

**Working Paper Series  
No. 14011**

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Do Patent Holders Holdup Innovation?

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May 2014

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Intellectual Property, Innovation, and Prosperity  
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# Patent Holdup:

## Do Patent Holders Holdup Innovation?

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### Abstract

President Obama and Congress have recommended major patent reforms based on the belief that the patent system allows patent holders to holdup the commercialization of complex technologies. Although reform proponents point to the rise in patent cases and the increased role of “trolls” in those cases, there is no evidence these developments have hurt what actually matters: the products that we buy and the prices that we pay.

In this paper, we find that the rate of innovation—as reflected in prices—has rarely, if ever, been faster than it is in exactly those industries that reform advocates point to as embodying the patent holdup problem. If patent holdup is slowing innovation, it is slowing it down to perhaps the fastest rate in human history. Our analyses also shed a skeptical light on the direction of major reform proposals that envisage a greater role for regulatory-type bodies and a commensurately smaller role for the courts. A considerable body of research suggests the prevalence of regulatory capture, which could undermine the good intentions of such proposals.

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## 1 Introduction

Both houses of the U.S. Congress are considering major proposals to “fix” the U.S. patent system. One of them is the Innovation Act (H.R.3309) and the other is the Patent Transparency and Improvement Act (S. 1720). President Obama shares their concerns. He issued five executive orders on patent reform during the summer of 2013, and emphasized the need for comprehensive reforms in his 2014 State of the Union Address.

These proposals stem from the belief that the patent system allows patent holders, either individually or collectively, to “hold up” the commercialization of complex technologies. From this perspective, patent holders exploit (1) the breadth and vagueness of patents and (2) the cost of adjudicating patent disputes to extract excessively large payments from manufacturers. In particular, when the patent system fails to define intellectual property rights clearly, more disputes arise; and, when manufacturers find it difficult to defend themselves against frivolous patent infringement cases, patent holders find it easier to shakedown manufacturers. Such a broken patent system increases the costs of commercializing technologies.

A common feature of patent reform proposals is to rely less on the courts and more on administrative / regulatory mechanisms for defining and enforcing intellectual property rights. For example, the Obama Administration has pushed the United States Patent and Trademark Office (USPTO) to examine patent requests more rigorously and define their patentable components more narrowly *ex ante* in order to reduce the reliance on the courts to make those determinations *ex post*. More specifically, reform proposals typically suggest granting more authority and responsibility to patent examiners to (1) determine whether an invention is genuinely non-obvious, useful, and novel—the three characteristics that define whether it is

patentable—and (2) to define the boundaries of patents more clearly to reduce litigation.<sup>1</sup>

Another proposed fix is to move disputes about some patents out of the expensive and inefficient judicial system and into a less expensive mandatory and binding arbitration system. In another words, if the exorbitant costs of adjudicating patent disputes in the courts make it easy for patent holders to holdup innovation, then government should create a new system for adjudicating intellectual property rights disputes. For example, Lemley and Shapiro (2014) and Padilla et al (2014) examine such a reform proposal for standard-essential patents. A standard-essential patent (SEP) is a patent on an invention that must be used to comply with a technical standard established by a standard setting organization. It is often alleged that the current system, in which patent holders negotiate individual contracts with implementers, allows SEP holders to earn not simply the value of the patent in the free market (the incremental value of the patent over the next-best alternative standard that could have been used), but up to the full value of standardization. Binding, baseball-style, arbitration would limit the value of the patent to its free market value, reducing the royalties paid on such patents. Advocates of this proposal argue that the resultant reduction in royalty payments, legal fees, and time spent in litigation would expedite commercialization of new technologies, with benefits to consumers in the form of better products at lower prices.

But, does the patent system need fixing and would these proposals actually improve the patent system? Those advocating for patent reform point to the more than doubling of patent related lawsuits since 2000 as evidence that the patent system is broken.<sup>2</sup> Advocates of reform

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<sup>1</sup> Under current practice, the United States Patent and Trademark Office (USPTO) reviews patent applications, but largely leaves it to the courts to define the validity and boundaries of patents.

<sup>2</sup> See, for example, the data and discussion in Almeling (2010), Executive Office of the President (2013), Hall and Harhoff (2012), and PricewaterhouseCoopers (2013). Schlicher (2011, chapter 8) presents detailed data on patent infringement actions and trials. Between 1987 and 2008 federal district courts disposed of some 43,000 patent infringement actions. Patent actions terminated each year almost tripled, from 1,050 in 1987 to 2,800 in 2008. Nevertheless, between 1987 and 2008 courts disposed by trial of 74 cases per year on average; the annual total

also stress the growing role of non-practicing entities (NPEs), sometimes called “patent trolls,” as evidence that the patent system needs fixing (e.g., Executive Office of the President (2013)).<sup>3</sup>

NPEs are non-practicing in that they do not make products; rather, they acquire patents from others and then assert the value of their patents with manufacturers if they believe those firms have infringed on their intellectual property rights. While NPEs accounted for 19% of patent cases in 2006, they account for over 62% today.

These observations on the increasing number of patent cases and the expanding role of NPEs, however, do not imply that the patent system is broken. While there has been an increase in patent litigation, there is no evidence that more patent litigation is associated with patent holders stymieing the commercialization of complex technologies or hindering innovation. Indeed, the rise in patent cases has been matched by an increase in patenting: the ratio of patent cases filed to patents granted has remained fairly constant since 1991. The rise in litigation could simply reflect the natural legal process of clarifying the nature and boundaries of intellectual property rights in a rapidly changing area. Similarly, while “patent trolls” are playing a much larger role in the U.S. intellectual property rights system, there is no evidence that these entities have adversely influenced the products that we use or the prices that we pay. The growth of NPEs could simply reflect comparative advantage: some entities are good at inventing and other entities are comparatively expert at asserting the intellectual property rights associated with those inventions. NPEs might just be efficient, specialized intermediaries, not signs of a broken system. While it is easy to count patent cases and trolls, these data do not provide information

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fluctuated between 60 and 80 cases disposed by trial, with no trend. Consequently, the fraction of actions decided by trial fell from about 6% in 1987 to about 3% in 2008. Each year between 70% and 80% of actions were terminated by settlement. The median time to settlement is 8 months; the median trial duration is 30 months. According to PricewaterhouseCoopers (2013), the number of patent infringement actions climbed to 5,000 in 2012. Between 2007 and 2012, 881 cases were disposed by trial, or 126 per year on average.

<sup>3</sup> Also, see discussions in Hall and Harhoff (2012), Kahn (2013), Larouche, Padilla, and Taffet (2013), and McDonough (2006).

about the relevant question: Are patent holders exploiting the system to holdup the commercialization of new ideas? Stunningly little evidence supports this contention.

This paper has three objectives. First, we draw on a well-established body of economic theory to articulate the testable implications of the patent hold up hypothesis. One prediction focuses on innovation and price declines. If the patent system is holding up innovation in patent-intensive industries—especially patent-intensive industries in which SEPs are crucial for production, theory suggests that those industries should experience comparatively slow rates of innovation and price declines. That is, theory suggests that we should assess the patent holdup hypothesis by observing what actually matters—the quality and prices of products—not by counting patent cases and trolls. The second prediction focuses on industrial organization. If the patent holdup problem is serious, then we should observe the classic industrial organizational response to holdup: patent-intensive industries should be characterized by large, vertically integrated firms that internalize and hence eliminate holdup.

The second objective of this paper is to assess empirically one key implication of the holdup hypothesis. We examine prices. Specifically, we compare long-run data on the relative prices of goods produced by (1) textbook holdup industries (bananas, sugar, and electricity distribution), (2) patent-intensive industries in which SEPs play a large role (computer laptops, RAM memory, telephone equipment and televisions), and (3) other patent-intensive industries (e.g., automobiles). Since many argue that patent-intensive industries in which SEPs play a large role are characterized by patent holdup, we evaluate whether the trends in prices of goods produced in SEP industries are similar to those of goods produced in known “holdup” industries. Is there evidence of patent holdup in relative prices?

We do not find evidence that favors the patent holdup hypothesis. We find that patent-intensive industries in which SEPs play a large role have experienced rapid price declines. Moreover, we find no break in the downward trend of prices associated with the sharp increase in litigation and NPE activity. In contrast, classic holdup industries have not seen similar price declines. Indeed, the differences between the two industries have to be expressed as orders of magnitude. The industries that proponents of the patent holdup hypothesis point to as most prone to the stymieing effects of litigation and patent trolls have experienced more—not less—rapid price declines than any other industry. The “poster industries” for the need to fix a broken patent system are exactly those industries that have experienced the fastest rates of innovation, new product development, and price declines.

The third objective of this paper is to evaluate the comparative merits of judicial and administrative / regulatory mechanisms for operating the system of intellectual property rights. Although the pace of innovation and rate of price declines is comparatively fast in patent-intensive industries, this does not mean that improvements to the intellectual property rights systems would not yield still faster innovation rates. Thus, we first review an extensive body of research on the general conditions under which administrative / regulatory-based systems work more effectively than litigation-based systems in addressing commercial disputes. We then use this research to assess whether the specific case of the U.S. patent system today is amendable to reforms that imply less reliance on the courts and more reliance on alternative mechanisms.

Our analyses shed a skeptical light on the view that reducing the role of the courts in defining and enforcing intellectual property rights will improve outcomes. Economic research suggests two general conditions under which administrative / regulatory-based systems are superior to litigation-based systems: (1) one party does not have the resources to win in court and

(2) the judicial system is more susceptible to subversion and corruption than administrative / regulatory entities. These conditions do not seem to characterize the U.S. patenting system today. In general, patent infringement cases involve Goliath fighting Goliath, which undermines one motivation for reducing the role of the courts.<sup>4</sup> Furthermore, the courts do not seem to be more prone to subversion and corruption than other U.S. agencies. Indeed, in the aftermath of the regulatory failures that characterized the financial crisis, the capture of regulatory agencies by industry seems to be a greater concern than corruption of the courts. Granting greater discretionary authority over the definition and enforcement of patents to a “regulatory” entity could jeopardize the objective definition and enforcement of intellectual property rights with potentially devastating ramifications on the U.S. economy.

It is crucial to emphasize the limitations of our analyses. First, we do not present evidence that the patenting system is well-functioning. Rather, we make one observation and present one finding. We observe that proponents of patenting reform have provided stunningly little evidence that the patent system is hurting the commercialization of innovative ideas or the creation of those ideas.<sup>5</sup> Where is the evidence supporting reform? Indeed, we find that prices are falling extraordinarily quickly in exactly those industries in which the proponents of reform argue that patent holdup is exerting the most pernicious effects. Looking across human history, it is not clear that the commercialization of complex technologies has ever been faster than it is today in those industries that reform proponents point to as most plagued by the patent holdup “problem.”

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<sup>4</sup> If anything, defendants in patent cases have deeper pockets than plaintiffs, thus undermining one motivation for proposed reforms that offer greater protection to defendants.

<sup>5</sup> Indeed, economic historians point out that the organization of inventive activity, including the role of non-practicing entities, has evolved over the last two centuries. For example, see Khan (2013), Kahn and Sokoloff (2004), Lamoreaux and Sokoloff (2013), and Sokoloff (1988).

Second, we are not arguing that special interests have captured the USPTO—or would capture an empowered intellectual property rights office; and we are not against efforts to improve the U.S. intellectual property rights system. We are, however, arguing that reform proposals should include a serious evaluation of comparative institutional effectiveness. Current reform proposals compare reality with an imaginary ideal—a perfectly functioning administrative / regulatory system that defines and enforces intellectual property rights at low cost. The work by Glaeser and Shleifer (2003), when applied to intellectual property rights, suggests great caution in contemplating reforms to the U.S. patent system that would rely less on the courts and more on a regulatory agency. Such agencies have often worked comparatively poorly in reality, because they are often more prone to subversion than the courts. Regulatory capture might be a bigger concern than the high cost of litigation. Our analyses shed a skeptical light on the desirability of relying less on the courts and more on regulatory agencies in defining and enforcing intellectual property rights.

The remainder of the paper is organized as follows. Section 2 uses economic theory to articulate testable implications of the patent holdup hypothesis. Section 3 empirically evaluates some of these predictions. Section 4 examines the value of patent reforms that would rely less on private litigation and more on public regulation. We conclude in Section 5.

## 2. Holdup and Its Testable Implications

### 2.1 *What is holdup?*

We first define “holdup” in broad conceptual terms and then use the classical example of bananas to illustrate the concept. The term “holdup” describes the following situation. A seller must make an investment that can only be used to produce an input for one buyer. The buyer will then use this input to sell a product to others. Before contracting with the buyer and making the buyer-specific investment, the seller can choose among many potential buyers, each of which needs the seller to make a buyer-specific investment. Hence, the opportunity cost of entering into the contract and making the investment is “high:” once the buyer-specific investment is made, the value of the investment in its next-best use falls dramatically. Knowing this, the buyer can break the contract after the seller makes the buyer-specific investment and demand a lower price—the buyer can behave opportunistically and “holdup” the seller.

As emphasized by Klein, Crawford and Alchian (1978), Williamson (1985), and Joskow (1985, 1988), economic agents will respond to the holdup problem in three possible ways. First, people may improve the contracting regime to eliminate opportunism and hence holdup. Second, they may choose not to undertake the activity. Since the seller knows that the buyer is going to act opportunistically and pay less than the contracted price, the seller might decide *ex ante* that the investment is not going to be profitable *ex post*. Third, the seller and buyer might integrate. The seller and buyer could merge, substitute a corporate governance structure for the market, and internalize opportunistic behavior. While integration reduces such opportunistic behavior, these benefits must be weighed against the costs of administering a larger organization (Klein, Crawford and Alchian, 1978) and Grossman and Hart, 1986). Indeed, sometimes these

diseconomies may be sufficiently severe that integration does not occur and hence the activity does not occur.

The classic example of a holdup industry is bananas.<sup>6</sup> Sellers make an investment in growing bananas (banana plantations) rather than growing other products after contracting with a buyer. The buyer, say a shipping company, picks up the bananas, transports them, and sells the bananas in retail stores that are typically far from the banana plantations. Once a seller picks the bananas, they decay rapidly. Consequently, holdup and opportunism is a threat. The buyer (shipper) can take advantage of the seller (plantation owner) by changing the terms of their contract ex post on the shipping dock. Essentially, the shipper demands a lower price or threatens to leave the bananas rotting on the dock. Holdup can work in the other direction too. The shipper has made a huge investment to travel to the specific port in the tropics to retrieve the bananas. The plantation owner can demand a higher price by threatening to force the boat to return with no bananas. Unless they can address this holdup problem, there will be less incentive for growers to plant trees or shippers to send ships to this port, and hence there would be no bananas on breakfast tables.

The banana industry solved the holdup problem in a classic manner: integration. The banana plantation and shipper merged. In the banana industry, the same firms that grow the fruit, often own the ships, the rail cars, the marketing operation, and the entire distribution chain. People addressed the holdup problem through integration and hence there are bananas on breakfast tables situated far from the tropics.

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<sup>6</sup> See, for example, the discussion in Haber and Menaldo (2011b). Kieff and Layne-Farrar (2013) draw a connection between holdup in bananas and patent holdup. Haber and Menaldo (2011a) find that the nature of natural resource endowments influences an array of institutional structures. Thus, an economy's comparative advantage, in say bananas, could influence an assortment of institutions associated with economic efficiency.

The preceding implies that the holdup problem affects the organization of firms: people organize firms to address problems. Hence, if there is a holdup problem, we should observe an organizational response to the problem. And, if there is not an underlying holdup problem, then we should see a different organizational form since there is no need to organize the firm in a way that addresses the holdup problem. To see this, consider Table 1. Rows distinguish industries where holdup is a problem from industries where holdup is not a problem. Columns distinguish industries where integration creates economies from industries in which integration creates diseconomies. Note that integration is not an unambiguous sign of a holdup problem, because it may be driven by the technological economies wrought by integration. By contrast, when an industry is composed of decentralized firms rather than by integrated firms, this suggests that holdup is not a problem. Simply put, if firms produce in a decentralized fashion, then it must be the case that integration creates no economies and that there is no holdup problem. Below we will use these implications to assess empirically the patent holdup hypothesis.

## *2.2 What is patent holdup?*

Lemley and Shapiro (2007) argue that when one patent covers a component of a complex product (i.e. a component of an i-phone, a tablet, or a TV) the patent holder can wait until manufacturers make investments in product design that are specific to that patent and then holdup manufacturers and charge excessive royalties. Knowing that patent holders will exploit them after making large investments in commercializing complex technologies, manufacturers reduce the introduction of new products. Elhauge (2008) has called this “the patent holdup conjecture.”

According to Lemley and Shapiro (2007), the holdup problem is even worse when the patent is “essential,” i.e. when the patent is necessary to comply with the standards established by a standard setting organization. Once specific investments in design are sunk, the owner of an essential patent can extract up to the value of standardization, which is far higher than the incremental value of the patent over the next-best alternative standard that could have been used.

The problem can be still worse. A complex product uses hundreds, even thousands of patented components, many of them essential.<sup>7</sup> When many patent holders simultaneously holdup the manufacturers of the complex good, there is “patent stacking,” so that excessive royalties pile up one on top of the other. Lemley and Shapiro (2007, p. 2013) argue that patent stacking further increases the marginal cost of production and hence the price of final output because components are akin to Cournot complements.

### *2.3 Testable implications of patent holdup conjecture: Prices, profits, and innovation*

One testable implication of the patent holdup hypothesis—and the one that we focus on evaluating empirically in this paper—relates to prices: Patent holdup should increase the marginal cost of production and put upward pressure on prices. It also pushes up average costs and long-run equilibrium prices. Thus, at best, the prices of patent-intensive products—especially patent-intensive products based on standard essential patents (SEPs)—should fall more slowly than other products.

Related to the testable implication on prices, the theory presented above also provides predictions on profits and innovation. On profits, if patent holdup materially afflicts patent-

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<sup>7</sup> As an example, take a 4G network. According to Gilroy and D’Amato (2008): “A 4G network depends on ten of thousands of individual patents. As of 2008, there were 18,300 patents and 16,254 pending applications particular to the development of a 4G network. But 4G relies, in turn on more than 80,000 patents that form the backbone of telecomm connectivity. [...] As of 2008, there were about 2,700 separate entities with active patenting activity in the 4G landscape.”

intensive SEP industries, then theory suggests that patent holders extract most of the surplus from these industries, reducing the profits of manufacturers in patent-intensive SEP industries. If patent holdup is successful, patent holders extract the rents. On innovation, the theory presented above also implies that if patent holdup plagues patent-intensive SEP industries, there will a slower rate of innovation in those industries because patent holdup reduces the pecuniary returns to commercializing such technologies.

#### *2.4 Testable implications of the patent holdup conjecture: industry organization*

A second set of testable implications—that we do not pursue in this paper—relates to industrial organization: If patent holdup is pervasive (and if manufacturers produce the complex good), then production should occur in integrated firms, not in specialized firms engaging in bilateral trade. A major observable implication of holdup is that, if output occurs, it should occur in integrated organizations.

To illustrate the nature of this industrial organization conjecture about holdup, consider two different modes of organizing production in complex-good industries: decentralization and integration. The left-hand panel of Figure 1 schematically shows how a decentralized complex-good industry works. At the top are the manufacturers of the complex good, usually more than one, who buy components and use the patents owned by others. There are also component manufacturers, who sell to the producers of the complex good and may also use the patents of others. And there are NPEs, who may or may not do R&D but which in any case own patents and earn revenues from licensing them to final good and component manufacturers, not from production. But while manufacturers produce and sell they also do R&D, own patents and license them. Though sometimes they earn royalties, there is also intense cross licensing. Last,

most agents participate in standard setting organizations (SSOs) where they try to influence standard setting. It is clear that decentralized, complex-good industries involve many agents with diverse interests. There is no question that there is constant bargaining and legal wrangling, both bilateral and multilateral, some of it in SSOs. And yet, some complex good industries seem to thrive. But note that the mere existence of these decentralized complex-good industries seems to run in the face of one of the main predictions of transaction-cost economics:

If holdup is pervasive in patent-intensive industries that rely heavily on standard essential patents, as suggested by the patent holdup hypothesis, then one should observe vertical integration of complex-good producers into components and R&D. The right hand side of Figure 1 shows the organization of an integrated industry, which is fairly simple: the manufacturer of the complex good integrates backwards into R&D and component production. Therefore, an integrated firm controls the whole production chain, owns patents and may rely also on trade secrets. Furthermore, when there is a holdup and when vertical integration addresses the problem, this will typically create big scale economies that lead to horizontal integration as well. For example, three firms control 50% of the world banana market.

Before turning to the evidence, it is worth emphasizing that patents can mitigate holdup and facilitate innovative activity in small, decentralized entities. An odd characteristic of the patent holdup hypothesis is that it typically ignores the crucial role that patents play in reducing holdup by manufacturers. The textbook characterization of innovation is that research involves (comparatively) large sunk costs and then very low marginal costs. That is, it is very expensive to invent a new technology—the “instructions” for building a product, but it is inexpensive to follow those instructions once they are invented. The inputs associated with following the instructions and building a product might be expensive, but the costs of reading and following

the instructions are trivial. Patents prevent manufacturers from acting opportunistically with inventors and simply using their instructions to manufacture and then sell the new product.

Without patents, there would be vertical integration: innovative activity would occur “in house,” in integrated organizations, not in decentralized entities.

Thus, if we observe decentralized innovation in an industry—think, for example, of silicon valley, then patents almost certainly play an important role in allowing that organizational structure to exist. But decentralization requires coordination. Part of this coordination is reached in SSOs, where a cooperative game is played. While there are conflicts, all are interested in reaching an agreement that makes production feasible. After the SSO has established standards, patents are important because they mitigate holdup by manufacturers and allow decentralized innovators to appropriate part of the value created by their innovation. Of course, bargaining over surplus is inherently adversarial, and some controversies reach the courts. But, this is neither *prima facie* evidence of holdup nor of the validity of the patent holdup conjecture.

### 3 Evidence

#### *3.1 Do prices of patent-intensive SEP industries stagnate?*

Electronic products—e.g. computers, laptops, phones, televisions—have become more complex over the last 20 years. They are comparatively patent-intensive industries that rely on standard essential patents (SEP) to enhance compatibility. The patent holdup hypothesis implies that the relative prices of goods produced in such industries should be “high” and fall only slowly over time. Moreover, if compared with industries that are prone to holdup but have solved their problem through integration, like bananas (call them “holdup industries”), SEP industries—which have not yet solved their problem and hence need patent reform—should perform worse, relative prices of banana-like holdup industries that have successfully addressed the holdup problem should fall faster than the relative prices of SEP industries that have not yet done so.

Figure 2 shows the consumer price index of goods produced by three standard holdup industries, electricity, sugar and bananas calculated by the BLS between 1992 and 2013. Sugar cane has similar characteristics to bananas. Electricity is a bit more nuanced.<sup>8</sup> Each price series is adjusted for inflation (it is a price relative to the CPI), where 1992 is the base year. SEP industries became more pronounced during the period from 1992 through 2013. Critics of the current patent system argue, therefore, that this is period when patent holdup has had the more deleterious effects on technology and the commercialization of complex technologies.

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<sup>8</sup> Electricity production has three stages, generation, high-voltage transmission and low voltage distribution. Generation is usually far from major consumptions (large industrial users and cities) and has to be transmitted over long distances. Thus the owner of the transmission system can holdup the generator. At the same time, turn, both distribution and transmission are natural monopolies and each can holdup the other. Not surprisingly, for many decades most electricity utilities were vertically integrated regulated monopolies. There has been extensive vertical unbundling around the world in the last 20 years. Nevertheless, transmission and distribution remain regulated monopolies and attempts to liberalize generation and electricity retailing have seen mixed results at best.

The relative price of each of the goods produced by the three holdup industries does not seem to show any trend. For example, the relative price of electricity falls until 2007, but then increases. And both bananas and sugar cost about the same in 2013 as they did in 1992.

Figure 3 compares the evolution of the average relative price of our three holdup industries with three patent-intensive SEP industries: telephone equipment, televisions and portable laptops, computers and PDAs. In addition, we show the relative price of automobiles, a patent-intensive—but non-SEP—industry. All four series are consumer price indices calculated by the BLS and adjusted for improvements in quality over time.

The contrast between the behavior of the relative price of SEP goods and that of holdup industries is stark. The quality-adjusted relative price of telephone equipment fell 6.7% per annum (p.a.) to about one-fifth of its 1992 level. But, this rate of price decline is slow compared with the quality-adjusted relative price of televisions, which fell to 1/25th of its 1992 level, which represents  $-14.4\%$  p.a. growth rate of its price. The quality-adjusted relative price of portable laptops, computers, and PDAs fell to about 1/666th of their 1992 level ( $-26.7\%$  p.a.). By contrast, the relative price of the average holdup industry (bananas, sugar cane, and electricity) fell only about 0.6% p.a., and the relative price of the patent-intensive, but non-SEP, automobile industry fell by only 2.3% p.a.

Perhaps, Figure 3 misses the big point: the rise of SEPs. Perhaps, Figure 3 just illustrates what happened *before* essential patent holders figured out how to act opportunistically and extract more money. And perhaps the boom in patent cases and non-practicing entities since 2005 caused a reduction in the rate of price declines that Figure 3 does not illustrate precisely.

In contrast to this concern, we find Figure 3 *understates* prices declines in SEP industries. But, relative prices suggest a different story. Figure 4 reproduces Figure 3 since 2005, adding

personal computers. Since 2005 the relative price of the average holdup industry increased by more than 15% (1.2% p.a.) and the price of automobiles fell 17% (2.3% p.a.). By contrast, between 2005 and 2013, the relative price of telephone equipment almost halved, with prices declining at a 7.4% annual rate. In another SEP industry, the relative price of personal computers fell to about one-third of its 2005 level, as prices declined at a 12.3% annual rate. As some additional example of SEP industries, the relative price of televisions fell to about one-seventh of its 2005 level, as prices fell 21.5% per year; and the relative price of portable laptops, computers and PDAs fell to about one-eighth of their 2005 levels (−22.8% p.a.). If anything, the rate of price declines in SEP industries seems to be accelerating!

### *3.2 Telephones: From a monopoly to a SEP industry*

The alert reader may have noticed in Figure 3 that the price telephone equipment increased between 1992 and 1997. Is that an anomaly? Telephone equipment is interesting, because it turned into a SEP industry only recently. Indeed, until 30 years ago, local telephone services were provided by one monopoly, AT&T, which manufactured equipment and did R&D. Thus, the long-run evolution of the relative price of telephone equipment allows us to compare industry performance under both regimes ---integration and SEP decentralization.

Figure 5, shows the price index of telephone and facsimile equipment (as calculated by the BEA's price indices for personal consumption) and, to compare with a SEP industry, the price index of TV sets. As before, each price series is adjusted for inflation (it is a price relative to the CPI) and now the base year is 1951. We chose 1951 as the initial year of the series because TVs have been included in the CPI since 1951.

The relative price of telephone equipment did not change much between 1951 and 1971. It fell somewhat during the seventies but then shoot up until the late 1990s. Thus, in 1997 telephone equipment was more than 35% more expensive than in 1951. Nevertheless, since its peak in 1997, the relative price of telephone equipment fell precipitously and, as we have already seen, the quality adjusted relative price is roughly one-fourth of what it was 16 years ago in 1997. The original cell phone, Motorola's DynaTAC 8000X, was introduced in 1983 and its retail value was \$3,995, about \$9,000 in today's dollars.

The ATT monopoly was broken up in 1982 and long distance was liberalized. Yet the relative price of telephone equipment began to rise. This should not be surprising, because the ATT breakup created seven independent regional local monopolies ---it didn't quite change industry structure. The grip of local fixed line monopolies on telephone equipment loosened only when mobile phones began to spread fast in 1999 and became an effective substitute of fixed phones.

Note that the trajectory of the relative price of telephone equipment is the opposite of what the patent holdup hypothesis would predict. As long as telephone equipment was used mainly by vertically integrated monopolies and unaffected by holdup, its relative price remained constant or increased. But when cell phone use diffused and telephone equipment became the quintessential SEP industry, prices plummeted, the opposite prediction of the patent holdup conjecture. Moreover, the trajectory of the relative price of telephone equipment contrast with that of televisions, which has fallen continuously since 1951, to about 1/250th in 2012 (−8.7% p.a.).<sup>9</sup>

Again, the behavior of the price of televisions is very different from that of other industries. Figure 6 compares the evolution of the real price of televisions between 1951 and

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<sup>9</sup> This includes adjustments for quality; see <http://www.bls.gov/cpi/cpihe01.htm>.

2012 with the evolution of the relative price of soft drinks, household electricity, pharmaceuticals and other medical products and cars, our non SEP industry.

Soft drinks cost about 20% more today than in 1951, and their relative price is constant since the mid-1990s. The price of pharmaceuticals, on the other hand, falls until the mid-1970s, but then increases. And the price of electricity shows ups and downs. The relative price of cars falls about 60% since 1951 ( $-1.6\%$  p.a.), but this performance is modest compared with televisions.

As in all our analysis confirms our conclusion: over long periods SEP industries tend to show better performance than most other industries. There is no evidence in favor of the patent holdup conjecture.

### *3.3 Relative to what?*

It might still be argued that, were it not for the holdup problem, prices of SEP industries' goods would have fallen even faster. But the argument, "it could be even better," begs the question "relative to what?"

A standard finding in the literature is that there is a negative relationship between an industry's relative growth rate of productivity and the growth rate of its relative prices. Relatively quick price declines are good indicators of relatively quick productivity growth. Indeed, empirical studies show that the regression coefficient is roughly  $-1$ <sup>10</sup> Hence, if an industry experiences average productivity growth across all industries, its relative price does not

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<sup>10</sup> The cross-industry evidence is consistent with flat, perfectly elastic long-run supply curves. With flat supply curves, relative price movements reflect cost changes; demand changes move only quantities. In turn, unit costs vary perfectly inversely with sectoral total- or multi-factor productivity. There are some standard works which show this: Salter (1960), who examined the productivity performance of 28 British manufacturing industries between 1924 and 1950; Salter (1960), which looked at 27 U.S. industries between 1923 and 1950; Oulton and O'Mahony (1994) who studied 136 manufacturing industries in Britain between 1953 and 1986; Kendrick and Grossman (1980), who looked at the whole US economy (20 industries in manufacturing plus agriculture, public utilities, construction and several service industries); and Nordhaus (2008) who extended Kendrick and Grossman's (1980) data until 2001.

change; and if an industry's rate of productivity growth is one percentage point faster than the average, the industry's relative price tends to fall by one percent faster as well.

Research also indicates that the maximum rate of long-run (over decades) productivity growth for an industry is typically less than 6% per annum. Thus, if average, cross industry annual productivity growth is 1%, the fastest rate of long-run relative productivity growth is about 5%.

Now, again consider the behavior of the relative prices SEP industry products. We found that the relative prices of SEP industries were falling by much faster than 6% per. Of course, the price data that we are using adjust for quality, so not all of the reported fall in the relative price of a SEP industry is due to productivity increases on the cost side. But it nonetheless shows that the performance of SEP industries is remarkable by any realistic standard. So the "without holdup it could be even better" is apparently saying that it could be even better than anything that is normally observed.

#### **4 Judicial vs. Regulatory Approaches to Patent Reform**

Although there is no convincing evidence that a broken patent system allows patent holders to holdup the commercialization of complex technologies, perhaps room exists to improve the current system by moving away from a system based on ex post private litigation to an intellectual property rights system based more on ex ante regulation.

To address this question, however, it is crucial to assess how judicial and regulatory mechanisms work in reality and not to compare the current patent system with an ideally functioning regulatory system. A perfect regulatory system that defines and enforces property rights at zero cost and with zero uncertainty and that eliminates market imperfections would be

nice. But, it does not exist. Hence, the relevant, practical question is: should the patent system be reformed in a manner that relies more on regulation?

In this section, we assess the comparative merits of judicial and regulatory mechanisms for defining and enforcing intellectual property rights. Currently, individuals and companies rely heavily on private litigation to address patent disputes. Such judicial remedies operate in an ex post manner: litigation occurs after one party believes another party has infringed on its property rights. To the extent that the private litigation process is a costly and inefficient mechanism for defining and enforcing property rights, reforms that grant greater decision-making authority to expert regulators could improve the system. For example, by defining the boundaries of a patent more precisely ex ante, public regulation might reduce wasteful litigation and inefficient court decisions that impede the development and commercialization of new ideas.

To assess the specific case of the U.S. patent system, we use an extensive body of economic research on the general conditions under which regulatory-based systems address social and commercial disputes more effectively than litigation-based systems. That is, we first describe the general conditions under which regulation is a more efficient strategy for securing property rights than private litigation. We then examine whether these general conditions hold for the U.S. patent system today.

#### *4.1 An economic framework for comparing judicial and regulatory approaches*

Economics suggests two core conditions for when greater reliance on public regulation—and hence less dependence on private litigation—improves the institutional mechanism for addressing commercial and social disputes. First, when large fixed costs of litigation tip the balance of justice toward the rich, effective public regulation can improve upon private litigation. Posner (1998) argues that individuals and firms of lesser means may confront prohibitive costs to litigating complaints against deep-pocketed adversaries. That is, when it is too expensive for David to sue Goliath *ex post*, public regulation that discourages abuses *ex ante* can provide a more cost effective mechanism for equitably addressing an array of commercial and social issues.<sup>11</sup> From this perspective, when there are *both* large fixed costs to litigation and one side in a legal dispute has much greater economic resources than the other, public regulation can improve on private litigation.

The vulnerability of the judicial system to subversion provides a second potential rationale for regulation. If special interests corrupt the courts, then private litigation will not produce fair, impartial decisions. Glaeser and Shleifer (2003) describe how the titans of industry in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries “acquired” judges, who issued decisions and injunctions that made it difficult for others to find justice through the courts. Glaeser and Shleifer (2003) argue that the resultant decline of judicial integrity encouraged the “rise of the regulatory state” during the Progressive Era. That is, the subversion of private litigation triggered calls for public regulation. For example, numerous writers and political leaders, including Woodrow Wilson, argued that since the courts were unwilling to stand up to large corporations, the government had the right—indeed, the obligation—to develop regulatory agencies to discourage commercial and

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<sup>11</sup> Shavell (1984) also addresses the costs associated with getting the actual violator to pay, so that an *ex post* judicial penalty might not discourage inappropriate behavior as effectively as a regulatory system with the authority to prevent such behavior *ex ante*.

social wrongs. If regulation can prevent a train accident, passengers do not have to rely on corrupt courts to compensate them with damages that both cover losses and incentivize railroads to operate safely.

Of course, it is not clear that the rich and powerful find it easier to subvert judges than regulators. If special interests are more effective at capturing public regulatory agencies than they are at influencing the courts, empowering regulatory institutions could adversely affect commercial and social outcomes. Don't empower more easily corrupted institutions if the goal is a fair, just system. It is therefore prudent to consider the comparative susceptibility of courts and regulatory agencies to subversion by special interests before recommending reforms that would augment the role of regulators.

#### *4.2 Application to patents*

We now assess whether these two general conditions of when greater public regulation enhances social welfare hold for the particular case of the U.S. intellectual property rights system today. We first assess whether patent infringement cases are characterized by situations in which David cannot fairly fight Goliath in the courts. We then turn to comparative subversion. In the U.S. today, is it easier to subvert the courts or regulatory agencies?

Consider the first condition: Do the fixed costs of litigation in patent infringement cases make it difficult for small plaintiffs or defendants to succeed in court? For the most part, defendants in patent infringement cases are comparatively big, successful firms; plaintiffs are rarely better-resourced than defendants. Indeed, the economic success of the defendant is often a prerequisite for litigation, as there are fewer incentives to sue a loss-making enterprise for patent infringement than a profit-making one. Nevertheless, it is the large, successful defendants who

are seeking regulatory reforms to inhibit the ability of plaintiffs to challenge them in court. Goliath wants public regulation as protection against private litigation.<sup>12</sup>

Thus, the particulars of the current U.S. patenting system do not represent a situation in which David cannot defeat Goliath in court. Both parties in these disputes often have the resources to win through private litigation. Many intellectual property rights disputes seem to involve Goliath fighting Goliath, weakening the rationale for greater reliance on regulation in defining and enforcing intellectual property rights.

Second, consider subversion. If regulatory agencies were less susceptible to capture than courts, this would offer a different rationale for empowering regulators. But, is this true? Are there good reasons for believing that special interests have a higher probability of corrupting the courts than they do of controlling a newly empower intellectual property rights regulator?

Political scientists and economists have produced an avalanche of research that makes it difficult to believe that special interests can more easily subvert the courts than they can capture regulatory agencies in the U.S. today. Based in part on the rich examples provided by Goldman (1947) and Hofstadter (1955) about the performance of regulators in the United States, Stigler (1971), Posner (1974), and Peltzman (1976) developed the core models of regulatory capture, in which powerful firms induce regulatory agencies to protect them from competition and private litigation. According to this view, the private interests of regulators are frequently aligned with those of the regulated and not with the interests of the public at large.

Although research on the pervasiveness of regulatory capture is too large to review here, a few examples illustrate the essence of this literature. In the aftermath of the financial crisis,

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<sup>12</sup> The plaintiffs in patent infringement cases typically have fewer resources than the defendants. The inability of low-wealth patent holders to challenge wealthy firms who they believe are infringing on their intellectual property rights might induce low-wealth patent holders to lobby for greater regulation. They have not been the most vocal and influence voices for regulation. Rather than seeking regulatory reforms to promote their interests, non-practicing entities have formed that ameliorate the high fixed costs of litigation and exert patenting rights on many patents.

financial regulation offers a good starting point. Book after book advertises the influence of financial institutions over the agencies charged with supervising and regulating those same institutions (e.g., Barth, Caprio, and Levine, 2006, 2012; Calomiris and Haber, 2014; Johnson and Kwak, 2010; Lewis, 2010; Sorkin, 2009). These researchers document the impact of the financial services industry on financial regulatory and supervisory agencies in the United States (Federal Reserve Board, Securities and Exchange Commission, Federal Deposit Insurance Corporation, Office of Federal Housing Enterprise Oversight), the United Kingdom (Financial Services Authority), Ireland (Irish Financial Services Regulatory Authority), and other countries. In these cases, the regulation does not appear *less* prone to subversion than the U.S. judicial system. Regulatory capture is prevalent beyond finance. Although regulators often justify restrictions on the entry of new firms by pointing to market failures and the desire to protect the public, DeSoto (1989) argues that regulatory agencies too often protect monopolies, not the public. For example, Chopping and High (1988) document how large U.S. whiskey manufacturers used regulatory agencies to drive out smaller producers. Libecap (1992) provides similar evidence for the case of U.S. slaughterhouses. In Russia, Boycko, Shleifer, and Vishny (1995) describe how the “anti-monopoly” agency was captured by large firms and used to eliminate smaller firms from the market and to erect barriers to the entry of new firms. In fact, for a broad cross-section of countries, Djankov et al (2002) document the strong positive relationship between the degree to which a country’s regulatory apparatus impedes the entry of new firms and the level of corruption in the economy. As a final, dramatic example of regulatory failure, consider the New York Times headline on March 30, 2014, which observed, “U.S. Agency Knew About G.M. Flaw but Did Not Act.” Even though the National Highway Traffic

Safety Administration's own investigators found design problems associated with fatal automobile crashes, they did not act to prevent future injuries.

Thus, from a comparative subversion perspective, regulatory agencies in the United States seem more likely to be subverted by special interests than the courts. There is little—to no—evidence that powerful plaintiffs and defendants in patent litigation cases have captured judges and biased the private litigation process. Courts are comparatively independent and unbiased. Some might argue that the next time will be different: Perhaps, a new regulatory agency can be designed that is not subject to capture and that will enhance the efficiency of the overall intellectual property rights system. Perhaps. From a practical perspective, however, many designs have been tried and a rich body of evidence describes the successful subversion of an array of different agencies. There seems little reason to believe that regulatory agencies will function with greater integrity than the courts.

Thus, neither of the two general conditions of when a greater reliance on public regulation will enhance social welfare holds for the particular case of U.S. intellectual property rights. First, patent infringement cases are not characterized by situations in which David cannot fight Goliath because of large fixed costs to litigation. Rather, Goliath versus Goliath is a better characterization of intellectual property rights disputes. Each side has the resources to battle it out in court, reducing one rationale for greater regulation. Second, the judicial mechanism for defining and enforcing intellectual property rights does not seem to be more prone to subversion than regulatory mechanisms. This obviates one rationale for greater regulation: the greater integrity of regulatory agencies relative to the courts.

#### *4.3 Findings on judicial and regulatory approaches and some limitations*

Economic research suggests two general conditions under which regulatory-based systems address social and commercial disputes more effectively than litigation-based systems: when one party does not have the resources to win in court and when the courts are more prone to subversion than regulatory agencies. Neither condition seems to hold in the United States with respect to the definition and enforcement of intellectual property. This sheds a skeptical light on reform strategies designed to enhance the institutional mechanism for defining and enforcing intellectual property rights by relying more on public regulation.

It is important to highlight the boundaries of our analyses. First, our point is not to argue that special interests have completely captured regulatory agencies or that judicial processes are unsullied by money and politics. Rather, our point is much narrower: Although one rationale for regulation is that special interests exert a more profound influence over courts than regulatory bodies, there seems to be no evidence for this rationale within the particular context of the U.S. intellectual property rights system.

Second, we are not arguing that markets are perfect and we are not contradicting Pigou's (1938) argument that regulation could address market failures. Rather, following Glaeser and Shleifer (2003), we ask a different question: Does private litigation or public regulation provide the most socially efficient mechanism for addressing these market failures within the context of intellectual property. That is, we assess whether a movement along the spectrum from a private litigation-based approach toward a more public regulation-based approach offers a socially efficient improvement in the mechanism for defining and enforcing intellectual property rights. Based on an extensive body of economic research, we do not find strong reasons for believing

that greater reliance on regulation would enhance the current U.S. intellectual property rights system.

## 5 Conclusions

Given the widespread, bipartisan calls for patent reform, there is stunningly little evidence that the current patent system is stymieing the commercialization of technology. Although reform proponents point to the rise in patent cases and the increased role of “trolls” in those cases, there is no evidence that litigation and trolls have materially hurt what actually matters: the products that we buy and the prices that we pay.

In this paper, we find that the rate of innovation—as reflected in prices—has rarely, if ever, been faster than it is today in exactly those industries that reform advocates point to as embodying the patent holdup problem. For example, the prices of goods produced by patent-intensive SEP industries relative to other good produced in the economy have fallen by 90% since the early 1990s. Indeed the prices of goods produced by patent-intensive SEP industries have fallen at about twice the rate of other patent-intensive industries. Although reform advocates point to patent-intensive SEP industries as most prone to patent holdup, it is in these industries where innovation seems fastest. If patent holdup is slowing innovation, it is slowing it down to perhaps the fastest rate in human history.

Our analyses also shed a skeptical light on the direction of major reform proposals that envisage a greater role for regulatory-type bodies and a smaller role for the courts. Current reform proposals compare the messy reality of the current court-based system with an imaginary ideal—a perfectly functioning regulatory system. But, an enormous body of economic research suggests that such regulatory-based institutions are more prone to subversion than the courts.

Regulatory capture might be a bigger concern than the high cost of litigation. Before materially altering the U.S. intellectual property system—a bedrock institution underlying long-run economic growth—more serious work is need.

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Table 1: When should one expect integration?

	Economies of integration	Diseconomies of integration
Holdup	Integration	Integration or no transaction
No holdup	Integration	Decentralized trade: markets or contracts

Figure 1: Integration and separation in industries that manufacture a complex product

The decentralized industry

- Final good  
(e.g. a cel phone, a tablet)
- Contains many patents and  
uses many standards
- Manufacturers compete

The integrated industry

- Final consumer product  
(e.g. a cel phone, a tablet)
- Contains fewer patents &  
many trade secrets
- No standards & no  
competition

Manufacturer I

- Owns & licenses  
some patents
- Licensee of other  
patents
- Member of SSO
- Does R&D
- Buys inputs
- Manufactures the  
final good

Manufacturer II

- Owns & licenses  
some patents
- Licensee of other  
patents
- Member of SSO
- Does R&D
- Buys inputs
- Manufactures the  
final good

Manufacturer

- Owns patents &  
trade secrets
- Does all R&D
- Manufactures  
inputs
- Manufactures the  
complex good

Input  
manufacturer I

- Owns some  
patents
- Licensee of  
other patents
- Does R&D
- Member of SSO
- Sells input

Input  
manufacturer II

- Owns some  
patents
- Licensee of  
other patents
- Does R&D
- Member of SSO
- Sells input

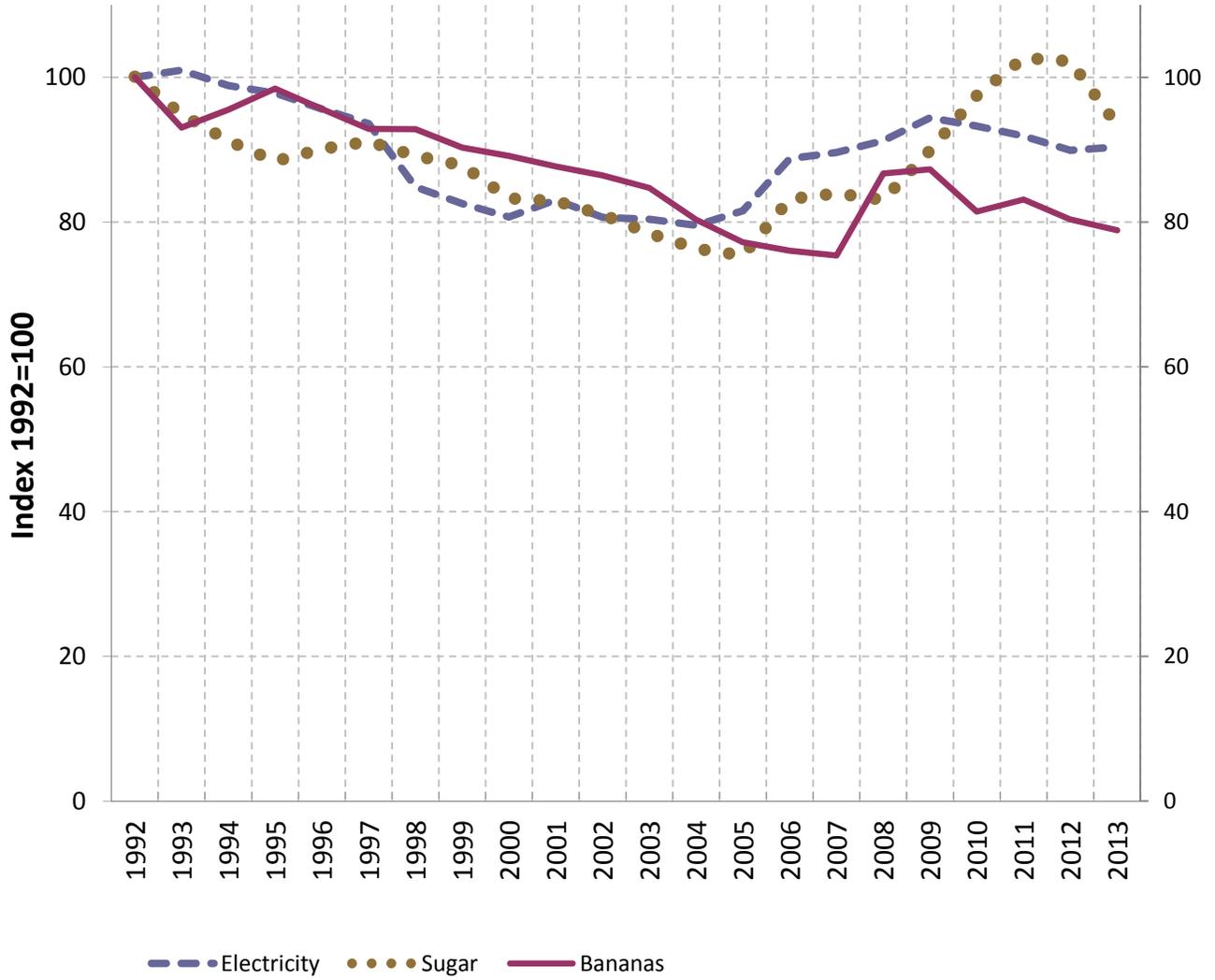
NPE I

- Owns &  
licenses some  
patents
- Member of SSO
- Does R&D

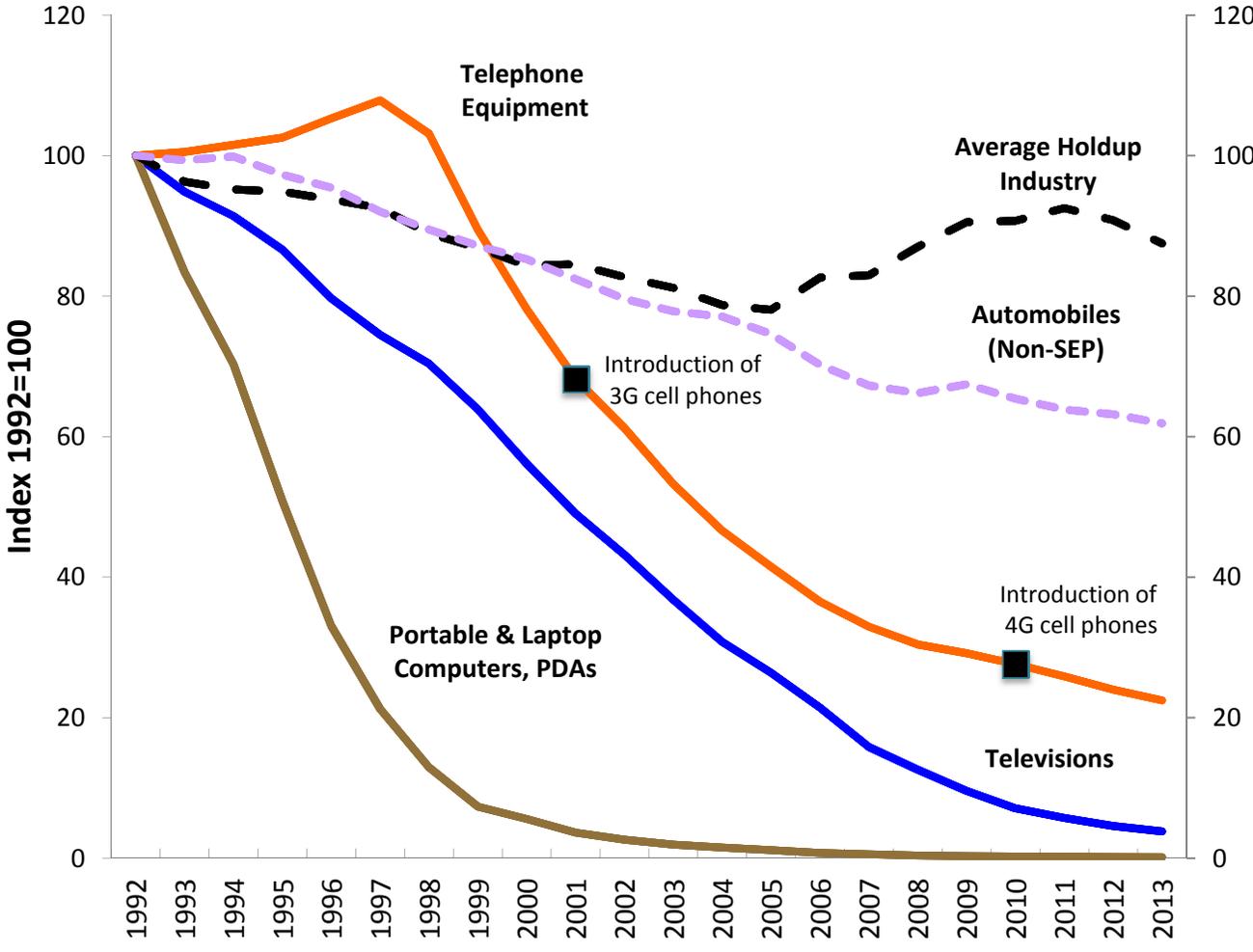
NPE I

- Owns &  
licenses some  
patents
- Member of SSO
- No R&D

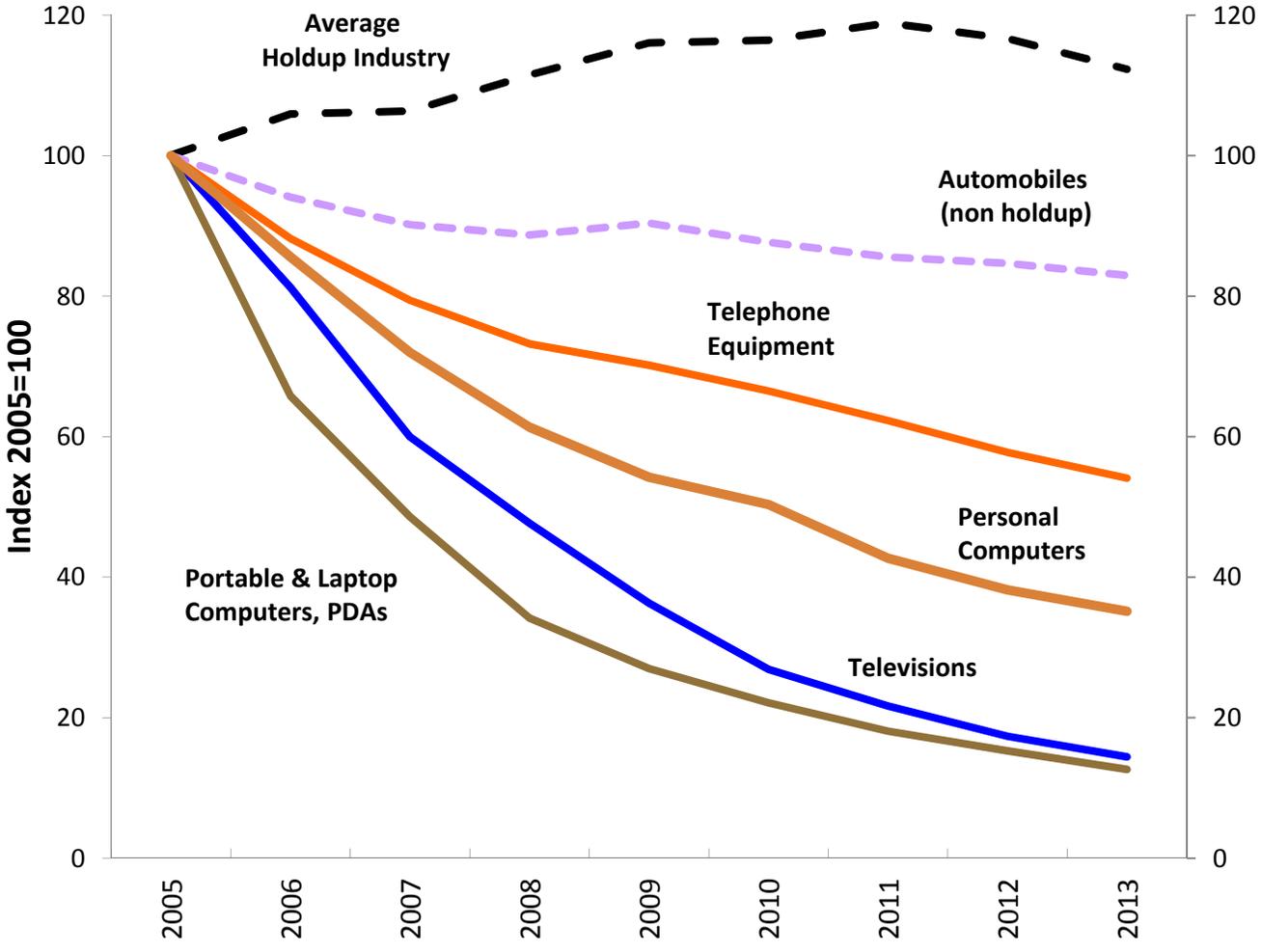
**Figure 2**  
**Relative Prices of Products from Textbook Hold Up**  
**Industries, 1992-2013**



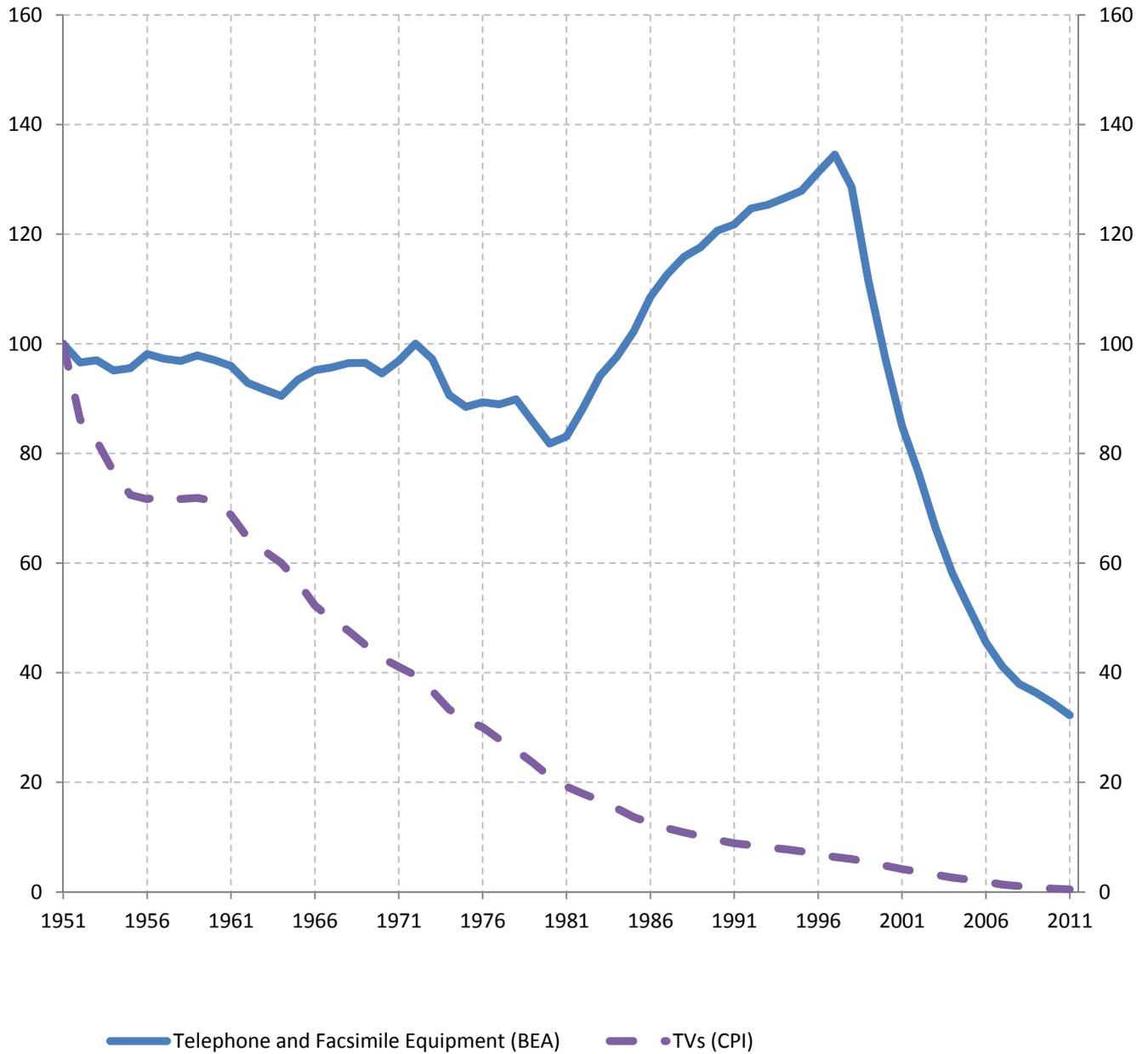
**Figure 3**  
**Relative Prices of Textbook Hold Up Products vs**  
**Consumer Products Produced by SEP Industries, and a Consumer**  
**Product Produced by a Non-SEP Industry, 1992-2013**



**Figure 4**  
**Relative Prices of Textbook Hold Up Products vs**  
**Consumer Products Produced by SEP Industries, and a Consumer**  
**Product Produced by a Non-SEP Industry, 2005-2013**



**Figure 5**  
**Relative Prices of Telephone & facsimile**  
**equipment and TVs, 1951-2012**  
**1951=100**



**Figure 6**  
**Relative Prices in Selected non-SEP Industries**  
**and Televisions, 1951-2012, 1951=100**

