Revisiting the Royalty Stacking Puzzle

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The puzzle

Growing concern about the impact of patent enforcement in the ICT industry:

- Excessively high royalty stack
  - Complementary patents
  - Cournot effect
- Patent pools vs patent trolls and patent privateers

The call for reform is not unanimous: some claim that royalty stacking is a theoretical possibility without empirical support

The absence of (clear-cut) evidence in support of royalty stacking is puzzling given that the theoretical foundations of this hypothesis remain unchallenged

Licensing under the threat of litigation

Downstream monopolist, firm D, with demand function, $D(p)$

N upstream developers. Each developer i holds a patent portfolio of x_i patents with $x_1 \geq x_2 \geq \cdots \geq x_N$

In the first stage, each upstream developer i sets a royalty rate r_i as a take-it-or-leave-it offer simultaneously; R denotes the aggregate royalty rate

In the second stage, the downstream manufacturer chooses whether to challenge in court the multiple patents that cover their products; L_D measures the litigations costs faced by D – See Bourreau et al. (2014)

The likelihood that a judge rules in favour of a patent holder $g(x)$ is increasing in the number and quality of its patents x

The royalty stacking proposition

Proposition 1 (Royalty Stacking). *If litigation is sufficiently costly for the downstream producer, in the unique equilibrium of the game all firms choose* ${r_i}^* = r^*$*(N), independent of each firm's patent portfolio. In equilibrium,* r^**(N) is decreasing in N but* R^**(N) is increasing in N.*

Patent holdings are only relevant to the extent that they can affect the probability that the patent holder wins in court.

This result is at odds with existing evidence suggesting that firms that hold better patents receive higher royalty payments

The litigation constraint

Owners of weak portfolios will be forced to moderate their royalty claims in order to avoid litigation over patent validity

The downstream manufacturer decides to litigate upstream developer i if and only if:

$$\left(1 - g(x_i)\right)[\pi_D(R_{-i}) - \pi_D(R_{-i} + r_i)] \geq L_D$$

Lemma 1. *The downstream producer will litigate upstream patent holder I if* $r_i \geq \bar{r}_i(\Lambda_i, R_{-i}), where$

- $\Lambda_i \equiv \frac{L_D}{1-g(x_i)}$ *is the litigation hurdle*
- $\pi_D(R_{-i}) - \pi_D(R_{-i} + \bar{r}_i) = \Lambda_i$
- $\bar{r}_i$ *is strictly increasing in* Λ_i *and* R_{-i}

The Inverse Cournot Effect (ICE)

The *Inverse Cournot Effect*: the higher the aggregate royalty rate, the higher the royalty that any litigation-constrained patent holder can charge

Proposition 2. *In the equilibrium of the game, there is a developer $\tilde{n} \in [1, N]$ such that those with larger patent holdings $i \leq \tilde{n}$, choose the monopoly rate ${r_i}^* = r^*$, decreasing in N, while developers with smaller patent holdings $i > \tilde{n}$, choose ${r_i}^* = \bar{r}_i(\Lambda_i, R^* - {r_i}^*)$.*

The royalty stack is not proportional to the number of complementary patents reading on a technology or the number of patent holders:

- Some litigation constrained patent holders will prefer not to enforce their patent rights
- Active litigation constrained patent holders will be unable to charge high royalty rates
- Active licensors with strong portfolios will limit their royalty rates to weaken the bargaining position of owners of weaker portfolios (due to ICE)

The Inverse Cournot Effect (ICE)

Two-Type Case:

$N_H, x = x_H, g(x_H) = 1$

$N_L, x = x_L,$ sufficiently low to be litigation constrained

The equilibrium aggregate royalty is lower than the one that would emerge when litigation is not binding

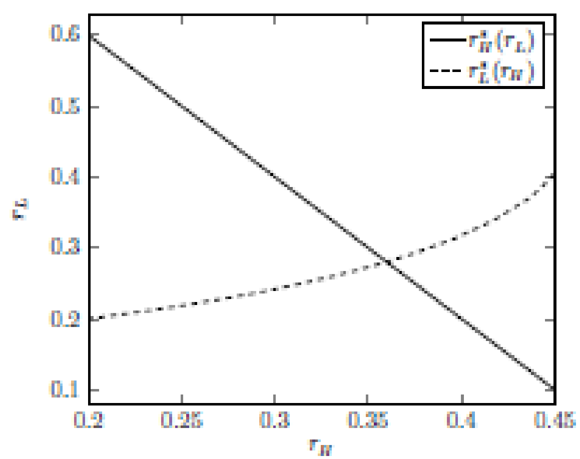

Figure 1: Equilibrium Royalty rates for large and small patent holders. The Cournot Effect, in equation (7), corresponds to the solid line. The Inverse Cournot Effect, in equation (8), corresponds to the solid line. Parameter values are $N_H = N_L = 1$ and $\lambda = 0.07$.

The Inverse Cournot Effect (ICE)

Continuum Case:

Continuum of heterogeneous developers, $s \in [0,1]$; $x(s)$ denotes the number of patents of firm s; $x(s)$ is decreasing in s;

Kumaraswamy distribution: $x(s) = b(1-s)^{b-1}$; $b = 1$, uniform distribution; higher values of b represent more skewed distributions

Royalty stacking is more likely to be a problem when patent holdings are less skewed. This is because ICE becomes more important when patent holdings are more skewed

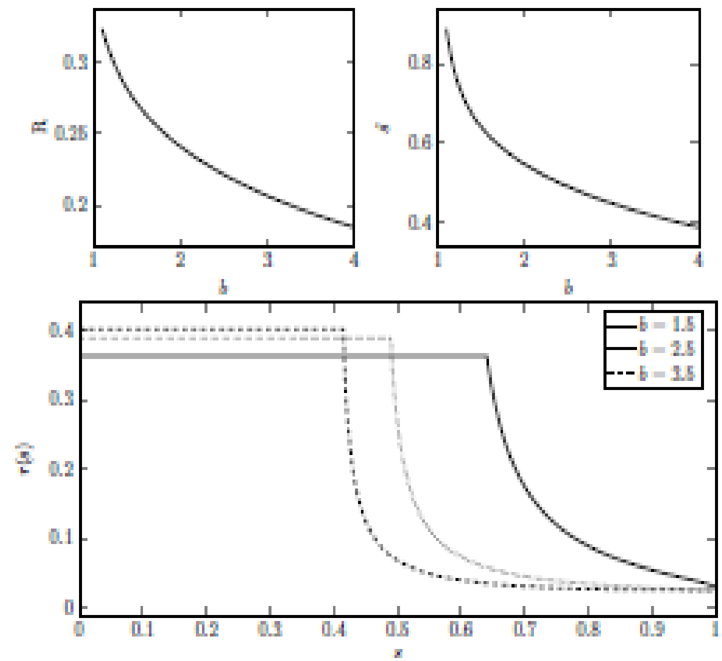

Figure 3: Equilibrium royalties and proportion of firms that are not limited by litigation (that is, $s < \bar{s}$ for different values of b). Demand is assumed to be $D(p) = 1-p$, $L_D = 0.01$, and a patent holder's probability of success is $g(x) = \min\{x, 1\}$.

Downstream competition

Royalty stacking is more likely to be a problem when downstream competition is strong

- Free riding
- Marginal return to litigation is small

Evidence from mum and pop stores

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Patent pools and privateers

Lemma 2. *The consolidation between all large patent holders always leads to a decrease in the aggregate royalty and an increase in the total profits of these firms.*

Lemma 3. *The consolidation between a large patent holder and a small one always leads to a decrease in the aggregate royalty but it will only increase the total profits of these firms if there are no other large patent holders.*

Lemma 4. *Patent consolidation by small firms results in higher profits if and only if the total royalty increases.*

Proposition 3. *Any consolidation involving a large patent holder will reduce the royalty stack but will only occur if it involves all large patent holders. A consolidation between small developers will be profitable if it increases the royalty stack.*

Merger control

Competition policy implication.

- Although welfare-increasing consolidation involving large patent holders may not always occur, welfare-decreasing consolidation involving small patent holders will always take place.

Standard Essential Patents

$$(1 - g(x_i))\left[\Pi_D(R_{-i}) - \Pi_D(R_{-i} + r_i)\right]$$

$$+ \underbrace{g(x_i)h(x_i)\left[\Pi_D(R_{-i} + \rho(x_i, r_i, R_{-i})) - \Pi_D(R_{-i} + r_i)\right]}_{\text{FRAND commitment}} > L_D.$$

- Stronger ICE – royalty stacking less problematic
- Owners of strong patent portfolios may be constrained if $h(x)$ is increasing fast with x, but $\rho(x, r, R)$ is not increasing significantly with x.
- Suppose $\rho(x, r, R)$ decreasing in R, then ICE is weaker and royalty stacking becomes relatively more problematic

Revisiting the puzzle

The absence of (clear-cut) evidence in support of royalty stacking is NOT as puzzling as it may have been thought since the royalty stacking hypothesis was based on an “imperfect” theory – i.e. a theory which was based on assumptions that do not fit the facts

Under the theory developed in this paper,

- Patent pools need not be welfare increasing
- Patent consolidation may prove anticompetitive
- Patent divestitures need not be anticompetitive

Thank you!

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