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Intellectual property rights hinder sequential innovation. Experimental evidence

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ABSTRACT

In this paper we contribute to the discussion on whether intellectual property rights foster or hinder innovation by means of a laboratory experiment. We introduce a novel Scrabble-like word-creation task that captures most essentialities of a sequential innovation process. We use this task to investigate the effects of intellectual property allowing subjects to impose license fees on their innovations. We find intellectual property to have an adverse effect on welfare as innovations become less frequent and less sophisticated. Introducing communication among innovators does not reduce this detrimental effect. Introducing intellectual property results in more basic innovations, with subjects failing to exploit the most valuable sequential innovation paths. Subjects act more self-reliant and non-optimally in order to avoid paying license fees. Our results suggest that granting intellectual property rights hinders innovation, especially for sectors characterized by a strong sequentiality in innovation processes.

1. Introduction

The question whether to grant intellectual property (IP) rights to innovators has been widely discussed in economics, law and politics.[1] Proponents of IP rights argue that temporary monopoly rights granted through patents or copyright provide incentives by protecting innovators from imitation and allotting to them a part of the social surplus generated by subsequent innovators (Arrow, 1962; Nordhaus, 1969; Scherer, 1972). Further, patents are assumed to induce disclosure of new technologies and therefore foster a swift and comprehensive diffusion of knowledge (Machlup, 1958). These traditional arguments have been increasingly put to question. Opponents of IP rights argue that the creation of monopolies on innovations increases prices, distorting resource allocations, causing inefficiencies and leading to welfare losses (Boldrin and Levine, 2013; Stiglitz, 2008). Moreover, too broad, too long, or too fragmented IP rights can give rise to gridlock and anticommons issues in downstream innovations (Heller and Eisenberg, 1998).

In this paper we contribute to the debate on the role of patents in the context of sequential innovation by means of a controlled real-effort laboratory experiment involving creativity. We introduce a novel design that allows us to create counterfactual situations and test directly the effects of IP rights on the innovation rate and welfare of a laboratory economy.

The issues of what are the optimal extent and nature of IP rights have been long debated, but neither theoretical nor empirical research has provided a final answer. Theoretical results cut both ways. Conventional wisdom is largely derived from static models, and does not robustly survive in dynamic, sequential innovation models that best describe sectors characterized by cumulative research (Scotchmer, 1991). Dynamic models offer a less positive view of the effect of IP on the rate of innovation and thus aggregate welfare. Green and Scotchmer (1995) study the division of profits between sequential innovators and suggest that it is desirable to minimize patent life. Moschini and Yerokhin (2008) analyze IP regimes with and without research exemptions. They find ambiguous effects and show that firms ex ante always prefer a full patent protection regime. In contrast, Bessen and Maskin (2009)

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[1] For a comprehensive literature review on theoretical aspects of patents see Gallini and Scotchmer (2002), Hall and Harhoff (2012), Denicolò (2008); for a review on central policy debates see Jaffe (2000).

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implement a model with sequential and complementary innovations, finding that IP rights are welfare-reducing, and, in some cases, are not even preferred by the inventor, who favors instead to publicly disclose her innovations. Going a step further, Boldrin and Levine (2008) theoretically and empirically show that innovators can earn competitive rents even in complete absence of monopoly power. Hunt (2004) investigates the role of the patentability standard in a sequential innovation model in which profitability of inventions is eroded by new inventions. He finds an inverse U-shaped relationship between patentability standards and the rate of innovation. Using an asymmetric-ability multistage R&D race model, Fershtman and Markovich (2010) find that the opportunity of licensing in a patent system might be superior to a system with strong patent rights. Summing up, the dynamic models focus on the trade-off between securing sufficient incentives to current and future inventors. The overall result of the theoretical analyses, though, seems to crucially depend on the assumptions of the respective model.

Empirical research also yields mixed evidence. Results on the impact of IP rights on innovativeness range from a positive influence (Ernst, 2001), an "inverted U" shaped relation (Aghion et al., 2005; Furukawa, 2007; Hashmi, 2013), a negligible impact (Dosi et al., 2006; Lerner, 2009) to a negative influence (Qian, 2007; Williams, 2013).[2]

Methodologically, both theoretical and empirical analyses are second-best with respect to the observation of a clean counterfactual situation. The absence of conclusive evidence might be due to the lack of natural experiments that could allow us to observe a counterfactual, non-existent patent-free world (Hall and Harhoff, 2012; Sørensen et al., 2010).

In this paper we exploit the unique characteristic of laboratory experiments of allowing to easily build counterfactual situations while retaining control over several confounding factors. We recreate a sequential innovation setting similar to Bessen and Maskin (2009), which fits best to copyrighted non-rivalrous goods and the respective industries such as software and semiconductors. In the spirit of Scotchmer (2004) we use this setting to explore the effects of IP rights on innovativeness and welfare.

The advantages of the laboratory in terms of control come at a cost. The laboratory creates an artificial environment that might lack external validity. In bringing IP rights to the lab we hence face a trade-off between replicating the complex interactions of creative, sequential innovation industries and making the task manageable for an experimental session characterized by time and monetary restrictions. This basic trade-off has been tackled in various ways in the still sparse experimental literature in the economics of innovation and IP rights. A laboratory task adapted to analyze innovation should include the use of both financial and creative resources, and should recreate both the incentive structure and the uncertainty of actual innovation settings. Moreover, it should provide an innovation space that is countable, in order to allow the researchers to analyze the data quantitatively. These constraints have been usually met by developing search tasks over some large, multidimensional space unknown to the subjects but controlled by the experimenter (Buccafusco and Sprigman, 2010; Buchanan and Wilson, 2014; Cantner et al., 2009; Ederer and Manso, 2013; Meloso et al., 2009). Another set of papers has instead forfeited control over the results of the creation process to focus on creativity only (see, for instance, Buccafusco and Sprigman, 2010; who let the subjects write poems). Toubia (2006) is, to the best of our knowledge, the only paper implementing a sequential 'ideation' task that requires creativity and provides some sort of countable space in which different incentive schemes for creativity can be studied.

To achieve a reasonable balance, and include both dynamics and creativity, we employ the design of Crosetto (2010) and develop a Scrabble-like word-creation task. The task involves creative use of scarce resources (letters) over a known but vast space (all the existing words), thus at the same time implementing creative effort and granting complete control of the results. We implement (strict) sequentiality by allowing only three-letter words to be created from individual letters, while longer words have to be built extending shorter ones, one letter at a time. Subjects are rewarded for creating words. Additionally, in some treatments subjects have to license, for a fee, their words and extensions to other subjects to serve as base for extensions in further periods.

Within this artificial but rich setting we implement two treatments, across subjects. First, we directly test the effects of IP rights on innovativeness and welfare by imposing two alternative IP regimes: a no-IP regime, where all license fees are exogenously set to zero, and an IP regime in which license fees are determined endogenously by subjects for each newly created word. Second, we test the robustness of individual licensing behavior in the case of stronger social interaction, by enabling or not chat communication. We thus investigate whether communication among innovators builds up altruistic norms that foster cooperation and decrease overall license fees for innovations.

We find that the presence of IP rights results in less and less sophisticated innovations and significantly reduces total welfare by 20–30%. This is due to IP rights causing a shift in behavior from more valuable, longer words towards less valuable, shorter ones. Subjects, in their quest to avoid paying license fees, forego innovation opportunities that are instead seized in absence of IP rights. Chat communication reduces the overall level of license fees, but this does not affect the rate of innovation: the detrimental effect of introducing IP rights holds both with and without communication.

2. Experimental design

2.1. Related experimental literature

Experimenters trying to deal with intellectual property issues face two sets of problems when designing their tasks. First, they need to translate the idea of innovation in the lab. This means allowing the subjects to use both financial and creative resources, but within a task in which it is possible to accurately assess quality and quantity of the goods produced. Introducing creativity and skills is crucial to obtain external validity of the results; control is crucial to allow for treatment comparisons and to derive robust results. Second, they must recreate a multi-period dynamic landscape in a relatively short-lived experimental session.

In order to deal with these basic design problems a first group of experiments chooses to model the creative process using search over complex spaces. Subject explore the search space looking for some optimal solution that yields higher payoffs, and that the experimenter knows and controls. Often this optimal solution is randomly chosen by the experimenter over the space. Meloso et al. (2009) use a combinatorial task, with an optimal non-obvious solution, and find that participants disseminate intellectual discoveries better in a market than in a patent system. Cantner et al. (2009) model R&D as a multidimensional search process with uncertainty, in which the best option is randomly determined. They investigate competition for innovation in a patent race scenario to classify investor types, finding that most subjects use objective investment criteria. Dimmig and Erlei (2013) use a similar task and show that the introduction of patenting has only a minor impact on R&D behavior. Ederer and Manso (2013) use a search task in a multi-

[2] Bessen and Meurer (2008) and Lanjouw and Lerner (2000) provide a review.

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