Factors Affecting Innovation and Patent Propensity of SMEs: Evidence from Macedonia

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***Abstract*-The innovation and proprietary knowledge nowadays represent a basis for new competitive strategies of the companies. In that regard, the patents are among the most representative indicators for their innovative activities. This paper is primarily focused on assessing the relationship between innovation and patent propensity of SMEs. More precisely, the main objective is to identify the significant factors that affect patent propensity of SMEs and to determine the implications of patents upon the SMEs innovation. In this context, the paper encompasses an analysis of several relevant factors such as: the available resources of SMEs, the strategies for development of intellectual property rights and the impact of policy measures. The empirical analysis of the patent propensity of SMEs is performed in a country specific context for Macedonia which provides a basis for proposing appropriate policy recommendations.**

Keywords **– patent propensity, innovation, SMEs growth**

1. Introduction

The innovations represent a driving force of businesses and give impetus to their competitiveness and growth. Nowadays, the innovations of companies are determined by a number of factors that imply various innovation results. In order to produce innovation at socially desirable level, there exist various forms of intellectual property rights (IPR) established and protected by law such as: patents, trademarks, designs and copyrights. The aim of defining property rights is to allow the innovators to appropriate the returns of their innovation for themselves. On the other hand, granting IPR leads to creation of non-rival goods which assume conferring monopoly and giving rise to potential inefficiency. Hence, this involves a trade-off between encouraging innovation and suffering the consequences of monopoly.

The patents are one of the main forms for protection of IPR used by companies and individual innovators. The patenting process is a subject of legal regulations and consists of several dimensions such as: length, breadth and geographical coverage [1]. Although it is questionable whether the patents are the best route for IPR protection, it has been generally accepted that they represent a significant indicator for innovation activities of companies and directly influence the improvement of their efficiency and competitiveness. Hence, the number of patents as a proxy for innovation output in a given economy or industry is widely used as a measure of innovation activities. Moreover, the patents bring additional opportunities for business cooperation and profit generation through licensing and joint ventures.

The empirical evidence shows that there is a significant distinction between large and small companies regarding the extent and characteristics of the innovation and the patent activities. Even though small and medium sized enterprises (SMEs) are an important generator of innovation in the national economies, their share in the total number of patents is considerably lower compared to larger companies [2]. The worldwide experience demonstrates that the growth in the number of patents is direct consequence of the policy measures, which in turn is conducive to innovation and productivity growth. Therefore, in the focus of this paper is the analysis of innovation and patent propensity of SMEs and assessment of the opportunities for more efficient articulation of their patent and innovation activities.

The aim of this paper is to identify the factors that determine innovation and patent propensity of SMEs as a precondition for their competitiveness and

DOI: 10.18421/TEM62-28
https://dx.doi.org/10.18421/TEM62-28

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growth with particular reference to Macedonia. The applied methodology is based on qualitative approach that encompasses content analysis of the existing literature, as well as analysis of secondary published data and other empirical studies. The paper is structured as follows: In section 2 we review the literature related to patent and innovation activities in the companies with an emphasis on SMEs. In section 3 we analyze the main factors affecting the patent propensity of SMEs including resources, policy and strategy, while section 4 provides elaboration of empirical findings related to innovation and patent activities in Macedonia. Finally, in section 5 we conclude and formulate policy recommendations for improving the innovation potentials of SMEs.

2. Literature review

There exists an ample empirical evidence that patents help startups' growth, create jobs, generate follow-on innovations and facilitate access to capital (Farre-Mensa et al., 2015)[3]. Generally, we can identify a number of advantages that induce companies to patent their inventions such as: i) prevention of invention abuse, i.e. providing protection from copying and imitation of the invention by third parties; ii) improving the company's reputation in the public, particularly in the cases when company has big patent portfolio; iii) commercial exploitation of the invention through licensing and other forms of IP-based contractual arrangements; iv) increasing the market value of the company; v) improvement of the company's bargaining power on the capital markets, i.e. acquiring venture capital and enhancing access to finance [4].

We assume that these achievements represent a strong motivation for SMEs to patent their inventions. However, the assessment of the impact of patents on SMEs innovation is a complex issue which generally, entails the dilemma whether the patent protection stimulates or limits their innovation. The answer to this question imposes the need of analyzing a number of factors that determine the attitude, strategy and activities of SMEs with respect to patenting.

The patent represents a legal instrument which provides protection of value appropriation from intangible assets and enables temporary monopoly of knowledge exploitation[1]. The main motivation of the companies to patent their inventions is prevention and protection from copying or imitation which grant companies to gain competitive advantage on the market and realization of monopoly profit [5]. According to Huges and Mina (2010) this function of patents represents a significant incentive for innovations. However, since the patents provide monopolistic rights to the owner and cause the prices of products to be set up on higher level, the effects of protecting innovation for the companies and the society are contradictory. Economists are then left to adjudicate as to the desirability of using IPR as a spur to innovation, given that it acts as an instigator of monopolistic inefficiency [6].

A number of analyses corroborate the association between the firms' innovation and patent activity emphasizing that patents represents a reflection of firms' innovation processes and a direct measure of their innovation output [7,8,9]. According to some findings, the patents are strong impulse for development of the innovation, i.e. "the benefits of patent protection are visible immediately in the form of enhanced research and development spending, cutting-edge technologies, and new products on market" [10].

Mazzoleni and Nelson (1998) identify four theoretical concepts that encompass various aspects of a patent impact on the innovation:

- 'invention motivation' theory according to which patents might represent an incentive for useful inventions;
- 'induce commercialization' theory based on the views that the patent protection of inventions induces a need for additional investment for development and commercialization of inventions;
- 'information disclosure' theory according to which patents are society's award to individuals who disclose their inventions;
- 'exploration control' theory which is founded on the belief that initial invention opens up many different perspectives for the following discoveries and inventions [11].

Galasso and Schankerman [9] develop a model which helps them to show that loosing the patent protection has disincentive impact on the innovation particularly in the case of core technology which serves as a basis for further innovation. In this context, they find out that losing a patent causes a large reduction in the level of innovation by small firms, but no significant effect for large firms.

The firms' patent propensity is to great extent determined by specifics, intensity and scale of innovation activities in different industries. Firm level studies confirm the high inter-industry variability in the propensity to patent [5, 12, 13, 14, 15]. The analyses show that small and medium sized enterprises (SMEs) in high technology sectors

[1]According to European Patent Office (EPO) the patent is defined as "a legal title granting its holder the right to prevent third parties from commercially exploiting an invention without authorization".

(biotechnology, pharmaceutics, semiconductors) carry out greater and more intensive innovation activities due to which a higher patent propensity has been noticed, i.e. SMEs are highly patent-intensive [16]. However, besides the fact that the patent propensity in these industries is relatively higher, some studies point out that patent activity does not always yield the expected effects. For instance, the research of Hall and Ziedonis in the field of semiconductors industry shows that "patents were among the least effective mechanisms for appropriating returns to R&D investments". However, in this industry in the same time it has been noticed that "the propensity of firms to patent has also risen", which they qualify as a "patent paradox" [15].

In addition to the high inter-industry variability of the patent propensity, differences in the choice of the means of appropriation have been noticed. Hence, in some industries (particularly in creative industries and IT sector) the existing patent metrics points out lower patent propensity of innovation, while greater propensity toward utilizing other forms for intellectual rights protection. In particular, measures for these industries should adequately consider trademarks and copyright, but also confidentiality agreements, semi-formal methods and "soft" strategies (i.e. secrecy and trust), which are the protection mechanisms most widely employed by SMEs [16]. Having in mind the fact that firms can use various protection mechanisms at the same time, it imposes a logical question whether they are utilized as substitutes or complements. In this context, some empirical evidence confirms the existence of complementarities in application of protection mechanisms. For example, the research of Schwiebacher and Müller for the German companies shows a complementary relationship between patent and trademark protection [17]. In addition, Graham and Somaya use litigation data on patents, copyrights, and trademarks to study the concurrent and overlapping IP protections used by software firms and conclude that there exists some prima facie evidence for complementarity in IP use [18].

In contrast, some analyses show substitutability in the application of protection methods. According to Png, in practice, particularly in the phase of invention exploitation, an alternative use of patents and secrecies has often been noticed, i.e. he emphasizes that "at the exploitation stage, patents and secrecy can only be substitutes, and stronger protection of trade secrets may lead businesses to switch from patents to secrecy (substitution effect)" [19].

Generally, the theoretical and empirical studies confirm that complementarities are obvious among patents and other mechanisms of formal intellectual property protection (trademarks and copyright), while substitutability is manifested among the informal mechanisms, i.e. when choosing between patents and secrecies. In this context, an important determinant is a firm size. Namely, the financial impediments faced by SMEs such as high costs for patenting often represent a limiting factor with respect to the patenting decision and force companies to use the informal protection, particularly secrecies.

The type and characteristics of innovation have also a strong impact on the patenting decision. Hence, according to Anton and Yao a higher patent propensity of smaller innovation has been detected because the competing companies in this case are not interested for imitation and abuse of patent rights as well as facing a risk of litigation and damage compensation. However, in the case of radical innovation there is a possibility to be protected by secrecy especially when property rights are weak [20, 4]. The literature on appropriation almost uniformly shows that patents have low effectiveness in protecting new products and processes [21]. Contrarily to these findings, the research of Hall et al. carried out in UK show that firms that have product innovation which are new on the market are characterized with higher patent propensity compared to firms that have process innovation. In other words, "product innovations that are generally novel are more likely to be based on a patentable invention and that process inventions are easier to keep secret and therefore less likely to be patented" [22].

3. Factors affecting SMEs patent activities

The patent activities of SMEs have to be analyzed in the context of a complex interaction among various factors. With respect to this, we focus our analysis primarily on the following factors: the available resources of SMEs, the strategies for innovation and IPR development and, the impact of policy measures (Figure 1.).

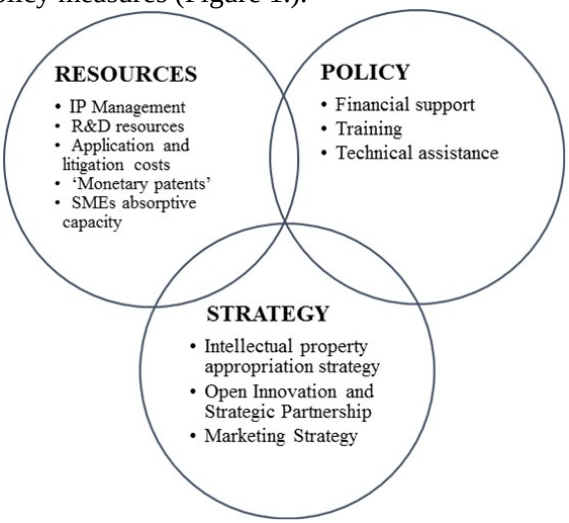

Figure 1. The factors affecting SMEs patent activities

In what follows, we describe the role of each factor that affects the patent activities in SMEs.

3.1. Resources

The available managerial resources represent an important factor for patent propensity of SMEs innovation. Namely, managers make a number of strategic choices when trying to capture returns from innovation investments, including what appropriation strategy to use and whether or not to patent [23]. Furthermore, the IP management encompasses a monitoring and enforcement of the intellectual property rights, as well as the capabilities for commercialization of inventions, it's licensing and making other contract arrangements that arise from IPR. However, the analyses show that SMEs do not possess the necessary managerial resources for efficient and full use of the IP potentials. For example, the analyses related to factors affecting IP protection by SMEs in Australia indicate the existence of two key limitations: first, SMEs are not necessarily well versed in how to manage IP as part of their business; and, second, IP is often not integrated into the overall business plans of SMEs [24]. Most of the SMEs do not have IP managers, which is a reason for their managers, besides other activities to carry out those which are related to IP. In addition, the efficient IP management requires skills and knowledge from different areas (legal, technological, commercial etc.) which SMEs cannot fully provide from their own resources. Therefore, it can be concluded that poor IP management skills within SMEs reduce their ability to fully benefit from the system and therefore, discourage its future use [25].

In addition, for SMEs is particularly important to develop abilities for efficient use of innovation potentials that contain the patent information. Namely, the patent information is mainly relevant with respect to detection of the existing level of innovation performances of the competing firms and achieved technological progress. At the same time, they can represent an important impulse and motivation for enhancing own inventiveness. The evidence shows that their usage is largely unexplored and under-utilized by SMEs. The existing empirical studies identify several reasons for insufficient utilization of patent information by SMEs such as: a lack of skills for carrying out a patent research, lack of awareness about the significance and size of information that contain the patent documents, high costs and unclear procedures [26,27].

The available financial resources are often emphasized as one of the key determinants for innovation and patenting. Generally, SMEs register smaller patent activity compared to big companies due to their financial constraints. The recent analyses confirm that innovation process is associated with costs arising a) at the invention stage, in terms of R&D expenditures for personnel and equipment, b) at the patent process stage for patent application, translation, renewal or lawyer fees and c) at the diffusion stage, when it comes to being target of opposition or litigation or defending an infringed patent as well as commercializing a patent [2].

Many SMEs consider that costs for property protection often exceed the prospective benefits from the protection. In this context, several analyses illustrate that SMEs do not always have capabilities for successful commercialization of patents, i.e. transformation of inventions into successful competitive advantage [28]. The experience shows that only small number of patents have significant value, while most of them have little value or do not have value at all. As a result, most patents are allowed to expire long before their statutory maximum life time, simply because their holders consider the renewal fees too high compared to the value of the patent [29]. Besides this, an additional burden for SMEs is the fact that most of the costs arise before the products reach markets or before gathering revenues and profit.

In addition, SMEs face costs for patent litigation due to violation of the intellectual property rights. In this context, "litigation and enforcement are broadly perceived by SMEs to be complex, costly and time consuming, often discouraging IPR defence, or even application for formal IPRs in the first place" [16]. For example, several studies in the EU confirm that litigation for patent protection is generally expensive process particularly for SMEs and individual entrepreneurs [29].

However, contrarily to the findings that financial limitations impede the patenting and development of innovative projects, there are stances according to which patents represent a way for overcoming and resolving financial limitations. Namely, they can provide additional financial resources for further development of innovation by attracting investors or generating revenues from licensing agreements. These patents where monetary motives have the primary importance in providing financial resources for SMEs are known as 'monetary patents' [30]. According to this view, SMEs have higher percentage of licensing the patent portfolio compared to big companies, among which almost one half of SMEs patent their inventions due to monetary reasons. According to De Rassenfosses "patents materialize the value of knowledge stock: they codify the knowledge and make it tradable, such that they can be used as collaterals" [30]. The patents ease the access to markets for venture capital for financially constrained innovators, especially small and young firms for whom information asymmetries are severe

and patents may be their primary guarantee asset [9]. They have an important role on valuing the firm and possibilities for its growth which represents a positive signal for potential investors and ease the access to the market of entrepreneurial capital. Furthermore, they also affect the nature of competition in the markets and represent an important incentive for undertaking new initiatives in circumstances of strong competition.

3.2 Strategy

Many of the previously elaborated limitations that face SMEs can be overcome or reduced by applying strategies for open innovation. The open innovation enables strengthening of the SMEs' innovation and competitiveness through cooperation with other firms and achieving synergy effects from integration of complementary skills, knowledge and technologies [31, 32]. SMEs and bigger firms alike benefit from flows of know-how resulting from formal and informal interactions, which can accelerate product development, improve the innovation process, and hasten the commercialization of new solutions. Successful collaborative, or 'open', innovation is underpinned by judicious management of IP to prevent unanticipated free-riding by partners or potential rivals [31]. As a consequence, the implementation of the open innovation concept assumes that patenting is perceived not only as a companies' defense mechanism which excludes the partners from the innovation process. Namely, the usage of agreements and partnerships in the research activities provides clear allocation of the ownership and property rights and their protection. In addition, they facilitate knowledge sharing, as partners are more willing to enter into cross-license deals and exchange their inventions with those of partnering companies [33]. Therefore, the intellectual property rights in the context of the open innovation concept can be qualified as new opportunities, advantages and options for companies in the domain of innovation development.

Additionally, for successful usage of the IP advantages, it is necessary that SMEs design appropriate marketing strategies. The intellectual property in combination with a marketing strategy enables differentiation of the company's products from those of the competition. At the same time, it eases the commercialization process of the patented products and informs clients with its specific advantages and characteristics.

3.3 Policy

The policies focused on promoting innovation and wider utilization of IPR represents an important factor for increasing patent propensity of SMEs. In order to strengthen the SMEs' capacities for efficient use of the IP system, governments apply measures that include assigning direct financial support for submitting patent application. In addition, the various types of financial stimulations intended for improving R&D can exert positive implications on the patenting. For example, the experience from Norway confirms that R&D tax credit scheme and direct R&D subsidies have positive and highly significant effects on patenting in SMEs [34].

Besides the financial support which is a common practice for many countries, the support that governments provide for SMEs encompass measures related to: awareness-raising and training on IP; technological in formation services; customized advisory services on IP; assistance for IP exploitation and technology transfer etc. [24]. For instance, the practice in Japan shows an obvious application of a wide spectrum of measures aiming to introduce and implement IPR strategies in SMEs. The support is focused on the SMEs' activities in the domain of IPR and is related to the following issues: (i) fostering human resources and consultation such as: IP system seminars, consultations related to the IP, help points for IP etc.; (ii) support related to the patent application and such as: application advisors, grants for foreign patent applications, survey of patent application trends and etc.; (iii) support aimed at request for examination, examination, appeals and registration such as: support related to examination request fee, conducting examination, etc. and, (iv) support for exploitation of patents such as: patent distribution advisors, patent distribution databases, patent distribution seminars etc. [35]. Although the positive experience shows that policy measures can provide an important impulse for greater use of IPR in SMEs, these measures are still not represented at satisfactory level in the practice of many developing countries.

4. Innovation and patent propensity in Macedonia

In order to analyze the innovation propensity of SMEs in Macedonia we use results from a survey on innovative business entities carried out by the State Statistical Office during the period 2012-2014. In this context, innovative business entities are defined as companies that have introduced a product, process, organizational or marketing innovation during the reference period. The results are presented in Table 1.

Table 1. Innovation activities in Macedonia by company size, 2012-2014

Size	Total	Innovative		Non-innovative	
		Number	%	Number	%
Small	2333	774	33.2	1559	66.8
Medium	549	230	41.9	319	58.1
Large	115	75	65.2	40	34.8
Total	2997	1070	36.0	1919	64.0

Source: State Statistical Office, Republic of Macedonia

From Table 1. we can notice that only one third of small companies in Macedonia are innovative, while the share of innovators is greater among medium sized (41.9%) and large companies (65.2%). Although the innovation propensity of small companies is the lowest, there is an uneven distribution with respect to type of sector. Namely, in the sector of Information and communication technologies about 52.1% of small companies are innovators, while the share of medium sized innovative companies reaches 82.1%. This is an indicator that innovative SMEs dominate in IT related industries, while large companies represent a generator of innovation in more traditional industries such as: manufacturing, trade, transportation and storage. With respect to the barriers for introducing innovation, Macedonian companies in the first place state the lack of internal finance followed by insufficient credit and private equity, uncertain market demand, difficulties in obtaining government grants and subsidies for innovation, lack of collaboration partners and lack of skilled employees.

With respect to the patenting activities of companies, there is no disaggregated data by company size. Therefore, we analyze the general trend of granted patents according to the data from the State Office of Industrial Property (SOIP). The dynamics of granted patents during the period 1996-2014 is presented in Figure 2.

From Figure 2. we can notice that the number of granted patents in Macedonia generally demonstrates an increasing trend which has been temporarily interrupted in 2010 and 2013. During the period 2006-2010, the number of patent applications received by the State Office of Industrial Property reached 1,796. However, it has to be emphasized that the share of the resident patent applications is very low. Namely, almost 90 percent of the patent applications during this time period come from non-resident applicants. For instance, in 2011 only 37 out of 405 patent applications were filed by resident applicants, while 368 were foreign applications. The number of filed patent applications in 2011 compared to 2010 increased by 11.3 percent and this growth is due to the increased number of non-resident, while to lesser extent the increased number of resident applicants [36].

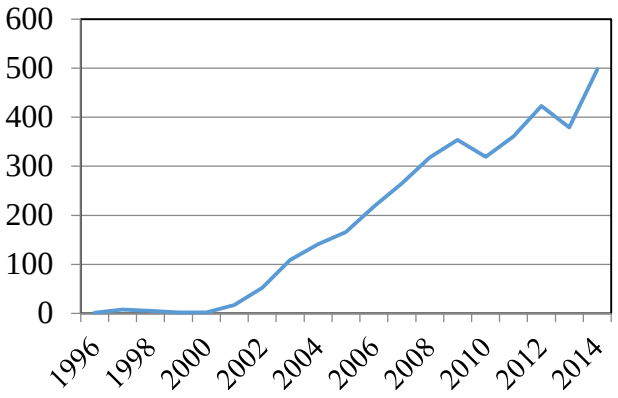

Figure 2. The number of granted patents in Macedonia Source: State Office of Industrial Property, Republic of Macedonia

During the period 2012-2016 an expansion in the number of patent applications is noticeable. This growth is generally a result of the increased number of applications submitted by non-residents, while the number of resident applicants marks decreasing trend. For instance, during this period only 156 applications out of 3034 have been submitted by resident applicants. The majority of these applications come from individuals, while only 11 come from SMEs and one university (Table 2.). In this context, it should be mentioned that most of the individual applicants are entrepreneurs who do not state the name of the legal entity in the application. However, the general perception is that the rate of patenting innovation by SMEs in Macedonia is extremely low. The main reasons for such situation are the following: Low innovation capacities of SMEs, lack of awareness about the importance of innovation for the competitiveness and growth of companies, insufficient knowledge of the benefits from protecting the IPR, lack of familiarity with the procedures of protecting the IPR, insufficient financial resources, lack of stimulation mechanisms by the governments for patenting the innovation.

Table 2. The number of patent applications in Macedonia, 2012-2016

Year	Total number of applications	Non-residents	Residents	
			Individuals	SMEs
2012	493	451	41	-
2013	541	501	38	2
2014	573	546	25	2
2015	719	691	26	2
2016	708	689	14	5

Source: State Office of Industrial Property, Republic of Macedonia

According to the World Economic Forum data, Macedonia is ranked on 68th place out of 138 countries in PCT patent applications per million people [37]. The number of patents in Macedonia is close to those observed in other countries in the Western Balkan region, but still low compared to other EU countries. Recent studies indicate that the Western Balkan countries have recorded very low levels of patent activities. Their technological effort at world frontier, as measured by the US patents, is extremely limited and measures around maximum 20 patents annually in Croatia, and around 10 in Serbia. In other countries, this type of effort is almost nonexistent [38]. An empirical research conducted by GfK in Macedonia which encompassed 492 companies shows that only 12 companies have patents registered with the State Office for Industrial Property, two companies registered patents with the United States Patent and Trademark Office and only one company registered a patent at the European Patent Office [39]. Having in mind that considerable number of patent grantees in Macedonia are individual inventors, we can assume that SMEs have still not recognized the role of patenting in the process of protecting the intellectual property.

5. Conclusion

The importance of innovation for the competitiveness of companies and for improving the macroeconomic performance in general has been widely acknowledged. However, the innovation process has been associated with the possibility that the market system guided by independent actions of companies will not lead to the optimal outcome, i.e. it will result in a market failure. According to the existing experience, there are various policy options for solving the above mentioned problem of under provision of innovation, among which the most prominent is definition of property rights. In this paper we focus on a patent as a particular form of protecting the IPR and we provide analysis of factors affecting the patent propensity of SMEs.

Among the potential factors as most relevant we identify the available resources of SMEs, the strategies for innovation and, the impact of policy measures. The analysis shows that the type of industry and the competition relationships on the market represent significant determinants of SMEs' patent propensity. In the process of identification of the SMEs' patent propensity also encompassed the effects arising from firms' characteristics, the available resources and their strategic directions, as well as the impact of policy measures on improving the IPR. The analysis of the factors that influence the SMEs' patent propensity generally enables identification of the weaknesses and barriers in the domain of IPR protection that face SMEs. This is the basis for determining the areas for policy intervention and creation of stimulating environment for enhancing the SMEs interest for patenting of innovation. In addition, they enable SMEs to identify its strategic activities in direction of strengthening own capacities for greater use of patents as one of the options for protecting the intellectual property rights.

The empirical findings in the case of Macedonia show that the rate of patenting innovation by SMEs is extremely low. Namely, the majority of patent applications are submitted by non-residents or individuals. In addition, we identify several reasons for low patent propensity such as: Low innovation capacities of SMEs, lack of awareness about the importance of innovation for the competitiveness and growth of companies, insufficient knowledge of the benefits from protecting the property rights, lack of familiarity with the procedures of protecting the property rights, insufficient financial resources, lack of stimulation mechanisms by the governments for patenting the innovation.

Taking into account the above findings we formulate several policy recommendations aiming to improve the patent propensity of SMEs in Macedonia. First, the direct measures should target the managers of the companies and other stakeholders in order to improve their awareness about the advantages of patenting innovations and/or education about the administrative procedures for patenting. In addition, the subsidies for companies in the process of application for patents can be used as an incentive for increased usage of patents. Second, the indirect measures should be focused on increasing the innovation capacities of companies that would eventually engender the need for using the mechanisms for protecting the IPR. In order to be effective these measures have to become a part of the national innovation system that will further increase the benefits from IPR.

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