The Dilemma of Defensive Patenting* (preliminary)

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Abstract

Defensive patenting safeguards the freedom of operation of a firm by building credible threats of infringement countersuits. But only operating firms, but not non-practicing entities (NPEs), are subject to infringement risks. Therefore defensive patenting is not effective against NPEs, and its positive impact on investment raises incentives of offensive patenting by NPEs. Private "defense-only" commitment via the Defensive Patent Licence or defensive patent aggregation may not fully revolve this "dilemma of defensive patenting."

Keywords: Defensive patenting, Defensive patent license, Defensive patent aggregation.

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*All errors are mine. Comments are welcome.

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1. Introduction

Firms often contend that defense is an important reason why they pursue patents (Taylor and Silberston, 1973; von Hippel, 1988; Cohen *et al.*, 2000; Hall and Ziedonis, 2001). For instance, a manager of Microsoft wrote in 2004 that:[1]

> *"At Microsoft, we used to pay little attention to patents... One of these big companies could dig through their patent portfolio, find something close to what we had done, then sue us, and we would have to go through an elaborate defense and possibly lose. So Microsoft did what most big companies do, which is start to build what is called a 'defensive' patent portfolio. So if a big company tried to sue us, we could find something in our portfolio they were afoul of, and countersue. ... since it was intolerable for all parties to engage, it resulted in a state called 'détente', or 'standoff'. This is what you see today for the most part in lots of industries."* (Chris Pratley, 2004)

A powerful patent portfolio builds credible countersuing threats, which help its owner to settle IP disputes or deter litigation in the first place.[2] Like a sturdy shield, it gives firms "freedom of operation," so that they can navigate through "patent thickets" (Shapiro, 2001) and invest in production facilities or further R&D fearless of threats from others' patent attacks.

Defensive patenting, nevertheless, is no panacea. The (initial) intention of defense by no means stops owners from offensively asserting their patent rights for the pur-

[1]Quoted from the blog of Chris Pratley, http://blogs.msdn.com/Chris_Pratley/archive/2004/05/01/124586.aspx (last checked on January 10, 2013). von Hippel (1988) describes similar strategic patent enforcement in the semiconductor industry: *"Firm A's corporate patent department will wait to be notified by attorneys from firm B that it is suspected that A's activities are infringing B's patents.... Because possibly germane patents and their associated claims are so numerous, it is in practice usually impossible for firm A — or firm B — to evaluate firm B's claims on their merits. Firm A therefore responds — and this is the true defensive value of patents in the industry — by sending firm B copies of 'a pound or two' of its possible germane patents with the suggestion that, although it is quite sure it is not infringing B, its examination shows that B is in fact probably infringing A. The usual result is cross-licensing ..."*

[2]Lanjouw and Schankerman (2003) finds that an infringement suit is less likely to be filed based on a patent held by a larger firm. This empirical evidence is consistent with the idea that defensive patenting strategy works better against a larger firm with a bigger hold-up stake. Somaya (2003) explicitly considers countersuits and finds that, in most cases, when a suit is countered by a countersuit, the two are disposed of within a day of each other. Without any legal or administrative factor underlying these two legally separated proceedings, it suggests a strong strategic concern for countersuits.

pose of collecting licensing income or gaining competitive advantage in the market.[3] Furthermore, the protection defensive patenting offers is only effective against other "operating entities" that carry out potential infringing activities. Patent-based countersuits are toothless against no-practicing entities (henceforth, NPEs) which have no product to infringe. This observation leads to the "dilemma of defensive patenting" (section 1): When defensive patenting does help firms gain more freedom of operation *vis-à-vis* other operating firms, by raising investments it also raises the returns of patent enforcement by NEPs and thus incentives of pursuing a pure offensive patent portfolio. In other words, defensive patenting can feed offensive patenting.

Defensive patenting is a response to patent thickets by individual firms. At a larger scale, recent private initiatives have attempted creative solutions beyond traditional collective IPRs arrangements such as patent pools and cross-licenses (Shapiro, 2001). The Defensive Patent License (henceforth, DPL), put forward by legal scholars, is a "truce alliance" with free membership that mandates no patent litigation among members (Schultz and Urban, 2012). A new business model, the defensive patent aggregation (henceforth, DPA) also emerges at the market: for-profit NPEs acquirie and then license their patents to other firms for defensive purposes, and at the same time commit not to offensively enforcing their patent portfolios (Wang, 2010; Hagiu and Yoffie, 2011). However, we show in section 3 and 4, respectively, that by encouraging investment they may also fall victim to the same dilemma.

Lastly, the DPA also emphasizes its benefit of "preemptive acquisition" of patents before they fall into the hands of "patent trolls." We conclude this note with some remarks about this practice in section 5.

[3]In recent years, Microsoft does not shy away from offensively enforce its patent portfolio against the Android camp, from core companies such as Motorola and Google to manufacturing companies like Foxconn and Inventec. On the other hand, Twitter has publicly committed to a purely defensive stance in its Innovator's Patent Agreement on April 17, 2012 (http://blog.twitter.com/2012/04/introducing-innovators-patent-agreement.html, last checked on January 10, 2013). Its exact promise, however, is to "not use the patents from employees inventions in offensive litigation without their permission." In addition, Twitter does not seem to have a significant patent portfolio. In the article of May 10, 2012, "Twitter Gambles on a Patent Plan," *The Wall Street Journal* reported that Twitter has at least two pending applications, but no issued patents (http://online.wsj.com/article/SB10001424052702304363104577392342603822440.html#articleTabs%3Darticle).

2. Defensive Patenting and its Dilemma

Two types of continuum firms, with size T_1 and $T_2 > 0$, decide whether to acquire a patent at time 1. At time 2, only type-2 firms decide whether to invest and build a (downstream) manufacturing facility. Time 3 is the enforcement stage. For simplicity, both patenting and investment decisions are observable to other players and take binary forms, and firm heterogeneity only appears at the cost side.

Downstream investment creates a value $v > 0$, and its cost is independently distributed among type-2 firms,with CDF $K(\cdot)$. The cost of patenting is also independently distributed, with CDF F_i for type-i firms, $i \in \{1, 2\}$. This cost consists the expense at preparing and prosecuting patent applications, as well as the costs of identifying and bidding for (existing) patents from other inventors.

For patent enforcement, a patent is valid and infringed *by all* operating firms, i.e., firms with downstream investment, with probability $\alpha \in (0, 1)$. There is no cost of patent enforcement, and the court's rulings are also independently distributed across different patents. If an operating firm, i.e., a firm with downstream investment, infringes on a patent, then the infringed party obtains a benefit $r \cdot v > 0$ and the infringing party incurs a loss $l \cdot v < 0$.[4] If there is mutual blocking between two "vertically integrated" firms, i.e., two firms having downstream capacities infring on each other's patent rights, then both incur a loss $\hat{l} \cdot v \geq 0$. But there is a probability $t \in [0, 1]$ that they can reach a "truce" and not sue each other is the first place.[5]

We first consider the investment decision of a type-2 firm. Let P_i be the total number of patents owned by type-i firms, $i \in \{1, 2\}$. At time 2, a type-2 firm that does not acquire a patent will expect its investment to infringe on $\alpha(P_1 + P_2)$ patents. It will invest when the investment cost is smaller than $\pi^M = v[1 - \alpha(P_1 + P_2)l]$. The total number of such "pure manufacturing" firms is the number of non-patenting type-2 firms, $T_2 - P_2$, times the investment probability,

$$M = (T_2 - P_2) \cdot K(\pi^M). \tag{1}$$

[4]Hence patent enforcement does not entail "negative externality." Downstream investment is sufficiently valuable such that all infringing parties can receive the same infringement compensation rv that is independent of the number of patent it infringes. The assumption that a patent may be infringed by all firms is only a simplying assumption to avoid unnecessary technical complications. It does not affect our qualitative results.

[5]When firms also differ in their infringement probability α and investment v, in general the probability of truce t will depend on the pair characteristics of these parameters. We believe that, by choosing firm heterogeneity at the cost side, we simply the analysis without losing the key insight.

A type-2 firm that has acquired a patent, on the other hand, faces a trade-off between investing under a "defensive patent shield" and not investing, hence keeping its patent purely"offensive." By not investing, it remains as a "non-practicing entity" and obtains an expected return $\pi^N = \alpha(M+I)rv$, where I is the number of "vertically integrated" firms, i.e., firms that both patent and invest. By investing, it becomes vulnerable to a total number of $P_1 + P_2 - I$ NPEs, but can still offensively enforce its patent rights against a number M of pure manufacturing firms. When facing another vertically integrated firm, the expected loss is

$$t \cdot 0 + (1-t)[\alpha^2 \hat{l} + \alpha(1-\alpha)(l-r) + (1-\alpha)^2 \cdot 0]v = \alpha(1-t)[\alpha\hat{l} + (1-\alpha)(l-r)]v. \quad (2)$$

There is no loss when two vertically integrated firms can maintain true or when the court rules no infringement on both sides. When $\hat{l} < l$, i.e., when mutual blocking alleviates the damage of patent infringement, the threat of a "litigation war" causes a smaller expected loss facing a vertically integrated firm compared with the loss facing a NPE. The expected investment return under the "defensive patent" is

$$\begin{aligned} \pi^I &= v - \alpha(P_1 + P_2 - I)lv + \alpha M r v - I\alpha(1-t)[\alpha\hat{l} + (1-\alpha)(l-r)]v \\ &= \pi^M + \pi^N + \alpha v I \triangle, \end{aligned} \quad (3)$$

where

$$\triangle \equiv [1-(1-t)(1-\alpha)](l-r) - \alpha(1-t)\hat{l} = t(l-r) + \alpha(1-t)(l-r-\hat{l}). \quad (4)$$

The firm will invest when the investment cost is smaller than $\pi^I - \pi^N = \pi^M + \alpha v I \triangle$. The number of vertically integrated firms is

$$I = P_2 \cdot K(\pi^M + \alpha v I \triangle). \quad (5)$$

The term $\triangle$ captures the "defensive premium," namely, the defensive value of a patent relative to its offensive function. We are interested in the case where patents encourage investment, i.e., $\pi^M < \pi^I - \pi^N$, which is ensured by the following assumption.

Assumption 1. (Defensive premium) $\triangle > 0$.

A necessary condition for this assumption to hold is $l > r$, namely, the loss from unilateral infringement is strictly higher than the gain in this case. This may occur when the infringer also incurs non-transferable losses in reputation or confidences

of other stake-holders, e.g., consumers, financing providers, or partners of joint ventures, *etc.*. Given $l > r$, higher truce probability t raises $\triangle$. The defensive premium is also decreasing in r and $\hat{I}$. Smaller r reduces the benefit of a patent as a pure offensive weapon, while smaller $\hat{l}$ implies less loss after mutual blocking. The impact of α, on the other hand, depends on the sign of $l - r - \hat{l}$. If mutual blocking can sufficiently alleviate the damage compared with unilateral infringement, i.e., if $\hat{l}$ is sufficiently small, such that $l - r - \hat{l} > 0$, then higher α will also raise $\triangle$.

Denote $L \equiv \alpha l v$, $D \equiv \alpha \triangle v$, and $R \equiv \alpha r v$. Given P_1 and P_2, let $(\hat{M}, \hat{I})$ be the subgame equilibrium at time 2, the investment stage. The number of manufacturing firms $\hat{M}$ is uniquely determined by the total number of patents $P_1 + P_2$. On the other hand, when $\triangle > 0$, investment decisions under defensive patenting are strategic complements, i.e., higher I raises a patent-holder's incentive to invest in downstream facilities. There may be multiple equilibria concerning the number of vertically integrated firms $\hat{I}$.[6] We consider only stable equilibria, i.e., an equilibrium $\hat{I}$ that is characterized by condition (5) satisfies the condition that, for all P_2,

$$P_2 D K'(\pi^M + D\hat{I}) < 1, \tag{6}$$

where K' is the pdf of investment cost. Intuitive comparative statics follow this selection.

Proposition 1. *(Patents and investment) $\hat{M}$ is decreasing in P_1 and P_2. A stable equilibrium investment $\hat{I}$ is increasing in $\triangle$ and decreasing in P_1. The impacts of P_2 on $\hat{I}$, and thus on the total investment $\hat{M} + \hat{I}$, are ambiguous:*

$$\frac{d\hat{M}}{dP_2} = -K(\pi^M) - (T_2 - P_2) L K'(\pi^M) \text{ and } \frac{d\hat{I}}{dP_2} = \left.\frac{K(c) - P_2 L K'(c)}{1 - P_2 D K'(c)}\right|_{c=\pi^M + D\hat{I}}. \tag{7}$$

Higher P_2 reduces π^M and discourages investment. But it also implies a larger pool of potential vertically integrated firms. The latter force may outweigh the former, and so $\hat{I}$ may be increasing in P_2. And when $P_2 D K'$ is sufficiently close to one, e.g., when $\triangle$ and so D is sufficiently large, the impact of P_2 on $\hat{I}$ will dominate its impact on $\hat{M}$. Higher P_2 can raise total investment.

Turn to time 1. A type-1 firm's incentive to acquire a patent depends only on offensive value π^N. The number of patents held by type-1 firms is

$$P_1 = T_1 \cdot F_1(\pi^N) = T_1 \cdot F_1(R(\hat{M} + \hat{I})). \tag{8}$$

[6]Since $K(\cdot)$ is an increasing function, for all P_1 and P_2, the existence of $I \in [0, P_2]$ that satisfies condition (5) is guaranteed by Tarski's fixed point theorem. If $K(\cdot)$ is continuous, then Brouwer's fixed point theorem also ensures the existence of $\hat{I}$.

For a type-2 firm, a patent provides an option value. Without a patent it can only invest as a manufacturing firm at time 2, with an expected return $\int_0^{\pi^M}(\pi^M - c)dK$. With a patent it can decide to invest under a defensive shield or remain as a NPE. The expected return of patenting is $\int_0^{\pi^M+D\hat{I}}(\pi^I - c)dK + [1 - K(\pi^M + D\hat{I})]\pi^N$. A type-2 firm will acquire a patent when patenting cost is smaller than

$$\begin{aligned} f &\equiv \int_0^{\pi^M+D\hat{I}}(\pi^I - c)dK + [1 - K(\pi^M + D\hat{I})]\pi^N - \int_0^{\pi^M}(\pi^M - c)dK \\ &= K(\pi^M)(\pi^N + D\hat{I}) + \int_{\pi^M}^{\pi^M+D\hat{I}}(\pi^I - c)dK + [1 - K(\pi^M + D\hat{I})]\pi^N. \end{aligned} \tag{9}$$

The number of type-2 firms that will build a patent portfolio is

$$P_2 = T_2 \cdot F_2(f). \tag{10}$$

An equilibrium of the whole game is a pair (P_1^*, P_2^*) that satisfies condition (8) and (10), and the investment pair $(\hat{M}, \hat{I})$ is determined according to the equilibrium number of patents. When CDF F_1 and F_2 are continuous, the existence of equilibrium is guaranteed by Brouwer's fixed point theorem. We also consider only stable equilibria, as required by the condition that, given P_1, $1 > T_2 F_2'(\partial f/\partial P_2)$, where F_2' is the pdf of type-2 firms' patenting cost.

By Proposition 1, an increase in P_1 reduces investments $\hat{M}$ and $\hat{I}$, and so the return of NPEs, π^N. Patenting decisions among type-1 firms are strategic substitutes. Higher P_1 also reduces π^M, π^I, and f; see the proof of Proposition 2. The stability condition ensures that, by reducing f, type-2 firms' patenting incentives are decreasing in P_1. Concerning P_2, if $\hat{I}$ is decreasing in P_2, then so are P_1 and f. But if higher P_2 raises total investment $\hat{M} + \hat{I}$, then P_1 is increasing in P_2. The following proposition if the main result of the note.

Proposition 2. *(The dilemma of defensive patenting) In a stable equilibrium, higher* $\triangle$ *and so* D *raises* P_1^* *or* P_2^* *(or both). If total investment* $\hat{M} + \hat{I}$ *is increasing in* P_2*, then higher* $\triangle$ *raises equilibrium* P_1^*.

Proof. To show that f is decreasing in P_1, recall that $\pi^I = \pi^M + \pi^N + D\hat{I}$. Hence we can ignore the impacts on boundary points, and obtain $\partial f/\partial \pi^M = K(\pi^M + D\hat{I}) - K(\pi^M)$, $\partial f/\partial \pi^N = 1$, and $\partial f/\partial \hat{I} = DK(\pi^M + D\hat{I})$. Since higher P_1 reduces π^M and, in turn, $\hat{I}$ and π^N, the threshold f is decreasing in P_1.

We express the strategic interactions between P_1 and P_2 by the best responses:

$$P_1 = \underset{(?)\ (+)}{\hat{P}_1}(P_2,\ D\ ) \ \text{ and } \ P_2 = \underset{(-)\ (+)}{\hat{P}_2}(\ P_1\ ,\ D\ ), \tag{11}$$

where higher D increases both $\hat{P}_1$ and $\hat{P}_2$, higher P_1 reduces $\hat{P}_2$, and the impact of P_2 on $\hat{P}_1$ has the same sign as $d(\hat{M}+\hat{I})/dP_2$. For each D, the equilibrium pair $(P_1^*(D), P_2^*(D))$ satisfies $P_1^*(D) = \hat{P}_1(P_2^*(D), D)$ and $P_2^*(D) = \hat{P}_2(P_1^*(D), D)$. Consider $D > D'$ such that $P_i^*(D) < P_i^*(D')$ for both $i = 1$ and 2. Since $\hat{P}_2$ is increasing in D and decreasing in P_1, we obtain $P_2^*(D) = \hat{P}_2(P_1^*(D), D) > \hat{P}_2(P_1^*(D), D') > \hat{P}_2(P_1^*(D'), D') = P_2^*(D')$, a contradiction.

By raising $\hat{M}+\hat{I}$, higher P_2 also increases $\hat{P}_1$. If $D > D'$ but $P_1^*(D) < P_1^*(D')$, then $P_2^*(D) > P_2^*(D')$, which in turn implies that $P_1^*(D) = \hat{P}_1(P_2^*(D), D) > \hat{P}_1(P_2^*(D), D') > \hat{P}_1(P_2^*(D'), D') = P_1^*(D')$, a contradiction. *Q.E.D.*

By the proposition, when defensive patenting becomes more effective (higher $\triangle$), at least one type of firms will increase their number of patents. A sufficient condition to increase the number of patents held by type-1 firms is that more patents held by type-2 firms, i.e., those with the opportunities to develop downstream capacities, encourage downstream investment. By previous discussion, the positive effect on total investment requires sufficiently high $\triangle$. We thus obtain that the dilemma: More effective defensive patenting can encourage offensive patenting.

3. Defensive Patent License as Alliance of Truce

Suppose that, between time 2 and time 3, i.e., after investment decisions are made but before the enforcement stage, patent-holding firms decide whether to join an "alliance of truce" and grant a "defensive patent license" (DPL) that ensures no patent litigation among members of the alliance.

NPEs surely will not join this alliance. Such a license only reduces the "targets" against which to enforce their patent rights. For vertically integrated firms, let $\mu^I \in [0,1]$ be the portion of these firms joining the alliance. Suppose that, after joining the alliance, a vertically integrated firm will enforce its patent rights against a pure manufacturing firm with probability $\phi^M \in [0,1]$, and against a non-member vertically integrated firm with probability $\phi^I \in [0,1]$. These probabilities ϕ^M and ϕ^I do not necessarily reflect the official rules of the license, but rather how the membership of the alliance may change the litigation propensity outside the alliance. In the previous analysis, without a formal alliance we have $\phi^I = 1-t$ and $\phi^M = 1$.

Denote $\kappa \equiv \alpha v[\alpha\hat{l} + (1-\alpha)(l-r)] > 0$. Given (μ^I, ϕ^M, ϕ^I), a vertically integrated firm obtains a payoff $v - (P_1 + P_2 - I)L + RM - I(1-\mu^I)(1-t)\kappa - I\mu^I\phi^I\kappa$ if not

joining the alliance, and a payoff $v-(P_1+P_2-I)L+RM\phi^M-I(1-\mu^I)\phi^I\kappa$ if joining the alliance. The firm has any incentive to join the alliance only when

$$[\mu^I\phi^I+(1-\mu^I)(1-t-\phi^I)]I\kappa>(1-\phi^M)RM. \tag{12}$$

At the right-hand side, participation to the alliance entails a cost of a softer stance against manufacturing firms. At the left-hand side, μ^I and ϕ^I are complementary in encouraging participation. That is, the benefit of participation is increasing in ϕ^I if and only if $\mu^I>1/2$, and increasing in μ^I if and only if $\phi^I>(1-t)/2$. An alliance is viable only when members are sufficiently litigant against non-members.

Suppose that $\phi^M=1$ and $\phi^I\geq 1-t$, i.e., the DPL does not soften litigation propensity against non-members. Both $\mu^I=0$ and $\mu^I=1$ are equilibria. For the former, by $1-t-\phi^I\leq 0$, a vertically integrated firm will not join when no other firms participate in the alliance; for the latter, if every other vertically integrated firm grants the DPL, then by $\phi^I>0$, a vertically integrated firm will join as well.

Under the equilibrium of $\mu^I=1$, a manufacturing firm's investment return is $v-[P_1+P_2-I+I(1-\mu^I)+I\mu^I\phi^M]L=\pi^M+I\mu^I(1-\phi^M)L=\pi^M$, the same as before. The investment payoff of a vertically integrated firm is $v-(P_1+P_2-I)L+RM\phi^M=\pi^M+\pi^N+I(L-R)$. Since $L-R>D$, a viable DPL has the same impact as an increase in D. By Proposition 2, if higher P_2 increases the total investment $\hat{M}+\hat{I}$, then the DPL encourages pure offensive patenting, i.e., patenting by type-1 firms.

Corollary 1. *(Defensive patent license) NPEs have no incentive to grant a DPL. Suppose that $\phi^M=1$ and $\phi^I\geq 1-t$, i.e., after granting a DPL, a firm does not become less aggressive toward non-members, There are multiple equilibria, $\mu^I=1$ and $\mu^I=0$, at the participation of the "truce alliance." If the equilibrium $\mu^I=1$ prevails and higher P_2 boosts total investment, then the DPL also encourages offensive patenting.*

4. Defensive Patent Aggregation: The Defense-Only Commitment

Another private attempt to cut through the patent thicket is defensive patent aggregation (DPA). In this note, we focus on its "defense-only" commitment, and how this commitment affects investment and NPEs' patenting incentives.

We introduce another group of firms, with size $A\geq 0$, that are clients of a defensive patent aggregator, which, to slightly abuse the terminology, is also called a

DPA. These firms only make investment decisions, with cost distribution K, and use the DPA's patent portfolio in patent countersuits. The DPA lends its whole (relevant) patent portfolio to clients under attack, but also commits to initiating patent litigations against any party, including non-clients. To single out the effect of this defense-only commitment, we assume that (i) clients of the DPA do not possess any patent, but instead "oursourcing" their patent strategy and relying on the DPA's patent portfolio to fend off patent attacks; and (ii) while (non-client) vertically integrated firms can only maintain truce among themselves with probability t, there is full truce between them and clients of DPA.[7] The second assumption can be justified by the defensive position of the DPA coupled by its large pile of patents, which would render any offensive attack unprofitable.

Given A, P_1, and P_2, at the investment stage, a type-2 firm that does not have a patent (and, by assumption, is not a client of the DPA) obtains an investment revenue $\pi^M = v - L(P_1 + P_2)$. The total amount of investment from these firms is $\widetilde{M} = (T_2 - P_2)K(\pi^M)$. We also denote $\widetilde{I}$ as the aggregate investment by type-2 firms that have their own patents, and I_A the aggregate investment by clients of DPA. A NPE obtains a return $\widetilde{\pi}^N = R(\widetilde{M} + \widetilde{I} + I_A)$, i.e., clients of DPA now also becomes of its target. And a vertically integrated firm's revenue is

$$\begin{aligned} \widetilde{\pi}^I &= v - L(P_1 + P_2 - \widetilde{I}) + R\widetilde{M} - \widetilde{I}\alpha v(1-t)[\alpha\hat{l} + (1-\alpha)(l-r)] \\ &= \pi^M + \widetilde{\pi}^N + D\widetilde{I} - RI_A. \end{aligned} \tag{13}$$

A type-2 firm with a patent will invest if the investment cost is smaller than $\widetilde{\pi}^I - \widetilde{\pi}^N = \pi^M + D\widetilde{I} - RI_A$. Comparing with the corresponding investment criterion in Section 2, there is a negative term associated with investments by clients of DPA. Note that this negative effect does *not* come from full truce between vertically integrated firms and clients of the DPA. It is due to the defensive commitment of the DPA. To see this point, let $t = 1$, and so $D = \alpha v(l - r) > 0$ as long as $l > r$; investment decisions of patent-holding type-2 firms are still complements. On the other hand, had DPA also

[7] A DPL requires its members not initiate patent attacks against other members. But the DPA only ensures that a firm is immune to patents held by the aggregator, but not to patents held by other members of the aggregator. Members of the DPA very often have their own patent portfolio. In fact, one of the major DPA, RPX Corporation, is backed by firms with sizeable patent-holdings such as IBM http://www.bizjournals.com/seattle/blog/techflash/2008/11/IBM_Cisco_support_RPX_in_defensive_patents34959854.html?page=all (last checked on April 2, 2013). Although DPA typically announces their intention of pure defensive stance, an interesting scenario is its member launches offensive attacks, and then draws on the patent portfolio of the DPA when facing counter attacks. We leave it for future research.

allowed its patent portfolio to be used for offensive purposes, then more investments by its clients would imply less exposure to offensive attacks and thus raise incentives of investment. Put differently, any defense is of no value without offensive threats. The defensive commitment of DPA reinforces the relative importance of a patent's offensive use, hence reduces a patent-owner's investment incentives.

Lastly, since a client cannot use the DPA's patent portfolio for offensive purposes, it only obtains a revenue by investing, with a payoff $\pi^A = v - L(P_1 + P_2 - \widetilde{I}) = \pi^M + L\widetilde{I}$. Its investment decision is affected only by the aggregate investment of non-clients, $\widetilde{I}$, but not that of other clients, I_A. This is, again, because of the pure defensive stance of the DPA.

The aggregate investment $\widetilde{M}$ is independent of other firms' investment decisions. Given P_1, P_2, and A, the equilibrium at the investment subgame is characterized by aggregate investment $(\widetilde{I}, I_A)$ such that

$$\widetilde{I} \equiv P_2 \cdot K(\pi^M + D\widetilde{I} - RI_A) \text{ and } I_A \equiv A \cdot K(\pi^M + L\widetilde{I}). \tag{14}$$

Given stability, i.e., condition (6), higher A raises I_A which in turn reduces $\widetilde{I}$. That is, a larger client base of the DPA, by increasing investments by this group, will induce more non-clients to use their patent portfolios for purely offensive purposes. If higher A also raises the total investment $\widetilde{I} + I_A + \widetilde{M}$, i.e., the positive effect, $dI_A/dA > 0$, outweighs the negative effect, $d\widetilde{I}/dA < 0$, then higher A will further increase the incentive of type-1 firms to pursue offensive patenting.

Proposition 3. *(The defensive patent aggregation) DPA raises incentives of non-clients to pursue an offensive stance for their patent portfolios.*

5. Road Ahead: More on the DPA

An assumption of our analysis is a sufficiently large pool of (potential) patents, hence a firm can build a non-negligible patent portfolio as long as it is willing to incur the cost. This assumption reflects the concern that the patent system, in particular in the United States, is "broken" because of the "flooding" of low-quality yet powerful patents (Jaffe and Lerner, 2004). To curb the damage of patent trolls, or excessive offensive enforcement, the patent office may need to tighten the examination standard and reduce the "supply" of questionable patents.

Alternatively, if there is only limited patent supply, patent accumulation may involve a bidding war.[8] In this regard, proponents of the DPA argue that this model can tackle the problem of patent trolls by "preemptive acquisition," that is, grabbing patents that posit potential threats before they fall into the hand of more aggressive owners. Success of this strategy hinges on how high the willingness and how deep the pockets of the DPA. The former in turn depends on the defensive *vs.* offensive value of patents. For the latter, the DPA needs a well-crafted pricing strategy, or licensing fee structure. Hagiu and Yoffie (2011) point out that the defensive-only commitment of the DPA may create free-riding problem, since non-clients are also benefited by this commitment. A practice the DPA adopts to mitigate this concern, Hagiu and Yoffie (2011) argues, is "catch and release:" reselling acquired patents to other entities that would pursue offensive enforcement against those who previously did not obtain licenses from the aggergator. Put differently, the DPA delays offensive attacks and creates a window during which operating firms can respond to future litigation threats, either by securing a license now from the aggregator, or by modifying their investment behavior, i.e., by inventing around the patents. A dynamic investment framework thus may be required to conduct a thorough analysis of the DPA and its impact, including its formation, patent acquisition, pricing, and firms' incentives of obtaining a license, to name a few. We leave these exciting and important topics for future research.

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[8]The reality may contain both. The average annual growth rate of patent grants in the U.S. between 1983, the year after the creation of the Court of Appeals for Federal Circuit, and 2011 is about 5.5% (USPTO patent statistics , http://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm, last checked on January 11, 2013). Quillen and Webster (2001) report that the allowance rate of the United States Patent and Trade Office (the number of applications allowed divided by the number filed) in the mid-1990s is 95%, versus 68% and 65% for the European and Japanese patent offices, respectively. On the other hand, a recent high-profile patent auction is the acquisition of Nortel's more than 6,000 patents in 2011 by a team including Apple, Microsoft, and RIM, beating Google with a price of $4.5 billion (http://www.forbes.com/sites/elizabethwoyke/2011/07/07/an-insider-on-the-nortel-patent-auction-and-its-consequences/, last checked on January 10, 2013).

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