Discussion of
"Falling into traps? Patent thickets, patent commercialization, and stock returns"
by Po-Hsuan Hsu, Hsiao-Hui Lee, and Tong Zhou

Evgeny Lyandres
Boston University

May 2017
Overview
**Patent thicket** – disperse ownership of prior patents that a given patent relies on (cites)
**Patent thicket** – disperse ownership of prior patents that a given patent relies on (cites)

Larger patent thicket $\uparrow$ expected litigation cost following patent commercialization

Theory: ✓* ; Empirics: ✓
**Patent thicket** – disperse ownership of prior patents that a given patent relies on (cites)

Larger patent thicket $\uparrow$ expected litigation cost following patent commercialization

Theory: ✓ ∗ ; Empirics: ✓

Higher expected litigation cost $\uparrow$ cost of commercialization and delays it
Patent thicket – disperse ownership of prior patents that a given patent relies on (cites)

Larger patent thicket ↑ expected litigation cost following patent commercialization

Theory: ✓ * ; Empirics: ✓

Higher expected litigation cost ↑ cost of commercialization and delays it

Theory: ✓ ; Empirics: ✓ *
Patent thicket – disperse ownership of prior patents that a given patent relies on (cites)

Larger patent thicket ↑ expected litigation cost following patent commercialization

Theory: ✓* ; Empirics: ✓

Higher expected litigation cost ↑ cost of commercialization and delays it

Theory: ✓ ; Empirics: ✓*

Delayed exercise lowers the value of GO and the ratio of GO to AP
**Patent thicket** – disperse ownership of prior patents that a given patent relies on (cites)

Larger patent thicket $\uparrow$ expected litigation cost following patent commercialization

Theory: ✓*; Empirics: ✓

Higher expected litigation cost $\uparrow$ cost of commercialization and delays it

Theory: ✓; Empirics: ✓*

Delayed exercise lowers the value of GO and the ratio of GO to AP

Theory: ✓
**Patent thicket** – disperse ownership of prior patents that a given patent relies on (cites)

Larger patent thicket $\uparrow$ expected litigation cost following patent commercialization

Theory: $\checkmark$* ; Empirics: $\checkmark$

Higher expected litigation cost $\uparrow$ cost of commercialization and delays it

Theory: $\checkmark$; Empirics: $\checkmark$*

Delayed exercise lowers the value of GO and the ratio of GO to AP

Theory: $\checkmark$

Lower GO/AP ratio $\downarrow$ operational and stock return volatility, risk exposure, and stock returns
The paper in one slide

**Patent thicket** – disperse ownership of prior patents that a given patent relies on (cites)

Larger patent thicket $\uparrow$ expected litigation cost following patent commercialization

Theory: ✓; Empirics: ✓

Higher expected litigation cost $\uparrow$ cost of commercialization and delays it

Theory: ✓; Empirics: ✓*

Delayed exercise lowers the value of GO and the ratio of GO to AP

Theory: ✓

Lower GO/AP ratio $\downarrow$ operational and stock return volatility, risk exposure, and stock returns

Theory: ✓
The paper in one slide

**Patent thicket** – disperse ownership of prior patents that a given patent relies on (cites)

Larger patent thicket \( \uparrow \) expected litigation cost following patent commercialization

Theory: ✓* ; Empirics: ✓

Higher expected litigation cost \( \uparrow \) cost of commercialization and delays it

Theory: ✓ ; Empirics: ✓*

Delayed exercise lowers the value of GO and the ratio of GO to AP

Theory: ✓

Lower GO/AP ratio \( \downarrow \) operational and stock return volatility, risk exposure, and stock returns

Theory: ✓

As a result, **patent thickets** \( \downarrow \) volatility, **stock returns**, and **market factor loadings**

Theory: ✓ ; Empirics: ✓*
Impressions

- A very cool idea
- The overall logic seems economically important
- Adequate modeling setup
- Impressive data compilation
- Thorough empirics
- Overall, really interesting and thought-provoking paper!
Impressions

- A very cool idea
- The overall logic seems economically important
- Adequate modeling setup
- Impressive data compilation
- Thorough empirics
- Overall, really interesting and thought-provoking paper!

But
Impressions

- A very cool idea
- The overall logic seems economically important
- Adequate modeling setup
- Impressive data compilation
- Thorough empirics
- Overall, really interesting and thought-provoking paper!

But

I am a discussant...
Model
The model’s logic

- Investment (real) option exercise is delayed when the cost of exercising the option is higher (i.e. the exercise threshold is higher)
  - Dixit and Pindyck (1988)
- The risk and expected return ↓ in the option exercise threshold
  - Carlson, Fisher and Giammarino (2006)
- **This paper**: The cost of exercising the option is endogenous
  - It is shown to be ↑ in patent thicket
  - **This is potentially a very important contribution!**
- As a result, risk and expected return ↑ in patent thicket
Endogenous option exercise cost – the idea

- There are $n$ firms, each owning a patent that the focal firm uses.
- Each firm charges the focal firm a price for using its patents (exploitation cost), $q_i$ for firm $i$, and has to pay a private cost, $c_i$.
- The higher the $q_i$ and the higher the overall exploitation cost, $\sum_i q_i$, the longer the GO exercise is delayed, and the lower the value of GO.
- Each firm does not fully internalize this reduction in value, leading to a larger $\sum_i q_i$ than would be charged by a monopolist holding all $n$ patents.
- The larger the $n$ the higher the total exploitation cost and the lower the value of GO.
  - The “population effect”
  - More interestingly, the “coordination effect”
The authors liken the coordination effect to Cournot competition. However, $q_i$ is price, not quantity, despite notation. So, this is price competition – a **homogenous product price competition**. The usual result is that such competition leads to prices equalling (constant) marginal costs. Why is this not happening here?
Coordination effect – intuition

- Why doesn’t price competition drive $q_i$ to $c_i$?
  - Because the buyer needs to buy not one product, but all of them
  - This makes the products perfect complements, not perfect substitutes
  - A very unorthodox setting, not sure I’ve encountered it

To summarize:

- When the firm has to pay exploitation costs for all patents, the total cost ↑ in $n$
- When the firm has to pay exploitation cost for just one patent, the total cost is zero or ↓ in $n$ if the marginal private cost is not constant

- **A conjecture**: There is a threshold fraction of patents for which the firm needs to pay exploitation costs
  - above which total exploitation cost ↑ patent thicket
  - below which total exploitation cost ↓ patent thicket
  - Perhaps this could lead to more nuanced empirical predictions
Other comments

- The payoff from exercising GO is perfectly correlated with the cash flows from AP
  - Is it reasonable?
  - Do you need it? (i.e. is it crucial?)
  - Relaxing it could lead to interesting cross-sectional predictions

- The “population effect” needs to be neutralized, you only need the “coordination effect”
  - I would assume $N$ firms holding $n$ patents, and do comparative statics w/r to $N$

- There is a condition in Proposition 2 (that expected return ↑ in patent thicket): $\theta_t < \Omega P_t^I$
  - If it is not satisfied then the effect is reversed
  - **Conjecture**: this effect must be satisfied always if GO exercise is optimal, i.e. $\theta^* < \Omega P^I*$
Empirics
The measure of patent thicket in the model is $n$

The empirical measure is 

$$1 - \sum_{j=1}^{J} \left( \frac{Numcites_{i,t}^{j}}{Numcites_{i,t}} \right)^2 \frac{Numpats_{i,t}}{Numpats_{i,t} - 1}$$

If firms are symmetric in terms of $Numpats_{i,t}$ and $Numcites_{i,t}^{j}$, then the measure of patent thicket is one, regardless of $n$

- I.e., the measure is constructed to be orthogonal to $n$

- Unlike HHI, $\sum_{j=1}^{J} \left( \frac{Numcites_{i,t}^{j}}{Numcites_{i,t}} \right)^2$

In the context of this paper, I am not sure this orthogonalization is appropriate, as $n$ is a crucial determinant of GO exercise timing in the model

The authors mention robustness to using HHI

I would use HHI as a primary measure of patent thicket
Asset pricing results – Interpretation

- CAPM estimation of portfolio returns shows that:
  - Difference in betas between two extreme patent thicket quintiles equals 0.07
    - This is equivalent to roughly 0.5% annual return spread
  - Difference in (monthly) alphas between two extreme patent thicket quintiles is 0.42%
    - This is equivalent to roughly 5% annual return
  - Does the market not understand the effects of patent thickets on risk?
  - Is there a trading strategy?
    - It would be interesting to think about carefully implementing it
  - Or we have a wrong asset pricing model?
  - I would include additional factors in the return regressions
    - Given the low correlations between patent thicket and size and B/M, I suspect that alphas are robust to Fama-French 3-factor model
    - But are they robust to inclusion of other factors?
Other comments

- Patent thickets are computed using only citations to patents of public firms
  - I would report results based on patent thickets computed using all patents
- Given that litigation is related to patent citations, can there be endogeneity of citations due to strategic omission of important citations?
- The test of the effect of patent thickets on the time to commercialization uses levels of new product introduction instead of their timing
  - In the model, eventual exercise of GO is a certainty
  - If both patent thickets and commercialization are constant over time, we should not expect a theoretical relation between patent thicket and subsequent commercialization within a given time frame
  - Thus, the test is a test of the time-varying nature of patent thickets and commercialization
A paper with great potential

Thought provoking – a highly recommended read