Elves or Trolls? The role of nonpracticing patent owners in the innovation economy

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Firm structure and the degree of vertical integration lie at the core of a key intellectual property concern currently under debate: “patent trolls.” While court opinions and competition agency decisions have focused on “non-practicing” patent holders as synonymous with trolls and hold up problems, this view of upstream specialists is far too narrow. In fact, patents in the hands of nonpracticing entities can increase competition, increase innovation, lower downstream prices, and enhance consumer choice. We explain why and when and argue for more business-model-neutral policy when it comes to patent licensing. Clearly, patents are a complex subject that cannot be portrayed as either all good or all bad; tradeoffs will always be involved. Likewise, patents in the hands of nonpracticing entities cannot be viewed as either all good or all bad. Without a better understanding of the many complicated effects of patents in high technology markets, we run the very real risk of misguided policy decisions. In light of that risk, we argue that more attention needs to be devoted to finding meaningful ways of identifying harmful behaviors, rather than on categorical labels based on firm structure or business model.

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1. Introduction

Firm structure and the degree of vertical integration lie at the core of a key intellectual property concern currently under debate. “Patent trolls”—those patent holders that prey upon manufacturers and other downstream firms by charging “supra-competitive” rates for their patents—have figured large in many of the latest theories of competitive abuse involving intellectual property licensing. The concern over trolls centers on opportunistic ex post behavior. After potential licensees have made investments or might be “locked-in” to using a certain production technology, trolls emerge to charge “excessive” royalty rates for the patents necessary for production. That is, the rates trolls charge exceed what they would have been able to obtain ex ante, before any lock-in, because they hold licensees’ investments hostage. When this kind of ex post opportunistic behavior occurs within a competitive downstream market, licensees will likely pass on the higher licensing costs to their customers, meaning higher consumer prices, lower quantities sold, and reduced social welfare. There is broad condemnation of this sort of ex post patent ambush, but there is little consensus on how to define and identify a patent troll.

Under a popular although highly controversial definition of a troll, the focus is on firms holding patents that they do not practice (i.e. “non-practicing” or “non-competing” firms). According to this definition of a troll, nonpracticing entities (or NPEs) impose undue costs on downstream manufacturers by charging more in licensing fees than their patented technology justifies (Shapiro, 2006; for opposing definitions of a “troll” see Golden, 2007; Lemley, 2007; McDonough, 2007). The contrast under this theory is to practicing patent holders—that is, vertically integrated firms implementing their own patented technologies in a downstream market. Thus NPE trolls are assumed to have an enhanced ability to hold up licensees with “too high” royalties because they do not operate in the downstream market and do not require cross licenses from competitors or other quid pro pros that might militate against unjustifiably high royalty rates. Without the constraint that cross-licensing poses, so the argument goes, NPEs are free to hold manufacturers’ capital investments hostage in order to increase the imposed royalty rate.

Apprehension over patent trolls and their capacity to hold up downstream players has emerged as an important factor in a number of policy arenas. For instance, in the US Supreme Court’s 2006 *eBay Inc. v. Mercexchange* decision related to injunctive relief for patent holders, Justice Kennedy’s concurring opinion cautioned that in deciding whether or not to grant an injunction the lower courts should recognize that:

> An industry has developed in which firms use patents not as a basis for producing and selling goods but, instead, primarily for obtaining licensing fees. For these firms, an injunction, and the potentially serious sanctions arising from its violation, can be employed as a bargaining tool to charge exorbitant fees to companies that seek to buy licenses to practice the patent.
The subtext of Justice Kennedy’s opinion is that the lower courts should tend toward denying injunctive relief to non-practicing patent holders, and in fact this is how many district courts appear to be interpreting eBay (Dauer and Cleffi, 2007).

Fears of patent trolls have also pervaded the policy decisions made by cooperative standard setting bodies. For example, in requesting business letter review from the US Department of Justice (DOJ) for significant changes to their intellectual property rights (IPR) policy, VITA argued that some members were demanding royalties that were “significantly higher than expected” (DOJ, 2006); that is, attempting patent hold up.

As the examples illustrate, the theories surrounding patent trolls focus on the potential for higher prices and lower social welfare to arise from the combination of patents and nonintegrated firm structure. We offer a counterpoint to this negative view. In particular, we argue that the definition of all NPEs as patent trolls is far too broad and is unjustified by economic theory and evidence. We consider the positive effect that patents in combination with nonintegrated firm structure can have on competition and innovation. In other words, we consider the benefits that NPEs can offer; demonstrating that the mere fact a patent holder does not practice its patent does not automatically imply that the patent holder is a troll, intent upon hold up.

In fact, most nonpracticing entities face a number of constraints aside from cross-licensing that limit their incentives and ability to practice hold up (Schmidt, 2006). Certainly genuine patent trolls, defined narrowly as those entities licensing their patents opportunistically ex post, are a real concern. But we must move away from the overly simplistic association between nonpracticing or noncompeting entities and patent trolls in order to make effective policy decisions. As our analysis shows, nonpracticing entities can play a decidedly pro-competitive role in an industry. We argue instead for more thought to be devoted to meaningful tools for identifying genuine patent trolls, as the simple practice/do not practice distinction is not informative.

The article proceeds as follows. We begin in Section 2 with a discussion of the beneficial role that patents can play in an industry, including increasing competition in a downstream market through the presence of upstream specialists. In order to codify our chain of reasoning, we present a very simple framework in Section 3. This framework, while a bare bones representation of high technology markets, helps to highlight the importance of comparative advantage inherent in specialization. It also demonstrates the impact of upstream specialists on industry structure, competition, and welfare—in both the short and long term. We conclude in Section 4 with the policy implications that emerge from the insights of our analysis.

The fact that patents can have far reaching positive implications for industry structure, competition, and social welfare—even when they are held by NPEs—implies that the recent focus on the dangers of noncompeting patent holders presents far too limited a view for policy analysis purposes. Clearly patents and the incentives
facing their holders is a complex subject that cannot be portrayed in black and white terms. Without a better understanding we run the very real risk of misguided policy decisions—either because long term effects are not considered or because only one aspect of short-term effects are considered. We posit that any policy proposal or court guidelines aimed at curbing patent troll behaviors and hold up problems, therefore, should be evaluated both in terms of the direct effect on the perceived problem as well as any indirect (unintentional) detrimental impact on patent-facilitated competition and frequently welfare-enhancing upstream specialization within the industry at hand.

2. The positive side of patents

The focus in the literature has often been on a comparative advantage for vertical integration because such integration can help to reduce production-related hold up problems and can mitigate double marginalization problems and other transaction costs that can plague industries with goods composed of complementary components (Cournot, 1838). The complements problem, however, is but one aspect of complex firm structures in high technology industries. Disintegration has positive effects of its own, including specialization. As the economic literature reaching back past Adam Smith has well established, specializing enables firms to focus on what they do best, enhancing productivity and increasing output. Thus the mirror image of the comparative advantage for integration in terms of reducing potential complements problems or transaction costs is the fact that nonintegrated upstream firms can have a comparative advantage in R&D and innovation (i.e. “pure” innovators). Alternatively, an upstream firm might specialize in coordination issues, providing a platform for inventors to sell their inventions to implementers (i.e. an IP market maker). These upstream specialists can have superior skills and business acumen for a relatively narrow slice of the production process, even though (or perhaps because) they lack the interest, the ability, or the resources necessary for commercializing innovations themselves.

The economics literature establishes that patents facilitate contracting between separate entities (Arora et al., 2001; Arora and Merges, 2004; Arora and Ceccagnoli, 2006).¹ This follows from the inherent differences between tangible and intangible goods. When two parties are negotiating over some physical product, the owner of the product can threaten to take it away at any time if the other party does not live up to his end of the bargain. Thus people are evicted from apartments when they fail to pay the rent and semiconductor manufacturers obtain no more silicon when they fail to pay their suppliers. Intellectual property, on its own, allows no such

¹Patents are, of course, not the only factor, as a large literature on firm boundaries attests, but they are a very important one in high technology sectors.
threat of exclusion or removal. Once an idea has been shared, it cannot be taken away or unlearned. Without rights of some kind, then, recipients of intangible goods would be in the profitable position of taking the property without paying. As a result, inventors and IP holders are typically reluctant to share their innovations without some form of protection (Anton and Yao, 1994).

This is where IPRs come in. Intellectual property rights of any sort—including patents, copyrights, nondisclosure agreements, trade secrets, etc—offer their holders some means of exclusion and a legal route to enforce that exclusion. Thus IPRs facilitate the sharing of information by reducing the inherent risks of appropriation. When knowledge is tradable in this manner, various parties can coordinate and contract as necessary to produce a commercial product for a downstream market (Merges, 2005). Patents are particularly useful because they offer protection for innovations that could be reverse engineered if disclosed (as trade secrets cannot) and because their codified nature and well understood enforcement mechanism can reduce the odds of dispute in the first place.

A key element in the argument that patents in particular facilitate exchange and contracting is the point that patents lower the transaction costs of contracting (Arora, 1996). Since patents bestow the right of exclusion—i.e. patent holders need not license their patents at all, or they may license exclusively to one or two licensees only—patents bring with them a standardized well understood enforcement mechanism. A contract over IP need not specify the consequences of deal-stopping problems such as appropriation or failure to pay; the parties understand that all of the traditional court resources for patent infringement will apply. The infrastructure surrounding patents and their enforcement therefore leads to simpler, and yet more complete, contracts as compared to other forms of IPR, which in turn can influence the decision to specialize upstream instead of vertically integrating. In fact, the availability of patents can induce licensing among entities that do not have manufacturing capabilities, particularly smaller upstream specialists (Arora and Ceccagnoli, 2006).

A second key factor is that patents can facilitate funding for startup companies. IPRs of any sort can mean that inventors with good ideas can do more than simply invent—they can try their luck in the marketplace. But patents are a relatively visible source of protection, and one that can be re-assigned and traded. As a result, financiers often look to patents when making investment decisions (Hellman and Puri, 2000; Hall and Ziedonis, 2001; Mann, 2005).

With venture capital backing, an inventor can enter a market as an upstream specialist, with a profit model based on licensing as opposed to manufacturing (at least initially). Corroborating this point, empirical research indicates that smaller firms are more likely to actively license their patents than are larger firms, other factors held constant (Gambardella et al., 2007).

The benefits of entering a market as an upstream specialist should be obvious; it is far less costly to enter a market with a relatively small staff of researchers and perhaps an IP lawyer or two than it is to build a factory to manufacture the inventions
covered by the firm’s patent portfolio. Just consider the plethora of software startups in comparison to the far smaller number of new computer hardware makers to see this point translated in practice. Lower upfront costs mean lower barriers to entry. Patents can therefore be viewed as increasing entry and competition by lowering the cost of market entry for upstream specialists.

On the other side of the specialization spectrum, the availability of patents for license can also encourage the entry of downstream specialists. For instance, in their study of the chemical processing industry, Arora et al. (2001) find that the presence of an active upstream technology supplier encourages greater downstream entry—particularly of marginal entities that would otherwise not enter if doing so required the development of in-house technology.

The fact that these patents are an important part of the decision to specialize is further corroborated in the literature on vertical integration and firm boundaries. This branch of the literature establishes that lower transaction costs involved in contracting between entities tend to lower the odds of vertical integration in favor of specialization (Lafontaine and Slade, 2007).

Combining, then, the points of easier contracting, increased licensing, the potential for comparative advantage in R&D and innovation, and the relative ease of entering a market as a specialist, it becomes clear that patents have the potential to play a pivotal role in industry structure. In particular, patents can increase competition, and product quality in the process, as they facilitate entry by upstream specialists (Oxley, 1999; but see also Gans et al., 2002).

Indeed, in a number of high technology industries, where both complementary inputs and comparative advantage in certain inputs are likely to be important features, we have seen the rise of upstream specialists (Gilson et al., 2008). According to Langlois (2003), “vertical disintegration and specialization is perhaps the most significant organizational development of the 1990s.” He catalogs a host of industries, including automotive, electronics, pharmaceuticals, and semiconductors to illustrate how widespread the specialization trend has been. For example, the number of specialist biotechnology firms, which emerged after the discovery of recombinant DNA technology in 1973, grew from a mere handful in 1975 to 4414 globally in 2007 (Ernst and Young, 2008). Of the 4412 global biotechnology companies in 2007, 798 were publicly held. The United States had 1,502 biotechnology firms in 2007 of which 386 were public (Ernst and Young, 2008).

A significant number of these firms focus on R&D and intermediate chemical inputs, leaving drug development and commercialization to larger pharmaceutical companies. As Arora and Merges (2004) argue in relation to the chemical production industry, “Patents facilitate arm’s-length trade of a technology-intensive input, leading to entry and specialization.” And Lieberman

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2 Of the 4412 global biotechnology companies in 2007, 798 were publicly held. The United States had 1,502 biotechnology firms in 2007 of which 386 were public (Ernst and Young, 2008).

(1987) finds that in chemical markets where many nonproducing entities patented there was indeed greater overall entry.

Semiconductors provide a particularly revealing case study. The industry experienced a seismic shift with the entrance of so-called “fabless” design shops in the late 1980s. Hall and Ziedonis (2001) explain that

...the period associated with strong U.S. patent rights has witnessed significant entry into the semiconductor industry by design, or ‘fabless’, firms that specialize in innovative products but contract out the manufacture of their products to owners of wafer fabrication facilities.4

The semiconductor industry has shown a significant increase in competition. For instance, figures from the Fabless Semiconductor Association indicate that the number of fabless companies worldwide has grown from roughly 500 in 1997 to about 1300 in 2007 (FSA, Industry and Data, 2008).5

Hall and Ziedonis find that fabless firms are five times more likely to patent than rival integrated semiconductor firms in their sample. Based on both interviews and empirical analysis, the authors conclude that “the importance of patents” lies in their function “as an imperfect but quantifiable measure of technology that enabled technology-based trades to be made in external markets, both in financial markets (venture capital) and with suppliers and owners of complementary technologies.”

Other industry studies corroborate this view. For instance, Arora and Nandkumar (2007) find in their empirical study of software encryption and the “information security market” that an increase in the number of upstream licensors leads to an increase of downstream firms lacking technology. In other words, more upstream specialists stimulate the entry of downstream specialists through the availability of licenses.

The industry evidence for semiconductors, chemicals, and software encryption, plus the timing of the general trend toward specialization in other industries all point toward an important link between patents, firm organization, and industry competition.6 In merging and extending these separate strands of the literature, we weave together theories on IPRs with those on firm structure and industry evolution in order to assess both short- and long-term competitive effects. In particular, we take

4Hall and Ziedonis (2001) also observe that division of labor in this industry was further aided by a more standardized interface between chip design and the wafer fabrication process.

5The number of members of the Fabless Semiconductor Association (both design shops and foundries combined) has grown from just 40 in 1994 to over 450 in 2004 indicating a rise in competition both upstream and downstream. (http://www.gsaglobal.org/resources/industrydata/facts.asp).

6The trend toward disintegration coincided with a number of policy changes that strengthened IPRs, including the passage of the Baye–Doyle Act in 1980, the creation of the Federal Circuit Court of Appeals in 1982 to hear patent case appeals, and the decision in State Street in 1998, a case that opened the door to business method patents (see, e.g. Lerner, 2002).
as already established that IPRs (and especially patents) facilitate contracting and therefore act as enablers for firms to specialize instead of vertically integrate. From this base, we then ask the impact that this process might have on innovation, competition, and consumer welfare immediately and over time.

Our argument can be summarized as follows. IPRs can increase the probability that upstream firms obtain outside financing, which makes specializing a more commercially viable means of entering a market. Patents in particular also make intangible products more easily traded by lowering the transaction costs entailed in technology contracts. Both of these effects increase the viability and attractiveness of disintegrating functions along the vertical production chain—that is, of creating specialists. Given the typically lower costs of entering a market as an upstream specialist, we can expect greater entry whenever specialization is possible. The upstream specialists will then seek downstream partners in order to earn a return on their patents through licensing; some of these downstream firms also could be specialists (not vertically integrated but specializing in manufacture without significant R&D operations). Increased entry leads to increased competition in upstream and downstream markets, and thus prices may fall and product quality and consumer choice may increase. In other words, the evolutionary paths for patents and industry structure are intertwined, and can have a dramatic impact on the competition and innovation taking place within an industry, both in the short and long term.

In order to clarify this argument, in the next Section, we present a very simple model that illustrates the dynamics of upstream specialization, increased entry, and competition. The simple framework clarifies the evolutionary repercussions for industrial organization, illustrating the potential for long-term competitive benefits stemming from patent protection. Beginning with a heterogeneous world in which vertically integrated entities coexist with specialists in each of the vertical layers of production, we show that patents or other IPRs that allow for contracting among specialists can increase the competition facing vertically integrated firms. By lowering the barriers to entry, IPRs can also provide an effective entrée to an industry through a specialist niche, which can then form the foundation for later vertical integration into other areas of the production process. That is, specialization can act as a stepping stone for firm expansion (Choi and Stefanidis, 2001, illustrate the other side of this argument, that having to enter two markets at once, R&D and manufacturing, raises barriers to entry). As a result of these forces, IPR-based contracting can increase the pool of talent from which an end product is created, meaning overall product quality and social welfare might increase.

7We recognize that all manner of factors can enter into the decision to integrate or specialize (see, e.g. Pisano et al., 1988; Teece, 1988; Hart and Moore, 1990). Our point here is simply that the presence of IPRs allows other motives to specialize to be acted upon.
3. A simple framework for considering firm structure

Consider a high technology industry that produces good $x$. In order to create a good that consumers are willing to purchase, assume that $x$ must contain two complementary elements, A and B. We could interpret the components A and B in a number of different ways, such as two necessary physical inputs (like a semiconductor chip and a laptop) or as a product and its retail distribution (such as mp3 files and online music stores), but in keeping with the argument presented above we maintain a particular interpretation: A represents the necessary technology or innovation behind good $x$ that emerges from the R&D process, while B represents the physical embodiment of technology A, created through the manufacturing process (e.g. the radio transmission technologies that make 3G mobile phones possible). According to this interpretation, A is the upstream component while B is the downstream component.

As is clear from the above discussion, many high technology industries comprise a range of firm types, from specialized to vertically integrated. To capture this fact within our simple framework, we consider three stylized firm types: upstream firms produce component A only; downstream firms produce component B only; while vertically integrated firms produce both A and B. Denote these three firm types as A, B, and AB, respectively.

Plainly, AB firms are the only ones with a ready commercial product $x$. Apple, with its innovation, software, and computer hardware all fully integrated is a good example of an AB firm. The other two firm types, A and B, have only one of the two necessary components and thus achieve a commercial product $x$ by combining their efforts through IPR-based contracting. Specifically, we assume that an A firm obtains a patent on its component, which it then licenses to a B firm, so that the B firm can manufacture good $x$ and offer it for sale on the downstream market. Keeping with the computer example, Microsoft (an A firm) has an IP agreement with Chinese computer maker Lenovo (a B). Denote the IPR contract enabled combination of entities as A/B, distinct from the vertically integrated combination AB. For now we assume that specialist A’s patented component does not block the vertically integrated firm.

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8Firm A can fulfill this role in one of two ways. It might be an R&D specialist, investing in research and patenting its discoveries. Alternatively, A might be a patent holding firm, collecting patented inventions from other inventors which it then aggregates into a portfolio for reduced transaction costs on the part of downstream licensees.

9Note that patent licensing is just one option. In some industries, the patents act as a protection mechanism, preventing appropriation, but are not explicitly licensed (Arora and Merges, 2004). The framework could also be extended to recognize that oftentimes contracting between specialists A and B represents a matching problem. As this issue is not central to our concerns here, we leave that point aside.

integrated AB’s production of good $x$; we explore the blocking patent scenario as a special case below.

Even without introducing any additional structure, we can already see the potential for significant benefits that IPR contracting enables. First, downstream competition can be increased: without patent licensing the production of $x$ is limited to the AB firms only.\footnote{Or, if the integrated firm also licenses its upstream component A at reasonable rates, then the downstream specialist B could obtain a license and produce $x$ as well. Since B’s $x$ would compete directly with AB’s, we would expect AB to set the licensing terms so as to maintain its market position and profit. Moreover, even if AB licensed on terms equivalent to its own internal (implicit) price, all $x$s would be based on one technology, that held by AB.} Specialists either would not emerge or would be relegated to niches, such as University labs or simple sub-contractors or foundries for the lowest value manufacturing aspects for the AB firms, such as off-shore outsourcers. Allowing the two complementary specialists to combine through contracting increases the number of entities supplying $x$ and thus stimulates price competition. Farrell et al. (1998) find just such an effect in their analysis: disintegrated industry structures (or “open” ones in their terminology) have more intense competition.

If $x$ is differentiated by upstream technology, then having more suppliers could increase consumer choice as well. Even if the vertically integrated firm AB does not offer either of the two components separately, the presence of the contracted specialist firm A/B can place competitive pressure on AB to increase the quality of its offering on the market. Arora and Bokhari (2007) corroborate these points. They find that vertically disintegrated market structures are more efficient, largely because of the selection effect of entry—an entity does not have to be good at both A and B to enter the market for $x$; being good at one of the two is enough.

We might expect all three firm types to occur naturally in a given industry for any number of reasons. For example, an entrepreneur inventor might have a breakthrough idea for a product but lack the financial means to invest in the equipment necessary to bring that product to market. This reason is reminiscent of the semiconductor design shops discussed above, as it cost upwards of $6 billion to build a chip foundry in 2007. In this context, patent-based contracts can be seen as clearly lowering the barriers to entry.

Alternatively, a new invention might emerge as a byproduct from research on something else. In this case, the firm generating the new invention might not want to pursue its commercial development since the firm’s core business lies elsewhere. For example, licensing noncore technologies has been an appealing alternative for biotech firms which often stumble upon valuable compounds outside of their concentration area (Good, 2006). If developing product $x$ is seen as a distraction of resources from the firm’s primary goals, then licensing the patent to another entity better equipped to develop the product, and thereby earning a return on the expense of the original R&D, can be a superior option to simply abandoning the idea. Patent
licensing in this scenario increases the disclosure of new technologies that might otherwise have been shelved.

Universities and government-operated labs represent another source of upstream specialists. Policy changes in the 1980s (namely, the Bayh–Dole and Stevenson–Wydler Acts) encouraged scientists and professors to patent and then license their innovations in order to increase the dissemination of new ideas and to raise the odds that such ideas make it into the commercial sphere (Jaffe, 2000). Sometimes these intellectual property rights are simply licensed by a university’s technology transfer office; other times, they spur start up firms, such as when digital imaging firm CDM Optics grew out of research conducted at the University of Colorado at Boulder. 12

Finally, an organization might simply be better at generating one component of x as compared to the other. Similarly, the firm might have established downstream facilities for another product market that can be readily extended to the market for x, but have little or no R&D capacity. This reason, comparative advantage, suggests another potential benefit from patent contracting: increased product quality. If entities focus on what they are best at, we should see the overall quality of product x improve as compared to that offered by integrated firms.

Set against these forces for specializing are countervailing forces for integration. For example, the production of x might entail economies of scale or scope that induce larger, more integrated firms. Or the complements problem might result in a double marginalization problem, meaning that integrated firms could offer lower priced products than two distinct contracted specialists, each trying to earn its own profit margin.

The question is then which forces will prevail? Will high technology industries tend to be dominated by specialists, integrated firms, or a combination of the two? Note that this question is simply a special case of the traditional “make or buy” decision studied by Coase (1937) and others. What makes the question special in this context is the additional element that independent specialists can have an easier time contracting with multiple firms as compared to a division of an integrated firm that would, by necessity, be negotiating with rivals.

Independence also suggests that specialists are likely to be more interested in licensing their inventions than vertically integrated firms are. Since their sole income stream comes from licensing revenues and they need not worry about downstream rivals, upstream specialists are more likely to license their inventions broadly (Arora et al., 2004). As a result, upstream specialists may increase downstream competition through broadly licensed IPRs.

The reasons behind specialization given above, and most likely others that have not occurred to us, suggest that any industry that involves complex products will induce the emergence of specialists, at least for some period of time. The ability or

inability of these specialists to contract with one another will then dictate whether nonintegrated firms are observed in practice or whether they remain subrosa, as potential entrants only. But even if the conditions allowing specialists to compete in a market do emerge, it is unclear whether a diversity of firm types will remain in the long term (assuming legislators and competition agencies do not intervene by disfavoring one or the other). The question is, will specialists ultimately displace their vertically integrated rivals or will we continue to see a diversity of firm structures?

To address these questions and to put more structure on our discussion of the potential benefits arising from IPR contracting and specialization, we consider next three individual cases based on the simple framework presented at the beginning of the section. We first consider uniform quality and production costs in components across firm types, as a benchmark case. For the second scenario, we analyze how things might change with comparative advantage. And finally, we consider a contrasting case in which the upstream specialist holds a blocking patent on \( x \) that can push AB from the market. We close the section with a discussion of the implications from the various cases for industry diversity of business models over time.

3.1 Equal quality and costs across firm type

In the general framework presented above, we ignored product quality and production costs; all \( x \) products were assumed to be of identical quality. We make that assumption explicit for our benchmark case. In particular, assume that product quality translates into higher end prices, but that even at the lower quality level the price is still high enough to cover costs. If quality levels are equal across products, then so are the prices (that is, no other factors, say brand recognition, enable price differentials). We also assume that quality has no effect on production costs, so firms with higher quality are able to achieve better products for given production costs. Consumers choose which good \( x \) to purchase on the basis of both price and quality, with the tradeoff of higher prices for higher quality viewed as worthwhile by some customers but not others. Finally, as noted above, for the time being we are assuming away both transaction costs and the possibility that A’s patent blocks AB’s production of \( x \); we relax both of these assumptions later.13

As our benchmark case, we consider equal product quality, equal prices, and production costs across firm types. To provide a stark case for the benchmark, normalize the distribution of firm types so that there is just one of each type, A, B, and AB. The qualitative results from this setup easily extend to multi-firm distributions with the one exception of the other extreme market structure, a large enough

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13This framework could be written in terms of a simple mathematical model, but given the straightforward nature of the points we wish to make, we felt the added complexity of a model was not warranted.
number of AB firms to create perfect competition even without the entry of any A/B firms.

Under this set of assumptions, if contracting between A and B is not possible, then AB will be a monopolist. If, on the other hand, patents allow firm A to contract with firm B, then entity A/B can enter the downstream market with its own version of \( x \). In this case, AB can no longer charge the monopoly price. If it did, firm A/B could charge anything just lower and capture all sales since no consumer would pay more for an equivalent product. Competition will also expand the quantity sold as price falls.

Even if we relax the assumption of just one firm of each type, so that AB does not begin as a monopolist but rather as an oligopolist competing with other vertically integrated firms, it is clear that the increased entry allowed by patent contracting increases competition in the downstream market and lowers prices, to the benefit of consumers. The benefits are not as dramatic but can be strong nonetheless.

An example of such a dynamic can be seen in the European mobile telecom industry. The second generation technology, GSM, has been dominated by handful of vertically integrated players (Bekkers et al., 2002). When specialists entered the market for the third generation mobile technology, WCDMA, downstream competition increased significantly.

If we introduce transaction costs or coordination problems, the above result could be softened but should nonetheless remain. Consider the special case of double marginalization, as this coordination problem is the one most often discussed in the context of NPEs and patent licensing. If double marginalization is a problem in the industry at hand, the vertically integrated firm(s) can have a cost advantage compared to contracted specialist firms. This follows because the B specialist will face a relatively higher price for the upstream input A than the implicit (transfer) price that AB charges itself. B could face higher costs of production in this case, although B also avoids the upfront cost of running an R&D program.\(^{14}\) Even so, as long as the double marginalization effect is less than the difference between the competitive price and the monopoly (or oligopoly) price for \( x \), the contracted specialists will still find it profitable to enter the market.

3.2 Comparative advantage

Let us now consider differentiated product quality. Assume first, for a given production cost, the contracted specialist entity A/B produces a higher quality product than the vertically integrated firm. Thus, when sufficient IPR protection emerges, firm A is able to contract with firm B to produce \( x \) and A/B will be able to charge

\[^{14}\]Note that contractual means of solving double marginalization do exist, namely a two-part tariff for patent licensing. Upfront fees, however, have the effect of shifting much of the risk downstream and so may be palatable to downstream firms. Risk sharing is, in fact, a key motivation behind royalty rates, which are only paid when downstream sales are made.
more than it otherwise would in the face of competition from incumbent AB because its product is higher quality. Nevertheless, compared to a monopoly/oligopoly of AB firms, consumers will face lower prices, increased quantities sold, and broader product choices.

In the polar opposite case, suppose that the vertically integrated firm offers the higher quality product, along with lower production costs and higher end prices. The premise here is that vertically integrated firms may enjoy economies of scope. For example, having an upstream R&D operation could lead to a better understanding of the downstream product, with spillovers across divisions of the company that enable higher quality manufacturing. Alternatively, a downstream presence could increase the productivity of R&D, say because the integrated firm learns better what end customers want based on which products sell in the marketplace (Grindley and Teece, 1997).

In this case, entry by the contracted specialist A/B still increases competition, raises the quantity sold, and therefore improves welfare. However, the two firm types reverse roles: it is AB that earns higher profits, having to lower its price from the monopoly one it charged before A/B entered but not by as much as it otherwise would have due to its superior product.

Finally, consider a hybrid scenario, with particular advantages for each firm type. In this case, a comparison of profits across the firm types is ambiguous, depending on the degree of cost savings compared to the price premium, all in relation to the differential in quantities sold (which are driven by both price and quality differences). Some specialists might enter as part of a phased strategy to become an integrated firm; others might enter with the intention of remaining specialists, with a comparative advantage in product quality. The point remains, however, that being able to enter as a specialist, because IPRs facilitate contracting and lower barriers to entry, increases competition in the downstream market to the benefit of consumers.

3.3 Blocking patents

As our final scenario, consider the case where the vertically integrated firm AB would have to license specialist A’s technology in order to remain in the market. This case might arise if AB started production while A’s patent wended its way through the patent office (which can indeed be a slow process), emerging for licensing only after AB was already selling x. Or it might be that the patent on A is a “submarine” patent, held at the patent office through a strategic use of patent continuations or divisional patent filings. Or, it might be that AB knew full well that A’s patent was essential for production of its good x but decided to infringe anyway because it thought that A would not have the resources to enforce the patent.

Whatever the reason for A blocking AB’s production of x, the outcome in this case is vastly different than those discussed above. Now, the emergence of A enforcing its
patent does not increase competition for the production of \( x \). To the contrary, it could eliminate the market for \( x \) if AB and A cannot come to licensing terms.\(^{15}\) Moreover, if A attempts to act opportunistically \textit{ex post} and charge AB a license fee that exceeds the value of the technology and instead incorporates a portion of AB’s sunk investments (that is, if A behaves like a patent troll), then consumers could see increased prices for good \( x \) depending on the competitive structure of the downstream market.

This one case, then, captures the concerns over NPEs acting as patent trolls. Taking all of the cases together, however, should make it clear that this one possibility is not enough to condemn all nonpracticing patents holders. In many, if not most, circumstances, the entrance of NPEs increases competition and enhances welfare. We turn next to the implications of these three cases for the entrance of specialists on long term industry structure and social welfare.

3.4 Competition, industry structure, and welfare over time

Now let’s add a time dimension to the problem to assess the long-term competitive implications. Assume that in period one firm AB is a monopoly. Then in period two IPR contracts emerge as viable so that the contracted specialist A/B enters the market as described in the various cases above. What should we expect in period three? The answer depends on the case at hand. The table below summarizes the different cases, which we then discuss.

Under the assumptions in the first and fourth case of Table 1, there is no reason to expect the vertically integrated firm AB to exit the market in the face of competition from specialists. True, when specialists enter the market AB earns less than the monopoly (or oligopoly) profit it once earned, but it is still able to earn a competitive return. Likewise, a contracted specialist entity A/B is able to capture some portion of the market for its product of equal or superior quality and also is able to earn a competitive return. Thus, here we expect the forces that create different firm types in the first place—comparative advantage, financing constraints, etc.—to maintain those different firm types in the marketplace as long as IPR contracting is feasible.

A diverse market structure is less likely to remain under the conditions of Case 2, with a clear comparative advantage to specialization. AB may well determine that selling off one layer of its business (R&D or manufacturing) and thereby becoming a specialist will enable it to achieve greater profits over its current structure. In the real world, this would materialize as a “spin off”—a process seen not infrequently. For instance, a number of mobile telecom firms have spun off their semiconductor chip facilities (used in the production of handsets) over the past decade. The most

\(^{15}\)AB could challenge A’s patent as invalid. If successful, AB could resume production of \( x \) without any licensing costs (but having expended resources for the litigation).
recent example of this trend is Motorola, which announced in March 2008 that it would be splitting into two separate publicly traded companies—one concentrating on nonhandset operations and the other company purely focusing on handsets (Cheng, 2008). As noted earlier, the semiconductor industry is perhaps an extreme example of disintegrated industrial structure. The high degree of specialization required both for design and fabrication has, in fact, resulted in multiple firm layers for certain chips. The X Architecture chip requires at least three levels of specialization: the design shop, a specialist software shop that writes the code to be used in manufacture, and the fabrication plant.

The third case presents the opposite dynamic, as now the comparative advantage belongs to integration, in terms of product quality and production cost. Naturally, under these circumstances we should expect more integrated firms in the long term. Nevertheless, the ability to enter a market as a specialist allows for relatively low cost entry, parsed into manageable steps: first develop the technology, contract with specialist B, then work toward merging with B or building out its own downstream operation so as to become a new integrated firm AB'. Alternatively, a B specialist might move into market x from a related market, contract with specialist A, and then either merge with A or develop its own upstream operations.

We see this kind of behavior in the real world as well. For instance, in mobile telephony a number of Asian handset manufacturers moved into the production of

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16X Architecture is a novel form of integrated circuit design based on the pervasive use of diagonal routing; it has increased performance, lower power consumption and can be manufactured at lower costs. However, X Architecture requires manufacturing tools of extremely high precision.
handsets conforming to the European standard from their base in manufacturing handsets for the Asian and US standards. After licensing the technology from upstream specialists, several of these firms have now begun to conduct their own R&D and are developing their own patent portfolios. Biotech offers another example. Genentech, a leader in recombinant DNA technology began by partnering with a number of pharmaceutical and chemical companies to research and develop its patented technologies but only began to develop manufacturing capability after several years (Wall Street Journal, 1985; Financial World, 1987). Moreover, when contracting with large pharmaceutical firms, biotech startups frequently try to retain “manufacturing rights” in the hope that they will eventually be able to vertically integrate into the production of the drug (Pisano and Mang, 1993). This was the case in the 1980s with biotech startup Cetus, which received royalties from the sale of drugs manufactured by other firms while maintaining the option of exchanging royalties for manufacturing rights. Cetus observed that they “we[re] committed to becoming a fully integrated health-care company” (Financial World, 1985).

It is only in the last case, where the upstream specialist’s patents block the manufacture of AB’s good $x$, that the implications of opportunistic use of IPRs on long term competition are unclear. We might expect that troll strategies are short term ones: firms that develop a reputation for opportunistic ex post licensing will be watched closely, with implementers either approaching such entities for contracts before any irreversible investments are made, or carefully working around any IPRs held by such firms. On the other hand, it can be difficult to anticipate patents in advance and it is not always possible to work around a patent, so firms practicing troll strategies may indeed be able to ambush manufacturing firms as a long-term practice. Defensive patenting on the part of vertically integrated firms would do little to deter a troll, as it does not need to cross license. We therefore conclude that for this case, the best solution would be patent reform. For example, continuation patents could be limited, as argued in Quillen and Webster (2001). In addition, the balancing test for injunctions, emphasized by the majority in the eBay case, could be strictly applied in any patent infringement case where troll behavior is suspected, as a means of limiting ex post hold up power.

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17 This appears to be the case in 4G technology. Asian mobile handset vendors such as Samsung and LG, who had only small stakes in 3G, have begun to invest heavily in intellectual property for 4G. See, M2 Communications, “ABI Research: Asia Companies to Hold Significant Share of Diverse 4G IP Landscape,” October 5, 2007.

18 In the early 1980’s Genentech’s technologies for producing human insulin, blood clot dissolving enzymes, growth hormones and other products were made commercial through licensing and financial support from various large companies. The same trend was apparent in a number of other biotech startups. After 1985 Genentech was able to commercially manufacture a number of drugs under its own name.

19 Shapiro (2004) has made similar arguments for patent reform.
4. Conclusions

In concluding their 2004 paper on patent-enabled contracting, Arora and Merges note that their “intent is not to argue for stronger patent protection, but rather to point out an insufficiently appreciated benefit...stronger property rights translate into greater benefits indirectly.” Several years later, it appears that the indirect benefits of patent protection are still “insufficiently appreciated.” The continued emphasis on patent trolls, defined merely as “non-practicing entities” by the US district courts and others, motivated our renewed look the dynamic relationship between patents, firm structure, competition, and innovation.

We find that the effects of patents in the hands of upstream specialists are far more complex than is recognized in much of the policy debate, by the lower courts, by some competition officials, or in segments of the academic literature. In fact, patents held by NPEs can offer a number of pro-competitive benefits. First, IPRs, and especially patents, assist the entry of specialists into a market, which has direct implications for the level of competition and therefore the prices that consumer pay. Second, as is well recognized, specialization can mean higher quality. This is no less a factor in IP contexts. Third, when it is upstream, specializing can also translate into more innovation, as rival firms are pushed to innovate in order to remain competitive in the market. These many positive effects must be weighed against the negatives presented by blocking patents and opportunistic ex post licensing.

The very simple framework we use to discuss the competitive effects of NPEs also suggests useful real world tests. The continued presence of both vertically integrated firms and contracted specialists, after the Darwinian process of competition has eliminated the weakest competitors, has implications for testing the presence of comparative advantage and transaction costs. If vertically integrated firms have a comparative advantage in economies of scope or scale as well as in solving certain coordination costs (such as double marginalization problems) that can accompany the production of multi-component products, then we should see specialist firms only in early start up phases. Rational players will use specialization as an entry strategy, given its lower upfront costs, but will strive for vertical integration over time in order to obtain stronger profits. If instead we see the long-term dominance of specialists, with vertically integrated firms exiting the market, then we can conclude that specialists offer a comparative advantage in quality, innovation, or cost. The presence of coordination problems, which can be solved by vertical integration, could soften the benefit of specialists’ comparative advantage. In this mixed case, we should see the coexistence of both vertically integrated firms and contracted specialists.

The importance of all of this is that policy—meaning legislation, court opinions, and competition agency decisions—should be careful not to view the effects of specialized patent holders too narrowly. The emphasis on patent trolls, and their
incentives and ability to practice hold up, has relied on far too sweeping a definition of trolls. In light of the analysis presented here, it is clear that we cannot provide such a simplistic definition for patent troll as all nonpracticing entities. Instead, we need to recognize that specialization can enhance social welfare, even in the context of patent holders. It can boost competition, raise product quality, and increase consumer choice.

While it is true that NPEs upset the traditional order in industries long characterized by vertically integrated players, and yes they can charge relatively higher royalty rates since cross-licensing is often not an option, these specialists can also have a decidedly pro-competitive role to play in the industry.

We therefore suggest that the policy debate should shift its attention toward finding meaningful ways of identifying harmful behaviors, rather than targeting certain business models. For example, one potentially fruitful route might be examining firms’ litigation history and tactics. Genuine trolls are said to litigate frequently and for low-quality, “junk” patents, so we might be able to identify these firms through the assessment of patent quality measures. If a patent holding firm is the upstream specialist at issue, we might consider their record of matching patent holders with downstream licensees, of placing venture capital with startup inventors, or of researching their acquisitions to ensure that only high-quality, valuable patents are obtained as means of distinguishing pro-competitive market-making from troll-like behavior. Surely more lines of inquiry of this type are possible, and given the importance of distinguishing opportunistic troll behavior from pro-competitive NPE behavior, we argue this is the path that should be followed.

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