

Valuation of Innovation and Intellectual Property: The Case of iPhone



Timo Korkeamäki, Hanken
Tuomas Takalo, BoF

“Today Apple is reinventing the phone...and boy,
we have patented it.”

- Steve Jobs Jan. 9, 2007 -

What do we do?

- We present a “new” innovation and IP valuation method
 1. We adopt an old method of valuation to
 - new purposes
 - old-but-forgotten purposes
 - usual purposes
 2. We do this in an advanced way
- We use this method to value Apple’s iPhone

What do we do?

- 1) We use event study method to value a number of innovation and IP related events
 - Patent applications and grants
 - Trademark registrations
 - Rumors and news

- 2) We distinguish “important” events from “noise” events by using stock market and internet activity data

What do we do?

- We consider the marginal impact of each event on the market value of
 1. Apple
 - private value
 2. Its major competitors
 - spillovers & business stealing effects
 3. Its major suppliers
 - value effects within the supply chain

Why Apple?

- Event study uses daily stock market data and works the better the more efficient the market is
 - Apple's stock is liquid, price discovery should be excellent
 - Apple is visible:
 - Keen analyst and investor following
 - Its innovation and IP management process is actively monitored by media and internet community

Why iPhone?

- A major case of cumulative innovation
 - Dramatic consequences to Apple, the mobile phone industry, the stock market, and even to the (Finnish) economy
 - shares of industry-profits, Nokia v. Apple
 - Summer 2007: 60% v. 1%,
 - Summer of 2011: 2% v. 56%
- A key factor making Apple the most valuable firm in the history

Figure 5: Apple Inc. Market Capitalization (in Billions)

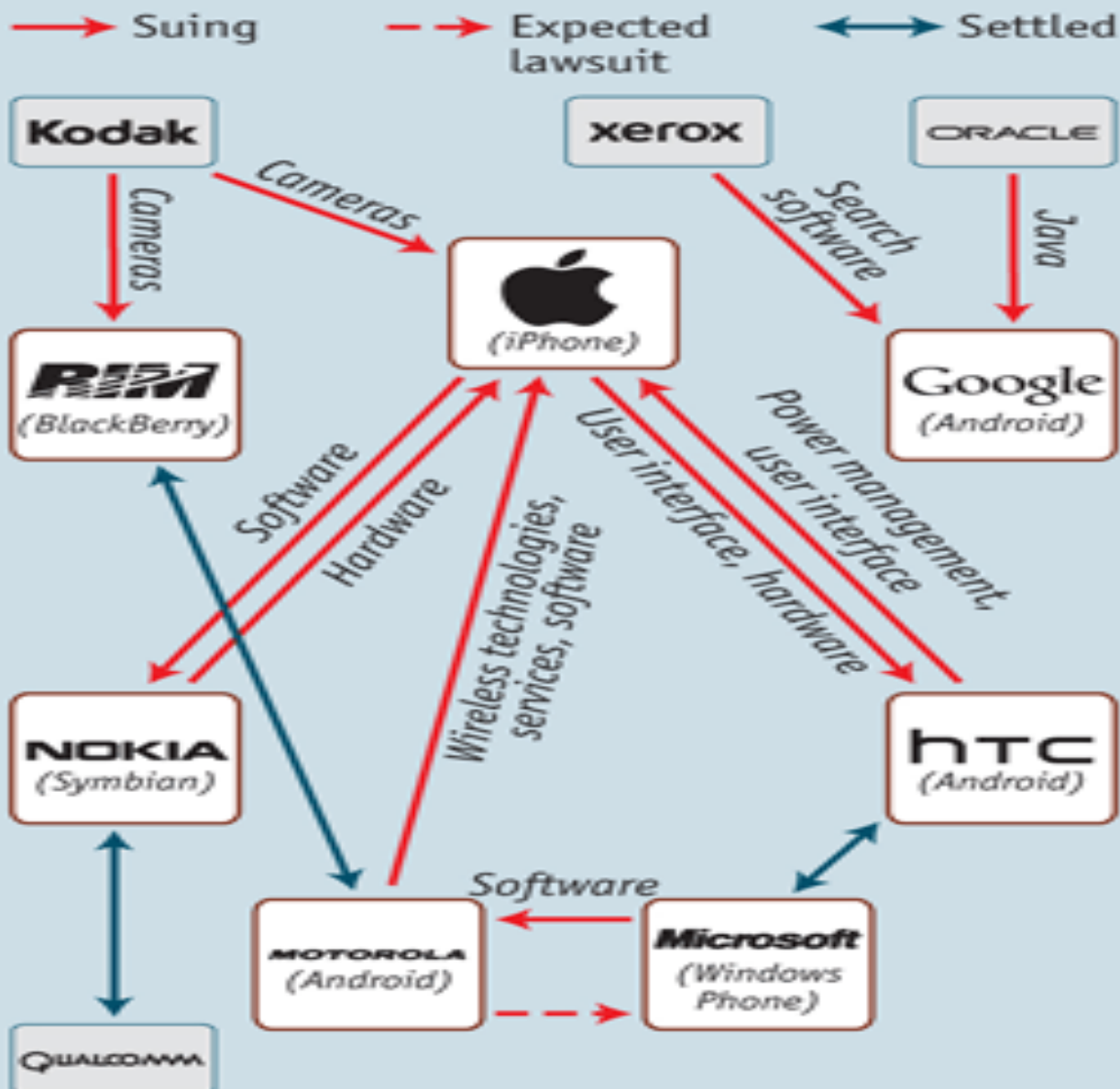


Why iPhone?

- Mobile phones is an industry where it is difficult to enter
 - Network externalities
 - Standardization
 - Patent thickets
- > extensive litigation and trading of intellectual property
 - What is the size of the cake in this trading and litigation?

Who's suing whom

Smart-phone industry, October 2010



Sources: Bristol York; company reports; *The Economist*

Literature

- Valuation of innovation using stock market reactions to news announcements
 - Chaney et al., J.Business-91 etc.
- IP valuation using daily stock market reactions
 - Patent litigation: Curtler & Summers, RAND-88 etc
 - Patent grants: Austin, AER-93, Patent and Ward RP-11 +some other
- Using patents & news to identify innovation:
 - Lerner, JFE-06

The rest of the talk

- Identification of relevant events
- Estimation methods
- Results
- Conclusion

Identification of our events

- Identification of news & rumors
 - Lexis-Nexis, Bloomberg, Google
 - Identification easy
 - 1st: Dec 15, 1999
- Identification of patents & trademarks
 - USPTO+others
 - Identification patents difficult
 - Trademarks easy
 - 1st: Singapore, Oct 2002
- Elimination of contaminated events

Identification of iPhone related patents

- How to distinguish iPhone related patents from other patents of Apple?
 1. We read a few iPhone related patents
 2. Used those as a base for a keyword search algorithm
 3. Read all patent documents that the algorithm produced
- > yields 213 iPhone related patents
(Feb 7, 2002->Dec 31, 2009)

Identification of important events

- Use abnormal *trading volume* as an indicator of information relevance (Tkac-JFQA99)

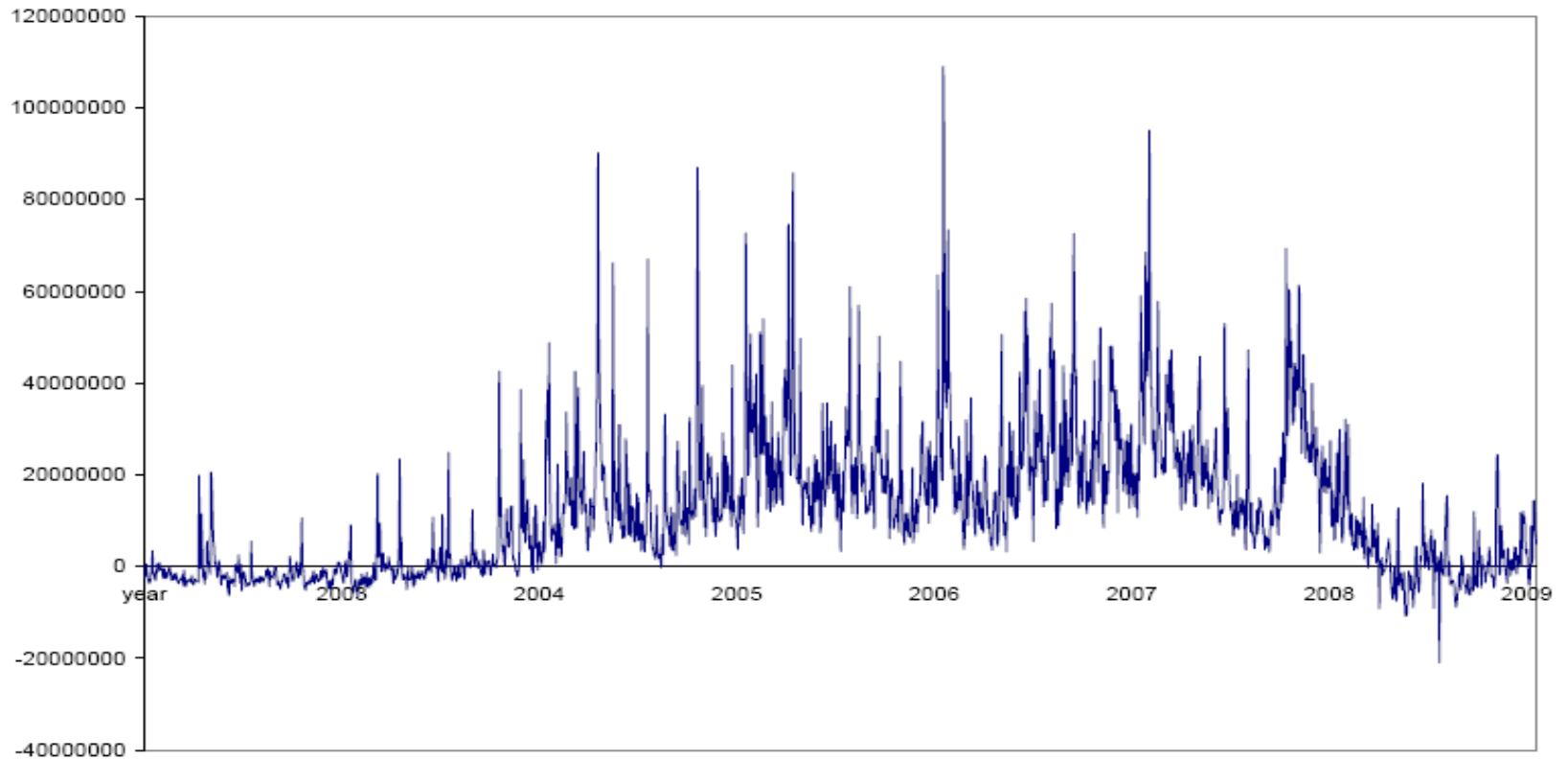
$$V_{i,t} = \gamma_i + \delta_i V_{i,mt} + \lambda_i D_t + \varepsilon_{i,t}$$

$$V = \log(\text{Vol} / \text{Mcap})$$

- In an analogous way we use an abnormal *Google search volume* as an indicator of information relevance

AAPL daily trading volume

Figure 2: Apple, Inc. abnormal daily trading volume



Summary of events by the end of 2009

	total	abn volume
News	74	21
Pat app	97	32
Pat grants	72	13
Trademarks	6	2
	<hr/>	<hr/>
	249	68

Event contamination

- No news days
- 9 patent days
- One trademark day

Identification of rivals and suppliers

- Given the patent thicket & network externalities, horizontal rivals easy to identify
- Suppliers
 - Teardown reports
 - Announcements of supply contracts

Estimation methods

- To estimate the abnormal returns we use
 - the market model,
 - the mean return model,
 - the FF model
 - etc

- The Market Model:

$$R_{it} = \alpha_i + \beta_i R_{mkt,t} + \varepsilon_{it}$$

- Estimation window
 - Fixed (pre-iPhone)
 - Rolling (-250,10)
- Event window (0)
- Daily returns: CRSP (Datastream)
- Mkt portfolio = CRSP value-weighted market index

Beta estimation

Figure 1: AAPL market model beta



Results:

Abnormal returns to news events

Average abnormal mean return (t=0)	AAPL	NOK	MOT	ERIC	RIMM
all events (n=74)	0.47%*	0.29%	-0.07%	-0.37%	-0.19%
abnormal volume events (n=22)	1.93%***	0.20%	-0.20%	-0.22%	-0.39%

Results:

Abnormal returns around the “important” news event day

	day-2	day-1	day0	day+1	day+2
Market model, 2003-2004 €	-0.26%	-0.53%	1.93%***	0.77%	-0.74%
Market model, (-250,-10) e	-0.23%*	-0.55%	1.92%***	0.79%	-0.75%***
Fama-French, 2003-2004 €	-0.11%	-0.57%	1.92%***	0.74%	-0.80%*
Mean return model, (-250,-	-0.14%	-0.48%	1.81%***	0.44%	-0.73%***
Mean return model, 2003-2	-0.11%	-0.38%	1.86%***	0.48%	-0.86%

Results:

Abnormal returns to patent applications

All patent application publication days

	aapl	nok	mot	eric	rimm
day-1	0.01%	0.27%	-0.20%	0.31%	-0.03%
day0	0.02%	0.20%	-0.31%	-0.37%	-0.49%
day+1	-0.36%	0.05%	-0.27%	-0.16%	-0.03%

with signif. trading volume and no contamination

	aapl	nok	mot	eric	rimm
day-1	0.29%	0.08%	-0.17%	0.68%	-0.78%
day0	1.13%*	0.11%	0.37%	-0.50%	-0.93%
day+1	-0.03%	0.13%	-0.53%	-0.09%	-0.42%

Results: grants&trademarks

- Patent grants exhibit no significant reactions
- > all significant new technological information in applications
- Cf. Novelty and disclosure criteria for patentability
- Nor do trademarks exhibit significant reactions

Market value results

- Our results are likely to yield a lower bound for iPhone value
 - Information leaks to the market before news and patent applications are published
 - We use a tight event window
 - We use a tight screen for events
 - Contaminated events thrown out
 - We only consider “important” events
 - We use event day dollars
 - Our estimates reflect the situation at the end of 2009

Results:

Value of iPhone \approx \$30bilj

Model	(Sign) Events	Value (\$bilj)
Market model	news	24,4
Market model with Fama-Fre	news	23,9
Mean return model	news	20,0
Mean return with fixed est. p	news	20,6
Market model	patent applications	7,8

Results:

Determinants of patent value

Backward cit	0.0018 (0.002)			0.0042** (0.002)	0.0038* (0.002)	0.0038 (0.004)	
Forward cit		-0.001 (0.002)		-0.0053** (0.002)	-0.0054** (0.002)	-0.005 (0.004)	
Time trend				<u>-0.0087** (0.003)</u>	<u>-0.0079** (0.003)</u>	<u>-0.0242** (0.010)</u>	
Claims				<u>-0.0089* (0.005)</u>	<u>-0.0122** (0.005)</u>	<u>-0.0116** (0.005)</u>	<u>-0.0165* (0.008)</u>
Signif. Volume					0.0127* (0.006)		
Constant	-0.005 (0.004)	0.002 (0.004)	0.0292* (0.016)	0.0966*** (0.035)	0.0875** (0.033)	0.2251** (0.091)	

Results:

Value effects in supply chain

	pre-ann	ann	post-ann
apple	0.0289*** (0.003)	0.1609*** (0.008)	0.0195*** (0.004)
servicep	0.0019 (0.003)	0.0195 (0.012)	-0.0034 (0.005)
supplier	0.0012 (0.003)	0.0638*** (0.019)	0.0033 (0.005)
Constant	-0.0044 (0.003)	-0.0370*** (0.008)	0.0011 (0.004)

Conclusions

- We use an old method of valuation to new and old goals:
 - We use daily stock market return data to study valuation of innovation and intellectual property via iPhone case
- We separate important events from noise events by using stock market and internet activity data

Conclusions

- iPhone value is roughly \approx \$30bilj
 - 25% is due to iPhone-patents
- Patent applications rather than grants contain new, valuable information to the market
- In the supply chain, Apple captures most of the value

Conclusions

- To us, the method works pretty well
 - We find some significant results of plausible magnitude
 - The method provides a lower bound of valuation
- How well the method can be used in case of other (publicly traded) corporations?
 - Apple, after all, might constitute the best case for the method