

# Patent Commercialization Strategy and IPO Underpricing: Evidence from the US Semiconductor Industry

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# Motivations

- Innovation creates information asymmetries between corporate insiders and external investors (Aboody & Lev, 2000)
- Information asymmetries represent a problem especially for the funding of younger and R&D-intensive firms, creating serious financing constraints (e.g., Guiso, 1998; Carpenter & Petersen, 2002)
- IPO may be a critical step in the financing of these firms, but the presence of high information asymmetries might result in potential inefficiencies and in higher risks of underpricing, the stock return of the first trading day (e.g., Guo et al., 2006).

# Motivation: the emergence of licensing-based business models

**ARM** The Architecture for the Digital World®



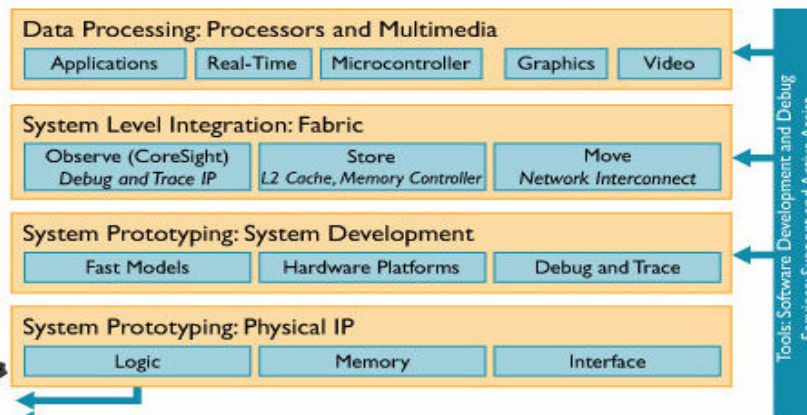
ARM Holdings is the world's leading semiconductor intellectual property (IP) supplier and as such is at the heart of the development of digital electronic products. Headquartered in Cambridge, UK, and employing over 1700 people, ARM has offices around the world, including design centers in France, India, Sweden, and the US.



## » Company Highlights

- The world's leading semiconductor IP company
- Founded in 1990
- Over 15 billion ARM based chips shipped to date
- 600 processor licenses sold to more than 200 companies
- Royalties received on all ARM-based chips
- Gaining market share in long-term secular growth markets
- ARM revenues typically grow faster than overall semiconductor industry revenues

The ARM business model involves the designing and licensing of IP rather than the manufacturing and selling of actual semiconductor chips. We licence IP to a network of [Partners](#), which includes the world's leading semiconductor and systems companies. These Partners utilize ARM IP designs to create and manufacture system-on-chip designs, paying ARM a license fee for the original IP and a royalty on every chip or wafer produced. In addition to processor IP, we provide a range of tools, physical and systems IP to enable optimized system-on-chip designs.



# Research Questions

We intend to analyze whether and to what extent **IPO underpricing** is affected by the choice of a given **patent commercialization strategy**

***i) How does the choice of a given patent commercialization strategy affect IPO underpricing?***

- licensing-based strategies vs.
- integrated strategies

***ii) Does a firm's patent stock moderate the effect of the patent commercialization strategy on IPO underpricing?***

# Is IPO underpricing associated with innovation?

- The most established explanation for underpricing resides in the model based on information asymmetries (Rock, 1986).
- IPO underpricing may be mitigated by credible signals:
  - e.g., *underwriter prestige* (Carter et al., 1998), *venture capital* (Megginson & Weiss, 1991), *presence of founders* (Nelson, 2003), *top management team* (Cohen & Dean, 2005) and *CEO equity* (Certo et al., 2003).
- Recent studies analyze the relation between IPO underpricing and different *innovation measures* finding:
  - > a positive relation between **R&D intensity** and IPO underpricing (Guo et al., 2006);
  - > the relation between **patents** and IPO underpricing depends on the appropriability regime (Heeley et al. 2007).

# Patent commercialization strategy and IPO underpricing

**Licensing-based patent commercialization strategies** increase information asymmetries between insiders and external investors:

- > Higher intangible intensity: financial statements and financial analysts' reports are less informative for external investors (e.g., Barron et al, 2002; Gu and Wang, 2005; Guo et al., 2005)
- > Risks of opportunistic behavior specifically related to the licensing contracts (e.g., Teece, 2000)

*Hypothesis 1. IPO underpricing will be higher for those firms relying more on a licensing-based patent commercialization strategy*

# From inSilicon IPO prospectus

Factors that could cause our revenue and operating results to vary from quarter to quarter include:

- shifts in demand for and average selling prices of semiconductors that incorporate our technology;
- large orders or regional spending patterns unevenly spaced over time;
- the financial terms of our contractual arrangements with our licensees and partners that may provide for significant up-front payments or payments based on the achievement of certain milestones;
- the relative mix of license revenues, royalties and services;
- the impact of competition on license revenue or royalty rates;
- establishment or loss of strategic relationships with semiconductor or systems companies;
- timing of new technologies and technology enhancements by us and our competitors;
- seasonality of demand; and
- changes in development schedules, research and development expenditure levels and product support by us and semiconductor and systems companies.

# Patent commercialization strategy and IPO underpricing

Patents are ambiguous signals of quality:

- They are perceived as a quality signal by external investors (e.g., Hsu and Ziedonis, 2008)
- ... but they increase underpricing (Chin et al., 2006)
- The transparency of the link between patents and appropriability affects information asymmetries and IPO underpricing (Heeley et al., 2007)

Patents are a more important quality signal when the patent commercialization strategy involves a clearer link between patents and firm performance.

*Hypothesis 2. A firm's patent stock negatively moderates the relationship between patent commercialization strategy and IPO underpricing*



# Semiconductor Industry

- High R&D intensity
- There is a widespread recourse to patenting (e.g. Hall and Ziedonis, 2001)
- The vertical specialization of design and manufacturing activities has led to the emergence of two different commercialization strategies (e.g. Hall and Ziedonis, 2001; Linden and Somaya, 2003; Ahuja and Lahiri, 2006):
  - > **integrated strategies**: adopted by firms engaged in the development, manufacturing and commercialization of new technologies;
  - > **licensing-based strategies**: adopted by firms focusing on the development of patented technologies which are then licensed to external partners (so called fabless companies).

# Sample

- 130 IPOs from the semiconductor industry in the U.S. (1996-2007)

IPO year	No. Firms	% of total sample
1996	8	6
1997	14	11
1998	6	5
1999	19	15
2000	31	24
2001	5	4
2003	5	4
2004	14	11
2005	9	7
2006	9	7
2007	10	8
<b>Total</b>	<b>130</b>	<b>100</b>

# Data Sources

- **SDC database:** IPO-related information
- **Worldscope:** accounting and financial data
- **SEC website:** IPO prospectuses (S1) of sample firms
  - *Information on firms' commercialization strategies*
  - *Disclosure on IPRs*
- **Delphion:** Patent portfolios of sample firms
- **Ritter's database:** Underwriters' prestige

# Variables

## Dependent Variable:

*Underpricing: the difference between the closing price of the stock at the end of the first day of trading and the initial offer price divided by the offer price*

$$\frac{P_1 - P_0}{P_0}$$

## Independent variables:

- *Licensing-based strategy*: Revenues from licenses/Total Revenues
- *Patent stock*: Number of patent applications in the 5 years before the IPO (Heeley et al., 2007)

## Control variables:

Log (age), VCBacked (dummy), R&D intensity (R&D/Revenues), Loss firms (dummy), Leverage (Debt/Assets), Revenues, Prestigious underwriter (dummy), Insider shareholders, Year dummies

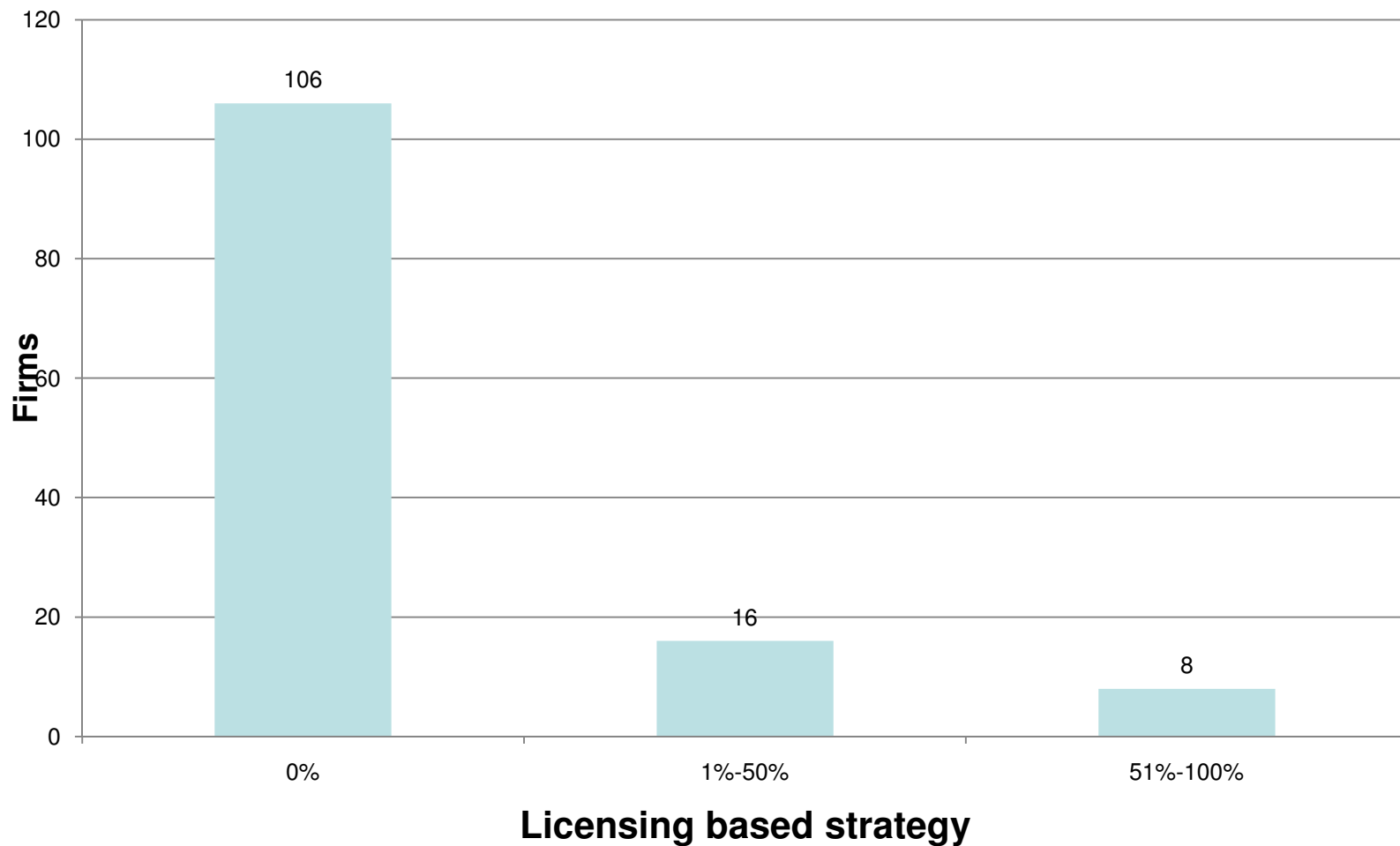
# Income statement from inSilicon IPO prospectus

	YEAR ENDED SEPTEMBER 30,				
	1995	1996	1997	1998	1999
	(IN THOUSANDS, EXCEPT PER SHARE DATA)				
<b>CONSOLIDATED STATEMENTS OF OPERATIONS DATA:</b>					
<b>Revenue:</b>					
License fees.....	\$ 2,106	\$ 2,832	\$ 4,272	\$ 7,304	\$ 14,973
Services.....	--	498	839	1,488	3,982
Total revenue.....	2,106	3,330	5,111	8,792	18,955
<b>Cost of revenue:</b>					
License fees.....	404	567	972	1,223	1,003
Services.....	--	97	638	734	826
Amortization of purchased technology.....	--	--	--	--	2,132
Total cost of revenue.....	404	664	1,610	1,957	3,961
Gross margin.....	1,702	2,666	3,501	6,835	14,994
<b>Operating expenses:</b>					
Research and development.....	798	1,808	2,310	2,947	9,092
Sales and marketing.....	575	1,223	2,128	3,843	6,350
General and administrative.....	281	549	1,049	1,368	3,364
Amortization of intangible assets.....	--	--	--	--	2,220
Stock-based compensation.....	--	--	--	--	--
Merger and restructuring charges.....	--	318	--	5,778	6,050
Total operating expenses.....	1,654	3,898	5,487	13,936	27,076
Income (loss) from operations.....	48	(1,232)	(1,986)	(7,101)	(12,082)
Income tax benefit.....	--	--	--	--	--
Net income (loss).....	\$ 48	\$(1,232)	\$(1,986)	\$(7,101)	\$(12,082)

# Descriptive statistics

<b>Variables</b>	<b>Obs</b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>
Underpricing	130	0.18	0.30	-0.63	1.24
Licensing-based strategy	130	0.05	0.15	0	1.00
Patent stock	130	30.90	57.94	0	308
log(Age)	130	2.30	0.85	1	92
VCbacked <sup>a</sup>	130	0.66	0.48	0	1
R&D intensity	130	4.26	25.01	0	257.16
Leverage	130	0.28	0.36	0	3.13
Loss firms <sup>a</sup>	130	0.50	0.50	0	1
Revenues	130	136.93	545.56	0	5660
Prestigious underwriter <sup>a</sup>	130	0.81	0.40	0	1
Insider shareholder	130	0.74	0.22	-0.99	0.99

# Licensing-based strategies



# Results

Licensing-based strategy	0.624	0.757
	<i>0.218***</i>	<i>0.239***</i>
Patent stock	0.000	0.001
	<i>0.000</i>	<i>0.000**</i>
Patent stock * Licensing based strategy		-0.003
		<i>0.001**</i>
log(Age)	-0.020	-0.019
	<i>0.036</i>	<i>0.036</i>
VCbacked <sup>b</sup>	0.077	0.084
	<i>0.057</i>	<i>0.054</i>
R&D intensity	-0.001	-0.001
	<i>0.001</i>	<i>0.001</i>
Leverage	-0.104	-0.098
	<i>0.076</i>	<i>0.074</i>
Loss firms <sup>b</sup>	-0.121	-0.127
	<i>0.051**</i>	<i>0.051**</i>
Revenues	0.000	0.000
	<i>0.000</i>	<i>0.000</i>
Prestigious underwriter <sup>b</sup>	0.172	0.168
	<i>0.054***</i>	<i>0.056***</i>
Insider shareholder	-0.231	-0.231
N	130	130
R <sup>2</sup>	0.3748	0.3876



# Discussion and conclusions

- The adoption of a licensing-based patent commercialization strategy increases underpricing at the IPO. *Innovation strategy matters for the financing of R&D-intensive firms going public*
- *Patents may represent a quality signal, but they are important when there is a clearer link with value appropriation at the firm level, i.e. patents are exploited directly through licenses*
- Firms that adopt a licensing-based strategy need greater attention to the creation and management of formal IPRs
- Implications for the timing of the IPO and on information disclosure

# Contributions

- Innovation financing literature
- Firm-specific determinants of IPO undepricing
- IPRs and value creation

# Limitations and future research

- We did not assess how specific characteristics of patent portfolios (i.e. quality, breadth, scientific strength) impact on underpricing
- Heterogeneous disclosure behavior
- Endogeneity issues