

Technology giants in patent wars: competition, litigations and innovation

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Background

- Patent wars involve aggressive intellectual property disputes and patent litigations.
- Substantial costs for parties involved in them: In 2012, average cost of U.S. patent litigation for cases with over \$25 million at stake was close to \$6 million per party through trial, and even higher for those cases with retrials or appeals (The American Intellectual Property Law Association)
- Damage to those found liable for patent infringement may be massive, examples:
 - Median damages awarded for U.S. patent holders in telecom industry 1995 – 2012: over \$50 million
 - In 2012, Samsung was ordered to pay over \$1 billion to Apple for its patent infringements (e.g., Iphone physical design, functions)

Background

- Large technology companies (e.g., Apple, Microsoft, Samsung) have been in the spotlight.
 - Criticized for their massive investments in patent infringement lawsuits and accumulation of patent portfolios to secure patents for litigation.
 - Also envisioned as the major originators of patent wars filing lawsuits against each other.
- Underlying forces of patent portfolio races and via what channels patent wars contribute to firm's accumulation of patent portfolios lack empirical evidence.

Research questions

- How large technology companies respond to
 - i) patent wars involving firm directly,
 - ii) patent wars not involving firms directly but emerging in their geographical market area,
 - iii) higher fragmentation of patent ownership?

- To what extent each of these elements contributes to
 - a) patent portfolio races
 - b) quality of their patented inventions?

Conceptual framework

- *Patent races* (game-theoretic models): firms compete to be the first inventors of certain technology. Winner of the race then obtains monopoly profits from its innovation via patent while the loser receives nothing.
- Patents are also transferable assets in IP transactions; firms license, cross-license and sell patents.
- Firms' innovation races often focus rather on *patent portfolio races* in which firms aim at accumulating vast patent portfolios that can be used as assets in intellectual property rights (IPR) disputes and negotiations.

Conceptual framework

- *Firm's involvement in patent litigation* may transfer its R&D personnel time use from innovation activities to litigation bureaucracy
→ Less/lower quality patentable inventions.
- *Intensifying patent war in firm's market area* may generate risk to get involved in costly and time consuming patent litigation.
→ Firm files more patents to secure its position in markets for technology even though it would not be directly involved in patent wars.

Conceptual framework

- *Fragmented ownership of patents*: more difficult for firm to detect all relevant patents it may potentially infringe in its products.
 - Patent portfolio races as firms defensively build up patent portfolios to forearm against infringement suits.
- OTH, threat of litigation/increased competition may-provoke tech giants to a) invest more in R&D or b) file applications to ideas they had otherwise kept secret to secure their future market shares or leading position.
 - a) → More and/or more valuable patented inventions
 - b) → No innovation effect, benefits society if valuable inventions (via spillovers).

Data

- Data from 20 major technology companies 2005 - 2014
 - Involved with wireless technologies subject to patent wars (smartphone manufactures, wireless carriers, operating systems designers and app developers)
 - Among top USPTO patentees 2005 - 2014 i) in technology areas covering communications and software (i.e., IPC classes H04 and G06) and ii) comprising words “cellular” or “mobile” in the abstract, title or description of their patent application.
- Patents in IPC classes H04 and G06 as the majority of smartphone related patents covered by IPC class H04 and most software-related patents covered by ICP class G06.

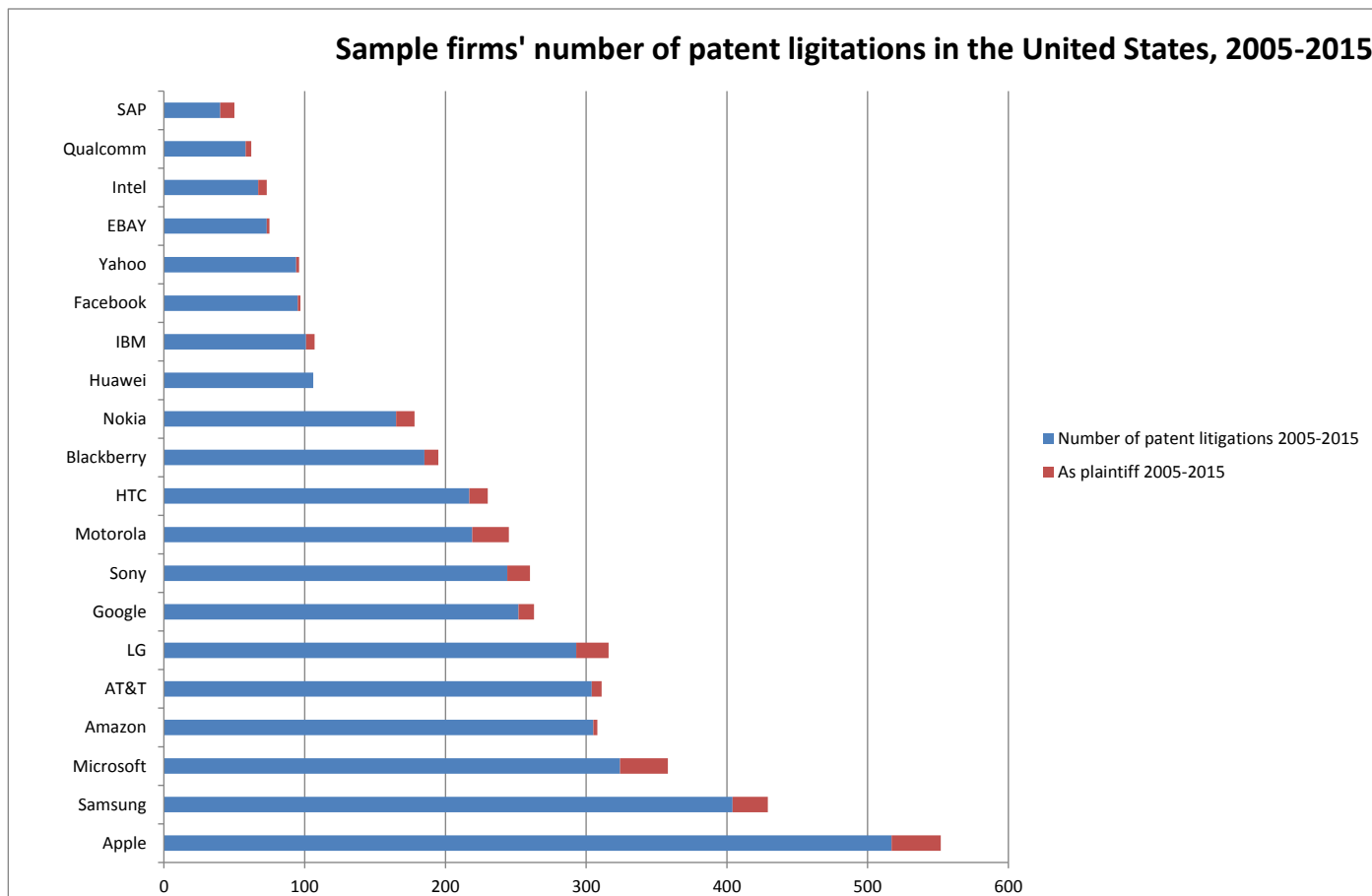
Data

- USPTO patenting as United States among biggest market areas for smartphones & single largest software market in the world.
- US patent law enables patentability of software&algorithms
→ Broad range of innovation relevant for tech companies covered.
- Patent disputes related to telecommunications, computer hardware/electronics and software industries had higher median damages awarded than industries overall 1996-2016.
 - Median damages award for all industries < \$6 million.
 - Median damages awarded for patented technology associated with computer hardware/electronics industry: \$73 million, telecommunications: \$34 million & software industry: \$37 million.

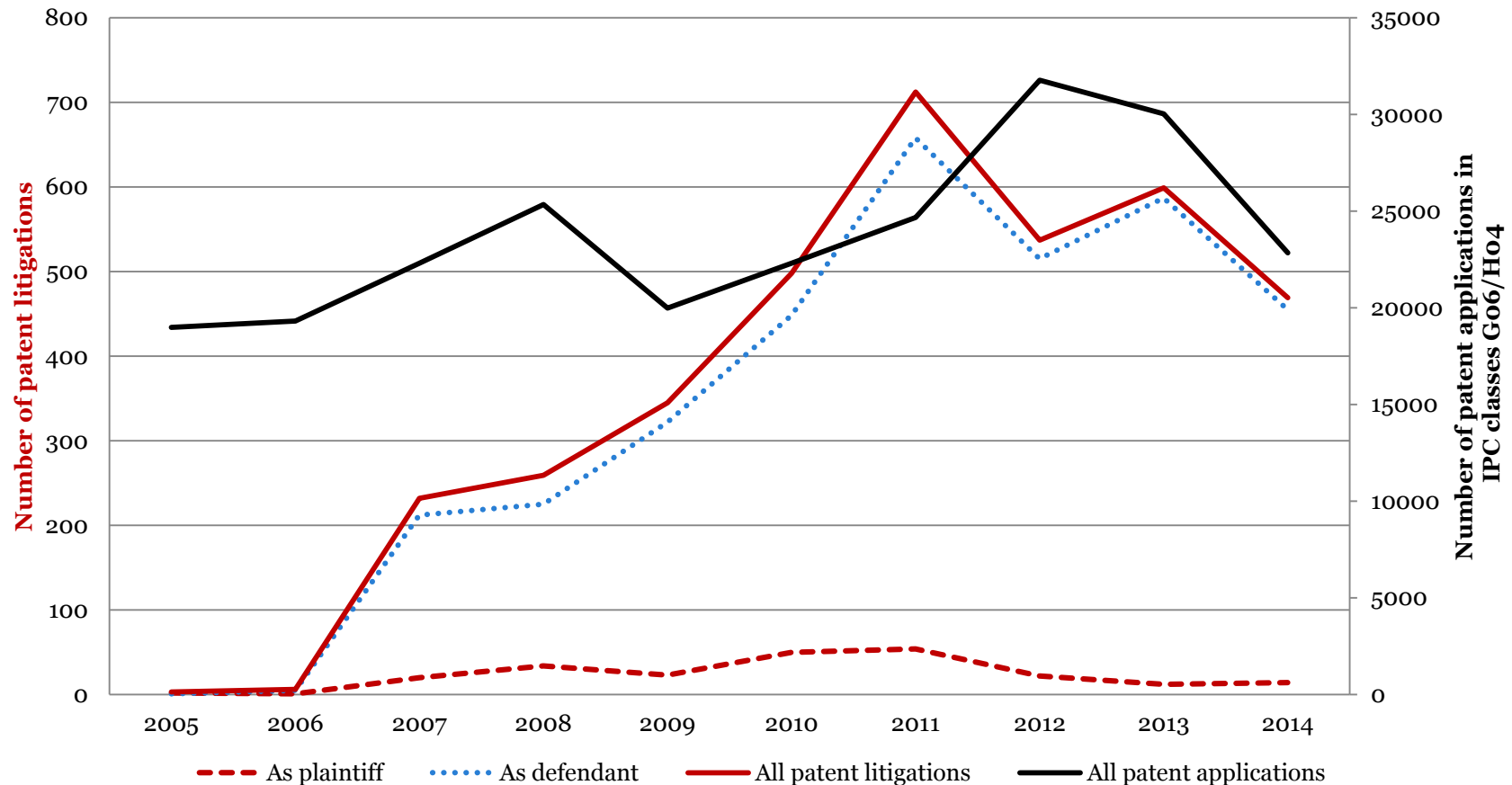
Data: patent infringement cases

- Patent cases handled by the district courts can be divided into the questions on patent infringement and patent validity.
- We consider patent infringement cases which involve the acts of making, using, selling, or offering to sell a patented invention, or importing into US a product covered by a claim of a patent without the permission of the patent owner.
- Patent is infringed when every element of at least one of its claims is infringed by an infringing product or process.
 - Patent claim defines the scope of invention sought to be protected by patent.

Sample firms' patent infringement litigations in the United States, 2005-2015



Patent litigations and patent applications of sample firms in the US, 2005-2014



Dependent variables

Variable name	Description	Data source	Mean	S.d.	N	Median
Applications	Count of patent applications filed in USPTO in IPC classes Ho4 and/or Go6 by firm i at quarter t	Patent Inspiration – Patent analytics engine www.patentinspiration.com Accessed: 2.12.2016 (based on European Patent Office's worldwide bibliographic database)	279,04	319,87	858	166,00
AvgFwC	Average count of forward citations of patent applications filed in USPTO in IPC classes Ho4 and/or Go6 by firm i at quarter t	Patent Inspiration	6,87	8,50	855	5,24
AvgFamsize	Average family size of patent applications filed in USPTO in IPC classes Ho4 and/or Go6 by firm i at quarter t	Patent Inspiration	4,57	4,84	855	3,87

Dependent variables

- Forward citations (i.e., later patents citing the subject patent) is commonly used measure of patent quality.
 - Associated to inventions with greater private returns to inventors and with greater social welfare.
 - High forward citation count = innovation is likely to be a building block for important technology area or new market with substantial growth potential.
- Patent family size that indicates the number of countries in which patent protection is sought also widely used measure of patent quality.
 - Due to relatively high costs of expanding patent protection abroad, firms tend to internationally protect only ideas of which expected value for firm is sufficient.
 - The literature also provides substantial evidence on the positive relationship between patent family size and firm value.

Econometric model

$$\bullet \text{ } PAT_{it} = \alpha_0 + \beta_1 \sum_{t-1}^{t-3} \text{Ownership_fragmentation}_{it-1} + \beta_2 \sum_{t-1}^{t-3} \text{Litigation_direct}_{it-1} + \beta_3 \sum_{t-1}^{t-3} \sum_j \text{Litigation_US}_{it-1} + \beta_4 RD_{iy} + \beta_5 X_{it}$$

Variable name	Description	Data source	Mean	S.d.	N	Median
In_Ownership_fragmentation	(log) Quarterly count of patentees with published U.S. patents in IPC classes Ho4 and/or Go6 by firm i at quarter t	Patent Inspiration	8,85	0,10	858	8,84
Litigation_direct	Quarterly count of patent infringement lawsuits filed in the U.S. District Courts or U.S. Courts of Appeal in which the company i acts as defendant in the United States.	Justia Dockets - public litigation records from the federal appellate and district courts https://dockets.justia.com/ Accessed: 27.8.2016 & 12.12.2016	4,22	4,81	858	3,00
Litigation_US	Quarterly count of all other patent infringement lawsuits filed in the U.S. District Courts or U.S. Courts of Appeal.	Justia Dockets	986,05	370,16	858	776,00

Estimation results: patent count (Nobs: 722)

Patent application count

	Negbin RE Applications	Poisson FE Applications
L.ln_Ownership_fragmentation	-0.383 (-1.20)	-0.430 (-1.17)
L.Litigation_direct	0.00240 (0.71)	-0.00187 (-0.38)
L.Litigation_US	0.000360*** (2.82)	0.000522*** (5.06)
ln_RD	0.589*** (17.00)	0.618*** (5.54)

Estimation results: patent family size (Nobs: 722)

Average Family size per patent

	Random effects Avg Famsize	Random effects Adj avg Famsize
L.ln_Ownership_fragmentation	7.201*** (2.64)	1.897*** (3.25)
L.Litigation_direct	-0.000248 (-0.00)	0.000456 (0.03)
L.Litigation_US	-0.000958*** (-2.60)	-0.000170** (-2.02)
ln_RD	-0.490 (-1.58)	-0.101 (-1.59)

Estimation results: forward citations (Nobs: 722)

Average count of forward citations per patent

	Random effects Avg FwC	Random effects Adj avg FwC
L.ln_Ownership_fragmentation	-4.754*** (-2.87)	0.321 (0.74)
L.Litigation_direct	-0.0804 (-0.76)	0.000462 (0.04)
L.Litigation_US	-0.00214*** (-3.12)	-0.000366** (-2.35)
ln_RD	-1.160 (-1.40)	-0.163 (-1.11)

Estimation results: patent races

- Major technology companies tend to file more patent applications after encountering a higher number of patent infringement cases in the major geographical market area.
- More fragmented ownership of recently published patents does not relate strongly to the firms' patenting behavior.
 - Our estimation results do not provide support for previous studies suggesting that fragmented ownership of patents generates patent portfolio races.

Estimation results: patent quality

- Relationship between the number of patent infringement cases in the US and family size of firms' subsequently filed patent applications is negative and statistically significant
 - Large technology companies respond to an increase in patent litigation cases by filing patent applications in fewer countries.
- The variable LITIGATION_US is also negatively and statistically related to the forward citation variable.
 - Patent wars reduce quality of patented innovation. In other words, during the patent wars firms tend to seek patent protection for less valuable inventions than otherwise.

Estimation results: patent quality

- More fragmented patent ownership also reflecting more intense technological competition (measured the number of patentees) is positively and statistically significantly related to patent family size.
- OWNERSHIP_FRAGMENTATION variable is negatively and statistically significantly related to forward citations.
 - It seems that more intense competition does not materialize as higher quality patented inventions. Instead, large technology companies tend to apply protection (geographically more broadly) for relatively less valuable patents.

Estimation results: patents with no foreign filings and no forward citations (Nobs: 722)

	Count of patents with with no foreign filings	Count of patents with no citations
L.ln_Ownership_fragmentation	-1.896*** (-3.86)	-0.878* (-1.76)
L.Litigation_direct	0.00646 (0.87)	-0.00767 (-1.28)
L.Litigation_US	0.000891*** (3.18)	0.000324*** (2.89)
ln_RD	0.878*** (4.21)	0.727*** (6.50)

Conclusions

- Our data suggest that high fragmentation of patent ownership does not form a sufficient threat of future patent infringement litigations for large tech companies to trigger patent portfolio races.
- The underlying mechanisms of patent portfolio races rather relate to the intensity of patent infringement cases emerging in the major geographical market area.
- Our data show that in almost all U.S. patent infringement cases, large tech companies act as defendants of patent litigations. When IPR battle gets more aggressive in the U.S. markets, technology giants respond defensively by filing more patent applications in the USPTO to prepare for potential lawsuits.

Conclusions

- Though stock of patents filed by large tech companies due to patent wars are clearly larger than otherwise, quality of their subsequently filed patent applications tends to be lower.
- Overall, our empirical findings hint that patent wars are socially wasteful:
 - Do not promote valuable innovation.
 - Generate substantial burden for the legal system.
 - Waste firms' resources (litigation bureaucracy, costs of patenting for signaling bargaining power in potential future patent disputes)
 - Strain patent offices with massive number of patent applications for inventions with little or no value at all.