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OPTIMAL PATENT PROTECTION AND EXPECTED UTILITY MODEL: A TRANSITION ECONOMY EXAMPLE

***Abstract.** This paper aims to critically appraise optimal patent protection using the expected utility model from the perspectives of governments to balance the motivation and social use of the intellectual property. In order to achieve this aim, the report has presented the working mechanism of governments towards patent protection; use of utility model by governments; past and present academic investigations on the topic; strategizing behavior of governments towards patents and as a brief example, a case of the transition economy. The expected utility model has provided an effective and efficient framework for the development of patent strategy by governments. The essay has noted that due to the differences between industries and their dynamics, it is expected that diverse patent regimes should be followed to balance the social utility and economic utility of the economic actor to engage in research and development.*

***Keywords:** Patent protection, expected utility function, optimization, transition economy.*

Introduction. The question surrounding balancing motivation to innovate and its social use have played a critical role in the development and deployment of government policies surrounding intellectual property [1]. Drawing upon Varian (2014), despite the modest rise in the research and development budget allocation across the globe, there has been a significant rise in patent applications across the developed, emerging, and developing national economies [2]. This patent surge has pointed out that the dynamics of optimal patent protection along with their expected utility has changed over the recent decades. This paper aims to critically appraise optimal patent protection using the expected utility model from the perspectives of

governments to balance the motivation and social use of the intellectual property. In order to achieve this aim, the report has presented the working mechanism of governments towards patent protection; use of utility model by governments; past and present academic investigations on the topic; and strategizing behavior of governments towards patents.

Moreover, approaching this topic from the perspective of reliability theory also can provide interesting outcomes. As Cerqueti & Lupi (2016) denotes, Reliability theory is of paramount relevance in a number of economic, engineering, and environmental contexts [3]. In particular, the reliability of a system is strongly connected with its riskiness. Risk is accepted when the associated system is reliable enough or, in other words, when the cost of its avoidance is higher than a predetermined threshold. Consequently, governments also have to have some kind of evaluation mechanisms.

Governments and Patent Protection. The overall decision of the firms or economic actors to engage in research and development can be modeled in the context of the expected utility model. Drawing upon Schoemaker (2013), expected utility theory postulates actions that underpin the selection process between different available alternatives [4]. The expected utility model has taken leverage from the rational choice theory, which argues that a rational economic actor is likely to select the choice of action that is expected to him yield the highest utility for the economic actor [5]. The role of the government is to understand the expected utility of all the economic actors that are involved in the development of innovation and creativity, which in turn should result in the optimization of the patent protection strategy. The governments are expected to maximize the intellectual property development that can be used for maximizing the long-term social outcome. It is safe to say that, in this case, we observe two sides - government and suppliers - who strive to maximize their expected utility. However, the government must regulate patent protection optimally that the fairness of the results finds its place among all participants of this process. From the perspective of decision theory, there are a lot of violations of its axioms and governments have to not only regulate but also do some innovation on their regulation principles over time. Accordingly, the use of expected utility as a tool protects its topicality.

The use of the expected utility model is to understand all possible alternatives from the view of a rational economic actor and developing contextual dynamics that would facilitate the selection of the optimal alternative [6]. Therefore, to estimate the optimal alternative strategy of the economic actor, the probability of each possible alternative and its outcome needs to be multiplied. It can be argued that the sum of the expected outcome multiplied with the probability of each alternative correspond with the expected utility for the specific alternative. In the light of this discussion, the expected utility function can be represented as follows:

$$E(u(d)) = \sum_x u(w_x) p(x)$$

Where: $p(x)$ = probability of each alternative

$u(w)$ = expected utility function over wealth

In the context of the expected utility model, it can be argued that as the probability of innovation becomes very low, the only motivation for economic actors to engage in the process is by attaching a higher expected utility over wealth to it. According to Schuett (2013), differing industries are governed by a range of different dynamics that can result in varying expected outcomes of investment in research and development [7]. The industry lifecycle analysis can be introduced to exemplify the differences. It is argued that the industries that are in the early phases of their lifecycle are likely to have a higher outcome per unit investment in research and development [8]. This per unit investment-related outcome deteriorates in industries that have transitioned into the maturity phase of their lifecycle (Feiwei, 2016). This difference suggests that governments require differing patent regimes for diverse industries to maximize the motivation of the economic actors in engaging in research and development.

Use of Expected Utility Function. The review of the academic literature has noted that there are several different choices available to innovators to protect their intellectual capital. Drawing upon Fagerlin et al (2013), the level of uncertainty is very high in the overall process that results in the development of innovation that can be patented. However, as the economic actors pass through the process, the information starts to build up which requires a re-evaluation of the motivation and

need for patent protection [9]. Drawing upon Conti et al (2013), a decision tree is an effective and efficient tool that can be used to rationalize the alternatives available to the innovator [10]. The researcher has therefore developed a simple decision tree to highlight the key alternatives that are available to the economic actors to protect their innovation through different formal and informal means as depicted in Figure 1.

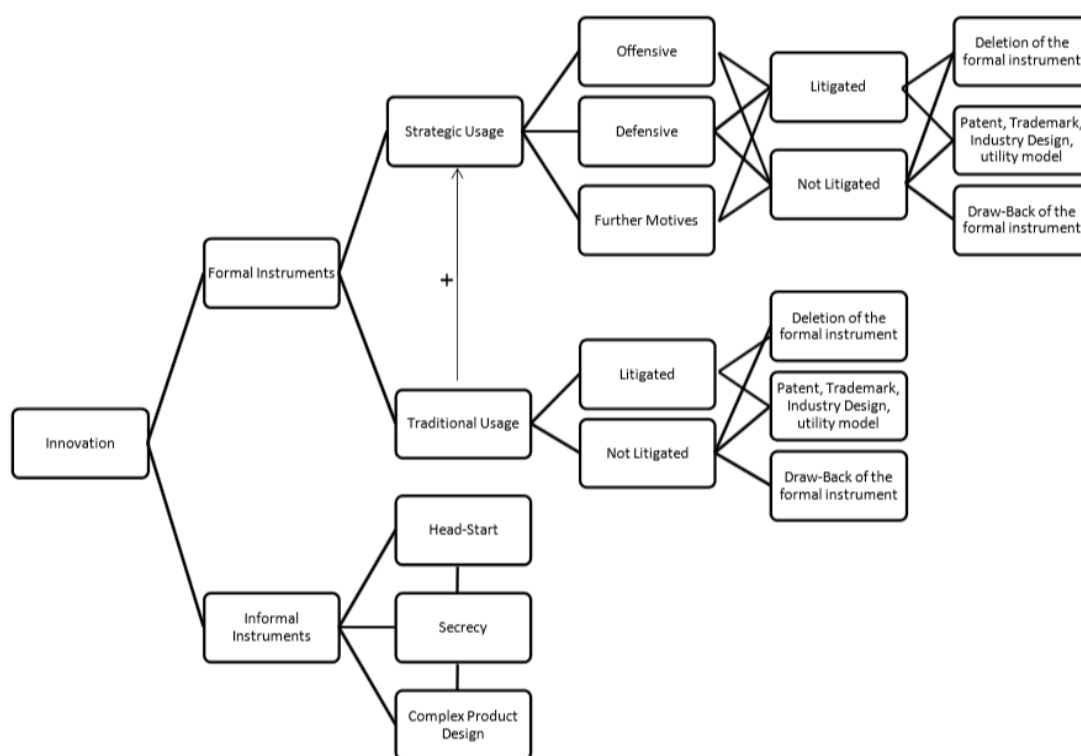


Fig. 1. Decision Tree of Alternative Choices Available to Protect Innovation (Own Analysis)

For this analysis, it can be assumed that the formal and information instruments are mutually exclusive for the economic actors. The expected probability of each outcome multiplied with the expected utility from the choice can be seen as the source of decision-making of the economic actors. Drawing upon Danzon et al (2015), it can be argued that if informal instruments provide a plausible case to fuel innovation then stricter patent controls should be put in place as there is already higher motivation to invest in the research and development [10]. Conversely, where such motivation fails, the governments are expected to provide incentives through longer exclusivity and a broader scope of patent protection.

Past and Current Research. There has been significant attention given to the expected utility model within economics academics. Patent protection and its implications on risk aversion and risk premia have been studied by Ching, (2010), Dutta (2011), and Schuett (2013) [8,7,11]. These investigations have developed a number of models based on expected utility for the economic actors. The core factors that have been noted to have implications on the decision making process of economic actors include: (a) overall size of the economic actor; (b) previous knowledge, understanding, skills, and competencies of the economic actor within the field; and (c) difference in the intensity of research and development.

There is also another stream of academic investigations that have focused on developing an understanding of the economic incentive provided by patent protection and its balance with the social need for innovation [8]. According to Conti et al (2013), there has been a higher concentration of the utility as the function of economic output, however, there remains a dearth of focus on quantification of social utility [9]. It can be argued that social utility is enhanced due to increased research and development outcome, however patent protection given to innovator can reduce the social utility due to price premium and lower volume produced by the innovator. However, at the same time, if there is a lack of motivation for the innovator to undertake essential research and development, then social utility is minimal. According to Ching (2010), governments are expected to undertake the balancing act between protecting and creating the social utility, while incentivizing innovators to invest in research and development [8].

Optimal Behaviour of Government. The optimal behavior of the government is to regulate the patent protection regimes for differing industries. According to Arrow (1992), the industries that have a higher overall probability of successful research and development outcomes should have patent protection regimes that have shorter protection periods and lower risk mitigation scopes [12]. This would essentially mean that the overall focus of the industry will be to use a non-formal set of protecting their intellectual property that can be developed with lower overall development in comparison with expected profitability. Such a patent regime can be seen as successful in the information technology industry. According to Benoît et al

(2010), information technology is currently in its growing stage of the industry lifecycle, which essentially means that the industry lacks saturation [13]. There is a scope of differentiation through innovation that can result in significant profitability for the economic actors.

Conversely, the expected utility model within highly regulated and mature industries like pharmaceutical and healthcare suggest that the probability of the successful outcome of research and development is very low [14]. This is the reason that such a low probability of success rates requires a higher level of expected utility function for any economic actor to engage in research and development in the industry. Therefore, governments are expected to increase the length of patent protection along with its scope so that economic actors can engage in research and development. This can be exemplified by the fact that out of more than 2,000 target molecules studies in laboratories, only a few pass through the regulatory process and becomes marketable drugs within the pharmaceutical industry [15]. The low probability of such a successful result requires long patent protection of 20 years for the firms to remain motivated in investing a significant portion of their profits into research and development. Therefore, a patent regime that is developed based on the expected utility model of economic actors within any given industry should be used to achieve an effective and efficient outcome.

A Transition Economy Example. Despite the differentiation among the industries and economic agents, the overall economic model also matters to balance the patent protection duration relayed on the expected utility function. For instance, a lot of studies conducted are related to the current quality level of market economies in the West. What if the government faced some kind of shift from one economic system to another one, like the collapse of The Soviet Regime resulted in 15 new economies which we consider as transition economies. Do governments need to adopt different approaches towards research and developments in these transition economies? Does the background of moving from ideological systems to liberal and free-market mechanisms play a critical role in the behavior modifications of the governments?

Although there are obvious and particular differences between economic systems of neoclassical and socialist economies, we can observe some common

features like Ellerman (2010) mentions: “Regardless of other differences, both neoclassical economics and socialist economics (e.g., in the former Soviet Union) agreed on modeling problems mathematically as the maximization of some objective function subject to various constraints so that problems would have an "optimal solution" (not necessarily unique)” [16]. As a consequence, this fact can give us a good starting point about the transition countries which also are considering as post-socialist or ex-socialist countries.

Moreover, we don't have to forget the generation which we can call "Soviet Man". Thus, the main “locomotive” of innovation is generations. The collapse of the Soviet Union ignited the conversion process from “Soviet Man” to “Economic Man” as Tverdohleb (2012) writes: "The population in these countries experienced a type of disillusionment and hardship previously unknown to them. Besides the macroeconomic challenges, other significant changes influenced the outcomes of transition: the total reconfiguration of the social structure; reevaluation of values, norms, habits, routines, leaders, and heroes; premature exposure to regional and international economic competition; and national identity crises for many of the newly re-created states (for ex. Russia, Ukraine, Serbia, Croatia, Slovenia, Czech Republic, Slovakia, the Baltic countries, etc.)" [17]. Furthermore, the author (Tverdohleb) mentions that the most important coordinator of the transition process indeed was exactly the shift from the “Soviet Man” to “Economic Man”. On the other hand, certainly, the level of the institutional quality is the indicator of the mentioned transformation and functional economic and social activities in these societies. Instead, when we look for the ex-socialist countries to identify the level of the formal institutional environment of the countries, we observe low indicators compared to western countries.

Hence, the points mentioned above is encompassing very crucial factors of innovation for an economy or society: economic model, generation, and institutionalism level. Considering these parts, above, I am depicting the general behavior of the governments which I consider as the possible scenarios in the case one innovation occurs. These scenarios are not representing unique applications or purposes, they are just simple interpretations of the individual behaviors as the result of being in front of risked situations.

Let's denote states of the world state 1 and state 2 by and respectively. Furthermore, let's suppose that a government of a transition economy doesn't know *Ex-ante* about which of these states will occur. *Ex-post*, one and only one of the states will occur. Moreover, let's denote by and the social welfare/fees ratio¹. So, this means the government must choose *ex-ante* between various uncertain bundles (r_1, r_2) . The expected utility function for the government of a transition economy can be considered as below:

$$U(c_1, c_2) = \pi_1 u(c_1) + \pi_2 u(c_2)$$

According to the concepts like risk premium, certainty equivalent, constant absolute risk aversion, risk neutrality, constant absolute risk-loving we can define the following scenarios for governments as the decision-makers for the transition economies:

Scenario 1 – is the scenario where governments will try to avoid risky choices² and prefer those innovations which are presenting bigger patent breadth. In this case, the curve for such kind of behavior will be a concave curve where the parameter of absolute risk aversion r is representing the concavity of the decision-maker.

Scenario 2 – If the risk premium is zero as the certainty level of any risky prospect is equal to the expected social welfare, the utility function u will be linear. In such economies which might be transition economies, where government decisions are very important and it is the main factor of regulation of the social welfare, this scenario is not desirable. However, due to different reasons, this path also can be possible.

Scenario 3 – The extreme point about the scenario approach can be identified as “risk-loving” which means a government loves and wants to make risky choices that are not maximizing social welfare. In this case, we have a right to say that a government may be having some malfunction among the institutions that can represent such kind of regulation.

Conclusion. In the light of the discussion provided, it can be concluded that patent protection plays a pivotal role in incentivizing innovators to invest in the

¹ This aspect represents that a government simply collects buyout fees in order to grant patent protection for a particular firm.

² Risky choices in this representation are very abstract terms and to clarify it, it can be considered as inefficient allocation of the recourses or decreasing the level of competition.

development of new products and services that can provide them with long-term economic rent and profit. The expected utility model has provided an effective and efficient framework for the development of patent strategy by governments. The research has noted that due to the differences between industries and their dynamics, it is expected that diverse patent regimes should be followed to balance the social utility and economic utility of the economic actor to engage in research and development. Consequently, scenario paths are general frameworks toward government behavior that depicts a three-way direction to this theme. Hence, a transition economy might describe more different realities from the experience of the free market mechanisms. Indicated scenarios are the customary perception of the combination of the expected utility function and patent protection processes.

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