Amortization	-

What we know:

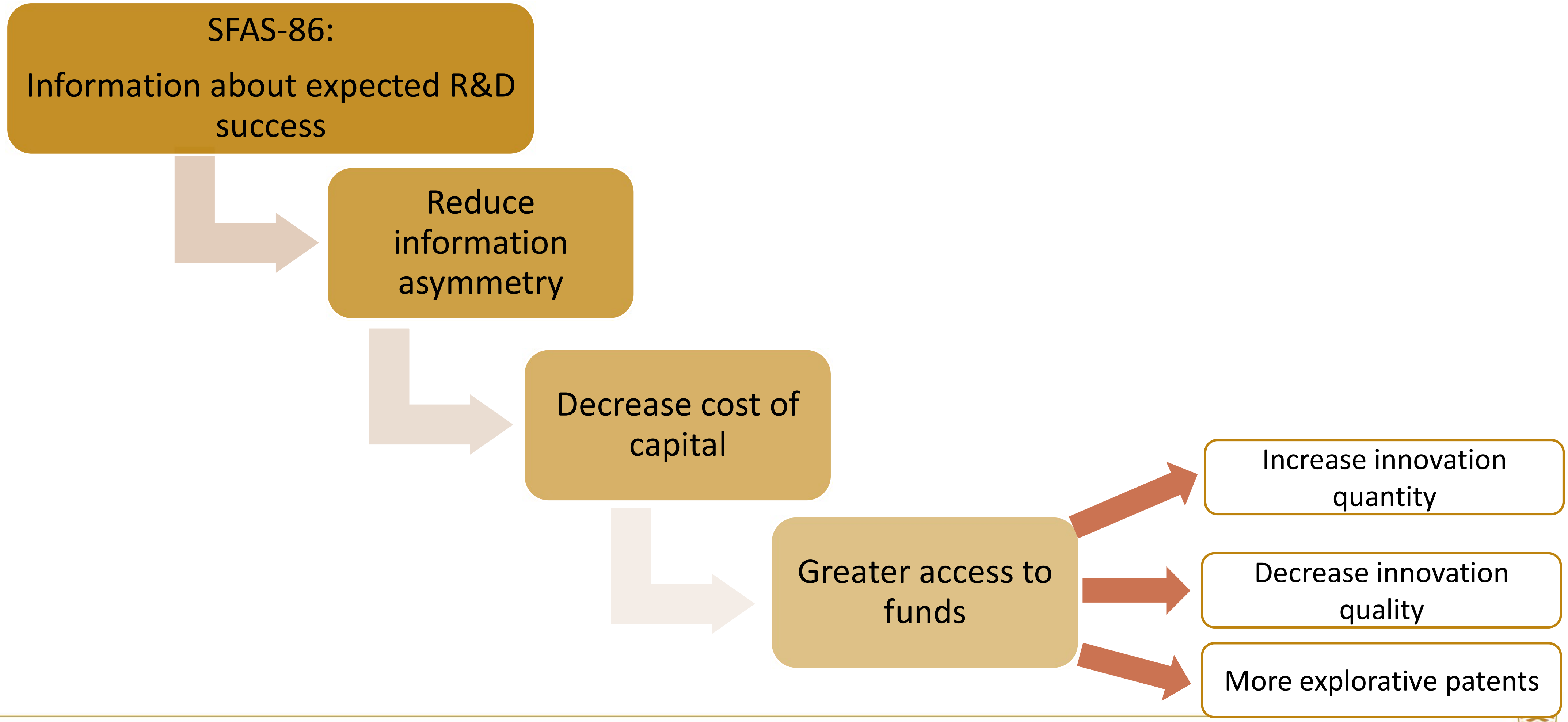
	Capitalization regime vs Expense regime
Pros	Software capitalisation information helps forecasting future economic benefits (Aboody and Lev, 1998)
	Software capitalisation information helps reduce information asymmetry (Mohd, 2005; Oswald, 2008; Krishnan and Wang, 2014) and firms' financing costs (Kreß, Eierle and Tsalavoutas, 2019).
	Software capitalisation is associated with lower underinvestment (Dinh et al. 2019).
	Mandated expensing of R&D results in information loss for investors (Wyatt, 2005).
	R&D expensing is associated with reduced R&D investment (Horwitz and Kolodny, 1980; Elliott et al., 1984; Wasley and Linsmeier, 1992).
Cons	Capitalised development costs in some IFRS countries are not informative (Dinh et al. 2016, Mazzi et al. 2019).
	Experimental evidence shows that managers tend to keep investing in failing projects when R&D capitalisation is allowed (Seybert 2010, 2016).
	Software firms' earnings quality declined following the adoption of SFAS-86 (Ciftci 2010) .
	Software capitalisers' innovation efficiency decreases relative to expensers following the introduction of SFAS-86 (Li 2012).

As prior studies focus on the economic consequences of R&D capitalization, we provide evidence on the effect of accounting for software development on firms' creation of **scientific values**.

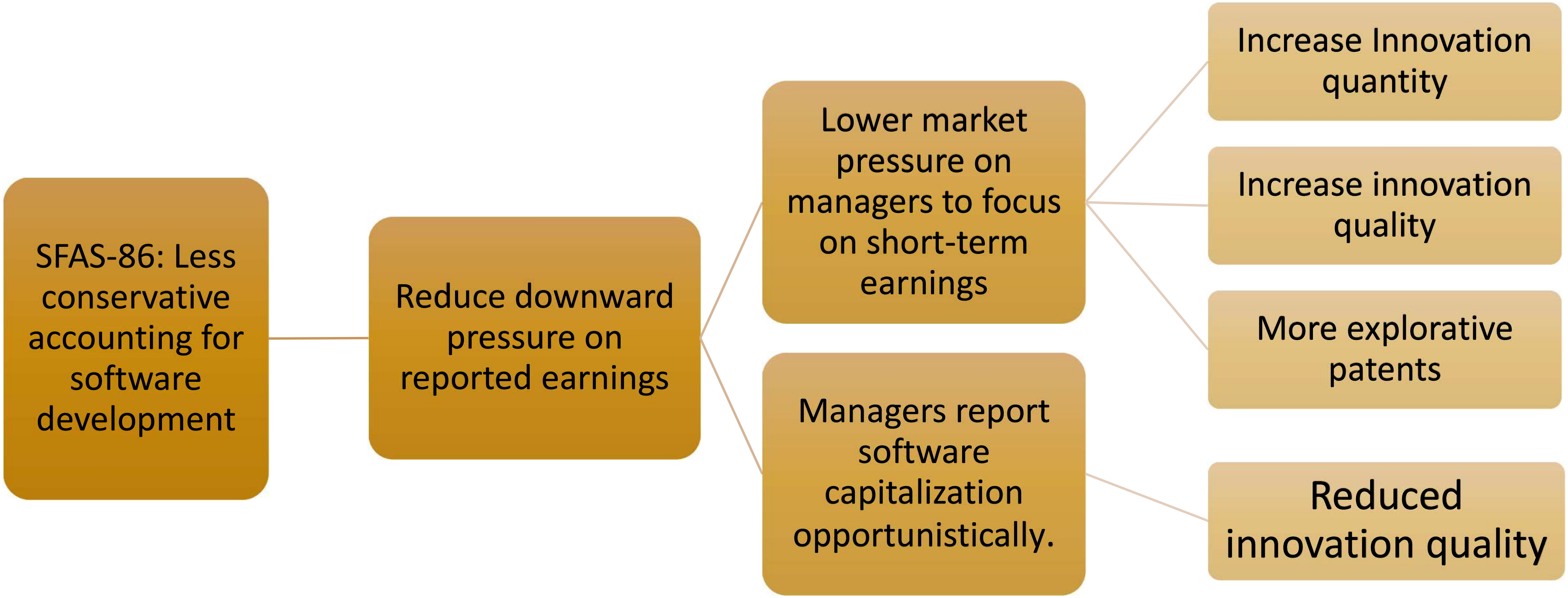
Innovation characteristics

Patent quantity	Patent quality	Innovation strategies
Total patent count: # of new patents applied in a year	***Average citation:*** Average citation received from new patents	***Explorative patents:*** % of new patents citing mainly unknown knowledge
Total citation count: # of citation received from new patents	***Patent Generality:*** How widely are new patents cited by different tech. classes	***Exploitative patents:*** % of new patents citing mainly known knowledge
	Patent Originality: How widely do new patent cite different tech. classes	***Patent diversity:*** How diverse are new patents' tech. classes
	Market value of patent: Economic value of new patents	

Hypotheses – information asymmetry and financing cost



Hypotheses – managerial myopia



Hypotheses – the Learning effect

Financial reporting affects managers' information set as they assimilate new information to comply with new accounting standards

SFAS-86 requires managers to learn about the feasibility and value of the underlying investment which reduce uncertainty in investment decision, ensure continuous monitoring of the project and evaluate existing and new knowledge

- Innovation Quantity?
- Increase Innovation Quality
- More Explorative Patents
- More Exploitative Patents

Research Design

- We compare changes in innovation characteristics following the adoption of SFAS-86 between software firms and other high-tech firms.

- Treatment Group:

  Identify software firms from Hall and MacGarvie (2010)

  130 public software firms

- Control Group

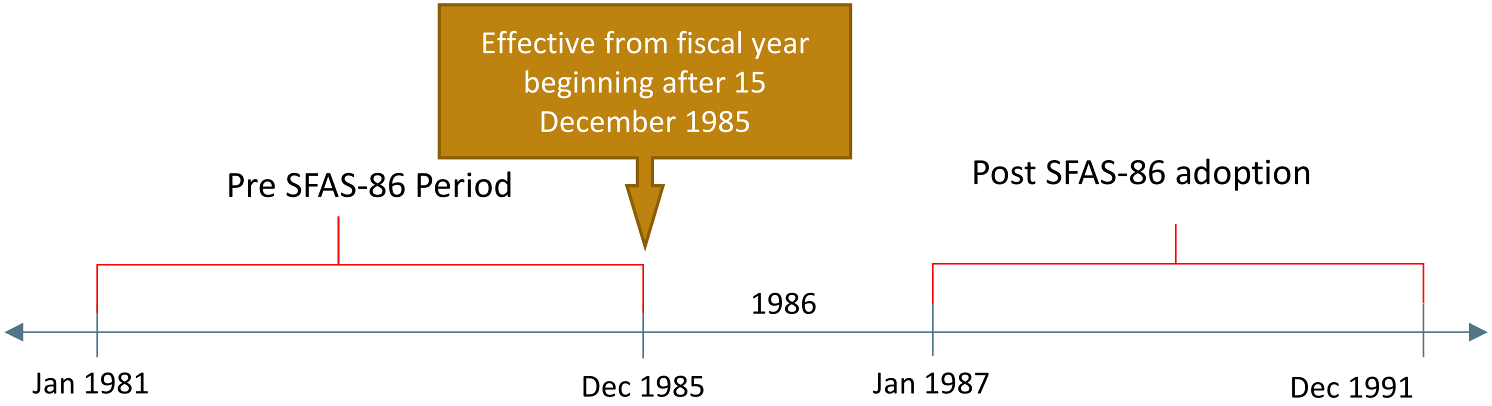
  223 other high-tech public firms

  Matched to treatment based on several common firm characteristics

- Alternative Control Group

  Private and government software entities matched on similar patenting activities

Timeline and empirical model



Pre SFAS-86 period: 1981 to 1985

Post SFAS-86 adoption period: 1987 to 1991

$$INNOVATION_{it} = \alpha_0 + \beta_1\, TREAT_i \times POST_t + \beta_2 SIZE_{it} + \beta_3\, ROA_{it} + \beta_4\, CAPEX_{it}$$
$$+ \beta_5\, TANGIBLES_{it} + \beta_6\, R\&D_{it} + \beta_7\, CASH_{it} + \beta_8\, LEVERAGE_{it}$$
$$+ \beta_9\, TOBINQ + \beta_{10}\, FOLLOW_{it} + \textit{Firm-fixed Effects}$$
$$+ \textit{Year-fixed Effects} + \varepsilon_{it}$$

Sample

- Data sources:
  - Patent and citation data come from the National Bureau of Economic Research database
  - Data on the economic value of patents come from Kogan et al. (2017)
  - Data on software firm classification come from Hall and MacGarvie (2010)
  - Financial data are collected from the CRSP/COMPUSTAT merged dataset.
  - Data on analyst following come from the I/B/E/S database.

- To be included in the sample, we require:
  - Non-missing total assets
  - Firms have at least one patent application in the pre-SFAS-86 period
  - Observations not from 1986

- The final sample has 10,195 firm-year observation. The matched sample contains 2,039 firm-year observations.

Average patenting activity by year (N=10,195)

	Software Firms (N=1,177)				Other high-tech Firms (N=9,018)		
Year	Patent	Citations	Average Citations		Patent	Citations	Average Citations
1981	42.17	378.66	8.80		5.99	44.09	5.96
1982	43.13	404.19	8.81		5.57	40.26	5.21
1983	39.96	375.06	11.16		4.94	37.07	5.12
1984	40.92	369.46	9.87		5.15	40.17	5.65
1985	44.37	406.35	10.17		5.31	43.45	6.12
1987	58.84	488.08	10.31		6.17	44.51	4.87
1988	66.70	539.11	8.31		6.46	41.84	3.98
1989	69.13	526.25	7.13		6.58	39.18	3.64
1990	74.78	490.17	6.32		7.10	38.51	3.06
1991	42.17	378.66	8.80		5.99	44.09	5.96

Main results

Compared to other public high-tech firms, public software firms'

- patent and citation ↑
- average citation, patents' generality and originality ↑
- monetary value ↓
- explorative patents ↑
- patents' portfolio diversity ↑

in the post SFAS-86 adoption period from the pre-SFAS-86 period.

Public vs private software entities

	Quantity		Quality			Strategy		
VARIABLES	$PATENT_{it}$	$CITES_{it}$	$AVGCITE_{it}$	$GENERAL_{it}$	$ORIGINAL_{it}$	$EXPLOIT_{it}$	$EXPLORE_{it}$	$DIVERSITY_{it}$
$TREAT_i \times POST_t$	0.123***	0.325***	0.246***	0.085***	0.082***	0.004	0.080***	-0.000
	(3.86)	(3.43)	(3.08)	(3.18)	(3.37)	(0.65)	(3.10)	(-0.02)

Consistent with main result, compared to private software entities, public software firms'

- innovation quantity increases
- innovation scientific quality increases
- produce more explorative patents

in the post SFAS-86 adoption period from the pre-SFAS-86 period

Other robustness tests:

- Falsification tests: adoption of SFAS-86 does not affect capital expenditure, the number of employees, tangible assets, M&A, leverage and profitability.
- No sign of pre-SFAS86 differences between the treatment and control groups.

The role of financially constraints firms

- We expect that SFAS-86 brings greater benefit to financially constrained firms by reducing the cost of capital, and consequently, fostering innovation.

- We use the KZ-index (Kaplan-Zingales Index) as a proxy to measure financial constraints.

- We find evidence consistent with the expectation on analyses of total citations, average citations, patent generality and explorative patents

Software capitalization and meeting performance targets

- SFAS-86 may provide opportunities for managers to use software capitalization to meet performance target.

- We predict that innovation activities of software firms that just meet or beat earnings targets are less benefited post SFAS-86 adoption.

- *MEET* =1 if the firm i's earnings change between year t and t-1 lies within the interval [0, 0.005] or zero otherwise.

- We find results confirming this prediction in analyses of innovation quantity, innovation scientific quality, and patent diversity.

Short-term earnings pressure from analysts

- Financial analysts can create market pressure on managers, which encourages them to be more myopic with innovation investment

- SFAS-65 may alleviate this effect.

- We find that the effects of SFAS-86 on software firms' innovation activities are stronger for firms with high analyst coverage.

Contributions

- This study extends research on accounting for intangible to focus the impact of accounting standards on firms' technology and scientific development. Innovation characteristics have significant social implications.

- Standards requiring R&D capitalization, such as IAS-38 and SFAS-86, may be associated with real economic and scientific benefits generated from greater innovation quantity, quality, and novelty.

- This study suggests that standard setters may take scientific benefits of accounting standard of intangible into consideration when evaluate the benefits and costs of such standards.

Conclusion and limitations

- Public software firms' innovation quantity, scientific quality, explorative patents and patent diversity increases while the monetary value decreases following the adoption of SFAS-86.

- Endogeneity issue: the estimated effects can be biased by the overall software boom in the late 1980s.

- Potential generalisability issue.
  - The event occurs almost 30 years ago.
  - SFAS-86 governs a specific class of technology innovation. It is able to provide specific guidelines on testing technical feasibility.

- Difficult to test the learning effect.

Thank you
and
Comments welcome