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Dynamics of Enforcement and Infringement of Intellectual Property Rights and Implications for Innovation Incentives

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Abstract

The literature recognizes the dynamics of Intellectual Property Rights implementation. However, a framework that examines these dynamics and analyses the interactions is missing. We use established theory to build a system dynamics model that explores the feedback effects of Intellectual Property Rights use, infringement and enforcement to explain how the strength of Intellectual Property Rights arises. Model analysis reveals that the strength of Intellectual Property Rights arises endogenously without being tied to the formulation of the law.

1. Introduction

Intellectual Property Rights (IPR) are in general considered to enhance the innovative activities in an industry. Different economic theories emphasize the role of IPR as a motivation for useful invention, as facilitating access to information, as promoting development and commercialization of useful products that are based on inventions and as enabling the exploration for derivative inventions (Nelson&Mazzoleni, 1997). The strength of IPR has two dimensions: the static design and the dynamic implementation and use. The static design of IPR determines the possibilities in which use restrictions can be enforced such as the scope of protection in the case of patents or a breeders or research exemption in the case of Plant Breeders Rights. The static design is usually formalized in the membership of a country in international treaties such as the Berne Convention, the Trade Related Intellectual Property Rights or the International Union for the Protection of New Varieties of Plants. Thus, input measures such as participation of a country in international conventions regarding IPR are commonly used to define the strength of IPR (Maskus, 2000). Other measures of the strength of IPR are e.g. the cross country index developed by Rapp&Rozek (1990) which is based on the assessment of legal texts with minimum standards proposed as guidelines by the US chamber of commerce. Another way to examine this parameter is to ask managers about their perception of the strength of IPR. The problem is that input measures cannot give a full picture on the strength of IPR as implementation and use are not taken into account. Innovation incentives also come from the perceived effectiveness of the legislative system, which is determined by enforcement. The strength of IPR can thus also be defined by output measures such as infringement numbers. The problem is that the output measures cannot give a full picture on how an IPR system works as infringement says little about how the system is actually used, i.e. what fraction of innovations is actually protected by IP laws and what fraction is protected by other, maybe informal measures. A decrease in infringement could mean that courts are working better but it could also mean that fewer innovations are generated or that people find other, informal and possibly less efficient ways to protect their innovation and thus their intellectual property.

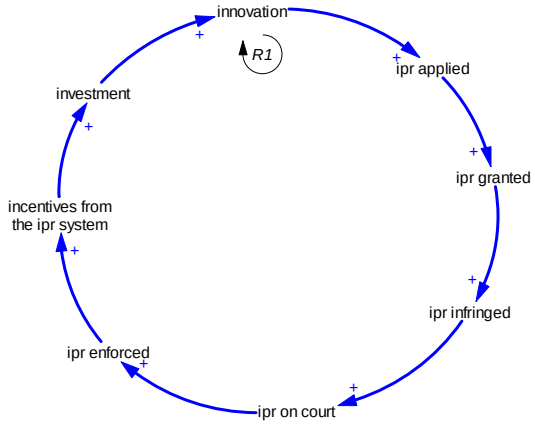
In this paper we look at the dynamic aspect of intellectual property rights, the implementation. As we consider implementational issues of policies there is an impact of the policy on the economy but also from the economy on the implementation of the policy. As Maskus (2000: 102) points out, „as an economy’s technological so-

phistication increases, inventors and creators require stronger protection for their works, thus demand for IPR rises. Of course, causation may go both ways, with stronger property rights also contributing to growth in incomes. The latter point remains subject to debate, being not yet well understood in empirical terms.” This paper aims at creating a better understanding of the feedback effect between the legal set up and the economy and thus tries to come to an understanding of the process involved in the emergence of a strong IP system. We thus answer the question of what the feedback processes are and what the implications for the use of IPR in an economy are, i.e. the enforcement of IPR and thus the effective incentive of IPR for investment and technological development over time. We will use the causal loop diagramming methodology to build the theory by using data from the literature and then in a second step build a simulation model to characterize the outcomes that these processes generate.

2. Theory

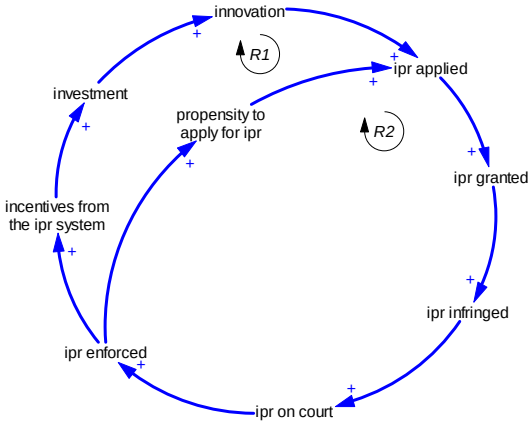
We first establish the link between the existence and quality of IPR and their impact on innovation as well as the impact of innovation on the quality of IPR. In an innovation producing economy a certain share of these innovations will be protected by IPR, some innovations, e.g. process innovations, will not be commercialized and some of the innovations might simply be kept as trade secrets. The share of innovations that qualifies for IP protection then undergoes an application process whereby IP examiners check criteria for the application of new IPR. Those criteria differ with the type of IPR that is applied for but encompass criteria like novelty, utility and non-obviousness (Mueller, 2003) in the case of patents or distinctiveness, uniformity and stability for plant variety protection After a period of examination of usually two years the IPR that was applied for becomes granted and then has a lifetime that again differs with the type of IPR. For patents lifetime in most jurisdictions is between 20 and 25 years. Trademarks are valid for 10 years and then must be renewed. A certain share of the granted IPR will be infringed upon. Infringed IPR can become persecuted. Infringers are hereby taken to court and IPR can be enforced. Successful enforcement will then send a positive signal to companies using and relying on IPR in the sense that the investments they have made into the commercialization of innovations enjoy some protection. This will give incentives to companies to invest further as well as increase a company’s revenue as their revenue losses by fake products decrease (OECD, 2008) Figure 1 illustrates these reinforcing relationships.

Figure 1: The basic IPR feedback loop



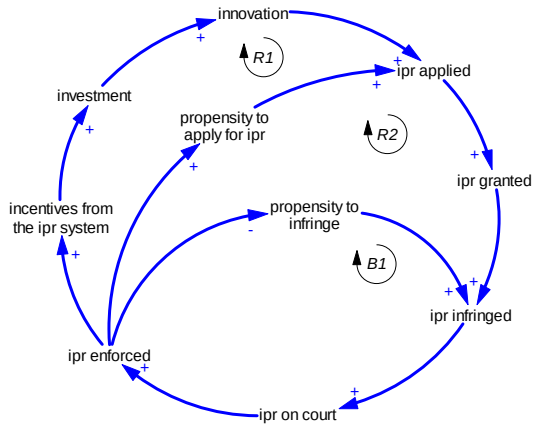
However, the way the IPR system is used also depends on how companies trust the IPR system. If enforcement cannot be guaranteed, companies often find other ways to keep innovations secret and thus to prevent competitors from copying them. The share of innovations that is protected with IPR and thus the number of IPR applied for depends also on the propensity of innovators to apply for IPR. Here the number of IPR that ended in court and were enforced (settled) gives trust to innovators. If IPR are enforced the propensity to apply for IPR will rise. Another factor that makes the propensity of applying for IPR rise is that as companies in a market mature, they can afford the direct and indirect costs of IPR. As an evidence of this Lerner (1995) finds that in a study of 530 US firms cases litigated by smaller firms disproportionately involve trade secrets, suggesting that this source of intellectual property protection is more critical to these companies. Figure 2 illustrates the link between increased IPR enforcement, the propensity to apply for IPR and the number of IPR applied for which adds a second reinforcing feedback loop to the dynamics of IPR.

Figure 2: Adding the link for propensity to apply for IPR



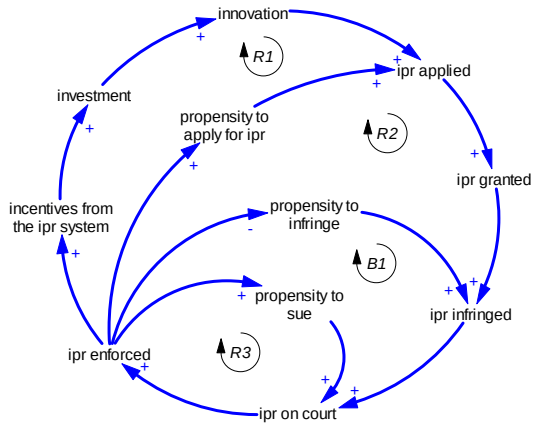
IPR enforcement also affects another variable, which is the propensity to infringe IPR. The stronger IPR enforcement is, the lower. We expect the propensity to infringe IPR to be. This in turn results in fewer IPR infringed. This goes in line with Lanjouw&Lerner (1997) who found that litigation costs and the threat of loosing a process deter firms from infringement. Figure 3 shows how stronger IPR enforcement lowers the propensity to infringe IPR and thus adds a balancing feedback loop to the conceptual framework.

Figure 3: Adding the link for propensity to infringe



As another effect IPR enforcement will also affect the propensity to sue. The propensity to litigate an IPR will most likely vary with the expected benefits of litigation. Suing is costly and companies will only take this step when they see a benefit to suing. The success rate of suing therefore depends on the effectiveness of the court system, which affects IPR enforcement. With increasing use of the patent system, patentees become more likely to file cases because of an increase in their expected probability of winning (Lanjouw&Lerner 1997). This relationship is illustrated in figure 4.

Figure 4: Adding the link for propensity to sue



3. Simulation model

We translate the theory developed in the previous section into a formal simulation model that allows us to explore the implications of the theory's assumptions.

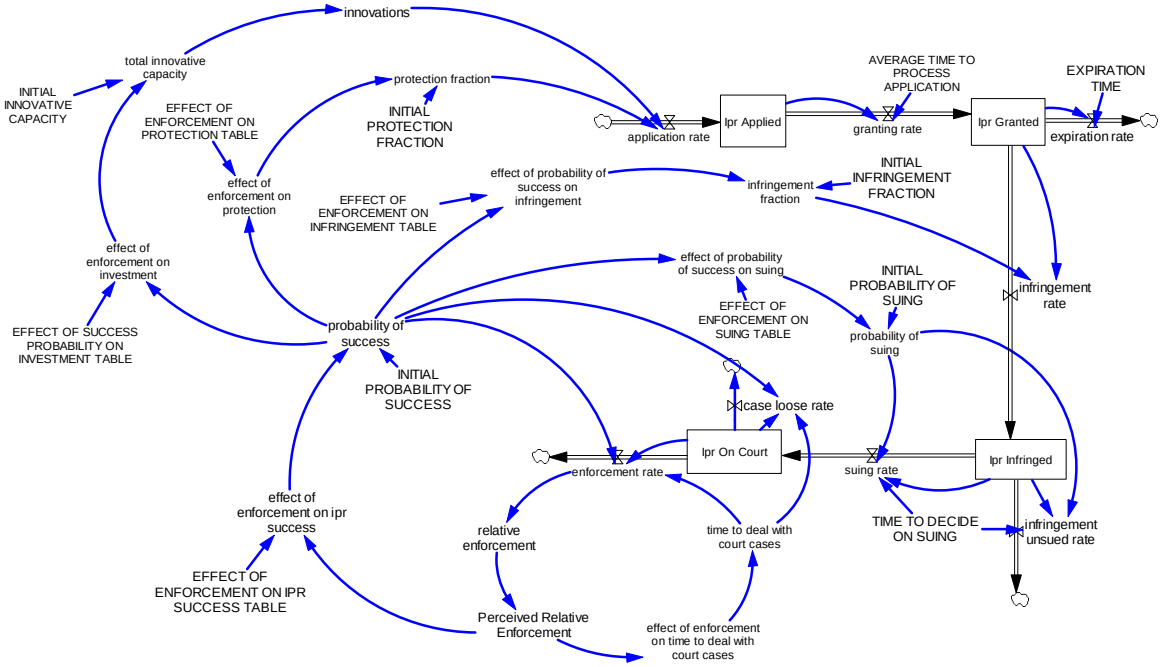
Very little empirical work on the endogenous relationship of the strength of IPR and the use of IPR and the incentives from IPR´s for investment and economic development exists. The feedback effect between the legal set up and the economy is not yet well understood in empirical terms (Maskus, 2000) and only a few studies have assessed the effects of counterfeiting and piracy on economies (OECD (2008). This is attributed in part to the lack of consistent cross-economy counterfeiting and piracy datasets.

We therefore initialize the simulation model (figure 5) to equilibrium and explore the general behaviour patterns that the feedback loops in the model create. Being more specific in terms of empirical work remains subject to future research at this point.

As a baseline we calibrate the model with parameter values typical for a situation with few innovative activities and with little IP experience. The initial innovation rate is 10, meaning that we look at an industrial sector that has a very low output of 10 innovations per year. This is a plausible number e.g. for an immature agricultural input industry in a developing country. Furthermore we assume an average time to process IPR applications of two years and an average IPR lifetime of 20 years. We assume an initial protection fraction of 10%, indicating that initially very little use is made of IPR. The initial infringement fraction is 70%, indicating that so far potential infringers of innovations would not be deterred by the possibility of being persecuted for fraud. The initial suing fraction is assumed to be 10%, suggesting that not many companies see a

benefit in enforcing their rights yet. The table function governing the effect of IPR enforcement on investment is a concave function. The table function that governs the effect of IPR enforcement on the protection fraction is an s-shaped curve. The table function regulating the effect of enforcement on infringement is a convex function and the table function governing the effect of enforcement on the suing rate is an s-shaped curve.

Figure 5: The dynamics of IPR simulation model



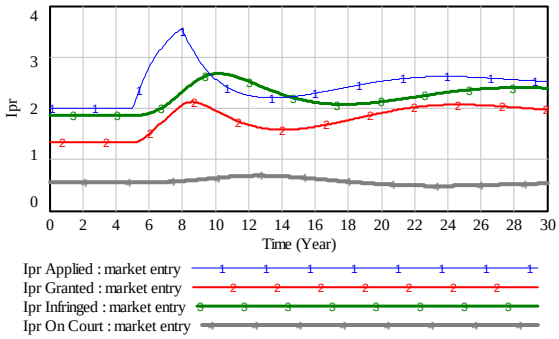
4. Analysis

In this section we report on a few scenarios that move the IPR system out of equilibrium. Figure 6 shows the reaction of the four stock variables (IPR applied, IPR granted, IPR infringed, IPR on court) to the market entry of new innovating firms. This scenario is based on the situation in the agricultural input industry in many developing countries. The domestic industry hardly has any innovative capacity. The situation changes with the market entry of one or several multinational companies that introduce their innovation, e.g. improved seed varieties, in the recipient country. For the purpose of our model we assume that at year 5 multinational companies enter the market and add 10 innovations to the already existing 10 innovations in the domestic industry. Figure 6 traces the reaction of the four IP stocks over time. The difference between Figure 6a and 6b lies in the sensitivity of the decision rule that influences investment as a reaction to changes in IP enforcement (effect of

success probability on investment, cf. Figure 5). In Figure 6b companies react slightly more sensitively to changes in IP enforcement and thus changes in the success probability. An increase in the probability of successful suing leads to a higher increase in investment than in Figure 6a. We tested the two different specifications of the decision rule as data related uncertainty about this parameter is high.

Figure 6: Reaction of the IPR system to the market entry of innovating firms

a)



b)

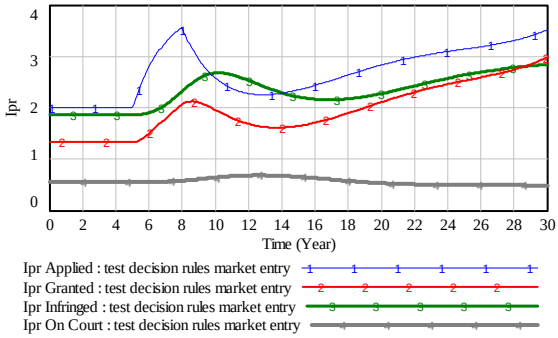
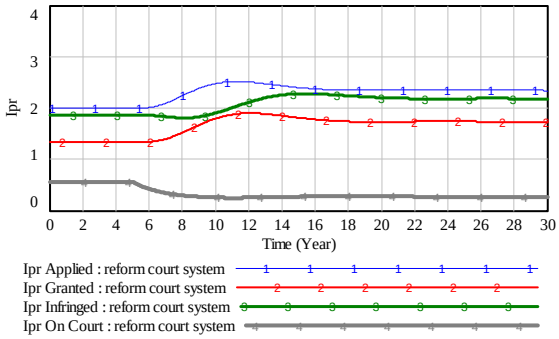


Figure 6 illustrates that the initial pulse increase in innovations leads to an increase in all four IP stocks. As infringement is high (initial infringement fraction of .7) the impulse cannot be sustained by the system and the number of IPR applied and granted decline again (B1 balancing loop). Only after a period of approximately 10 years has the legal system acquired enough routine to handle IPR court cases and thus the time to deal with court cases decreases. This represents an institutional learning process. This may be due to the fact that judges become used to handling IPR cases. The legal system also becomes economically more feasible as the high fixed costs of dealing with court cases can be spread more widely (Maskus, 2000). Thus, enforcement increases and encourages more protection of innovations (R2 reinforcing loop) and more investments in research and development (R1 reinforcing loop). This leads to an increase in IPR applied and granted. Depending on the decision rule that companies apply this increase can be sustained over time and lead to the dominance in the three reinforcing feedback loops (Figure 6b). Eventually, the number of IPR granted exceeds the number of IPR infringed. If companies are more cautious with their reaction to changes in the IPR system the number of IPR applied and granted stagnate at a slightly higher level than at the outset of the simulation but IPR infringed exceed the number of IPR granted (Figure 6a).

Figure 7 illustrates the reaction of the IPR system to changes in the court system. Such scenario represents a situation where judges receive specific to deal with IPR cases and thus the average time to deal with court cases drops to half of its initial value. The figure again shows results for the two versions of the decision rule (effect of success probability on investment) applied in Figure 6.

Figure 7: Reaction of the IPR system to reforms in the court system

a)



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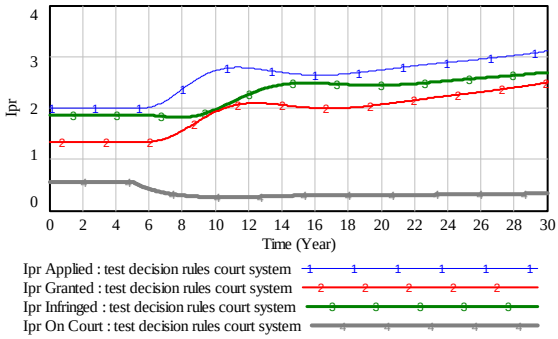

According to Figure 7 the three reinforcing feedback loops propagated by the literature are eventually able to dominate the behaviour of the IPR stocks as long as companies are fairly sensitive to changes in the IPR system (Figure 7b). The difference to the scenario tested in Figure 6 is that in Figure 7 the IPR system evolves more from inside, i.e. without the impulse (and also the disturbance) generated by very sizeable market entry through new companies. Both cases demonstrate that the strength of intellectual property rights arises endogenously, i.e. it is not tied to an original formulation of IP and contract law.

5. Discussion

In this paper we showed the feedback loops that govern the implementation of IPR over time. By formalizing these relationships we illustrated the effect that the feedback loops have on the system over time. Our results confirm Maskus (2000) in that the demand for protection of innovations and thus of intellectual property rises with economic development and with technological change. IPRs are accordingly inherently dynamic, both in their formation and their effect. Thus, out of observing the behaviour of the interaction of IPR application, infringement and enforcement we derived how the incentive of a functioning IP system for innovating economic activities develops over time. We thus showed that laws are dynamic. If enforcement is missing, strong laws on paper can result in low effective protec-

tion, deterring further use. Our model identified the stocks in the IPR system, where delays occur and how these delays affect the use of the IPR laws. Strongly formulated laws can reduce delays in the system such as the time it takes until infringement drops, the time it takes until owners of IPR perceive it to be worthwhile to sue and the time it takes for infringers to be deterred from strong punishments for IPR infringement. Empirical evidence needs to be gathered to test these hypotheses.

With our model we demonstrated that for an IP system to work properly owners of IPR need to protect and sue to enforce their rights and that even infringement has a role in that it causes the court system to work more efficiently on IP cases. Eicher&Garcia (2008) point out that private patent infringement suits are often necessary steps to establish patent value. By formalizing the relationships in a simulation model we were able to identify additional behaviour patterns such as the oscillatory tendency in the IPR system that have so far not been documented in the literature.

It remains to be discussed if it is indeed the enforcement rate that gives an incentive to protect intellectual property or if it is another parameter of the system such as the IPR on court or the IPR infringed that sends a signal for protecting, infringing and suing.

So far we have focused on the dynamics of application and enforcement of a policy, namely IPR. However, the important effect for studying economic dynamics is the impact of this loop on economic development. Studying how the process of a policy gaining strength affects the innovative capacity of an industry is therefore the logical next step. The limitation of the model with regard to this analysis is that only IPR affect innovation capacity. In the real world there is also the share of IPR that is not infringed that affects innovation capacity. IPR granted but not infringed generates revenue that can be reinvested into research and development. Thus the enforcement rate is only one incentive to generate innovations out of several, possibly more powerful mechanisms. The relative importance of this loop compared to other positive feedback loops of corporate growth needs to be explored by extending the model. Empirical data need to be gathered for the model in order to deliver empirical evidence of the theory and to differentiate between different kinds of IPR. Dynamics might be different with copyright where owners do not have to apply for protection but are automatically granted copyright when they publish their work. Trademarks and Patents, on the other hand, require an application and approval process in order to work.

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