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Welfare analysis of alternative patent policies for software innovations

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Abstract

We present a duopoly model that extends existing patent policy design models in the economics literature to formalize the links among the patent policy levers set by public policy (patent height and width), the strategic decisions made by firms (R&D investments, product development, product imitation, patent decision, and product pricing), the purchasing decisions made by consumers, and the market parameters. This integrated model enables policymakers to better analyze the impact of alternative patent policies on the level of social welfare and the distribution of that welfare among innovators, imitators, and consumers in a range of industry contexts—specifically targeting issues of software patents. Critical results include (1) an increase in patent width unambiguously increases R&D spending to generate a novel idea; (2) an increase in patent height may increase or decrease R&D spending depending on the efficiency with which an innovator can transform the novel idea into a commercial product; (3) while enforced patents will improve innovator profits they may worsen imitator profits, consumer welfare, or both and may even worsen total social welfare; (4) the optimal (social welfare maximizing) policy design is characterized by a relatively high patent height and moderate patent width.

Keywords: Patent policy; Patent height; Patent width; Software patents; Social welfare; Innovation; R&D

1. Introduction

Technological innovations are a major source of economic growth, typically leading to improvements in productivity, per capita income, and standard of living for consumers [12,23]. They are also a source of competitive advantage and market power for many innovating firms, often leading to bargaining power with customers, barriers to entry for competitors, and a flow of profits from licensing fees. Firms engage in costly research and development (R&D) activities to discover and develop an innovative product. However, a discovery that is instantly imitated by competitors at low cost may not yield enough revenues to allow the innovator to recoup its R&D

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costs. The threat of cheap, quick imitation of technological innovations (e.g., software applications and internet-based business methods) has increased significantly with recent advances in software reverse engineering techniques. Competitors may use these techniques to reverse a program's machine code back into the source code in which it was written, allowing them to duplicate how software programs perform certain operations without having access to the actual program.

One policy tool available to the US government to encourage technological innovation is a patent system that provides innovating firms with some protection from derivative products (or provides exclusive rights to make, use, or sell an innovation) for 20 years from the date the patent is awarded[1]. Patent law requires that an innovation under review must be new, useful, and nonobvious to a person of ordinary skill in the relevant field. Once a patent is awarded, it provides the patent holder with a scope of protection from imitation by competitors. A patent holder who believes that a patent has been infringed may file suit against those who make, use, or sell the derivative product to stop their use of the infringing product or to collect licensing fees. In the economics literature, the novelty and nonobvious requirement is referred to as the patent height and may be defined as the minimum quality improvement (or the minimum number of new product characteristics) a firm must make to an existing, well-known product to be awarded a patent. Once a patent has been awarded, the scope of protection from imitation is referred to as the patent width. If patent protection is narrow, then competitors may imitate a large number of the patented product's characteristics without infringement. Alternatively, if patent protection is wide, then competitors may imitate only a small number of the patented product's characteristics without infringement[2].

The government views patent law as a policy tool used to stimulate R&D and innovation and maximize social welfare. However, recently, there has been debate in the popular press about the effectiveness of software patents in achieving these goals. Some argue that patent examiners may not possess the expertise to properly set the patent height (i.e., the novelty requirement) that an innovating firm must attain to be awarded a patent. As a result, patent examiners sometimes award patents to well-established software features (i.e., examiners' set patent height too low). Others argue that court judges may not possess the expertise to properly assess the patent width (i.e., whether a derivative software product, or imitation, infringes an existing patent). As a result, court judges sometimes prevent the use and sale of differentiated derivative products (i.e., courts' provide too wide a scope of protection). Examples of software patents that have been challenged in court as either too low or too wide include Amazon.com's patent for its One-Click technology[3], Priceline.com's patent for its Name Your Own Price technology[4], Allan Konrad's patent

[1] Patents do not cover specific systems; instead, they cover particular techniques that can be used to build systems, or particular features that systems can offer. Patents on computer software were first granted in 1981 following a Supreme Court decision in the Diehr case [4]. Prior to this time, software developers copyrighted individual programs or made them trade secrets. Copyright was traditionally understood to cover the implementation details of a particular program; it did not cover the features of the program or the general techniques used. Trade secrecy, by definition, could not prohibit any development work by someone who did not know the secret.

[2] We observe that the patent design literature has used different terms to define these two dimensions of patent policy—protection from improvements and protection from imitation. For example, the dimension that protects innovators from improvements has been referred to as height [6,14], novelty requirement [29,30], and leading breadth [24,29], while the dimension that protects innovators from imitation has been referred to as width [14], breadth [10,11], and lagging breadth [29]. Although authors in this literature have used different terminology, in this paper, for consistency, we have chosen to use the term patent height to refer to protection from improvements and patent width to refer to protection from imitation.

[3] On September 29, 1999, Amazon.com was awarded a software patent—Patent No. 5,960,411—for its One-Click technology, an online shopping tool that stores customers' billing information so that they do not have to reenter it every time they make a purchase. BarnesandNoble.com and thousands of independent software developers have publicly criticized the PTO for granting this patent in the first place, describing the One-Click technology as a trivial application of cookies to save customer information that was already in wide use prior to Amazon's patent claim in 1999.

[4] On August 11, 1998, Priceline.com was awarded a software patent—Patent No. 5,794,307—for its Name Your Own Price technology, a reverse-auction mechanism that allows buyers to name the price they are willing to pay for hotel and airline reservations. The validity of this patent has also been questioned because the concept of reverse auctioning was well-established prior to Priceline.com's patent claim in 1998.