Dynamic Analysis of Intellectual Property: Theory, Evidence and Policy

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Intellectual property law always intervenes in markets that already have private sources of intellectual property rights. This observation complicates the conventional assumption that more IP always reduces the size of the public domain and less IP always expands it. Withdrawing “public IP” will make no difference in the size of the public domain if the market responds by migrating to “private IP” substitutes. Withdrawing public IP can even enhance entry barriers and reduce the size of the public domain if certain firms have lower-cost access to private IP than others. That perverse case is not only plausible but typical. In general, weaker public IP tends to advantage more integrated firms that have lower costs of adopting private IP; conversely, stronger public IP protects less integrated firms that have high costs of adopting private IP. Restricting public IP effectively restricts the feasible range of organizational forms, resulting in hierarchical environments dominated by integrated firms that maintain a complementary suite of innovation, financing and commercialization capacities or bureaucratic environments dependent on tax-based and philanthropic transfers. Expanding public IP restores the full range of organizational forms, enabling entrepreneurial environments populated by specialized R&D-intensive firms that rely on contract to procure the financing and commercialization inputs required to reach market. These relationships between intellectual property, firm organization and market structure provide the basis for a novel reconstruction of U.S. patent history that identifies tendencies in the organizational structure of U.S. technology markets under weaker and stronger patent regimes (defined as a combined function of patent validity and antitrust enforcement). Consistent with theoretical expectations, periods of weak patent protection tend to drive innovation toward transactionally poor environments dominated by hierarchical and bureaucratic entities while periods of strong patent protection tend to support transactionally diverse environments consisting of bureaucratic research entities, large integrated corporations and smaller R&D-intensive firms.
Introduction ................................................................................................................................................. 4

I. Redefining IP ................................................................................................................................................. 8
   A. IP = Private + Public IP ....................................................................................................................... 8
   B. Assessing Propertization Levels ........................................................................................................... 9

II. Dynamic Analysis of IP Rights .................................................................................................................. 11
   A. Conventional (Static) Analysis .............................................................................................................. 11
   B. Dynamic Analysis ................................................................................................................................. 12
      1. Set-Up .............................................................................................................................................. 12
      2. Analysis ............................................................................................................................................ 12
         a. Conventional Case ......................................................................................................................... 13
         b. Indifference Case ............................................................................................................................ 14
         c. Perverse Case ................................................................................................................................. 14

III. Structural Effects of Public IP ................................................................................................................ 15
   A. Structural Effects: Micro-Level .......................................................................................................... 16
      1. The Incumbent’s Advantage ............................................................................................................ 16
      2. The Entrant’s Predicament ............................................................................................................. 19
         a. Commercialization by Contract .................................................................................................. 19
         b. Commercialization by Integration ............................................................................................ 22
      3. The Entrepreneurial Function of Intellectual Property .................................................................... 23
         a. Contracting Costs ........................................................................................................................... 23
         b. Financing Costs ............................................................................................................................ 24
   B. Structural Effects: Macro-Level ........................................................................................................... 25
      1. Public IP and Organizational Freedom ............................................................................................ 26
      2. Innovation Architectures ............................................................................................................... 27
         a. Entrepreneurial Innovation .......................................................................................................... 28
         b. Hierarchical Innovation .............................................................................................................. 30
         c. Bureaucratic Innovation .............................................................................................................. 30

IV. Empirics: The Architectural History of Innovation Markets ............................................................... 32
   A. Historical Trends in Patent Protection and Market Structure ............................................................ 33
1. Trends in Patent Strength ............................................................... 33
   a. Period I: Strong Patents .......................................................... 33
   b. Period II: Weak Patents ......................................................... 34
   c. Period III: Strong Patents ..................................................... 35

2. Structural Trends ........................................................................... 37
   a. The New Deal Effect: Weak Patents + Strong Antitrust = Protected Markets ................................................................. 38
   b. Cracks in the Consensus: The Subtle Vices of Weak Patents .......................................................................................... 41
   c. The Federal Circuit Experiment: Strong Patents + Weak Antitrust = Competitive Markets .................................................. 43

B. Market Snapshots: The Structural Effects of Strong Public IP ................. 47
   1. Biotechnology: Integration by Contract ........................................ 47
   2. Semiconductors: Interrupted Integration ....................................... 48
   3. Innovation-Only Entities: Complete Disintegration ....................... 49

C. Historical Trends in Political Economy: Incumbents (Usually) Prefer Weak Public IP .... 52
   1. Late 19th Century (U.S. Railroads) ................................................. 54
   2. Late 1930s (New Deal) ................................................................ 54
   3. 1960s – Present (Software Patents).............................................. 55
   4. Late 1990s (Financial Method Patents) ......................................... 56
   5. 2000s (Patent Reform Debate) .................................................... 56

V. Do Structural Effects Matter? ................................................................ 57
   A. The Social Value of Organizational Choice ...................................... 58
   B. Why Are There Any Limits on Public IP? ....................................... 59
      1. Why Conventional Reasons for Limiting Public IP Are Deficient ............ 60

Conclusion ................................................................................................ 63
Conventional discussions of intellectual property (“IP”) assume that the state is the sole provider of IP rights, which sadly intervene in a public domain that is otherwise free of access constraints. This is false. Even if the state fails to supply sufficient IP, markets do not sit still. Innovators¹, and the various entities that undertake the tasks required to commercialize innovations, adopt substitute mechanisms to regulate access and generate the premia required to cover costs and earn a positive return. As I have documented elsewhere, robust innovation environments are virtually never free of “property rights”²—and happily so, for otherwise privately-funded innovation would dwindle without any mechanism by which to regulate access, generate revenues and cover the costs of innovation and commercialization. In this Article, I present a novel dynamic approach to IP analysis that views both the state and the market as sources of IP. The state supplies “public IP” and the market supplies “private IP”. Taking into account the market’s capacity to supply IP produces a diverse range of scenarios that violate the standard assumption—a bedrock of conventional IP analysis—that decreases in IP (meaning, state-issued IP) expand the public domain and increases in those rights reduce it. Take the most extreme case in which the state abolishes, fails to supply, or declines to enforce IP rights. Standard analysis anticipates that an open-access commons obviously results. Dynamic analysis holds that nothing is obvious—or rather, everything depends on the market response to the state’s action. If the market adopts private IP that makes up any shortfall in coverage, abolishing public IP has no effect on the aggregate constraints—that I call the “propertization level”—that govern access to the relevant pool of technological or creative goods. This contingency is indicative of a broader principle. The real effect of any nominal change in formal IP rights depends on the extent to which those rights are effectively enforced and, what has been overlooked, the extent to which the market supplies functional equivalents for those rights. Decreasing public IP might increase access, as would be conventionally expected, leave access unchanged or perversely decrease it; conversely, increasing public IP can generate the same unbounded range of outcomes.

A multiplicity of outcomes does not mean that those outcomes are random. The market’s response to changes by the state in public IP—which then determines the resulting propertization

¹ By “innovators”, I refer to all individuals, firms and other entities engaged in the activities encompassed by the production, testing and commercialization of novel ideas, technologies and creative goods. Where necessary, I refer specifically to subsets of the innovation or commercialization process. This definition applies as well to the related term, “innovation”.

level—depends on innovators’ costs of adopting private IP substitutes. If those substitution costs are high, then changes in public IP will tend to have a strong effect on the market’s ability to regulate access to, and therefore earn a return on, innovative output; otherwise, those changes will have little to no effect. This principle has a clear practical implication. Changes in public IP will tend to have the weakest effect on larger, older and more integrated entities (which I will call “hierarchical” entities), who can substitute scale economies, reputational capital, internal financing and accumulated know-how for shortfalls in public IP and therefore still expect to earn roughly the same return on innovative effort in the absence of public IP. Conversely, public IP has the strongest effect on smaller, younger and less integrated entities (which I will call “entrepreneurial” entities), who inherently bear higher costs in accessing private IP substitutes and therefore cannot expect to earn the same return on innovative effort in the absence of public IP. If the state reduces public IP, then entrepreneurial entities bear escalating costs in regulating access through private IP, expect reduced returns on innovation, curtail activities and ultimately withdraw from the market. By contrast, hierarchical entities can substitute toward private IP at no or little cost, expect relatively unchanged returns, and therefore are largely impervious to reductions in public IP. If substitution costs are too high even for hierarchical entities, then there is insufficient supply of both public and private IP and all innovators exit or seek funding from state or private patronage. The result: the market allocation of innovation resources is displaced by bureaucratic allocation driven by rent-seeking behavior, reputational prestige and philanthropic goodwill.

A dynamic approach anticipates innovators’ responses to changes in public IP as a function of innovators’ costs of adopting private IP substitutes. Those costs are in turn a function of the organizational form under which the innovator operates. But a fully dynamic analysis requires taking one further step. Organizational forms are not fixed: innovators can elect to undertake any part of the innovation and commercialization process through various organizational forms, ranging from an academic research department to a small start-up to a large multinational conglomerate. Changes in public IP have different effects on the expected returns to innovation depending on the type of entity in which the innovation process is situated: for entrepreneurial entities, those changes can be existential; for hierarchical entities, those changes may be trivial. By anticipation, innovators respond to changes in public IP by selecting organizational forms that maximize expected returns on innovation, given the anticipated level of public IP. In the aggregate, those micro-level organizational selections determine the macro-level “architecture” of
the relevant innovation market. Again, take the extreme case in which public IP is abolished or unenforced: innovators will anticipate low expected returns using entrepreneurial forms (e.g., the startup) and will migrate toward hierarchical forms (e.g., the large incumbent) protected by the advantages of scale or bureaucratic entities (e.g., the government or academic research institute) supported by taxes or philanthropic goodwill. Now suppose public IP is restored and enforced. Innovators can now capture returns using any combination of organizational forms and will efficiently select those forms that maximize expected returns to innovation. The potential result: an entrepreneurial environment that supports unintegrated or weakly-integrated entities that primarily engage in R&D and rely on contractual relationships with third parties to achieve commercialization and capture returns on innovation. This outcome is made feasible by a public IP regime that enables entry by individuals and entities that lack any other cost-comparable mechanism by which to appropriate returns on innovative effort.

The dynamic approach shifts the focus of IP analysis away from its traditional concern with the relationship between formal IP rights and innovative output. That inquiry has yielded limited determinate results, frustrating strong normative arguments both for and against formal IP rights. The dynamic approach re-directs empirical inquiry into the manner in which changes in public IP influence the market’s selection of organizational forms. Following this approach, I present a

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novel reconstruction of U.S. patent history that identifies and accounts for trends in the architectural structure of U.S. technology markets as a response to changes in the strength of patent protection. While the evidence is still preliminary, historical trends largely track theoretical expectations. Periods of weak patent protection (most notably, the period extending from the New Deal through the 1970s) coincide with organizationally-poor environments characterized by reduced use of the patent system, the concentration of R&D in large firms and government-funded entities, and a feeble secondary market in IP rights. At that time, the figure of the scientist-entrepreneur diminishes as innovation principally takes place within the confines of large corporations, universities and government laboratories. By contrast, periods of strong patent protection (most notably, the late 19th century and the late 20th century through the present) coincide with organizationally-rich environments characterized by active use of the patent system, a shift of R&D toward younger and smaller firms, and a robust secondary market in IP rights. At those times, the figure of the scientist-entrepreneur re-emerged as innovation shifted in part toward younger and smaller firms engaged primarily in R&D activities. This is best-illustrated by markets in which integrated incumbents have been challenged by patent-protected entrants that rely on contractual relationships with third parties to assemble the commercialization inputs required to reach market. To be sure, entrepreneurial innovation does not come without social costs—observers in the late 19th and early 21st centuries lament the transaction and dispute-resolution costs inherent to patent-intensive markets. Those costs, which fall disproportionately on large firms that provide the most attractive litigation targets, account for another consistent pattern: with some exceptions, incumbents in technology markets tend to support relaxations in patent coverage; by contrast, individual inventors, smaller firms and their financial backers tend to take the opposite view. Those differences in preferred levels of public IP follow systematically from differences in the costs of substituting toward private IP alternatives.

Organization is as follows. In Part I, I develop a terminology for analyzing the interaction between public and private IP rights. In Part II, I present the dynamic analysis of intellectual property. In Part III, I describe the organizational effects of changes in public IP and the manner in which those effects promote different market architectures. In Part IV, I apply those propositions to identify and account for historical trends in the architecture and political economy of innovation markets. In Part V, I discuss normative implications.
I. Redefining IP

To prepare a foundation for the dynamic analysis of IP rights, it is necessary to develop a terminology that can capture both the public and private instruments by which innovators can regulate access and capture returns on innovation.

A. IP = Private + Public IP

The new institutional economics literature uses the term, “property rights”, to cover both legal rights whereby asset holders can regulate access through legal rights and “economic rights” whereby asset holders can regulate access through non-legal mechanisms. Legal commentary on IP naturally focuses on legal rights—patents, copyrights and other variants—that regulate access to a pool of technology or creative assets. This legal-centric focus can both (i) overstate economic rights in cases where legal rights are not well-enforced (a typical case); and (ii) understate economic rights in cases where holders of “innovation goods” have non-legal capacities by which to regulate access to those goods (again, a typical case). As depicted below, those non-legal mechanisms—which I will call “private IP”—fall into two categories: (i) direct mechanisms that secure exclusivity over the innovation good and extract value by regulating access to it; and (ii) indirect mechanisms that expose the innovation good to imitation but extract value by securing exclusivity over complementary goods and services. Direct mechanisms include: (i) imitation barriers, which are a function of technological characteristics inherent to a particular good or technological measures undertaken by the holder of that good; and (ii) contractual agreements that impose restraints on use of the relevant good. Indirect mechanisms include: (i) production, testing, distribution and other efficiencies associated with economies of scale and associated know-how; (ii) cost-of-capital advantages; (iii) brand capital and associated goodwill; (iv) network effects and associated switching costs; and (v) the sale of complementary goods or services. With the exception of the pharmaceutical and chemicals industries, survey studies indicate that larger firms in most technology-intensive industries rely primarily on these private technologies to extract value from innovation. Private IP explains why innovative output is often robust in markets in which public IP is weak, unused or absent.

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4 For the original statement of this approach, see Yoram Barzel, Economic Analysis of Property Rights (2d ed. 1997; orig. pub. 1989) [hereinafter Barzel, Property Rights].

5 By “innovation good” or “innovation asset”, I mean any intangible asset, whether technological or creative.

B. Assessing Propertization Levels

Any successful innovation environment operates under some combination of legal and non-legal mechanisms—that is, public and private IP—that regulate the unconsented use of technological and creative goods, which in turn generates revenue streams to fund innovation and commercialization activities. Those constraints together determine the percentage of the relevant stock of technological and creative goods, $S$, that is protected against unconsented use. I refer to that “closed” percentage as the propertization level, denoted by $P$, where $0 \geq P \leq 1$. Statutory and case law set forth nominal $P$ values, denoted by $P_n$, which represents the percentage of $S$ that is closed to unconsented use as a matter of formal law; the remaining portion of $S$ corresponds to what intellectual property scholarship and jurisprudence call the “public domain”. These are at best roughly indicative of real $P$ values, denoted by $P_r$, which represents the percentage of $S$ that is actually closed to unconsented use. The value of $P_r$ is a function of (i) the investments made by holders of innovation assets to enforce $P_n$; and (ii) the investments made by those holders to

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Public IP regimes are typically enforced almost entirely by private action; by definition, the same is true of private IP regimes.
acquire and implement non-legal technologies that regulate access to $S$, in each case subject to a discount rate that those investments are actually successful in regulating access. This is represented as follows below: $P$ denotes the propertization level, ranging from no propertization at $P = 0$ to complete propertization at $P = 1$.

Figure II: Propertization Level

Real propertization values may fall below or above nominal propertization values. Let’s briefly explore both scenarios. As a practical matter, the investment required to adopt and enforce any public IP right is significant and, given the extreme skew in the commercial value of technological and creative output, future expected returns are low. It is therefore expected (and is actually the case) that firms or individuals eligible to make use of public IP rights will often if not usually decline to do so, due either to failure to apply for those rights, renew those rights or enforce those rights. Without even considering private IP substitutes, real propertization levels will therefore tend to lag considerably behind nominal propertization levels, as denoted by $P_{r1}$ above. Taking into account private IP can then push real propertization values above nominal propertization values, as denoted by $P_{r2}$ above. Even in the extreme case where the nominal value is zero, the real value may still be positive. For example, sound recordings enjoyed no formal protection under U.S. copyright law until 1971; however, prior to that time (and setting aside state-law protections), they were protected against unauthorized replication at cost-equivalent and quality-equivalent levels by technological constraints (meaning, $P_r > 0$ but $P_n = 0$). Today the situation is approximately reversed: sound recordings enjoy robust protection

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10 This expectation is consistent with evidence on renewal fees: (i) currently, most patent holders allow patents to lapse prior to the end of the full 20-year term due to failure to pay renewal fees (see Kimberly A. Moore, *Worthless Patents*, 20 Berkeley Tech. L. J. (2005); and (ii) historically, copyright holders did the same when copyright law required payment of renewal fees, see William M. Landes & Richard C. Posner, *The Economic Structure of Intellectual Property Law* (2003).
under public IP, but significantly degraded protection as an effective matter given the availability of low-cost and quality-equivalent reproduction technologies (meaning, $P_n > P_r > 0$).

II. Dynamic Analysis of IP Rights

In this Part, I develop a dynamic analysis of IP rights that takes into account innovators’ ability to substitute toward private IP to secure returns on innovation. Taking into account these substitution effects complicates anticipating the real propertization levels that result from changes in nominal propertization levels as set forth in formal law. Those effects often run counter to conventional intuitions that increases in formal IP always imply increases in actual propertization and access costs.\(^{11}\) Precisely the opposite is sometimes the case.

A. Conventional (Static) Analysis

Conventional analysis follows the natural intuition that increases in public IP always increase access constraints and therefore reduce the size of the public domain (and decreases in public IP always achieve the opposite outcome).\(^{12}\) This principle drives the incentives-access tradeoff that drives virtually all intellectual property scholarship and jurisprudence: when the state takes some action that increases the strength of public IP, this enhances innovation incentives by increasing IP holders’ expected pricing power but degrades access by raising the expected costs borne by users. The opposite outcome prevails when the state takes some action that reduces the strength of public IP: incentives decline but access increases. Without much exaggeration, all economically-informed analysis of intellectual property law reduces to an attempt to calibrate public IP such that the marginal incentive gains in the form of increased innovation from each extension of public IP just equals marginal social losses in the form of reduced access. This conventional framework is only reliable, however, if we assume that the propertization levels nominally delineated by formal law are indicative of the actual propertization levels under which innovators actually operate in the market. That assumption is false in a broad range of circumstances.

\(^{11}\) Some of the following analysis consolidates and refines my earlier discussion in Barnett, *Trivial*, supra note ___.

\(^{12}\) Any “increase” or “decrease” in public IP could take place with respect to any number of attributes of the relevant entitlement, including application fees and procedures, duration, subject matter, scope, available remedies, and enforcement costs. Unless specified more precisely, use of those terms in the following discussion can be construed as covering any of those attributes.
B. Dynamic Analysis

Formally, conventional IP analysis assumes that $P_r = P_n$. This assumption is unrealistic on two counts. First, it ignores the fact that innovators will often fail to adopt or enforce public IP rights, so it may be the case that $P_r < P_n$ (that is, a nominally protected asset is really unprotected in practice). Second, it ignores innovators’ ability to use private IP in lieu of public IP, so it may be the case that $P_r > P_n$ (that is, a nominally unprotected asset is really protected in practice). If we take into account those complicating factors, the conventional positive relationship between the strength of state-issued IP rights and users’ access costs no longer holds over all plausible circumstances.

1. Set-Up

Suppose that a firm must elect between using private IP or public IP to regulate access to a particular attribute of an innovation good. The firm will only adopt the public IP right, and will only make efforts to enforce it, provided the cost of doing so yields an expected net positive gain relative to using the private IP right. The effect of any change in nominal propertization levels ($P_n$) on real propertization levels ($P_r$) therefore simply depends on the difference in cost between enforcing public and private IP to secure a unit of return on innovation. I will denote the cost per unit of return provided by a public IP right as $C_{pu}$ and the cost per unit of return provided by a private IP right as $C_{pr}$. For simplicity, I assume that enforcement costs are constant for any given IP right (that is, there are no diminishing returns to enforcement effort).

2. Analysis

Suppose a market populated by two firms that are identical except for the costs incurred to substitute private IP for public IP. Firm A has high costs of substituting toward private IP and therefore expects that $C_{pu} < C_{pr}$. Firm B has zero or “negative” costs of substituting toward private IP and therefore expects that $C_{pu} \geq C_{pr}$. We can now identify three possible effects of upward and downward adjustments in the value of $P_n$ on the value of $P_r$. In each case, those effects depend on the firm’s cost of substituting toward private IP in lieu of public IP, which in turn determines the firm’s preferred least-cost instrument for regulating access to the relevant stock of innovation goods. These effects are summarized in the Table below.
Table I: The Diverse Effects of Changes in Public IP

<table>
<thead>
<tr>
<th>Case</th>
<th>Change in (P_n)</th>
<th>Firm(s); Cost Characteristics</th>
<th>Change in (P_r)</th>
<th>Size of Public Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease in Public IP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>-</td>
<td>Firm A: (C_{pu} &lt; C_{pr})</td>
<td>-</td>
<td>Increases</td>
</tr>
<tr>
<td>b</td>
<td>-</td>
<td>Firm B: (C_{pu} &gt; C_{pr})</td>
<td>None</td>
<td>Same</td>
</tr>
<tr>
<td>c</td>
<td>-</td>
<td>Firm A: (C_{pu} &lt; C_{pr})</td>
<td>+</td>
<td>Decreases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Firm B: (C_{pu} &gt; C_{pr})</td>
<td></td>
<td></td>
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<tr>
<td>Increase in Public IP</td>
<td></td>
<td></td>
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<tr>
<td>d</td>
<td>+</td>
<td>Firm A: (C_{pu} &lt; C_{pr})</td>
<td>+</td>
<td>Decreases</td>
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<tr>
<td>e</td>
<td>+</td>
<td>Firm B: (C_{pu} &gt; C_{pr})</td>
<td>None</td>
<td>Same</td>
</tr>
<tr>
<td>f</td>
<td>+</td>
<td>Firm A: (C_{pu} &lt; C_{pr})</td>
<td>-</td>
<td>Increases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Firm B: (C_{pu} &gt; C_{pr})</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Conventional Case

For Firm A, \(C_{pu} < C_{pr}\). This is implicitly assumed to be the universal case in conventional analysis. If the state makes available a public IP right (case (d)), then the holder will shift resources from enforcement of private IP to enforcement of public IP, which delivers a return on innovation at a lower per-unit cost. Holding everything constant, the holder will “consume” more IP, thereby increasing the value of \(P_r\) and curtailing the size of the public domain, as would be expected following an increase in the value of \(P_n\). Conversely, if the state curtails public IP (case (a)), then the holder is forced to make up the shortfall in coverage by shifting enforcement resources to more costly private IP substitutes. Holding everything constant, the holder will “consume” less IP, thereby decreasing the value of \(P_r\) and increasing the size of the public domain, as would be expected following a decrease in the value of \(P_n\).\(^{13}\) In a more extreme (but the typically assumed) case, \(C_{pr}\) is so large that the firm would exit the market if it had to bear

\(^{13}\) That is not the only possible outcome. Depending on the innovator’s budget constraints and elasticity of demand for protection, the holder may bear the higher cost of maintaining coverage at constant levels, resulting in no change in real propertization levels and the associated size of the public domain. Nonetheless a social loss would still have been incurred given that the same level of protection is being supplied at a higher resource expenditure.
that cost—that is, there is no feasible private IP substitute to make up any shortfall in public IP coverage. In that case, the public domain is expanded to its maximal size but it contains nothing—the classic efficiency loss anticipated by the conventional argument for formal IP.

b. **Indifference Case**

For *Firm B*, $C_{pu} \geq C_{pr}$. In contrast to *Firm A*, *Firm B* is indifferent to changes in the value of $P_n$: it will always prefer to use private IP and, assuming no constraints on the supply of private IP, it will never adopt public IP. Even if the state increases the value of public IP (*case b*), *Firm B* will decline to invest resources in enforcing the entitlement and $P_r$ remains the same. By the same rationale, *Firm B* is indifferent to reductions in public IP (*case e*) given that it always has available to it a lower-cost private alternative. In this case, changes in public IP don’t matter: the value of $P_r$ and the size of the public domain, remains constant across all values of $P_n$.

c. **Perverse Case**

So far I have identified (i) a conventional case where, for *Firm A*, the value of $P_r$ moves in tandem with the value of $P_n$ (*cases a, d*) and (ii) an indifference case where, for *Firm B*, the value of $P_r$ remains constant irrespective of changes in $P_n$ (*cases b, e*). Under certain circumstances, a perverse case is realized: the value of $P_r$ falls when public IP is introduced and increases when public IP is withdrawn. This can be observed by placing *Firms A* and *B* in competition and supposing that these firms are identical expect for a single difference: for *Firm A*, $C_{pu} < C_{pr}$; for *Firm B*, $C_{pu} > C_{pr}$. Suppose the state withdraws public IP (*case c*) and, due to the absence of any cost-feasible private IP substitute, *Firm A* exits the market while *Firm B* is unaffected due to its low-cost access to private IP substitutes. Assuming no other potential entry threats, *Firm B* will then occupy the entire market and might elect to use private IP to increase access constraints—that is, increase the value of $P_r$—with respect to its stock of innovation goods. To see why, consider that the extent to which a firm elects to control access to its innovation goods affects the pricing of those goods. If a firm gives away a particular feature of its innovation good (and does not increase accordingly the price of other features), then the price for that feature is effectively set at zero; if a firm regulates access to that same feature, then the price is set at some positive value determined by market exchange. Competitive pressures may induce firms to give away certain valuable features at a zero price (as I have shown elsewhere, this is a common strategy in certain technology markets\(^{14}\)). In the monopolized market that would exist following exit by

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\(^{14}\) That is the case in markets such as mobile and desktop computing, in which platform holders compete to provide developers with free access to “APIs” (application programming interfaces) for
Firm A (and, again, assuming no entry threats from firms with cost-equivalent access to private IP), Firm B would operate under reduced pressure to provide these implicit pricing reductions.\(^{15}\) Hence, a perverse outcome results: withdrawing public IP raises entry barriers and protects the incumbent, who can implicitly raise prices by limiting access to some feature of the relevant innovation good, thereby effectively reducing the size of the public domain, or at least investing fewer resources into innovation given the absence of an entry threat. Conversely, if the state restores public IP in that market \((\text{case } f)\), then Firm A would re-enter, compelling Firm B to implicitly lower prices to competitive levels by forfeiting some level of access to that same feature, thereby effectively expanding the size of the public domain.\(^{16}\)

### III. Structural Effects of Public IP

In this Part, I operationalize the dynamic approach to IP analysis in two concrete steps. First, I examine the manner in which the effects of public IP on firms’ propertization choices differ as a function of firms’ organizational structure, which roughly proxies for firms’ ease of access to private IP substitutes. Second, I examine the manner in which innovators respond to changes in public IP by adjusting the choice of organizational forms used in the innovation and developing applications for the platform, or in search and social media markets, in which platform holders compete to provide users with free access. See Jonathan M. Barnett, *The Host’s Dilemma: Strategic Forfeiture in Platform Markets for Informational Goods*, 124 HARV. L. REV. 1863 (2011) [hereinafter Barnett, *Host’s Dilemma*].

\(^{15}\) It is not necessary to make the extreme assumption that firm A exits the market entirely. The perverse effect described above would still result, but in moderated form, if firm A stayed in the market but could not compete as effectively with firm B due to the higher costs borne by firm A to substitute toward private IP.

\(^{16}\) This is not the only perverse case. Suppose a market without public IP but with a powerful but crude form of private IP. As a result, the holder of an innovation asset faces the choice between a zero level of exclusionary power (for example, releasing the technology into the market without protection) or an extremely high level of exclusionary power (keeping the technology in a secret vault). Now assume the state releases a public IP entitlement that the innovator can use to achieve an intermediate level of exclusionary power at a cost that yields a net gain relative to the existing options of zero or complete exclusion. Intermediate levels of protection can be achieved either by adjusting enforcement efforts or by using public IP rights to tailor contractual provisions that finely regulate usage by a third party. But why would the innovator choose to reduce the real propertization level? It will do so whenever reducing the level of exclusionary power increases the innovator’s expected revenues. This could occur for several reasons: increasing access makes the asset more attractive to potential buyers, gives buyers an implicit discount in the total cost of accessing the relevant bundle of product attributes, or induces sales of a complementary good in which the holder has a competitive advantage. A perverse (and virtuous) result ensues: increased public IP increases access to the protected good and increases the expected return on innovation. By implication, if the state withdraws public IP protection, then the innovator will be compelled to return to use of the more severe private IP right, resulting in a decrease in the size of the public domain and, perversely (but viciously), a decrease in the return on innovation. For further discussion of this case, see Barnett, *Is Intellectual Property Trivial?*, supra note __.
commercialization process. In the aggregate, the thousands of organizational choices made by innovators at each stage of the innovation and commercialization process determine the architecture of the innovation market. Through those choices, the extant level of public IP indirectly exerts influence over firm and market structures.

A. Structural Effects: Micro-Level

In the preceding Part, I described two idealized types of firms that respond differently to changes in public IP based on cost differences in using private IP substitutes: Firm A, which is burdened by high-cost access to private IP instruments; and Firm B, which enjoys low-cost access to those same instruments. Those two idealized categories can now be translated into real-world firm types. Firm A corresponds to older, larger and more integrated incumbents—what I will call “hierarchical” firms—who have access to a wealth of private IP instruments. Firm B corresponds to younger, smaller and unintegrated firms—what I will call “entrepreneurial” firms—who do not have any comparable access to private IP. Comparative differences in the costs of accessing private IP imply that large integrated firms are mostly insensitive to changes in public IP (what I called the “indifference case” above) while small unintegrated firms are highly sensitive to those changes (what I called the “conventional case” above). The reason is simple: it is easy for hierarchical firms to replicate and often outmatch public IP by recourse to private IP; for entrepreneurial firms, it is hard to do so.

1. The Incumbent’s Advantage

Conventional scholarly and policy discussions assume that a world without public IP lowers entry barriers by making the relevant stock of intellectual goods available to all interested parties. Put differently: less IP, more access. That intuitive assumption does not hold true under a dynamic analysis that takes into account the existence of private IP alternatives and firms’ differential costs of accessing those alternatives. Private IP is ubiquitous and often effective; however, it is not always available at the same or feasible cost to all firms. The private IP mechanisms that can substitute for public IP are most easily available to hierarchical firms that are large in size and highly integrated, and, as a simple function of time in the market, hold abundant reputational capital. Entrepreneurial firms inherently tend to lack these characteristics. Consider some of the most powerful forms of private IP: scale economies in production, testing,

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marketing and distribution; accumulated know-how; cost-of-capital advantages; network effects and associated switching costs; risk-diversification capacities; and brand name and associated goodwill. These all tend to be characteristics that are inherent to firms that have achieved a certain size or level of integration, acquired ample internal capital (or hold collateralizable assets or revenue streams that reduce the cost of external capital), attracted a dedicated user base, accumulated a sufficiently broad portfolio of goods and services, and have been in the market for a sufficient amount of time.\textsuperscript{18} The differential distribution of private IP instruments across the total population of firm types flips the standard assumption that less IP always implies more access. To the contrary: weakening or removing public IP issued by the state can raise entry barriers by advantaging incumbents or other integrated firms that have the lowest-cost access to private IP substitutes. Differential access to private IP translates into a competitive advantage for dominant firms whenever public IP is reduced or withdrawn by the state.

This proposition is most dramatically illustrated by a business strategy often ruefully observed in technology markets. Namely: large incumbents pursue a “fast second” strategy that free-rides on the R&D of small firms and then outmatches those firms in undertaking the downstream tasks required to commercialize the innovation and support the innovation after release into the market. Thomas J. Watson, Jr., the famous leader for several decades of IBM, perhaps the longest-running incumbent in technology markets, describes this explicitly as the firm’s core competitive advantage:

“In the history of IBM, technological innovation wasn’t the thing that made us successful. Unhappily there were many times when we came in second . . . [but] we consistently outsold people who had better technology, because we knew how to put the story before the customer,

\textsuperscript{18} On the “natural” advantages of large firms in access to scale economies, brand capital and internal capital, see \textsc{William L. Baldwin} \& \textsc{John T. Scott}, \textsc{Market Structure and Technological Change} 13-14 (1987); \textsc{F.M. Scherer}, \textsc{The Economic Effects of Compulsory Patent Licensing} 83-84 (1977) [hereinafter \textsc{Scherer, Economic Effects}]; \textsc{U.S. Cong., Office of Technology Assessment, Innovation and Commercialization of Emerging Technologies} 23- 24, 57 (1995), avail. at http://www.fas.org/ota/reports/9539.pdf. This point has been emphasized by Prof. \textsc{William Kingston}. \textsc{See \textsc{William Kingston}, Invention and Monopoly} 23-24 (1967); \textsc{William Kingston, Innovation, Creativity and the Law} 58-62 (1990) [hereinafter \textsc{Kingston, Innovation}]; \textsc{William Kingston, The Political Economy of Innovation} 83-84 (1984) [hereinafter \textsc{Kingston, Political Economy}]. Roughly the same argument is made in a different context by \textsc{Alfred Chandler}; when he argues that large firms dominated American industry starting in the late 19\textsuperscript{th} century due to managerial and organizational innovations that fully exploited economies of scale and scope in production, distribution and marketing. \textsc{See \textsc{Alfred D. Chandler, Scale and Scope: The Dynamics of Industrial Capitalism} (1990).}
how to install the machines successfully, and how to hang on to the customers once we had them.”

In a variation on the fast-second strategy, a small firm anticipates this outcome and, recognizing its predicament, provides a large firm with access to its technology on asymmetrical terms that reflect the large firm’s lower commercialization costs. That is: the small firm-innovator forfeits access to its technology at a “low” price that reflects the incumbent’s credible threat to expropriate it later and reduce the innovator’s returns to zero.

The small firm-innovator’s fears are not without foundation. Evidence of the incumbent’s natural advantage is well-illustrated by numerous cases in which incumbents have used superior production and distribution capacities to outmatch entrants with superior innovation capacities. In every case the technological pioneer lost the market to an established incumbent that held a superior portfolio of complementary assets by which to monetize the technology. A recent example that is particularly well-known is the internet browser: Netscape pioneered the market in the late 1990s and initially captured a dominant market share; however, it rapidly lost that position to Microsoft, which could easily outcompete Netscape by giving away the browser and then earning revenues through the suite of complementary goods and services embodied by the Windows software and associated applications. Earlier examples abound of technologies that were either unprotected or underprotected by patents and fell prey to commercialization by existing incumbents: 35mm cameras (introduced 1925); ballpoint pens (introduced 1945); mainframe computers (introduced 1946); credit cards (introduced 1950); diet soft drinks (introduced 1952); ATMs (introduced 1965); pocket calculators (introduced 1971); CAT scanners (introduced 1972); the money-market mutual fund (introduced 1973); MRI machines (introduced 1978); and even the personal computer (introduced 1975).

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19 See Thomas J. Watson, Jr. and Peter Petre, Father, Son & Co.: My Life at IBM and Beyond 2 (1990).


2. The Entrant’s Predicament

The incumbent’s advantage implies that public IP often levels a playing field that is otherwise inherently tilted in favor of large dominant firms that have differential access to private IP substitutes. This proposition is roughly consistent with surveys of firms concerning the relative importance of patent protection as compared to other mechanisms by which to capture value on innovation. Outside pharmaceuticals and certain chemical markets, large firms tend to assign a low ranking to patents; by contrast, in certain markets, start-ups and smaller firms tend to assign high values to patents as compared to other appropriation mechanisms. It might therefore be concluded that strong public IP is a precondition for entry by entrepreneurial firms into technology markets. But there are two objections to overcome before that proposition can be safely adopted. Responding to these objections clarifies the circumstances in which public IP plays a role in preserving entry opportunities for unintegrated or weakly-integrated firms in innovation markets.

a. Commercialization by Contract

Even in a weak public IP environment, an entrepreneurial firm could mimic the scale economies, reputational capital and internal know-how of a vertically integrated firm by contracting with external suppliers that can provide the required set of commercialization functions at a competitive cost. If that were the case, then even entrepreneurial firms would be indifferent to significant reductions or even eliminations of public IP and the perverse case identified above would not follow. But this objection runs into a well-known transactional obstacle, sometimes known as the “information paradox”. The logic runs as follows. Absent a public IP right, an entrepreneurial firm faces expropriation risk to the extent it must disclose some part of its technology in negotiating with outside providers of commercialization inputs. This is

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22 *See supra* note 6.


an implied form of the familiar holdup problem. Assume an innovator that has developed a valuable technology but has no cost-feasible independent commercialization capacities. Once the innovator discloses its technology to a third party with the capacity to use that technology in a product or service that competes with the innovator’s intended product, the technology has no or lesser value for any other user. As a result, the third party can “hold up” the innovator, who will rationally forfeit almost the full value of its innovation. By anticipation, the innovator declines to submit the innovation and, absent a feasible commercialization mechanism, declines to innovate altogether or, at least, reduces his investment in innovation activity.\(^{25}\)

Theoretical arguments postulate, and anecdotal evidence suggests, that the information paradox may not always be so severe. In particular, a combination of graduated disclosure and reputation effects may sometimes ameliorate (but not eliminate) expropriation risk.\(^{26}\) The extent to which those methods are available will vary in different environments and technologies. But this limited possibility of accessing private IP does not relieve the entrepreneurial firm from expropriation risk; rather, it means that the severity of expropriation risk varies across the universe of information-exchange transactions, as organized by certain relevant parameters.

Formally, we can state that expropriation risk, \(R = f(v, c_{\text{comm}}, r, c_{\text{copy}})\), where: \(v\) = the innovation’s value; \(c_{\text{comm}}\) = commercialization costs; \(r\) = reputational capital and repeat-play effects; and \(c_{\text{copy}}\) = copying or reverse-engineering costs.\(^{27}\) Each of these factors impacts the value of \(R\) in different ways: as an innovation increases in value, \(R\) increases since the gains from opportunistic behavior increase; as commercialization costs increase, \(R\) increases since the innovator has a reduced ability to commercialize without a counterparty’s assistance; as reputational capital increases, \(R\)

\(^{25}\) Economists have developed theoretical models in which the idea submitter can capture a portion of the value of its innovation by threatening to disclose it to a competitor of the recipient. In that case, the idea submitter can claim the difference in surplus value between monopolistic and duopolistic pricing. See J. J. Anton & D.A. Yao, *Expropriation and Inventions: Appropriable Rents in the Absence of Property Rights*, 84 AMER. ECON. REV. 190 (2004). While this strategy forecloses complete expropriation, it still precludes the innovator from fully recovering the value of its innovation (or more precisely, recovering as much value as could be gained if the innovation were subject to an enforceable public IP right). Moreover, this model assumes that (i) the duopolists would be able to maintain stable above-cost pricing; and (ii) the technology would not be subject to reverse-engineering once it is released into the market by the duopolists. I am not aware of any evidence showing that this mechanism has been used in practice.

\(^{26}\) For qualitative evidence that technology firms sometimes use graduated disclosure strategies to mitigate negotiating obstacles, see Michael J. Burstein, *Exchanging Information Without Intellectual Property*, TEXAS L. REV. (2012). For an assertion (but without providing evidence) that information transactions can proceed safely by relying on reputation effects, see Burk & McDonnell, *supra* note __.

\(^{27}\) For a theoretical model that takes into account these and other parameters, see Ashish Arora, Marco Cecchegnoli & Wesley M. Cohen, *Trading Knowledge: An Exploration of Patent Protection and Other Determinants of Market Transactions in Technology and R&D*, in FINANCING INNOVATION (eds. Naomi Lamoreaux & Kenneth L. Sokoloff 2007).
decreases since the counterparty expects increased long-term gains from nonopportunistic behavior; as copying costs increase, $R$ decreases since the counterparty has a limited ability to imitate.

The combined impact of these parameters on expropriation risk is depicted below. In the “hostile zone”, expropriation risk is high under every parameter: it is easy to imitate the innovation, which has high value; the innovator has high commercialization costs; and the counterparty is subject to weak reputation effects. In the “friendly zone”, expropriation risk is low under every parameter: it is hard to imitate the innovation, which has low value; the innovator has low commercialization costs; and the counterparty is subject to strong reputation effects. These relationships follow common sense: transferring low-value information to a trusted academic colleague may be a particularly safe transaction; transferring high-value information to a direct commercial competitor is particularly unsafe; all other scenarios imply some expropriation risk at different degrees of severity.

**Figure III: Expropriation Risk in Information Transactions**

![Diagram](image)

The hostile zone identifies a transactional environment in which public IP is a precondition for the interfirm bargaining that must take place for an entrepreneurial innovator to obtain the funding and commercialization capacities required to reach market and earn a positive return.

Note that this describes the paradigmatic scenario involving an individual innovator (let’s say, a physician who invents a new medical device) who wishes to sell to, or enter into a joint venture
with, a large integrated corporation (let’s say, Johnson & Johnson). In all other transactional environments, public IP may not be a strict precondition for achieving commercialization at a cost-feasible level but still “adds value” by reducing expropriation risk and thereby reducing transaction costs. While the precise size of the “hostile zone” in any particular market is an empirical question, any casual review of trade-secret litigation involving alleged misappropriation in the course of business negotiations suggests that it clearly covers a nontrivial portion of the total universe of technology transfer transactions.\(^28\) Even outside the hostile zone, an innovator entering into a negotiation with an unrelated third party over an informational asset is always better off with a patent (or other public IP right) than without it.

b. Commercialization by Integration

It could be argued that, even in business environments that fall inside the hostile zone, the entrant could still resolve the holdup problem without public IP. The solution is simple avoidance: the innovator could raise funds to independently construct a vertically integrated production, marketing and distribution infrastructure for commercializing the innovation with minimal to no interaction with third parties.\(^29\) But any capital-raising transaction triggers some positive level of holdup exposure with respect to the providers of capital inputs—for example, a venture capitalist may have incentives to transfer technologies from one portfolio company to another.\(^30\) Let’s assume that some capital providers are constrained from opportunistic action by some combination of reputation effects and reverse-engineering costs. Even in that more friendly transactional setting, the innovator-entrepreneur still runs up against the cost-of-capital disadvantages that afflict firms that must source funding externally for innovation projects. External capital markets for funding R&D suffer from widely-observed imperfections that derive from the forecasting costs, long lag times, and informational asymmetries inherent to R&D projects.\(^31\) This is particularly true in the case of a small or newer firm, which (in the absence of

\(^{28}\) For discussion of some characteristic litigation, see Merges, *Transactional View*, supra note ___.

\(^{29}\) It is true that holdup risk can persist to some extent within the framework of a corporate entity, given the inability to fully constrain the mobility of human capital and the difficulty in drafting contracts that can limit the post-employment use of internal knowledge. Nonetheless, it seems reasonable to assume that the risk of expropriation by employees operating inside the firm is less than the risk of expropriation by third parties with no connection with the firm. For a similar assumption, see Henry O. Armour & David J. Teece, *Vertical Integration and Technological Innovation*, 62 REV. ECON. & STAT. 470, 470-71 (1980).


\(^{31}\) For a review of these deficiencies, see Josh Lerner, *The Governance of New Firms: A Functional Perspective*, in FINANCING INNOVATION 405-07 (eds. Naomi Lamoreaux & Kenneth L. Sokoloff 2007).
patents or other public IP) cannot offer tangible collateralizable assets, a past record of commercial success, or reputational capital to bolster its claims with respect to the value of its technology. Even assuming that reputation effects sufficiently mitigate expropriation risk, the innovator must pay an elevated premium to attract unsecured lenders to a project with uncertain commercial value and few to no collateralizable assets. The result: the innovator will either be unable to raise sufficient capital at a feasible cost, resulting in complete exit from the market, or it will do so at a premium that inflates its commercialization costs and reduces its expected returns. If that is the case, then the innovator that lacks independent wealth is in a difficult predicament: (i) it cannot easily raise sufficient funds to avoid expropriation risk by integrating independently; and, without those funds, (ii) it cannot protect against the expropriation risk inherent to securing commercialization services through contractual relationships with third parties.

3. The Entrepreneurial Function of Intellectual Property

We can now identify concisely the two key functions of public IP in supporting entrepreneurial innovation outside the confines of a hierarchical entity.

a. Contracting Costs

Public IP reduces the transaction costs that may otherwise preclude arm’s-length bargaining over commercialization inputs in hostile environments where economic stakes are high, reputation effects are weak, graduated disclosure is not feasible, and commercialization costs are high. In some industries, this is a critical aid for smaller R&D-intensive firms that have strong innovative capacities but weak commercialization and financing capacities and, therefore, are most vulnerable to the incumbent’s advantage. That is a point of particular concern in light of repeated findings that smaller firms have been a disproportionate source of the most radical forms of technological advance (as indicated by patents and various other measures of innovative


33 For related views, see, Merges, Transactional View, supra note ___; Kieff, supra note ___.

34 This assertion has empirical support. See Arora et al., supra note __, at 392-393 (finding that stronger patents are correlated with more IP licensing and sale transactions in the case of smaller firms and firms with weak complementary assets for commercialization purposes, while there is no such correlation in the case of larger firms and firms with strong complementary assets).

contribution)\textsuperscript{36} while large firms have tended to concentrate on modest cost-minimizing improvements to existing technologies.\textsuperscript{37} Consistent with this pattern, historical evidence shows that large corporations depend on small firms and individual inventors as sources of important innovations.\textsuperscript{38} Patents facilitate these upstream-downstream transactions by enabling a small capital-constrained innovator to secure commercialization services at a reduced risk of expropriation, thereby liberating the innovator from the necessity—and potentially, infeasible task—of independently integrating forward. That results not only in a private gain for the innovator but a social gain for all parties that can then enjoy the invention earlier than, and at a lower cost than, would otherwise have been the case.

b. Financing Costs

Even assuming no expropriation risk, public IP can reduce the financing costs incurred by an entrepreneurial firm that wishes to integrate forward into some or all commercialization functions.

\textsuperscript{36} See Anthony Breitman & Diana Hicks, An Analysis of Small Business Patents (2008) (report prepared for the Small Business Administration, Office of Advocacy) (using a database of 1,293 top patenting firms, based on patents issued 2002-06, of which 40% were issued to firms having fewer than 500 people); CHI Research, Inc., Small Serial Innovators: The Small Firm Contribution to Technical Change (2003) (report prepared for the Small Business Administration, Office of Advocacy) (finding that, on average, small firms outperform large firms on various measures of innovative contribution, including patenting per employee, citations per patent, and links to cutting-edge technology). These studies are consistent with findings from earlier periods. See Jacob Schmookler, Patents, Invention and Economic Change: Data and Selected Essays 37-40 (eds. Zvi Griliches & Leonid Hurwicz 1972) (reporting that smaller firms expend fewer R&D dollars per patent, which suggests greater research productivity, and use a greater share of their patents, which suggests greater patent value); John Jewkes, David Sawers & Richard Stillerman, The Sources of Invention (1958) (finding that small firms were responsible for a significant number of major inventions during 1900-1950).

\textsuperscript{37} See Richard R. Nelson, Merton J. Peck & Edward D. Kalacheck, Technology, Economic Growth & Public Policy 53-54 (1967). Proposed reasons for incumbents’ innovative conservatism include: (i) the incentive intensity required for the most creative types of innovation declines in bureaucratic organizations due to defects in monitoring and compensation mechanisms, see Williamson, supra note ___; (ii) agency costs in large corporations discourage disruptive innovations that place management under high risk of reputational penalties in the case of failure, see Bengt Holmstrom, Agency costs and innovation, in The Markets for Innovation, Ownership and Control (eds. Richard H. Day et al. 1993); and (iii) large-number conditions give rise to diseconomies of scale as a result of increasing communication and coordination costs, see Preston R. McAfee & John McMillan, Organizational Diseconomies of Scale, 4 J. Econ., & MGMT. STRATEGY 399 (1995).

\textsuperscript{38} See Willard F. Mueller, The Origins of the Basic Inventions Underlying Du Pont’s Major Product and Process Innovations, 1920 to 1950, in The Rate and Direction of Inventive Activity (1962) (out of 25 important new products introduced by Du Pont, 15 were based on work by independent inventors or smaller firms that initially did R&D outside Du Pont).
without relying on the existing infrastructure, reputational capital and scale economies of a dominant firm. There may be a number of reasons for doing so: to preserve a credible “outside option” when negotiating with outside suppliers, to develop long-term commercialization capacities, or to maximize internalization of all profit opportunities. Forward integration requires financial capital. Patents and other forms of public IP reduce the cost of capital by offering potential investors and lenders a collateralizable asset and, at least in some markets, a loosely informative signal of technological value. Empirical evidence supports this assertion, finding that patents and patent applications, as well as the quality of patents, increase investors’ valuation of start-ups in the semiconductor, biotechnology and other technology markets, resulting in greater access to capital. Even if an innovator is located in the “friendly zone” where it could safely transact with third parties, public IP still confers social value by mitigating the information asymmetry between innovator and investor, thereby lowering the firm’s cost of capital, expanding its financing opportunities, and increasing its expected returns on innovation.

**B. Structural Effects: Macro-Level**

So far I have analyzed the micro-level effects of public IP on firms’ propertization choices, and as a result, those firms’ innovation choices, given those firms’ existing organizational forms and associated costs of substituting toward private IP. The fundamental argument is simple. Public IP has a strong effect on the expected innovation returns of firms that are younger, smaller and less integrated (often entrants), who have fewer cost-feasible mechanisms to regulate access. Public IP has little effect on the expected innovation returns of firms who are older, larger and more integrated (often incumbents), who have an abundance of alternative cost-feasible mechanisms to regulate access. But there is a second step required to complete the dynamic analysis of IP. Absent legal or technological constraints, organizational forms are not fixed. Given a certain level of public IP protection, innovators will select the combination of

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organizational forms—ranging from the most hierarchical to the most entrepreneurial—to conduct each stage of the innovation and commercialization process at the lowest possible cost, thereby maximizing expected net returns on innovative output. This observation provides the basis for linking changes in public IP on the one hand to organizational form and market structure on the other hand. If changes in public IP alter innovators’ costs of capturing returns on innovation as a function of organizational form, then, everything else being equal, innovators will respond to changes in public IP by adjusting their choices of organizational form so as to minimize those costs and maximize expected returns. In the aggregate, individual firms’ organizational choices generate the architecture of an innovation market.

1. *Public IP and Organizational Freedom*

At each step on the pathway leading from idea conception through development through market release, each innovator (or holder of an innovation good) must elect the organizational form used to complete that step. To illustrate, suppose a physician-scientist is selecting the organizational entity or transactional form in which she will innovate and commercialize her medical-device innovation. Some possibilities include an academic position at a research university, a salaried position at a large integrated corporation, or a founder of an independent start-up. The innovator-physician’s choice among those organizational options will be influenced by the available level of public IP. Weak public IP elevates the cost of using stand-alone entrepreneurial forms that expose innovators to expropriation risk when interacting with outside providers of commercialization inputs and, as a result, compel innovators to secure the financing required to integrate forward independently. But financing can be difficult to secure at a reasonable cost without public IP. Absent sufficient capital, the innovation is not developed or the physician must elect from the remaining two organizational options: she can develop the innovation as an employee of an integrated firm or academic research entity. The former entity finances the innovation through internal cash flow while the latter entity finances the innovation externally through tax or philanthropic transfers. Strong public IP reduces the cost of using entrepreneurial forms by mitigating the expropriation risk and informational asymmetries inherent to contracting with outside suppliers of commercialization and financing inputs. As a result, it enables innovators to select freely from the full range of organizational choices—ranging from the most hierarchical to the most entrepreneurial forms—throughout the innovation and commercialization process. Organizational freedom inherently results in private and social efficiency gains. Absent expropriation risk, the innovator can freely select the combination of organizational forms that minimizes innovation and commercialization costs and maximizes
expected net returns; by contrast, under weak public IP, the innovator is confined to the most hierarchical organizational forms, which may fail to yield cost-efficiencies that could have been achieved under less integrated organizational forms.

2. **Innovation Architectures**

In the aggregate, innovators’ organizational choices at each stage of the innovation and commercialization process—essentially, an iterated series of thousands of make-buy decisions—generate the innovation architecture in any given market. The interaction between public IP and organizational form yields three core types of innovation architectures. Those architectures are distinguished by the extent to which innovation resources are allocated by external market forces rather than internal allocation by a firm or political allocation by the state.\(^{41}\) Three core types of innovation architectures can emerge under different public IP regimes: (i) an *entrepreneurial* regime; (ii) a *hierarchical* regime; and (iii) a *bureaucratic* regime.\(^{42}\) As public IP declines in force, each regime is characterized by declining degrees of organizational freedom and a declining role for external market forces in the allocation of innovation resources (as distinguished from internal managerial forces within a firm or political forces within the state). An entrepreneurial regime emerges under the highest level of public IP and allows innovators to select from the full range of organizational forms; a hierarchical regime emerges under intermediate to zero levels of public IP and constrains the feasible set of organizational forms to large integrated entities; and a bureaucratic regime emerges under weak to zero levels of public IP in environments where even large integrated entities do not have cost-feasible access to private IP substitutes. In the latter case, the market allocation of innovation resources is entirely

\(^{41}\) The following typology does not include “free appropriation” or “commons” environments that have received some attention in the recent legal literature. That is because, as I have argued elsewhere, outside of non-commercial or non-capital-intensive settings, some exclusionary constraint is almost invariably used to control access at some point on the total product/services bundle. *See* Barnett, *Illusion of the Commons, supra* note __. In particular, as I have shown with respect to open source software (*see* Barnett, *Dilemma, supra* note __), even well-developed forms of “collective invention” tend to rely on direct or indirect support from revenues generated by excludable complementary assets. Hence, these “open innovation” environments are best characterized as a variant of “hierarchical innovation” in which innovators collaborate within the framework of a semi-closed multilateral arrangement or operate under the implicit umbrella of a hierarchical entity.

displaced by cash transfers from the state or private patrons. These relationships can be represented as follows below: $a$ denotes a bureaucratic regime; $b$ denotes a hierarchical regime; and $c$ denotes an entrepreneurial regime.

**Figure IV: Public IP and Innovation Architectures**

![Diagram showing the relationship between organizational freedom, public IP, and market allocation.]

### a. Entrepreneurial Innovation

The link between strong public IP and organizational freedom can be observed in a variety of technology markets. Increases in the strength of public IP are typically followed by two types of organizational innovation: (i) growth in the number of small technology-intensive firms that supply R&D inputs to large integrated enterprises, and (ii) the development of financing and trading markets that innovator-firms can use to realize the market value of their innovations through assignments, licenses, joint ventures and other contractual mechanisms. Consider briefly four well-documented cases. First, in the United Kingdom, courts had been hostile to patentees’ infringement claims until the 1830s, at which time patentees experienced greater enforcement success in court. That shift in judicial attitudes, coupled with a subsequent reduction in patent application fees as part of reforms enacted in 1852, was followed by the emergence of a class of professional inventors who sold inventions through a secondary market of manufacturers and other corporate assignees.\(^{43}\) Second, strong enforcement of U.S. patent rights following the Civil War (and coupled with dramatic reductions in patent application fees) supported the emergence of an independent class of individual inventors, who used patents to secure financing from outside investors or to monetize patented technology through assignments.

and licenses to third parties. The archetypal example is the commercial laboratory founded by Thomas Edison to develop early lighting technologies, which relied on patents to attract outside capital, block imitators, and finance future research, development, and commercialization.

Third, as I will discuss subsequently in detail, the same pattern appears in technology markets in the late 20th and early 21st century United States: increased formation of R&D-intensive (and often scientist-founded) startups, who then rely on patents to engage in trading, licensing and sale transactions with larger downstream enterprises to achieve the steps required to complete commercialization. Finally, the same pattern can be observed in the organizational structures used by multinational enterprises when establishing manufacturing and R&D facilities in foreign jurisdictions. Firms tend to choose more hierarchical structures—for example, local divisions of the corporate parent—when transferring technology to jurisdictions with weak IP protections and less hierarchical structures—for example, joint ventures between the corporate parent and local third parties—in jurisdictions with strong IP protections. As these cases suggest, increasing the strength of public IP expands firms’ organizational opportunities and firms take advantage of that freedom by moving R&D and commercialization functions out of the firm and into the market. Absent legal compulsion, firms would only make those organizational choices if doing so lowered costs and increased profits; hence, any IP regime that facilitates those choices necessarily improves the efficiency of the innovation and commercialization process.

44 See Naomi R. Lamoureaux & Kenneth L. Sokoloff, Inventors, Firms and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries, in LEARNING BY DOING IN MARKETS, FIRMS AND COUNTRIES (eds. Naomi R. Lamoreaux et al. 1999); Lamoureaux & Sokoloff, Decline of the Independent Inventor, supra note __.


46 See infra Part __.

b. **Hierarchical Innovation**

If strong public IP tends to pull R&D out of the firm and into the market (or more precisely, provides firms with the option to do so), then weak public IP should have the opposite effect. This does not necessarily alter the total volume of innovative output; however, it shifts the organizational structures in which that output can be feasibly generated. AT&T’s Bell Labs illustrates how weak public IP drives R&D into the entry-protected environment provided by hierarchical organizational forms. During its tenure as a national telephone monopoly (roughly 1949-1982), AT&T was required by judicial order to make all its patented innovations available at a reasonable cost—essentially, a modified form of a compulsory license that can be construed as a form of weak public IP since it limited AT&T’s ability to extract the full market value from its technological assets. AT&T did not cease innovation as a result (as would be predicted by conventional IP analysis); to the contrary, its research arm, Bell Labs, produced a slew of remarkable innovations during the ensuing decades. Bell Labs could support innovation under a weak public IP regime because it had access to a powerful set of private IP instruments that were not available to any other firm. Thanks to the government-granted national telephone monopoly, AT&T received an assured stream of revenues on complementary services in a protected market (a statutory fee collected from local telephone operating companies), which provided a steady cash stream to support R&D. But Bell Labs’ innovative vigor is not a certain social gain relative to stronger public IP regimes: it may have masked the suppression of less integrated and more efficient innovator-entities that could not survive without the support of strong public IP. Given the resulting expropriation risk, few innovators would undertake (and few outside investors would bear) the risk of starting a stand-alone firm whose sole asset—technological knowledge—would be exposed to expropriation during the commercialization process or following market release. This organizational constraint certainly did not have catastrophic effects on innovative output; however, as I discuss in greater detail subsequently, it apparently skewed the allocation of innovation resources toward hierarchical organizations that had lower-cost access to private IP substitutes for public IP.

c. **Bureaucratic Innovation**

In the most extreme (but not atypical) case, the absence of strong public IP replaces market-financed innovation with the most advanced form of an integrated and self-financing entity:

\[48\] See infra note _.

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Bureaucratic innovation will be most prominent in environments where (i) public IP is absent or weak and (ii) vertical integration or some other form of private IP is not a feasible device for capturing returns on innovation. In those cases, capital-intensive innovation in the absence of public IP can only proceed on the basis of private philanthropy or tax-funded transfers to innovation entities organized as private firms, nonprofit research institutes, or, in the case of direct procurement, government laboratories. These transfer instruments were proposed as federal government policy in 1943, when the Roosevelt administration sponsored a Scientific Mobilization Bill to increase funding of research by government agencies with the explicit purpose of “competing” against private firms and undermining the influence of the patent system. The federal government implicitly pursued these policies by establishing the National Science Foundation and, in the postwar period, flooded the academic and industrial research market with federal R&D dollars through research grants and R&D procurement contracts. This intervention placed large swaths of R&D output outside the reach of the patent system, either because recipients of federal funding were subject to restrictions on patenting or because the government simply took title to thousands of federally-funded patented inventions or exercised eminent domain powers to use a patented invention without the holder’s consent. Quite accurately, postwar commentators observed that R&D had become “socialized”—that is, tax-supported state transfers had superseded the market as the principal source of financing

For a similar view of the state as the highest form of integrated organization (with the lowest-powered incentives and most extreme bureaucratic constraints), see Oliver Williamson, Transaction Cost Economics, in HANDBOOK OF NEW INSTITUTIONAL ECONOMICS (eds. Claude Menard & Mary M. Shirley 2005).

Note that these conditions would be satisfied in an environment where (i) the courts are hostile to the enforcement of patents (or other public IP rights) and (ii) the government imposes antitrust constraints on the ability of firms to fully achieve economies of scale, whether through acquisitions or internal growth. In that case, absent philanthropy, no private-market mechanisms could support capital-intensive innovation, which would either wither or have to be funded by the state. Interestingly, the postwar period during which courts were hostile to patents was generally also a period during which the courts and federal agencies aggressively enforced antitrust constraints on firm size and growth.


See Howard I. Forman, Impact of Government’s Policies on the Economy and the American Patent System, in PATENT PROCUREMENT AND EXPLOITATION, supra note ___. In 1963, the Comptroller General of the United States endorsed the view that the federal government could freely use its eminent domain power to use any patented invention, subject only to a claim of “reasonable compensation” by the patent holder. See id.
innovation. This outcome is indicative of a general principle. When public IP is weak and there are no adequate private IP substitutes, neither an entrepreneurial regime populated by unintegrated firms nor a hierarchical regime populated by highly integrated firms is feasible. Rather, innovation can only be preserved under a bureaucratic regime governed by administrative fiat.

IV. Empirics: The Architectural History of Innovation Markets

The organizational understanding of intellectual property can now be summarized simply. Expanding public IP maximizes the range of organizational structures that can be used to implement the innovation and commercialization process; constraining public IP generates a skewed mix of organizational forms that shifts innovation and commercialization activities toward hierarchical and bureaucratic structures. In this Part, I apply these theoretical propositions to construct a novel understanding of the historical relationship between patents, firm structure and market structure. The results are promising: the tripartite classification of innovation architectures—entrepreneurial, hierarchical and bureaucratic—and the proposed relationship between those architectures and the level of patent protection approximately track structural trends in U.S. technology markets. Increases in the strength of patent protection coincide approximately with movements from entrepreneurial to hierarchical and bureaucratic innovation architectures; decreases in the strength of patent protection coincide with movements in the opposite direction. As further support, the political-economic behavior of large integrated incumbents and small unintegrated entrants is consistent with the proposed inverse relationship between size and scale on the one hand and demand for strong public IP on the other hand. The former tend to advocate for relaxed public IP, which is consistent with those firms’ access to low-cost private IP substitutes, while the former tend to advocate for strong public IP, which is consistent with those firms’ lack of access to low-cost forms of private IP.

54 See David Smith, Technological Innovation and Patents, in PATENTS AND PROGRESS: THE SOURCES AND IMPACT OF ADVANCING TECHNOLOGY (eds. Wroe Alderson et al. 1965). By 1962, at which time government-funded R&D exceeded industry funded R&D, a well-known economist observed: “[P]olitical feasibility and what the government considers to be the public need have become the principal instruments of control, replacing private profit incentives and the traditional legal instruments of antitrust laws and the patent system.” See Jesse Markham, Inventive Activity: Government Controls and the Legal Environment, in THE RATE AND DIRECTION OF INVENTIVE ACTIVITY, supra note __, at 592-93.
A. Historical Trends in Patent Protection and Market Structure

Available evidence shows that periods of strong patent protection tend to support mixed innovation environments populated by a robust population of entrepreneurial forms; by contrast, periods of weak patent protection tend to support hierarchical and bureaucratic architectures.

1. Trends in Patent Strength

U.S. patent history since the Civil War can be divided roughly into three periods: (i) a period of strong patent protection in the late 19th century and early 20th century; (ii) a period of weak patent protection starting at the time of the New Deal and ending in the early 1980s; and (iii) a period of strong patent protection starting in the early 1980s and running through the present. This typology is broadly consistent with narrative descriptions of patent history as well as empirical data on three principal indicators of patent strength: (i) validity rates (the rate at which a patent is upheld if litigated); (ii) affirmance rates (the rate at which positive findings of validity and infringement by district courts are upheld on appeal); and (iii) patentee win rates (the rate at which a patentee ultimately prevails on validity and infringement). During times that roughly overlap with period (ii) (in particular, the period 1939-1982), the most comprehensive data set shows that validity rates, affirmance rates and, in part of that period, patentee win rates are historically low, implying weak patent protection; during times that roughly overlap period (iii) (in particular, the period 1983 through the present), validity rates, affirmance rates and, in part of

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55 Prof. Kingston proposes a similar typology for innovation in Western industrialized countries, identifying patents as the primary means of protecting innovation during 1870-1930 and brand capital and secrecy as the primary means during 1930-1990. See KINGSTON, INNOVATION, supra note __, at 63; see also KINGSTON, POLITICAL ECONOMY, supra note __, at 83-88. The leading treatise on patent law has a similar history of patent strength, viewing 1880-1892 as a period during which the Supreme Court was unfriendly to patents; 1892-1930 as a patent-friendly period; 1930-1950 as a patent-hostile period, which is then somewhat ameliorated by amendments reflected in the 1952 Act; and the period after 1982 as another patent-friendly period. See 1 DONALD S. CHISUM, CHISUM ON PATENTS §OV-9 to §OV-12 (1993). Chisum’s typology is consistent with empirical evidence. Based on various indicators, Profs. Henry and Turner identify five major “eras” in patent protection, with the weakest era being the period 1939-51 and the strongest era being the period 1983-1990. In contrast to the 3-period typology described above, they divide the Federal Circuit period (1983-present) into early and late periods (the early period being a “strong” patent period and the late period being more moderate), and the post-World War II/pre-Federal Circuit period (1939-1983) into early and late periods (the early period being a “weak” patent period and the late period being more moderate). See Matthew D. Henry & John L. Turner, Across Five Eras: Patent Enforcement in the United States 1929-2006 (Working Paper 2013) [henceforth Henry & Turner, Five Eras].

56 Those data show that infringement rates (that is, the rate at which courts find a patent to be infringed) sometimes do not move in the same direction as these other indicators. For that reason, patentee win rates do not always move uniformly in the same direction as validity rates and affirmance rates. For fuller discussion, see infra note __.
that period, patentee win rates are historically high, implying strong patent protection.\textsuperscript{57} Below I describe each period of patent history in greater detail, drawing on data from multiple studies. While those studies do not use identical samples and methodologies and therefore are not perfectly comparable\textsuperscript{58}, the studies’ results are largely consistent for the same periods and in general draw a consistent picture of trends in patent strength over time.

a. \textit{Period I: Strong Patents}. During the period 1860-1914, available data show that patents were upheld as valid approximately 45\% on average when litigated in the appellate courts (or the Supreme Court, which had appellate jurisdiction in patent cases until 1891), with a temporary decline in validity rates during 1887-91.\textsuperscript{59}

b. \textit{Period II: Weak Patents}. For the period 1921-1955, the validity rate in appellate litigation drops to 35\%, starting with a rate of approximately 40\% in the late 1920s, then declining in the late 1930s and reaching a low point of approximately 15\% during the war years and recovering moderately thereafter to approximately 35\%.\textsuperscript{60} That validity rate holds constant (on average) in appellate litigation during the period 1953-1978.\textsuperscript{61} During 1953-1982, appeals

\textsuperscript{57} In particular, based on the most comprehensive dataset available (consisting of all appellate and district court patent infringement decisions, for the period 1929-2006), empirical researchers have identified structural breaks in validity rates in 1939 (when patents become significantly weaker) and 1983 (when patents become significantly stronger). For the entire period, the patentee win rate is 27-29\%, except for the years 1939-51, when it falls to 20\%, and the years 1983-1990, when it rises to almost 50\%. See Matthew D. Henry, Thomas P. McGahee & John L. Turner, \textit{Dynamics of Patent Precedent and Enforcement: An Introduction to the UGA Patent Litigation Datafile} (Working Paper 2013), at 15-16; Henry & Turner, \textit{Five Eras, supra} note _.

\textsuperscript{58} For a detailed review of the evidence and various methodological imperfections, see Henry et al., \textit{supra} note _.


\textsuperscript{60} \textit{See} Lawrence Baum, \textit{The Federal Courts and Patent Validity: An Analysis of the Record}, 56 J. PATENT OFF. SOC’Y 758 (1974) (using sample that includes all appellate cases in which patent validity was an issue and a final determination reached for the period 1921-1973, excluding design and plant patents). The results are virtually the same as those reached in another study covering an overlapping period, see C. Marshall Dann, \textit{Adjudication of Patents under the 1952 Act}, in \textit{The Encyclopedia of Patent Practice and Invention Management} (ed. Robert Calvert 1964) (for period 1925-62, covering all patents adjudicated on appeal in which validity was an issue).

\textsuperscript{61} \textit{See} GLORIA K. KOENIG, PATENT INVALIDITY: A STATISTICAL AND SUBSTANTIVE ANALYSIS (rev. ed. 1980). This figure is consistent with other studies covering partially overlapping periods. \textit{See} Henry & Turner, \textit{Five Eras, supra} note _ (for the period 1939-83, finding a rate of validity of 40.1\%); P.J. Federico, \textit{Adjudicated Patents, 1948-54}, 38 J. PAT. OFF. SOC’Y 233, 236 tbl. 2, 237 tbl. 4 (1956) (for the period 1948-54, finding a validity rate of 35\% for sample that includes all final adjudicated cases on appeal in which patent validity was an issue, including utility patents, design patents and plant patents); Martin R. Horn & Saul Epstein, \textit{The Federal Courts’ View of Patents – A Different View}, 55 J. PAT. OFF. SOC’Y 134 (1973)
courts upheld district-court findings of validity and infringement at a rate of 60%, and affirmed district courts’ invalidity findings at a rate of 85%.62

c. Period III: Strong Patents. After establishment of the Federal Circuit in 1982, the court heightened the standard for proving patent invalidity, adopting a “clear and convincing evidence” standard in lieu of a “preponderance of the evidence” standard. The change mattered: the average validity rate in appellate patent litigation jumped upward to approximately 67% for the period 1982-94.63 Thereafter, the Federal Circuit appears to have taken a more measured approach: during 1989-1996, the average validity rate (taking into account “final” district court decisions) declined to 54%; and, during 2003-09, the average validity rate in the Federal Circuit declined further to 40%.65 Consistent with the trends reflected by average validity rates, the Federal Circuit appears to have been especially “pro-patent” immediately after its establishment, affirming district-court findings of validity almost 90% of the time during 1982-1990 and

(for the period 1961-70, including all federal appellate cases involving a final determination of validity, and finding a validity rate of 36%, or 39% if cases adjudicated by the Court of Claims are included).


thereafter has taken a more moderate approach. For the period 1982-2002, the Federal Circuit affirmed district court findings of validity and infringement at an increased rate of 72% and affirmed invalidity decisions by a district court at a reduced rate of 57%.

Unsurprisingly, the market and the state have responded to these changes in patent strength by adjusting the number of patent applications and patent grants. Roughly speaking, weak patent enforcement translates into fewer patents being applied for and being issued; and strong patent enforcement has the opposite effect. As shown in the Figure below, the numbers of domestic patent applications and grants (adjusted for population growth) largely coincide with historical movements in validity rates, affirmance rates, and (less uniformly) patentee win rates. Three points are notable: (i) domestic patent applications and grants remain historically high and stable throughout the late 19th and early 20th century (the first strong patent period), aside from a short-


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66 See Henry & Turner, Impact on Patent Litigation, supra note __, at 100-01. This tendency toward increasing the strength of patents is qualified by a concurrent tendency in the Federal Circuit to limit patentees’ ability to extend the scope of patents through nonliteral infringement (also known as equivalents) theories in litigation. See Glynn S. Lunney, Jr., Patent Law, the Federal Circuit and the Supreme Court: A Quiet Revolution, 11 SUP. CT. ECON. REV. 1 (2004). In an almost 60-year survey of appellate patent litigation (1944-2001), Prof. Lunney shows that, while the Federal Circuit is more likely to uphold the validity of a patent, it is less likely to find that the patent is infringed—meaning, that the Federal Circuit inaugurated a regime of patents that were more likely to be held valid but narrower in scope and hence, less likely to be found infringed. For similar findings identifying an upward movement in infringement rates from 1990-91, see Henry & Turner (2013), at 4; Henry et al; Henry & Turner (2006). As Profs. Henry & Turner (2013) note, the market appears to react dramatically in its patenting behavior (as indicated by patent applications and patent litigation) to changes in the validity rate; however, no similar dramatic response is observed to changes in the infringement rate, although it logically affects the win rate and hence, any patent’s ultimate threat value in licensing and settlement negotiations. For reasons yet to be determined, that suggests that the validity rate is a more important indicator of patent value than the infringement rate. Note that the validity rate and infringement rate do not exhaust the factors that influence “patent strength”; notably, this does not include the expected magnitude of patent damages and antitrust-derived constraints on patent licensing, both of which obviously impact the expected value of a particular patent. Hence, the offsetting effect of “countermovements” in the infringement rate may be overwhelmed by those other factors.


68 Source for patenting data: U.S. Patent & Trademark Office, avail. at http://www.uspto.gov/web/offices/ac/ido/oeip/taf/h_counts.htm; source for population data 1900-2011: U.S. Census Bureau; source for population data 1860-1899: Texas State Library and Archives Commission, United States and Texas Populations 1850-2010, available at https://www.tsl.state.tx.us/ref/abouttx/census.html. Population estimates prior to 1900 are only available at 10 year intervals; for purposes of population adjustment, I assumed that the population growth for each 10-year interval was evenly divided across the entire interval. Prior to 1963, the PTO does not break out foreign and domestic patent applications. For that period, I estimated the number of domestic utility patent applications by assuming that the foreign share of utility patent applications is equal to the foreign share of utility patent grants (which is provided by the PTO). That is: I assume that the quality of foreign patent applications is equal to the quality of domestic patent applications and that the patent office displays no bias against foreign applications.
lived decline in the late 1880s; (ii) there is a long-lived historical decline in domestic patent applications and grants from the late 1930s through the early 1980s (the weak patent period); and (iii) there is a long-lived historical increase in domestic patent applications and grants since the early 1980s through the present (the second strong patent period). Changes in patent strength naturally drive patent application and issuance. As courts reduce patent enforceability, patent applicants assign a lower valuation to patent rights and therefore invest fewer resources in patent applications. Assuming the patent office’s grant rate does not increase significantly (that is, assuming reasonably that the patent office does not lower examination standards in response to increased judicial scrutiny), fewer patents are issued. The opposite outcome results when the courts signal increased enforceability.

Figure V: Historical Trends in Utility Patent Applications and Grants (1860-2011)

2. Structural Trends
Following theoretical expectations, it would be expected that periods of weak patents would drive innovation toward hierarchical and bureaucratic forms of organization; conversely,
periods of strong patents would facilitate innovation under entrepreneurial forms of organization. Available evidence is broadly consistent with those expectations.

\[a. \textit{The New Deal Effect: Weak Patents + Strong Antitrust = Protected Markets}\]

Starting roughly during the New Deal, any technology-intensive firm operated in the face of judicial and regulatory antipathy to patents as well as aggressive enforcement of the antitrust laws.\(^69\) The result was a wholesale expropriation of large portions of the existing patent stock. In 1941, the Supreme Court narrowed the field of patentable subject matter by declaring that patents were limited to inventions that represented a “flash of genius”\(^70\) (a decision later overruled by Congress in 1952). That decision was one in a string of decisions by the Court throughout the 1940s that invalidated important patents\(^71\), leading Justice Jackson to observe in a dissent in 1949 that “the only patent that is valid is one which this Court has not been able to get its hands on”\(^72\). The Supreme Court’s proclivity to invalidate patents influenced lower courts to do the same.\(^73\)

Subject to some variation across circuits, that patent-hostile legacy persisted over several decades with some regularity (interrupted by the even-handed approach reflected in the 1952 Patent Act), resulting in validity rates as low as 15% in certain circuits.\(^74\) Concurrently antitrust law limited


\(^72\) \textit{See Jungersen v. Ostby & Barton Co.}, 335 U.S. 560, 572 (1949) (Jackson, J., dissenting). The appellate courts had made similar observations. \textit{See, e.g., Picard v. United Aircraft Corp.}, 128 F.2d 632, 636 (2d Cir. 1942) (“We cannot . . . ignore the fact that the Supreme Court . . . has for a decade or more shown an increasing disposition to raise the standard of originality necessary for a patent.”)

\(^73\) Historical data for this period show sharp declines in validity rates among federal appellate courts in response to Supreme Court opinions that established high thresholds for patentability. \textit{See Dann, supra note _}, at Fig 1, p21. \textit{See also Baum, supra note _}, at 759 (noting general view that courts had adopted particularly hostile attitude toward patents in the 1930s and 1940s, which had persisted for several decades thereafter). In congressional hearings in 1955, a patent attorney testified that there are “fewer patent infringement suits tried today . . . because there has been a deterioration in the value of patents as a result of decisions of the Supreme Court. Clients are advised now to sue on patents only as a last resort.” \textit{See Hearings Before the Subcmte. on Patents, Trademarks and Copyrights of the Cmte. on the Judiciary, 84\(^{th}\) Cong., 1\(^{st}\) Session, Oct. 10, 11 and 12, 1955, “Synopsis of Hearings”, at p. XVIII (1956); see also id., at p.XXXII (noting survey of judges in 1949 indicating widespread hostility to patents).

\(^74\) Between 1921 and 1930, 57% of the patents adjudicated in the Second Circuit were upheld as valid; between 1931 and 1940, the rate fell to 36%; between 1941 and 1950, the rate fell again to 15%, and
patentees’ ability to exploit patents, including: (i) compulsory licensing orders in antitrust consent decrees (during 1941-1959, compulsory licensing orders in antitrust consent decrees involved an estimated 40,000-50,000 patents75) and (ii) the “patent misuse” doctrine, which was recognized by the Supreme Court in 193176, expanded by the Court in 194477, and thereafter applied widely.78 By the 1970s, antitrust-based regulation of patent licensing was so severe that much of the standard toolkit of a licensing attorney could trigger a “per se” objection even without evidence of anticompetitive effect.79

Not surprisingly, firms responded to this combination of weak patent and strong antitrust law by investing fewer resources in obtaining patents, as suggested by the long post-war trough in patent issuance. Conventional IP analysis would anticipate a corresponding downward shift in innovative output: fewer IP protections means reduced profit expectations, which reduces incentives to innovate relative to other activities. But there is no indication that firms stopped innovating: as of 1953, private research expenditures constituted $2.4 billion, a significant increase compared to the $116 million in private research expenditures as of 193080, and continued to increase steadily thereafter, reaching $80 billion by 1985.81 That type of observation is challenging for a static understanding of public IP: R&D investment should decline as expected returns on R&D decline. But it is consistent with a dynamic understanding that anticipates that firms respond to withdrawals of public IP by moving to the next least-cost mechanism by which to capture returns on innovation, in which case expected returns on R&D may be unaffected or,

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76 Carbice Corp. of America v. American Patents Development Corp., 283 U.S. 27 (1931).

77 Mercoid Corp. v. Mid-Continent Investment Co., 320 U.S. 661 (1944).

78 See Rose, supra note __, at 531-32; Baum, supra note __.


given the implied entry barrier to smaller firms, even improve. Empirical evidence shows that, in response to compulsory patent licensing during the 1940s and 1950s, large firms did not reduce R&D but obtained fewer patents and adopted increased secrecy precautions, indicating a more integrated business model.\footnote{See Scherer, \textit{Economic Effects}, supra note \_, at 64, 66-67; Mogee, \textit{supra} note \_, at 248.} Observers throughout the 1950s and 1960s report that industrial R&D had largely concentrated in the hands of “giant” vertically integrated firms with complementary production and distribution capacities.\footnote{See Nelson et al., \textit{supra} note \_, at 67, and 56 (noting that, as of the late 1960s, “the bulk of corporate R&D spending is done by a few large firms in a few industries, and concentrated in a few product fields”); William L. Baldwin, \textit{Contracted Research and the Case for Big Business}, 70 J. Pol. Econ. 294 (1962) (noting observations and testimony to this effect by scholars in 1956 and 1959). These observations are consistent with data: as of 1970, firms employing more than 5000 persons (that is, large firms) accounted for almost 90% of private R&D expenditures. See Christopher Freeman & Luc Soete, \textit{The Economics of Industrial Innovation} 229 (1997).} By 1972, a former commissioner of the Patent Office observed that, due to the high “morality rate” of patents, business is “turning more and more to trade secrecy as a means to protect intellectual property . . . it seems like the patent system . . . is about to come crashing down on our heads.”\footnote{See Chandler, \textit{supra} note \_. For a similar suggestion, see Hart, \textit{supra} note \_, at 96, who argues that the New Deal attack on patents may have prompted firms to rely on internal R&D, tacit knowledge and other means to capture gains from innovation.}

While a host of institutional, economic and other environmental factors played a role, the organizational ecology of the post-New Deal period—clusters of stable oligopolies as documented famously by historian Alfred Chandler—can be derived from the patent-hostile legal regime that prevailed throughout that time. Large self-contained entities such as DuPont, Alcoa, IBM, AT&T and Xerox were largely immune to these declines in the strength of patent protection, and expansions in antitrust liability, because they mostly undertook R&D internally in university-like research entities financed from cash flow generated by a diversified portfolio of products and services.\footnote{See David Mowery & Nathan Rosenberg, \textit{Technology and the Pursuit of Economic Growth} 150-51, 156-58 (1989); David Mowery, \textit{The Boundaries of the U.S. Firm in R&D}, in \textit{Coordination and Information: Historical Perspectives on the Organization of Enterprise} 148, 156-57 (eds. Naomi R. Lamoureux & Daniel M.G. Raff 1995); Clarke et al., \textit{supra} note \_, at 5-7. Moreover, large incumbents in some industries followed industry customs that tolerated limited information-sharing among similarly-situated competitors, either as a result of reverse engineering, employee movement or patent licensing at “below-market” rates. On these practices in the automotive industry during the 1950s and 1960s, see Lawrence J. White, \textit{The Automobile Industry Since 1945}, at 214-15 (1971); and, for similar practices in the semiconductor industry, see David J. Teece, Peter Grindley & Edward Sherry, \textit{Appendix A: The Semiconductor Industry}, in David J. Teece, \textit{Managing Intellectual Capital} 193 (2000).} Having been compelled to withdraw from the external market in IP
assets, these firms could safely operate within a “black box” that was substantially protected from expropriation risk and antitrust scrutiny or, alternatively, could expand the size of the black box through acquisitions. Perhaps not coincidentally, firms adopted the latter strategy during the “merger wave” of the 1960s and 1970s, in which large conglomerates frequently acquired targets in unrelated industries (chosen in order to limit antitrust scrutiny). Under a weak public IP regime, the competitive advantages of bigness may have reflected not only economies of scale as a means by which to reduce production, distribution and marketing costs (the conventional explanation) but as the only remaining means by which to generate and maintain the complementary assets required to capture returns on innovation in the absence of public IP. The postwar period illustrates the fallacy of assuming that a market without public IP enjoys no access constraints. To the contrary: it was precisely the existence of barriers to entry based on private IP, and the associated stream of rents, that sustained private innovation in the absence of robust public IP.

b. Cracks in the Consensus: The Subtle Vices of Weak Patents

During the postwar period of weak patent enforcement and strong antitrust prosecution, the entry barriers associated with “Big Business” were not necessarily a source of concern and often were even welcomed. Commentators widely accepted the hypothesis that concentrated industries consisting of large oligopolistic firms with extensive R&D capacities—what the economist Joseph Schumpeter had called “trustified capitalism” were best-suited to support R&D due to the “natural” entry barriers provided by large size and economies of scale. This position was most famously promoted by economist John Kenneth Galbraith, who declared dramatically in 1952 that “[a] benign Providence . . . has made the modern industry of a few large firms an

89 For the original statement of Schumpeter’s views, see JOSEPH SCHUMPETER, CAPITALISM, SOCIALISM AND DEMOCRACY 106 (1950). For similar thoughts widely cited in the contemporary literature, see DAVID E. LILIENTHAL, BIG BUSINESS: A NEW ERA 69-72 (1952). For a review of the literature that follows Schumpeter’s views, see Lamoureux & Sokoloff, The Decline of the Independent Inventor, supra note __, at 360; BALDWIN & SCOTT, supra note __, at 64-65.
almost perfect instrument for inducing technical change."\textsuperscript{90} and again in 1972 that “the entrepreneur no longer exists as an individual person in the mature industrial enterprise”.\textsuperscript{91} As late as the 1980s, this type of thinking persisted among scholarly commentators, who hewed to a deterministic narrative according to which the uncoordinated entrepreneurial capitalism of the late 19\textsuperscript{th}-century had been “rationally” supplanted by the coordinated oligopolistic capitalism of the postwar period (and, as will be discussed, various forms of government-funded R&D\textsuperscript{92}). But those commentators may simply have been drawing a conclusion about comparative innovation capacities across firm types given the prevailing weak public IP regime. The “chaotic” organizational landscape of many of today’s innovation markets could not be more different and the vigor of those markets makes that thinking seem almost quaint today.\textsuperscript{93}

It is important to remember that Schumpeter (unlike Galbraith) arrived at the “Schumpeterian hypothesis”—that is, the view that capital-intensive innovation takes place most efficiently inside large-firm oligopolies—reluctantly. This is because Schumpeter recognized that large-firm innovation comes at a heavy social price: reduced competitive pressure in pricing and output, reduced innovative intensity, and ultimately, the loss of the entrepreneurial function that drives free-market economies. The attack on strong public IP that commenced during the New Deal (and persists in much of today’s academic and policy commentary on IP) may have been intended to “open the commons” and preserve entry opportunities into technology markets that would otherwise be dominated by patent-wielding incumbents. But this reasoning suffers from a fundamental defect. Removing public IP pushes firms to adopt private IP substitutes that are most easily available to the largest and most well-established firms. Weakening patents restricted entry opportunities and thereby sheltered incumbents against entry threats from entities that had limited access to private IP substitutes. This is an anomalous outcome following standard static analysis of IP: reducing IP should always improve access and open up markets to competition. But this outcome easily falls within the universe of plausible outcomes following a dynamic analysis. The absence of strong public IP compels firms to adopt the next least-costly substitute to maintain returns on innovation: in this case, the scale, reputational capital, and cost-of-capital

\textsuperscript{90} See John Kenneth Galbraith, American Capitalism, The Concept of Countervailing Power 91 (1952).
\textsuperscript{91} See John Kenneth Galbraith, The New Industrial State 87 (1967; rev. ed. 1972); see also id., at 93, 96.
\textsuperscript{92} See Smith, supra note __, at 250.
\textsuperscript{93} For similar views, see David J. Teece, The Dynamics of Industrial Capitalism: Perspectives on Alfred Chandler’s Scale and Scope, 31 J. ECON. LIT. 199, 217-18 (1993); Acs & Thurik, supra note __, at 25.
advantages that are inherently more available to large established firms. Ironically, weakening public IP strengthens the competitive position of incumbents that, outside of selected industries, can most easily do without it.

c. The Federal Circuit Experiment: Strong Patents + Weak Antitrust = Competitive Markets

Starting in the early 1980s, several actions reversed the weak enforceability of patents, the declining patenting rate, heavy antitrust constraints on patent licensing, and the inhibiting effect of federal research dollars on patenting opportunities. Two major legal developments took place during this period: (i) the “antitrust revolution”, as reflected by a slew of judicial decisions and changes in prosecution policy at the antitrust agencies that expanded firms’ licensing freedom\textsuperscript{94}; and (ii) the “patent revolution”, as reflected by enactment of the Bayh-Dole Act in 1980, which enabled recipients of federal research funding to apply for patents on the results of that research, and the establishment in 1982 of the Court of Appeals for the Federal Circuit\textsuperscript{95}, a specialized appeals court for patent-related litigations. As described above, under the influence of the Federal Circuit, the strength of patents improved considerably, as measured by both the rate at which courts invalidate patents and the rate at which appeals courts uphold district-court findings that a patent is valid and infringed.\textsuperscript{96} The most salient developments are described in the Table below.


\textsuperscript{96} See supra note __.
### Table II: How the Patent System Was Restored (1980-1988)

<table>
<thead>
<tr>
<th>Year</th>
<th>Action</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>Bayh-Dole Act</td>
<td>Enabled small business and nonprofit institutions that receive federal funding to patent inventions developed with that funding.</td>
</tr>
<tr>
<td>1982</td>
<td>Court of Appeals for the Federal Circuit established.</td>
<td>Increased uniformity of patent law adjudication. Widely considered to have increased strength of the patent system.</td>
</tr>
<tr>
<td>1986</td>
<td><em>Polaroid Corp. v. Eastman Kodak</em> (D. Mass.)</td>
<td>Injunction issued that shut down large Kodak facility. Largest patent damages award to date ($901M).</td>
</tr>
<tr>
<td>1987</td>
<td>Executive Order 12591</td>
<td>Extended Bayh-Dole Act to all businesses.</td>
</tr>
<tr>
<td>1988</td>
<td>Amendments to Patent Act</td>
<td>Patent misuse cannot be based on tying patented with unpatented product, absent evidence of market power in the patented product.97</td>
</tr>
</tbody>
</table>

Not surprisingly, an increase in the value of patents, and an expansion in the latitude given to patentees to exploit patents, has apparently encouraged innovators to apply for and obtain more patents. In turn, expanded use of the patent system appears to have precipitated (or at least, has been accompanied by) an architectural shift in U.S. innovation markets. The increase in patenting rates starting in the 1980s has been accompanied by three indicators of increased entrepreneurial innovation, reduced hierarchical innovation, and reduced bureaucratic innovation. These include: (i) dramatic growth in the venture capital ("VC") market for financing innovation, starting at approximately $20 million as of 1980, peaking at $1 billion in 2000 and declining to $286 million as of 201198; (ii) a shift in the mix of private R&D from large to small firms, so that


the share of U.S. industrial R&D performed by small firms grew from less than 5% in 1981 to more than 25% by 2003 and almost 21% by 2009 (Fig. VII)\textsuperscript{99}; and (iii) a decline in the share of R&D activities financed by the government, which declined from a peak of almost 70% of U.S. R&D in 1963 to less than 30% by 2009 (Fig. VIII).\textsuperscript{100} Consistent with structural effects observed in strong patent periods during 19\textsuperscript{th}-century Great Britain and the United States, patents have played an important role in the rise of the externally-financed startup in the late 20\textsuperscript{th} century and early 21\textsuperscript{st} century U.S. market. Small firms in certain technology markets tend to be aggressive adopters and enforcers of patents as compared to large-firm incumbents.\textsuperscript{101} Increased and higher-quality VC investment appears to be associated with increased patenting rates by VC-funded firms\textsuperscript{102}, which is consistent with widespread industry observations that VC funding is often predicated on a secure patent position.\textsuperscript{103}

The big picture is dramatic. Starting roughly around the early 1980s, U.S. R&D investment has shifted from being an enterprise mostly financed and undertaken by a cozy partnership between “Big Government” and “Big Business” to being a mixed enterprise implemented and undertaken by a mix of government-financed, self-financed and externally-financed entities. To be sure, other technological and economic factors are at play in these developments.


\textsuperscript{100} Source: \textsc{Nat’l Sci. Foundation, Sci. & Engineering Indicators 2012}.

\textsuperscript{101} See supra note __.

\textsuperscript{102} See Josh Lerner & Peter Tufano, \textit{The Consequences of Financial Innovation: A Counterfactual Research Agenda}, in \textit{The Rate and Direction of Inventive Activity Revisited} 545-47 (ed. Josh Lerner & Scott Stern 2012). In particular, Lerner and Tufano show that (i) changes in venture capital investment generate changes in the number of patents; (ii) a dollar of venture capital is three or four times more potent in stimulating patenting than a dollar of traditional corporate R&D; and (iii) patents held by VC-backed firms have higher quality, as measured by citation data and litigation activity. Another study finds that start-ups with patents attract more VC funding and funding from higher-prestige VC firms, which in turn translates into higher IPO success rates. See Jerry Cao & Po-Hsuan Hsu, \textit{Patent Signaling, Entrepreneurial Performance and Venture Capital Financing}, (relying on patent data for VC-backed firms in the U.S. from 1976-2005) (Working Paper 2010).

Nonetheless, these trends conform to the expected emergence of an entrepreneurial environment following an increase in the strength of public IP.

Figure VI: The Rise of Entrepreneurial Innovation
(% Total Private U.S. R&D Spending, 1982-2009)

Figure VII: The Decline of Bureaucratic Innovation
(% Financing of Total U.S. R&D, 1953-2009)
B. Market Snapshots: The Structural Effects of Strong Public IP

The evidence with respect to structural tendencies in U.S. technology markets is merely suggestive; at this level of analysis, no effort is made to control for other contributing factors and hence no claim of causality is made. But there is further reason for confidence if we examine closely specific technology markets that illustrate even more vividly the structural effects of strong public IP. Below I describe three contemporary markets in which strong public IP appears to have produced the structural effects anticipated as a matter of theory. In particular, the availability of patents in these markets facilitates contracting relationships that lower entry costs for innovator-entrepreneurs who lack financing, production and distribution competencies.

1. Biotechnology: Integration by Contract

In 1980, the PTO issued a patent to Stanford researchers, Stanley Cohen and Herbert Boyer, for the fundamental gene splicing technology used in biotechnological R&D. In 1982, the Supreme Court upheld the patentability of genetically engineered microorganisms, and, in 1991, the Court of Appeals for the Federal Circuit upheld the patentability of sufficiently isolated genetic material. Together with the Bayh-Dole Act enacted in 1980, these and other actions secured the extension of patent rights to biotechnological innovations, which have formed the basis for thousands of firms that have entered the industry (as compared to only one entrant in the pharmaceutical industry during the period from World War II until 1975!). The combination of federal funding and patent rights have supported the growth of vertically disaggregated transactional structures in which (i) university technology transfer offices negotiate the outflow of academic research to an independent start-up entity and (ii) the start-up develops the technology and can then bargain safely with established pharmaceutical firms that have advantages in the capital-intensive testing, marketing and distribution functions required to reach market. The

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104 For a full discussion, see Maryann P. Feldman et al., Lessons from the Commercialization of the Cohen-Boyer Patents: The Stanford University Licensing Program, in INTELLECTUAL PROPERTY MANAGEMENT IN HEALTH AND AGRICULTURAL INNOVATION: A HANDBOOK OF BEST PRACTICES (eds. A. Krattiger et al. 2007).


result is a vertical division of labor that allocates innovation and commercialization functions to the entities that have the strongest capacities to execute each function.\textsuperscript{109} Without public IP, those transactions would be fraught with expropriation risk, upstream innovators would have difficulty raising sufficient capital to integrate forward independently, and large integrated pharmaceutical firms would be compelled to integrate backward into upstream research functions.\textsuperscript{110} In short: the university spinoff would either not materialize at all (given the absence of any commercialization incentive) or would effectively function as a division of a large integrated pharmaceutical firm. Given that more integrated organizational options are currently available but tend to be declined in favor of vertically disaggregated structures, it can reasonably be concluded that strong public IP has enabled the market to make an efficient organizational choice that drives down innovation and commercialization costs, thereby minimizing the capital investment required to achieve entry and maximizing the social value generated by the innovation process.

2. **Semiconductors: Interrupted Integration**

Historically leading firms in the semiconductor industry maintained vertically integrated structures but exchanged technical information on a regular basis, extracted “below-market” royalties in cross-licensing agreements, and rarely initiated patent litigation.\textsuperscript{111} The aggressive adoption and enforcement of patent rights by smaller design-oriented firms starting in the 1990s upset this gentlemanly status quo and supported the emergence of an alternative structure to the vertically integrated model. These “fabless” firms—that is, design firms that lack any fabrication manufacturers acquire upstream biotechnology firms. But this is still consistent with the “division of labor” effect attributed above to patents. Without patents, the potential acquirer could not commit against expropriating an upstream firm’s technology, either outright or through a depressed purchase price, which by anticipation would reduce upstream firms’ incentives to invest in R&D, which would in turn depress the flow of R&D inputs to downstream firms over the long term. For evidence related to this point, see M. Higgins & D. Rodriguez, *The outsourcing of R&D through acquisitions in the pharmaceutical industry*, 80 J. FIN. ECON. 351 (2006).

\textsuperscript{109} A recent study confirms these tendencies toward a vertical bifurcation of innovation and commercialization tasks: as industries place greater emphasis on R&D and technical functions, the distribution of small new private fast-growth firms and large established fast-growth public firms shifts in favor of the former; as industries place greater emphasis on production functions, that same distribution shifts in favor of the latter. See SMALL BUSINESS ADMINISTRATION, OFFICE OF ADVOCACY, INNOVATION AND SMALL BUSINESS PERFORMANCE: EXAMINING THE RELATIONSHIP BETWEEN TECHNOLOGICAL INNOVATION AND THE WITHIN INDUSTRY DISTRIBUTIONS OF FAST GROWTH FIRMS (2006).

\textsuperscript{110} These transactional hazards will vary in intensity in each particular case. A recent contribution provides qualitative evidence that biotechnology firms can sometimes address the risks of information exchange by a combination of graduated disclosure and reputation effects. See Burstein, supra note ___.

plant—have strong R&D capacities but lack manufacturing capacities and enter into agreements with third-party suppliers for that purpose, subsequently recovering the fabricated chip for distribution to the market.\textsuperscript{112} By facilitating transactions with third-party providers of commercialization inputs, patents enable these upstream design-specialist firms to detour around the immense scale and cost-of-capital advantages enjoyed by vertically integrated incumbents in the chip fabrication process. Absent strong public IP, those difficult-to-replicate competencies would either bar or discourage entry by shifting to incumbents the lion’s share of the profits derived from any new chip design. As in the biotechnology sector, patent rights facilitate bargaining by mitigating expropriation risk among unrelated parties, and, as a result, promote a division of labor that allocates tasks among firms with the strongest capacities in R&D, design, production, distribution and other functions required to deliver a product to market. This explains why chip design specialists are especially intensive users of the patent system, as indicated by the vigor with which they pursue patent applications and, relative to large integrated firms, enforce patents against alleged infringers.\textsuperscript{113} This zealous enforcement behavior is a rational response to the fact that these firms have few scale economies, no cost-of-capital advantages, and few complementary excludable assets by which to recover returns on innovation.

3. \textit{Innovation-Only Entities: Complete Disintegration}

Recent legal and popular commentary on technology markets has focused on the phenomenon of the “patent troll”: that is, an entity that opportunistically acquires and litigates patents in order to extract hold-up licensing fees from cash-rich enterprises that rely on the technologies claimed by those patents. While the attention paid to these unproductive forms of patent-dependent entrepreneurship certainly has merit (and will be discussed further below\textsuperscript{114}), it has deflected attention from a structurally related but qualitatively different class of \textit{productive} forms of patent-dependent entrepreneurship.\textsuperscript{115} These entities (which encompass the technology transfer office of a research university) engage solely or primarily in R&D but lack any

\textsuperscript{112} \textit{See} Hall & Ziedonis, \textit{supra} note __. For further discussion, see Barnett, \textit{Law of Organization}, \textit{supra} note __.


\textsuperscript{114} \textit{See infra} note __ and accompanying text.

\textsuperscript{115} On the distinction between productive and unproductive forms of entrepreneurship, see Baumol, \textit{infra} note __; \textit{see also} BAUMOL, \textit{FREE MARKET}, \textit{supra} note __, at 61-62; \textit{WILLIAM J. BAUMOL, ENTREPRENEURSHIP, MANAGEMENT, AND THE STRUCTURE OF PAYOFFS} 9-10 (1993) [hereinafter \textit{BAUMOL, ENTREPRENEURSHIP}].
downstream operational capacities, derive virtually all revenues from licensing out patented technologies to downstream manufacturers and other entities (usually on a broad non-exclusive basis), and are therefore heavily dependent on patent rights. Without patent rights, these innovation-only entities would have no feasible appropriation mechanism and could not exist without integrating downstream into capital-intensive and labor-intensive manufacturing and distribution functions, operating as a division of a large-firm incumbent, or, in the case of an individual, as an employee of a hierarchical firm or bureaucratic agency. The following entities, which are the driving force behind a wide range of technologies, exemplify this disembodied innovation structure.
### Table III: Stand-Alone Innovation Entities

<table>
<thead>
<tr>
<th>Firm (Year Founded)</th>
<th>Value</th>
<th>Activities</th>
<th>Patent Holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal Oil Products (1914)</td>
<td>Acquired in 2005 by Honeywell for $1.6 billion.</td>
<td>Supplied patented engineering technology to the chemicals and petroleum industry. See Arora, supra note __.</td>
<td>Between 1921 and 1955, research at principal laboratory resulted in 8,790 patents. See American Chemical Society, A National Historic Chemical Landmark, UOP Riverside Laboratory (1995).</td>
</tr>
<tr>
<td>ARM Holdings plc (1983)</td>
<td>Approx. $900 million in revenues in 2012; $16.5 billion market capitalization as of Dec. 2012.</td>
<td>Licenses patented chip design technologies to manufacturers of mobile handsets, smartphones, tablets and “mini” PCs. The ARM processor is the world’s most widely-used 32-bit microprocessor family and is found in most mobile phones.</td>
<td>Holds over 1,671 patents. ARM Holdings, 2011 Annual Report.</td>
</tr>
</tbody>
</table>
C. Historical Trends in Political Economy: Incumbents (Usually) Prefer Weak Public IP

If the theoretical arguments set forth above are correct, then large integrated firms should favor weak levels of public IP that erect implicit entry barriers to smaller entrants (and, as discussed subsequently, to limit exposure to opportunistic patent litigation); conversely, those same entrants should favor strong public IP in order to neutralize the cost-advantage enjoyed by incumbents in accessing private IP substitutes. Contrary to natural intuitions that large firms always prefer more public IP to maximize pricing power, political economic behavior in the patent system is roughly consistent with these expectations. With the exception of the pharmaceutical industry,122, large incumbents usually oppose increases in patent strength, while smaller entrants (and their financial backers) take the contrary position. In 1939, the president of Bell Labs declared before Congress that Bell Labs had grown so large that “it cared little about patents anymore”.123 In 2002, the chief intellectual property counsel of Cisco, one of the world’s leading information technology firms, testified similarly before Congress: “Everything we have done to create new products would have been done even if we could not obtain patents on the innovation and inventions contained in those products . . .”.124 The Table below lists actions undertaken by larger and smaller firms to lobby for and against changes in the patent system, which is then followed by a fuller explanation of selected lobbying activities.

122 This exception does not contradict my general thesis. Pharmaceutical firms suffer from a large difference between invention and imitation costs, such that even large firms do not have access to adequate protection technologies without public IP. Therefore these companies oppose all legislative and judicial efforts to increase the legal penalties for, and lower the costs of prosecuting, copyright infringement.


Table IV: Large Firms’ Activism Against Stronger Patents (and Other IP)\textsuperscript{125}

<table>
<thead>
<tr>
<th>Time</th>
<th>Proposed Action</th>
<th>Effect on IP Strength</th>
<th>Incumbents’ Position</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid/late 19\textsuperscript{th} c.</td>
<td>Abolition or non-introduction of patent laws in certain European jurisdictions.</td>
<td>Weaker</td>
<td>Supported by some large firms and trade groups.\textsuperscript{126}</td>
<td>Unsuccessful, except in Switzerland (until 1888) and Netherlands (until 1911).</td>
</tr>
<tr>
<td>1870s</td>
<td>Judicial “savings” doctrine that increased patentees’ damages.</td>
<td>Stronger</td>
<td>Opposed by large railroads.</td>
<td>Successful. Favorable Supreme Court decision (1878).\textsuperscript{127}</td>
</tr>
<tr>
<td>1930s (New Deal)</td>
<td>Restrictions on patentees’ rights, including compulsory licensing.</td>
<td>Weaker</td>
<td>Supported by Ford Motor Co., General Motors, Bell Labs.</td>
<td>Unsuccessful. But compulsory licensing ordered in antitrust litigations (1940s-50s).</td>
</tr>
<tr>
<td>1960s</td>
<td>Extension of patents to software.</td>
<td>Stronger</td>
<td>Opposed by IBM, other large hardware manufacturers.\textsuperscript{128}</td>
<td>Successful: Congress protected software under copyright. In 1981, Supreme Court extended patents to software.\textsuperscript{129}</td>
</tr>
<tr>
<td>Early 1990s</td>
<td>Increased utility threshold for patent applications for isolated genetic material.</td>
<td>Weaker</td>
<td>Supported by large pharmaceutical manufacturers.</td>
<td>Successful. Revised utility guidelines issued by PTO in 1995.\textsuperscript{130}</td>
</tr>
<tr>
<td>Late 1990s</td>
<td>Extension of patents to financial methods</td>
<td>Stronger</td>
<td>Opposed by large financial services incumbents.</td>
<td>Partially successful. Patents upheld but legislation amended to provide prior user rights and “second look” examination by PTO.</td>
</tr>
</tbody>
</table>

\textsuperscript{125} Unless otherwise indicated, support for all information in the Table is found in the subsequent narrative discussion.


\textsuperscript{127} \textit{Railway Co. v. Sayles}, U.S. Reports 97 (Oct. 1878).


\textsuperscript{129} \textit{Diamond v. Diehr}, 450 U.S. 175 (1981)

\textsuperscript{130} \textit{UTILITY EXAMINATION GUIDELINES}, 60 FED REG. 36263-265 (July 14, 1995).
<table>
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<tr>
<th>Time</th>
<th>Proposed Action</th>
<th>Effect on IP Strength</th>
<th>Incumbents’ Position</th>
<th>Outcome</th>
</tr>
</thead>
</table>
| 1990s- | *Sui generis* right for information databases.                                   | Stronger              | Opposed by Bloomberg, Dun & Bradstreet, Yahoo.  
|        |                                                                                   |                       |                                                                                          |                                                                          |
| 2006-  | Restrictions on patentees’ rights, including higher probative standard for damages, higher standard for injunctive relief, lower standard to show obviousness. | Weaker                | Supported by large information technology and financial services firms.                   | Successful. Favorable judicial decisions. Recent legislative amendments expand opportunities to oppose patent applications. |
| present|                                                                                   |                       |                                                                                          |                                                                          |
| 2011   | Increased opportunities for third parties to submit prior art to contest or otherwise oppose patent applications. | Weaker                | Supported by large information technology and financial services firms.                   | Successful. Legislation enacted in 2011 (America Invents Act).            |
|        |                                                                                   |                       |                                                                                          |                                                                          |

1. **Late 19th Century (U.S. Railroads).** During the late 1870s, the U.S. railroad industry lobbied for legislation to overturn a judicial doctrine, known as the “savings” doctrine, that increased the amount of damages to which patentees were entitled. At the same time, railroad incumbents disclosed technical knowledge to limit the patentable subject matter available to individual inventors and collectively financed defensive litigation against third-party infringement suits. In 1878, the railroads ultimately prevailed in litigation before the Supreme Court, which rejected the savings doctrine in damages calculations.\(^{132}\)

2. **Late 1930s (New Deal).** The congressional Temporary National Economic Committee (“TNEC”), a body assembled to study concentration trends in U.S. industry, considered proposals to constrain patentees’ rights, including a blanket compulsory licensing proposal advocated by the Roosevelt administration.\(^{133}\) Outside the pharmaceutical and...

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133 For the text of Pres. Roosevelt’s proposal for compulsory licensing of all patents, see Folk, *supra* note __, at 4.
chemicals industries, the response of leading firms was surprisingly tepid or even cooperative. Bell Labs and Ford Motor executives supported the proposed reforms and stated that patents were not particularly important in supporting R&D. Representative of General Motors expressed a similar indifference to the availability of patents. Tellingly, the parts and accessories manufacturers that supplied the automotive industry took precisely the opposite position. This is consistent with theoretical expectations: unlike the auto manufacturers, an upstream parts supplier has no or few complementary assets by which to recover returns on innovation and, without a patent, would be subject to expropriation by its downstream clients.

3. 1960s-Present (Software Patents). In the 1960s, the Patent Office began to issue patents for software innovations, despite ambiguity as to whether these innovations fell within the scope of patentable subject matter. This elicited a policy debate in which IBM and other leading computer manufacturers vigorously opposed the extension of patents to software. In 1966, a Presidential Commission (including computer industry executives) formally recommended against patent protection and Congress elected to protect software solely through the weaker form of protected provided by copyright. Those manufacturers’ opposition most likely stemmed from the fact that they had integrated vertically into software, which was sold as an unpriced component of a hardware/software bundle. Enabling patenting would have enabled entry into the industry by prepackaged software firms who had not borne the cost of developing complementary hardware assets. These efforts to block the extension of patent protection succeeded for almost

134 See FRIITZ MACHLUP, THE PRODUCTION AND DISTRIBUTION OF KNOWLEDGE IN THE UNITED STATES 168 (1962), citing HEARINGS BEFORE THE TEMPORARY NATIONAL ECONOMIC COMMITTEE (1940). Edsel Ford, the then-CEO of the Ford Motor Co. declared his support for the proposed reforms and, together with the company’s legal counsel, reported that Ford would carry on research even without patents and offered its patents to “any applicant” at no charge and abstained from enforcing its patents against parties who failed to enter into a license. See HEARINGS BEFORE THE TEMPORARY NATIONAL ECONOMIC COMMITTEE 182, 257-58, 262, 1049 (1938).

135 See HEARINGS BEFORE THE TEMPORARY NATIONAL ECONOMIC COMMITTEE 332 (1938).

136 See FOLK, supra note __, at 23, 175-176 (1942). Interestingly, the same dichotomous valuation of patents appears to have prevailed in the steel industry, where evidence collected in the 1950s indicated that large steel companies were not especially dependent on patents while companies that supplied equipment to the steel industry were reliant on patents. See Robert M. Weidenhammer & Irving H. Siegel, Patent and Other Factors in the Future Organization of the Steel Industry, 1 PATENT, COPYRIGHT & TRADEMARK J. RES. & EDUC. 112, 117 (1957). The same rationale as stated above explains this differential valuation.


two decades until the Supreme Court upheld patent protection for certain software applications in 1981.139

4. Late 1990s (Financial Method Patents). In 1998, the Court of Appeals for the Federal Circuit extended patent protection to financial-method innovations.140 Not coincidentally, it was a small financial-services firm that initiated the patent infringement litigation against State Street Bank & Trust, a large financial-services incumbent. Since that time, large financial services firms have lobbied (principally through the Financial Services Roundtable), mostly successfully, to restrict the scope of this decision.141 These reforms have included: (i) legislative changes in 1999, which immunized prior secret users of financial methods against infringement claims brought by subsequent patentees of those methods142, (ii) changes made by the PTO in 2000 to institute a “second look” review of business method applications143; and (iii) more general changes made to the Patent Act in 2011, which expand the opportunities for third parties to submit prior art, or take other actions, in opposition to a patent application. In the judicial sphere, financial services companies have continued to submit amicus briefs that support narrow understandings of patentable subject-matter with respect to business method innovations, which have achieved some success in recent Supreme Court rulings that have moderately limited the scope of patentable subject matter.144

5. 2000s (Patent Reform Debate)

Large firms’ preference for weaker public IP is clearly illustrated by recent lobbying activity surrounding the America Invents Act of 2011, which amended the Patent Act, and multiple patent cases adjudicated in recent years by the Supreme Court. In a study of amicus briefs filed at the Supreme Court involving patent-related cases during 1989-2009, Prof. Coleen Chien found that public corporations filed briefs favoring the patentee only 32% of the time; by contrast, universities favored patentees 75% of the time and patent holding companies favored the

140 State Street Co v. Signature Financial Group, 149 F.3d 1368 (Fed. Cir. 1998).
141 See Barnett, Property as Process, supra note ___.
144 See Chien, supra note __. For the relevant decisions, see Bilski v. Kappos (S. Ct. 2010); Association for Molecular Pathology v. Myriad Genetics (S. Ct. 2012).
patentee virtually all of the time.\textsuperscript{145} The opposition to strong patent protection is especially consistent in the case of large information technology and financial services companies: among all amicus briefs filed by those companies in patent-related litigation, only 36\% favored the position of the patentee.\textsuperscript{146} Another study finds that large information-technology firms have tended to lobby to reduce patent damages, limit the patentability of business method patents, raise the threshold for obtaining patent protection, limit the ability to obtain injunctive relief, and, as reflected in the America Invents Act, expand opportunities for third parties to challenge issued or pending patents.\textsuperscript{147} These proposed reforms to patent law (which have been partially adopted by recent judicial decisions and recent amendments to the Patent Act\textsuperscript{148}) have been opposed by the pharmaceutical industry and a variety of weakly-integrated innovation entities: the biotechnology industry (constituted mostly by smaller firms)\textsuperscript{149}, the “fabless” segment of the semiconductor industry, small businesses\textsuperscript{150}, the venture-capital firms that back those innovators, and patent-holding firms.\textsuperscript{151}

V. Do Structural Effects Matter?

So far I have presented a theoretical case that weak public IP is likely to induce hierarchical market architectures, while strong public IP is likely to reverse that effect, and an empirical case that historical changes in market structure, and political-economic behavior by affected constituencies, roughly conform to those expectations. As a normative matter, these organizational effects might be viewed as merely aesthetic. That is, different levels of public IP


\textsuperscript{146} See id.


\textsuperscript{148} Several recent Supreme Court decisions have restrained patentees’ rights. These include: Quanta Computer v. LG Electronics, 553 U.S. (2008) (upholding patent exhaustion doctrine); KSR Int’l v. Teleflex, Inc., 550 U.S. 398 (2007) (relaxing standard for finding a patent to be invalid as nonobvious); Medimmune v. Genentech, 549 U.S. 118 (2007) (expanding circumstances under which patent licensee may seek declaratory judgment that the licensed patent is invalid); eBay v. MercExchange LLC, 547 U.S. 388 (2006) (holding that, even if patent is found valid and infringed, injunctive relief only issues subject to traditional 4-factor test). Additionally, in 2011, the Federal Circuit issued a decision that raises the evidentiary threshold to obtain damages (Uniloc USA v. Microsoft (Fed. Cir. 2011).

\textsuperscript{149} See Kesan & Gallo, supra note __.


\textsuperscript{151} See Barnett, Property as Process, supra note __; Barnett, Law of Organization, supra note __.
support different types of innovation architectures—Silicon Valley v. Bell Labs v. National Institutes of Health—but the resulting effects on total innovative output are indeterminate or negligible. However, even if changes in public IP have trivial effects on total output (which would appear to cast doubt on the necessity of public IP at all), the effects on the distribution of innovation and commercialization functions across firm types are likely to be nontrivial and, in the case of entrepreneurial innovators, an existential matter. Even setting aside whether there exists a plausible distributional preference in favor of the individual inventor or the small firm, the distorting effects of weak public IP on the available set of organizational forms give rise to efficiency effects that reduce the social value generated by innovation.

A. The Social Value of Organizational Choice

It could be argued that there is no intrinsic social interest in preserving an entrepreneurial culture in which innovation takes place in smaller and disaggregated entities, rather than a hierarchical culture in which engineers typically work as paid employees within a large corporate enterprise, or a bureaucratic culture in which scientists typically work as paid employees within a government bureaucracy or tax-funded private research institute. If that is the case, then the existence of private IP apparently undermines the case for public IP, which can be dismissed as an unnecessary intervention that imposes a tax on the many for the benefit of the few. This is an old argument made by opponents and skeptics of the patent system from its inception through the present day. The underlying logic suffers from a basic defect that is surprisingly overlooked: it ignores the social costs of forcing innovators to rely on private IP to regulate access to innovation goods in lieu of public IP. This argument presumptively assumes without inquiry that “adequate” substitutes for public IP—scale economies, first-mover advantage, reputation


\[153\] I am aware of two prior exceptions, which are rarely cited. First, William Kingston noted that the “monopoly” instituted by the patent and copyright systems may be preferable because it counteracts other “more powerful monopolistic forces”. See KINGSTON, INVENTION, supra note __. Second, Stephen Cheung chastised economists for promoting abolition of the patent system without analyzing how inventors would respond in its absence. The answer: secrecy, which would result in even less access to technological knowledge. See Steven N.S. Cheung, Property Rights in Trade Secrets, 20 ECON. INQUIRY 1 (1982).

\[154\] The business management literature emphasizes the “first-mover advantage” as a means of appropriating returns in the absence of constraints on imitation. See William T. Robinson et al., First-Mover Advantages from Pioneering New Markets: A Survey of Empirical Evidence, 9 REV. IND. ORG. 1 (1994). This refers to two distinct phenomena: (i) markets with short product cycles and limited imitation barriers that enable first-movers to capture value within the current product cycle; and (ii) markets with
effects, and so on—always impose fewer social costs as compared to public IP. But there is no reason to make that assumption. To the contrary: as suggested by roughly a half-century during which patent strength was significantly weakened, the absence of public IP often benefits the few at the expense of the many by privileging large incumbents that can more easily substitute toward private IP alternatives. Even absent any adverse effects on total innovative output, the locus of innovation may inefficiently shift as the innovator-entrepreneur is driven back from the market and toward the bureaucratic confines of the large firm or academic research institute—the only remaining viable sources of funding in a weak public IP regime. That certainly punishes smaller unintegrated firms, and potentially even punishes larger integrated firms, each of which is forced to operate under organizational structures that internalize innovation or commercialization functions even when those functions could be supplied at a lower cost on the open market. In short: underpropertization induces overintegration. The result is inefficient (at least on a gross basis) on multiple fronts: the dissemination and trade of technological information are inhibited and innovation and commercialization costs are inflated above the technological minimum, which reduces expected innovation returns, discourages innovation ex ante and distorts the volume or variety of technologies that reach users ex post.

B. Why Are There Any Limits on Public IP?

The standard assumption that more IP always means less access (and vice versa) has proven to be an unreliable guideline for assessing the net propertization effects of changes in public IP. The reason is by now familiar: withdrawing formal IP can privilege large integrated incumbents who can easily adopt private IP substitutes, thereby raising barriers to entry by smaller unintegrated firms who cannot easily do the same. That proposition has a radical normative implication: it generates a presumption in favor of the most feasibly complete level of public IP in order to maximize organizational freedom and enable innovators to select the least-cost set of organizational mechanisms for conducting the innovation and commercialization process. That implication is “radical” because it does not track even the strongest forms of contemporary or past public IP regimes, which typically limit the scope of IP rights and impose long product cycles but strong consumer inertia. In the first case, the first-mover advantage falls under the rubric of imitation barriers mentioned above; in the second case, the first-mover advantage falls (in part) under the rubric of brand capital mentioned above.

This assertion is consistent with my argument that large integrated firms strategically support weak public IP regimes in order to raise entry costs for less-integrated rivals. The large integrated firm may maximize profits in a market where entry by less-integrated providers is precluded, even though it could achieve lower innovation and commercialization costs in a market in which it was exposed to greater entry. In short: the pie is smaller but the incumbent’s slice is larger in absolute terms.
significant burdens on parties seeking to obtain and enforce those rights. Some explanation is therefore required to account for typically observed limitations on public IP. There are two non-exclusive possibilities. First, as discussed above, those limitations may be inefficient and arise because integrated incumbents exert political influence to limit public IP and discourage entry by unintegrated but more innovative firms. Second, as I will now discuss, those limitations may be efficient insofar as extremely strong levels of public IP induce “unproductive” forms of entrepreneurship consisting of rent-seeking legal innovations that divert resources away from socially productive activities. More precisely: beyond a certain level of public IP, the marginal social costs generated by unproductive entrepreneurship overwhelm the marginal social gains generated by productive entrepreneurship, resulting in a net loss. This explanation best accounts for observed limitations on public IP and provides an account that is more nuanced and more precise than the deadweight losses and access costs usually used to justify such limitations.

1. Why Conventional Reasons for Limiting Public IP Are Deficient

The standard rationale for limiting public IP is well-known—but deficient. As a “monopoly” entitlement, public IP imposes social costs that should be incurred only to the extent required to induce and commercialize innovation. Those social costs are two-fold: (i) the deadweight losses inherent to positive pricing of a nonrivalrous good having low to zero variable costs of production and distribution, and (ii) the transaction costs of increased dispute-avoidance and dispute-resolution activities inherent to a public IP system. In any case where those social costs exceed the social gains attributable to any incremental increase in public IP protection, then that increase should be avoided and any political-economic activity in its favor can be dismissed as unproductive rent-seeking. What is often missed in that standard formulation is that the countervailing social costs only “count” to the extent that they represent incremental costs relative to the deadweight losses and transaction costs that would still exist in a market with weaker or zero levels of public IP. Conventional analysis implicitly sets those preexisting costs at zero because it assumes that a market without public IP is free of access constraints. Therefore it counts on a “one-for-one” basis any positive access charges or transaction costs incurred in connection with public IP. This is bad social accounting. If innovation markets without public IP

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156 On the distinction between unproductive and productive economic activities, se Baumol, supra note __.

157 I am aware of one other commentator who has questioned whether the incremental pricing power exercised by the patentee should count as a true social cost, on the ground that that is merely the social price paid for inducing innovation that would not otherwise exist. See Kenneth W. Dam, The Economic Underpinnings of Patent Law, 23 J. LEGAL STUD. 247, 250 (1994).
still operate under private IP that constrains unauthorized usage (which is necessarily the case in any successful innovation market), then the costs properly attributed to any increase in public IP must be limited to the incremental portion of those costs. Abolish the patent system and asset holders will redirect resources to establishing integrated supply chains that minimize interaction with outside parties or to developing anti-piracy technologies that impose positive access costs on unauthorized users. Even in a market without public IP, transaction costs and deadweight losses will still arise—and may even be greater—whenever innovators use private IP to regulate access and thereby block usage by some parties willing to cover the variable costs of production and distribution (but not the fixed costs of R&D or content generation). In any successful innovation market without public IP, both transaction costs and deadweight losses must therefore be positive by necessity. Without rents in excess of normal returns, no innovator would have any incentive to sink time and capital into an enterprise that necessitates a fixed-cost investment and is inherently subject to a high risk of failure.\(^{158}\) Hence, the benchmark of a perfectly competitive market without deadweight losses or transaction costs is not the appropriate baseline against which to judge the efficiency losses properly attributable to public IP.

This observation has an important (and, to my knowledge, overlooked) implication. If deadweight losses and transaction costs have positive values even in markets without public IP, then there is no assurance that any proposed increase in public IP will increase the deadweight losses and transaction costs in the relevant market or, conversely, that any proposed decrease in public IP will reduce those costs. Just as real propertization levels do not necessarily move in tandem with, or even in the same direction as, nominal changes in public IP, so too there is no assurance that deadweight losses and transaction costs decline as public IP is reduced, or vice versa. Taking into account the costs of increased public IP produces results that are consistent with the proposed association of entrepreneurial and hierarchical firms with, respectively, stronger and weaker forms of public IP. As I have argued throughout, the incremental gains from increased public IP tend to be greatest for entrepreneurial firms and smallest for established hierarchical firms. Those positions are roughly flipped with respect to the social costs from increased public IP: that is, the costs of increased public IP will tend to be greatest for hierarchical firms and smallest for entrepreneurial firms. Hierarchical firms have the most to lose and the least to gain from increases in public IP; conversely, entrepreneurial firms have the least to lose and the most to gain. The reason is two-fold: larger established firms tend to have large cash reserves and, in certain industries, produce complex multi-component technologies and, as a

\(^{158}\) See Kingston, supra note __; Cheung, supra note __.
result, are subject to hold-up threats by opportunistic patentees who claim infringement with respect to a critical and difficult-to-replace component. This is especially true in the case of large information-technology firms, which explains why these firms have invested in obtaining reforms to the patent system that raise the threshold for accessing the patent system and limit infringers’ exposure to patent damages. Just as upward and downward shifts in public IP coverage exert ambiguous effects on propertization levels \textit{a priori}, so too those shifts result in ambiguous effects \textit{a priori} on the total sum of deadweight losses and transaction costs borne by users in that market. In particular, there exist plausible circumstances under which reducing public IP can increase “on net” total deadweight losses and transaction costs, while increasing public IP can reverse that effect. The standard reason for limiting public IP to reduce deadweight losses and transaction costs is therefore unsatisfactory as a general guideline—although it will continue to have explanatory force in the conventional (but far from universal or perhaps even typical) case in which public IP is a reliable indicator of actual propertization levels.

2. A Better Reason for Limiting Public IP

There still remains a robust ground for limiting the public IP made available by the state in general. This is supported by one type of transaction cost that is unique to public IP. As public IP increases in strength, it induces entry not only by productive forms of patent-based entrepreneurship that add social value through innovation that would not otherwise exist but \textit{un}productive forms of patent-based entrepreneurship that deplete social value through legal innovation. Hence, increases in patent strength since the early 1980s have facilitated both the efficient formation of entities that facilitate the licensing of R&D output from upstream firms to a broad pool of downstream licensees (for example, a university’s technology transfer office) as well as the inefficient formation of entities (pejoratively known as “patent trolls”) that engage in opportunistic acquisitions and litigations of dubious patents. Not coincidentally, roughly the same phenomenon occurred during the late 19\textsuperscript{th} century, which witnessed the emergence both of intermediaries that facilitated efficient technology transactions and “patent dealers”\textsuperscript{159} that brought dubious patent infringement suits. Opportunistic use of the patent system compels litigation targets—in particular, incumbents with cash reserves that attract plaintiffs’ lawyers\textsuperscript{160}—

\textsuperscript{159} See Atlantic Works v. Brady (S. Ct. 1883) (stating that the patent laws sometimes “create a class of speculative schemers, who make it their business to watch the advancing wave of improvement and gather its foam in the form of patented monopolies, which enable them to lay a heavy tax upon the industry of the country without contributing anything to the real advancement of the art”).

\textsuperscript{160} These litigation costs provide further explanation for the support of large financial-services and information-technology firms for reforms that would reduce patent protections. As users of upstream
to divert resources from socially productive activities without promoting innovation, thereby imposing a social cost that would not exist at some lower level of public IP coverage. This is a specific transaction cost that can be fully attributed to public IP, rather than to the generic combination of deadweight losses and transaction costs that could arise in equal, greater or lesser amounts even in markets in which public IP is entirely absent. The size of that cost depends on the costs incurred to defend against opportunistic litigation, courts’ willingness to shift those costs to losing parties, the rate of administrative and judicial error in issuing and adjudicating public IP entitlements, and the peculiarities of certain technologies that may facilitate or frustrate verbal descriptions of that technology for patent drafting purposes. Those factors may vary across technologies and markets, which provides a fruitful line of inquiry to pursue in explaining the comparative performance of the patent system across technologies and industry segments as a positive matter and in designing tailored reforms to the patent system as a normative matter.

**Conclusion**

Intellectual property law always intervenes in markets that already have some private source of intellectual property rights. That simple observation upsets a foundational assumption of conventional approaches to intellectual property law: namely, more IP reduces the size of the public domain and less IP expands it. Withdrawing public IP may make no difference in total propertization levels if the market can simply “fill in gaps” by migrating to private IP substitutes. Withdrawing IP can even enhance entry barriers and reduce the size of the public domain if incumbents have lower-cost access to private IP substitutes relative to entrants. That perverse case is not only plausible but widespread across the full range of modern technology markets. In general, weaker public IP tends to advantage more integrated firms that have lower costs of adopting private IP; conversely, stronger public IP protects less integrated firms that have high costs of adopting private IP. As a result, expanding public IP supports (but does not mandate) entrepreneurial markets populated by unintegrated firms with stand-alone innovation capacities; conversely, restricting public IP promotes hierarchical markets dominated by integrated firms that hold complementary production and distribution capacities to capture returns on innovation. These proposed relationships between the level of public IP, firm organization and market structure provides a powerful tool for identifying and accounting for historical tendencies in the architecture and political economy of technology markets. The casual relationship between technology inputs, these firms are exposed to the adverse pricing effects of strong public IP; as holders of complex multi-component technologies with extensive cash reserves, these firms are exposed to the transaction costs associated with opportunistic infringement litigation.
intellectual property rights and innovative output is complex and defies any easy generalization. By contrast, the relationship between intellectual property rights, firm organization and market structure provides the basis for a far more determinate and nuanced understanding of the practical effect and social value of intellectual property rights.