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DEPARTMENT OF ECONOMICS

Economics of Intellectual Property

The impact greater patent grants and patent protection strength has on development
(1998-2011)

By

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DECLARATION

I declare that *Economics of Intellectual Property, How beneficial are stronger patent rights to developing countries, South African case*, is my own work, that it has not been submitted for any degree or examination in any university, and that all the sources that I have used or quoted have been indicated and acknowledged by complete references.

Jason Powell

Signature:

Date: 24 November 2014

ABSTRACT

The importance of intellectual property (IP) in the global economy has increase tremendously since the 1990's, with the development of trade related IP protection laws. The increased importance of intellectual property has led to the purpose of this study, which analyses the impacts felt by developed and developing countries. Due to the improvement in protection of patents as well as the increase patent grants has on economic and human development. The study uses composite indices to measure the impacts of patents against development. Across a range of countries which envisage, the main parts of the developed and emerging economies.

KEYWORDS: Intellectual Property Rights (IPR), patents, copyright, Foreign Direct Investment (FDI), innovation, South Africa, World Intellectual Property Organisation (WIPO)

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LIST OF ABBREVIATIONS

HDI	Human Development Index
IP	Intellectual property
IPR's	Intellectual property rights
NPS	New Patent Strength
OECD	Organisation for Economic Co-operation Development
OLS	Ordinary least squares
WIPO	World Intellectual Property Organisation.

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CHAPTER ONE: INTRODUCTION

1.1 Statement of the problem

When asked the question, “How much would you pay to know something?” Would the value of the information be worth more if you are told it was something that could earn you lots of money, or if it is incriminating information? How would you place a value on this piece of information? How would the seller know if his getting a good deal or not? When an inventor sells his creation to a production company, who knows if the product will succeed and what the rate of success would be. This makes the valuation of knowledge a challenging matter, and the wealth of knowledge an interesting subject matter for investigation.

This develops the importance which has been acknowledged by Stiglitz (2008: 1695) that the new economy is one which has knowledge at its centre. This accumulation of knowledge is said to be the new method of wealth accumulation. He emphasises that the beneficiaries of this new knowledge economy, depends on how the production of knowledge is protected and regulated.

It is also addressed in many literatures and by the WIPO (2008:164) that many countries especially developing nations are finding intellectual property to be of greater value to society in recent times. The WIPO (2008:164) continue to state that developed countries have used this tool of improving the IPR's in their country for social and economic development.

We then get contrasting literature by Nicholson (2006:318) who state that most developing countries particularly countries in Africa are net importers of intellectual property. These African countries stand to face more hurdles in trying to educate people as copyright laws become stricter, through restricting the access to information. Nicholson (2006:321) goes on to state that developed countries were given unrestricted time frames and space to reach their levels of development, the African countries should be given the same courtesy. African countries should therefore work together to create a copyright solution that can work specifically in Africa.

It is noted by Attaran and Gillespie-White (2001: 1887) that South Africa is an exception to the rest of Africa with reference to patents and performs significantly better than most of the other African countries.

The facts presented by Nicholson (2006), raise the issue this research looks to address, are developed countries feeling greater impacts than developing countries and by how much are the developed countries outperforming the developing countries?

However research notes that the economics of intellectual property is a field of economics which has not received the attention in theory, given its importance shown in empirical studies. It has been said by many authors, including, Gogan (2014:194) that intellectual property has had an increasingly important role in valuations of companies as well as linked to economic development.

Most studies have been done on developed countries in terms of accessing the economic benefits received from holding IPR's especially the United States of America. Developing countries have not received much attention for research with regard to the economic benefits received from IPR's. This is backed up by, Kaplan (2009:1) who says, that minimal research has been done in South Africa to assess the economic influence of the strong IPR's.

The importance of knowledge has increased as time has moved on towards the information age. The valuation of this form of wealth is crucial to the fair compensation for the creator, as the importance of this wealth has increased in significance in recent years.

Moser (2003: 1) raises the point that developed countries are the driving force behind, lobbying for patent laws to be introduced in developing countries where they might not exist currently or the patent expire quickly. We can therefore expect the developed countries to find much more benefit associated with intellectual property just based on the structures established already.

1.2 Objectives of the study

The problem the research looks to address is: are there human and economic development benefits to the strengthening of IP and the increasing of the number of patent grants? The research solves two problems by assessing the impact of stronger IPRS and greater values of patent grants, with real GDP and the HDI index. This being a research focused on development economics, these two development indicators are used.

The research hopes to prove, that stronger patent laws encourages innovation and has economic benefits in developed countries and not in developing countries, or less prominent in developing countries. The usefulness of this is that we can see the harm that IPR's will have on developing countries, when they are meant to stimulate development.

1.3 Structure of Paper

The research paper consists of five chapters. Chapter one presents a statement of the problem and raises the research question of what impact greater patent grants and stronger patent laws would have on economic development between developed and developing countries. It concludes by giving the research structure.

Chapter 2 is the review of the literature of intellectual property. This provides a background to the study and a feel to what is happening in the world of intellectual property. In this chapter I explain the concept of IP and how it can be a form of economics. I list the different types of IP and then state their importance in different facets of life, including the benefits to financial capital as well as social capital.

Chapter 3 provides the methodology the research uses for analysis and explains each variable with its association to the study. Chapter 4 presents the results and graphs, with chapter 5 concluding the research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter is constructed in a way to help the understanding of the theoretical outlook of intellectual property and how it is linked to economics. With reference to the topic linking economics and intellectual property there is not much literature available on that exact relationship, but when we deconstruct the topic we find topics which have been researched thoroughly. This is why it is crucial to have a broad understanding of the topic of intellectual property before trying to make an analysis with reference to its benefits or costs to economic development.

This chapter follows a structure of firstly explaining the concept of intellectual property, then the fields of IP protection, the research then deconstructs the economics of intellectual property. Breaking it down to the aspects of human capital theory, the link IP has with FDI and trade and finally the impact IP has on development.

2.2 Concept of Intellectual Property

The term intellectual property is given a generic definition by Rockman (2004: 4) and Gogan & Draghici (2013:868) describing any property rights which are intangible. These are usually assets we cannot see or touch, as a person uses their personal capacity and knowledge to develop something which provides the creator exclusive control over the reproduction of the creation. Rockman (Ibid) continues to state that intellectual property law is an aspect of the law, which provides protection for these creations. The organisation at the forefront of this is the World Intellectual Property Organisation (WIPO).

The WIPO (WIPO, 2008: 4) became a specialised agency of the UN in 1974; this organisation however had been established in Stockholm four years prior to joining the UN as a specialised agent. The convention which established the WIPO was signed in 1967 and was enforced from 1970 onwards.

Intellectual property dates back even further than this, as it is stated by the WIPO (2008:4) that its origin dates back to 1883 and 1886 when the Paris Convention which had its focus on the protection of industrial property and the Berne Convention which focused on the protection of literary and artistic works.

These conventions lead to the establishment of international secretariats, with supervision placed under the Swiss Federal Government. The name used most currently previous to WIPO was the French acronym BIRPI which translates to the United International Bureaux for the Protection of Intellectual Property.

The establishment of the WIPO and its role as a UN specialised agent, (WIPO, 2008: 5) for the purpose of enforcing the correct treaties and agreements for the promotion of creative intellectual activity and to ease the distribution of technology linked to industrial property to developing countries, with the goal of achieving development in a social, economic and cultural manner, this is documented by Bloom and Van Reenen (2002:97)

The authors elaborate that, these goals are achieved through the protection of IP, as will be discussed in detail later in this chapter, the protection of Intellectual Property, stimulates innovation, which is a key driver for the creation of monopolies, which have large economic benefits to the creator. These statements are backed up by authors such as Gould & Gruben (1996: 324) and Kansa, Schultz & Bissell (2005: 287), who go on to say that the owner of the property rights are provided with the ability to set the limitation of use of their creation.

The negative side to this is addressed by Kansa, Schultz and Bissell (2005: 288) that people are not always correctly rewarded for their intellectual creations, this can occur through the replication of the work without the correct permission. This has led to the rising cost in the subscription to scientific journals and the increase text books prices experienced between 2000 and 2005 as documented by Kansa, Schultz and Bissell, (Ibid). This is the reason for the protection of all forms of intellectual property, as different types of intellectual property are governed by different laws.

The WIPO (2008: 15) lists the different fields of intellectual property as follows, patents, copyrights, trademarks, industrial design and trade secrets.

2.3 Fields of IP Protection

2.3.1 Patents

A product which is patentable is defined by Yang and Kwon (2013: 207) as any invention in the field related to technology given, they involve, and inventive step which can be applicable to industrial application of a product or process. This definition is supported by that of the WIPO (2008: 17), who define a patent to be a document issued for the exclusive exploitation of this product or process by its creator.

The WIPO (2008:17) also note that patents can be referred to as monopolies as will be elaborated in the research, but the form of monopolies is slightly different as they explain, the patent provides the right to exclude the exploitation and use of the patent by others, but does not give the creator the right to practice non-competitive strategies, which is discussed in the intellectual property and innovation section.

Moser (2003:1) notes that patent laws are conceptualised to stimulate innovation, by creating the optimal incentive, which ties in with the WIPO's reward of monopoly creation. The extent to which a monopoly is provided depends on the origin of the invention.

According to Kanwar and Evenson (2008: 52) in different countries patents are treated differently, with respect to many important factors. These factors include, the patent coverage, the length of the patent, the different memberships that countries would belong to with reference to patent agreements, the strength of enforcement also varied considerably between countries and the conditions for revoking of a patent also varies amongst countries.

In South Africa a patent is defined by the Government Communications (2013) as the exclusive protection of an invention. This invention needs to create a dynamic answer to a problem, and by doing this, permission for 20 years will be granted. This which is issued by the government of South Africa is known as a patent grant and is used as one of the variables in the regression of this research.

Patents are found mostly in the pharmaceutical and food industry as Kaplan, Ritz Vitello & Wirtz (2012: 212) note. They continue to emphasise patents importance in pharmaceuticals by stating the competition faced by products from branded companies against the products created by generic companies.

The reduction in the cost of pharmaceutical products is a possibility as noted by Aronsson, Bergman & Rudholm (2001: 425) but only if greater competition is created through the regulations set aside by the government.

The fact that South Africa is different to the rest of Africa with reference to patent protection is explained by Attaran, Phil & Gillespie-White (2001:1887) who present that the number of patents in the rest of Africa with the exception of South Africa, would lie between 3 to 4 patents out of 15 per country when compared to South Africa with 12 out of the 15. The situation in South Africa differs from many of the rest of the African countries, to the point that South Africa is seen as the clear leader in IP related issues on the continent, (Attaran, Phil & Gillespie – White, 2001:1886).

Research states that (Attaran, 2004:159) patents cannot be the cause of the restriction to access of essential medicines in developing countries; this is because they do not exist 98.6% of the time. Therefore the researcher goes on to say that with such a little revenue at stake most pharmaceutical companies decide to ignore patent protection in developing countries.

2.3.2 **Copyright**

It is stated by Oppenheim (2001:18) that development in the electronic information industry would not be possible without copyright protection. This is because of the fact addressed by Cornish (2004:1) that anything we create is an extension of our-selves. He then states further that copyright is important in the effort to ensure the constant growth in writing, performing and creating.

This links in with the definition of copyrights by the WIPO (2008:40) which states that copyright law protects creativity involved with mass communication, with Von Seidel(1998:74) listing the areas of copyright protection as literary works, computer programs and software, artistic works and musical works which included cinematographic films and radio and television broadcasts. Examples would be the copyright protection issued to a researcher/ author of a journal article or the sound clip produced by a musician.

It is stated by Cornish (2004:2) that libraries find themselves in a unique and important position with regard to copyright. The libraries are the custodians of the copyright law as

most of the works are stored in libraries; their job is to protect the interest of the creator without abuse of the copyright product.

Cornish (2004:6) as well as the WIPO (2008: 42) list four qualifying aspects to achieve copyright protection. These three characteristics are explained by Von Seidel (1998:75). The work must be original, meaning the creator could not imitate any part of the creation from elsewhere. The second characteristic is that the work needs to be in a material form, either a recording or document, which means the copyright, cannot protect an idea. The third characteristic explained by von Seidel (Ibid) is a qualified person, which states that the creator be a resident of the country in which the copyright will be registered too. The final characteristic for achieving copyright protection is the international co-operation, which involves the signing of international treaties, this is not necessary if protection is only required in a domestic setting.

Von Seidel (1998:77) addresses the fact that the different types of copyrights have different term structures with reference to the length of protection, but the average years of protection for most copyrights as Oppenheim (2001:31) notes that the Berne Convention requires a minimum of 50 years.

This protection of IP as addressed by the WIPO (2008:213) is of great importance because of the increase in worldwide trade with regards to products embodying protected intellectual property rights. This increase in trade coupled with the large advancements in technology, have been the reasons for large improvements in the enforcement of IPRS especially copyrights.

Copyright varies from other forms of IP protection as von Seidel (1998: 73) states that copyrights do not have to be registered as they exist automatically.

2.3.3 **Trademark**

The WIPO (2008: 68) defines trademarks as a sign of individualisation of a good, which distinguishes it significantly from competitor's goods. They continue to state that trademarks have been around for as long as 3000 years, as Indian craftsman would sign their names into their products. The WIPO states (2008:67) that the economic influence back then was limited but had increased significantly during the industrialisation era.

The WIPO (2008: 71) stipulate that a trademark, needs only meet two requirements and coverage is pretty standardised around the world. The first requirement is to distinguish the product from one producer to another and the second, that the patent should not have misleading images in the eye of the public.

The function of a trademark are explained by Hart, Fazzani & Clark (2006: 82) having the main function of one firms goods from another firms goods. This enables consumers to distinguish a distinct difference between similar products. The aauthors continue to state, which is supported by Blanco White and Jacob (1986: 13) that a good trademark is valuable to the tools for the owner as it provides a key selling mechanism for the product.

It is noted by Hart et el (2006: 83) that good trademarks can be used to promote the sale of a new product line, which has been associated with a trademark which has been successful.

2.4 The Economics of Intellectual Property

2.4.1 Intellectual property as an economics

Stiglitz (2008: 1695) accentuates that globalisation's importance has increased to being one of the most important factors in today's world. This statement on the increasing importance of intellectual property is backed up in many literature including, Gogan(2014), Gogan & Draghici, Gould & Gruben (1996), Chu, Cozzi & Galli (2012) and Rey & Salant (2012). Stiglitz(Ibid) continues by stating that the role of intellectual property in globalisation is a key determinant as the world moves towards the new knowledge economy.

The economics of knowledge and intellectual property must be understood to still have economics at the core of it. Therefore it looks at the basics of economics as explained by Mc Connell and Brue(1999: 31) to be analysing impacts of policies created to influence consumer choices, based on a simple cost- benefits analysis. These consumers firstly require the foregoing of another good which is the opportunity cost, with the ultimate goal of achieving some form of benefit from the choice they had made.

When making this economic decision, of what will be your opportunity cost, it is essential to know the type of goods you are dealing with. This is due to different goods being treated differently among consumers, based on the characteristics of the good and consumer behaviour theory.

Knowledge, which is explained in Chapter 1 to form part of intellectual property, finds itself being best explained by the characteristics of a public good. This was documented by Stiglitz(2008: 1699), who describes knowledge as non-rival in consumption, because the knowledge I have taken from him and reproduced in this paper has not been taken away from the knowledge that he has and can be consumed con-currently around the world. Therefore everyone can use this good and at numerous times too. The non-excludability aspect of this public good is empirically explained in the section, problems in measuring IP.

We now find ourselves in a position to state the opportunity costs and the benefits linked to intellectual property. With regard to opportunity cost, Gould and Gruben (1996: 325) list the two options available. The one is a strong patent protection system and the other is a weak patent protection system. Both systems have their advantages and disadvantages, which work differently for developed and developing countries, (Stiglitz: 1719) but tends to have greater benefits for the developed world.

The main benefit of intellectual property protection is defined by many economists such as Stiglitz (2008: 1696) to increase the initiative to innovate, through the restriction of information, which creates an information monopoly. Through the sale of the knowledge the creator, is then able to acknowledge a return on investment. Information monopolies increase the initiative to innovate, due to numerous benefits of this form of competition, to the owner of the IPR. The inflows received from the sale of knowledge, is viewed as the return on investment.

The return on investment is linked to the prize system, which was employed many years ago, during the operation of The Royal Society of Arts and Technology, was still present. The prize system awarded a prize normally monetary prize to anyone who shows distinct innovation. Siglitz (2008: 1719) states the size of the prize is linked to the magnitude of the contribution. The magnitude of the contribution is in a direct link to the level of human capital available. As is explained human capital and intellectual property are not the same thing, but the one is a result of the other.

These benefits received from the protection of intellectual property, tend to be the cause of the problems we find in intellectual property. This can be seen for each of the benefits listed above.

The first problem with intellectual property is the measurement in the value of the asset as documented by OECD, (2010: 13). When measuring an intellectual asset: an intellectual asset is valued at the benefit accrued to the owner of the property. This is challenging in the respect as to how to assign the potential of a product before it is released, which is compounded with the effect of benefit to be received over many years.

The second challenge has to do with the assigning of property. Stiglitz (2008: 1703) explains real property to be defined by exact geographical boundaries and the specification if the protection extends to mineral as well as air rights. The main feature of real property is it is easy to define. When Stiglitz (Ibid) turns his attention to intellectual property, he and others like him struggle to establish the natural boundaries which are found in real property. The question put fourth was does the patent cover the entire product, or just the operation of that product in a particular way.

The problem which is raised when looking at the monopolistic competition, which is formed due to the issue of IPR, is addressed below, in detail, in the following section.

2.4.2 Intellectual Property and Innovation

The protection of intellectual property is linked to the effort of innovating. This has been documented by Stiglitz(2008), Gould & Gruben (1996) and many other researchers. There are two sides to the intellectual property coin, either strong protection or weak protection, we have to look at the benefits and costs of both situations, with reference to innovation. We are looking at the rate of innovation and as the strength of IP protection will explain, the level of monopolistic power issued has an influence on the level of innovation as well. It is documented by Braga and Willmore (1991: 425) that there is a tendency for the protecting of intellectual property, which does not increase innovation, due to the nature of competition.

We have to analyse the impact which would occur under the two different extremes of IP protection. The research firstly looks at the situation which would suit a situation of weak protection and then the situation of strong protection. We assess the need for weak and strong intellectual property systems, in light of the statement by Gould and Gruben (1996: 324) that the reproduction of technology is much more profitable, due to the cost effectiveness of imitation, when looking at a closed regime.

Weak protection of intellectual property is said to be pursued for two reasons, (Gruben & Gould, 1996: 325) the one being the access to free information which you would normally have to pay for and the second, is the monopolistic power which is associated with strong protection. These authors claim that monopolies have incentives to accumulate patents as a way of prohibiting entry into an industry. They continue by emphasising that the formation of monopolies have severe implications on the developing world.

When looking at the structure of developing countries IPRS systems, (Maskus, 2000:6) it is seen to resemble information which is imitated from foreign producers. This leads the author to believe that incentive for innovation in developing countries is low due to the lack in protection.

Developing countries tend to have IPRS systems that favor information diffusion through low-cost imitation of foreign products and technologies. This policy stance suggests that prospects for domestic invention and innovation are insufficiently developed to warrant protection

An extreme example is provided by Chin and Grossman (1990: 91), which supposes a country to not have any ability to conduct research and development, would also have no encouragement to protect for IP laws. The consumers in these countries now cannot purchase products due to the fear of imitations that occur due to the lack of IP protection.

These implications are explained in the empirical studies on antiretroviral drugs in Africa and the battle of a South African AIDS activist.

The fact that stronger intellectual property laws leads to a stimulation of innovation, has been researched by Mansfield(1986: 180) to be apparent in the United States. On another study conducted by Lee and Mansfield (1996:185) they found that United States firms specifically in the pharmaceutical and chemical industries, would limit the foreign direct investment to countries which have weak intellectual property laws. This problem is highlighted by Gould and Gruben (1996: 327) who state that as a country with weak IP protection, this will affect the ability all firms in the country to purchase technology, even when the firms are willing to pay for the technology. We see the exclusion then of the developing countries from international trade, this is highlighted in the section on TRIPS.

It is stated by Gould and Gruben, (1996: 329) that we tend to see stronger intellectual property rights in countries which are more developed. This is to be expected. The authors

continue to state, that most countries which have greater levels of development generally are more likely to have free trade agreements. The link between FDI and trade are explained by Aizenman and Noy (2006: 320) to be a two way linkage, below is explained what happens when intellectual property is one of the factors determining the level of FDI and trade.

2.4.3 **Link between FDI, Trade and Intellectual property**

Gould and Gruben (1996: 329) make a firm statement, stating that the protection of intellectual property rights definitely has positive effects on economic growth for those countries, which have a comparative advantage in sectors which require many patents, such as high technology sector. Countries who have a disadvantage in high technology production, would find the effect on economic growth to be less important.

As the extreme example of Chin and Grossman (1990:91) & Gould and Gruben (1996: 327) point out countries which are strong in intellectual property protection, which tend to be net innovating countries, could engage in spiteful decision making against these countries with reference to trade and foreign aid.

It is documented by Gould and Gruben (1996: 324) that open trade systems are more likely to illustrate strong links between intellectual property and innovation. This strong link is due to the fact that in an open market, a local firm is more likely to face competition from foreign producers not only in the products produced, but in the processes used to produce those products.

These authors continue by stating that countries which exhibit strong IP protection schemes, will have the advantage of receiving all the licenses from innovative firms. This is because, the firms are not afraid to issue the patents to these countries as they are confident in the enforcement agency. It was found in the study conducted by Gould and Gruben (1996:324) that there is a positive link between, strong IP enforcement and FDI, with specific reference to the research and development facilities.

In a study conducted by Glass and Saggi (2002: 408), their results found that stronger IPR protection makes multinationals not much safer when comparing the northern to southern countries with reference to imitation. They continue to state that the increasing cost of strengthening IPR's in the south would lead to the focus of imitation success instead of

innovation. The authors as well as Smith (1999: 152) that imitation leads to lower FDI, due to the resources used up during the imitation process in the South, there are fewer resources available for innovation in the North and innovation also starts to decrease.

The author concludes by stating that trade liberalisation in conjunction with intellectual property protection, has a strong link to greater economic growth.

2.4.4 **Theory of Human Capital**

The theory provided on human capital is brief, due to the explanation provided in chapter 3 by Ul Haq on human development.

Competitiveness and economic growth is stated by Cadil, Petkovova & Blatna (2014: 86) to have been increasing in importance over the last 20 years. It is noted in Romer's 1986 study, that increasing returns and long run growth, as well as in Lucas's 1988 study on the mechanics of economic development, which fully incorporated the benefits of human capital to economic development.

These studies have proven that human capital is a key determinant for per capita income. Aghion and Howitt (1998: 30) stress the role of human capital as a factor for the promotion of greater investment in technology leading to economic growth.

Human capital's definition is stated by Black, Hashimzade, & Myles (2013) to be a collection of resources which includes, all the knowledge, talents, skills, abilities, experience, intelligence, training, judgment, and wisdom possessed individually and collectively by individuals in a population. These resources are the total capacity of the people who represent a form of wealth which can be directed to accomplish the goals of the nation or state or a portion thereof.

It can be seen with the association of the definition of intellectual property, that greater human capital would enable greater ability to achieve intellectual property assets. Therefore the assumption is made in literature by, Caddy (2000: 142), Pöyhönen & Smedlund (2004: 360) & Pedrini (2007: 356), that due to the increase in intellectual property assets due to human capital development, intellectual property protection increases when human capital increases.

CHAPTER THREE: METHODOLOGY AND DATA

3.1 Introduction

The methodology will follow two indices namely, the New Patent Strength (NPS) index and the Human Development Index (HDI). These two indices are used to try and spot if there is a relationship between the improvements of these indices and whether the explanatory variables have any significant influence. We expect to see the increase in the NPS as patents increase, in each country as well as the more developed countries to have a higher NPS index. We expect similar results with regard to the HDI index, because the greater the human development, the greater we would expect to see innovation and therefore a need for a strong NPS index, and an increasing level of patent grants.

The period of analysis is from 1998 until 2011, this is because the index was created for these years, and allows us a reference period of 13 years. This provides good data to observe trends if any have formed. This research focuses on 9 different countries, five of which are developed and four which are developing. These countries are namely, USA, Canada, Japan, Germany, France, Spain, Brazil, India, China and South Africa as the reference country.

The developing countries were selected based on their close association with South Africa, Brazil, India and China and the countries from the developed world, who have strong economies and are known for strong links in intellectual property.

The research uses a dated panel series for the data, as the data is covering a period of time from 1998 to 2011, as well as the range country variables which are dummies.

The structure of this chapter is as follows, the origin of the data used for these variables is provided to authenticate the research. Next, the variables of two indices and the other explanatory variables are explained and linked to the study. The limitations for the data are stated and the chapter concludes with the model used to determine the results.

3.2 Data Sources

The data in this research was accumulated from reliable sources to hold for authenticity of the study.

The NPS index which has been stated above to be from the study conducted by Papageorgiadis, Cross and Alexiou in 2013, was selected due to the article being published recently, as well as the association the study has with strongly accepted indexes in the field of intellectual property such as Ginarte and Park's IP strength index.

The HDI index has been sourced from the annually published Human Development Report dating from 2000 until 2013, because the HDI index is published two years in arrears. The HDI index will allow us to see if a relationship exists between patent strength and human development.

GDP per capita was sourced from the World Bank website. This will allow us to see the impact patent protection has on development of people with respect to income.

The number of patent grants was sourced from the WIPO data bank. This variable is used to see if more patents are granted when the protection in a country increases.

It is clear to see the data is sourced from highly reliable sources, which have regular publications; therefore, this will limit any bias of the results.

3.3 The Variables

3.3.1 The New Patent Strength Index

This index developed by, Papageorgiadis, Cross and Alexiou in their 2013 study called International patent system strength 1998-2011 is used in this research. The index is seen as a measure of the strength of patent protection in a country. The use of this index in the research is because it quantifies the additional aspects of the patent system of countries within which patent rights are granted, infringed and enforced. The index is calculated on the basis of the transactions costs theory. How the index is calculated and the data used is explained below.

The original article uses six secondary data sources which fit a certain criteria developing a method of quantifying the effects of the three transaction costs. This new criterion created a way of strengthening the reliability and authenticity of the new index. The criteria allows now for regular update of the index as the authors provide for an annual spread of the data from 1998 to 2011.

The criteria for the data sources are for the data to have a conceptual relevance to the theoretical framework, allowing to serve as an accurate proxy of the patent system and its related transaction cost. The next criteria needed to be met, was to increase the longitudinality¹ of the index, by having an early date for initial publication. The data sources needs to be collected and reported over an extended period of time, increasing the reliability as well as the strength of the new index. The last two criteria for the selection of the data sources are that it covers a large amount of countries which increases the applicability of the index and the data also needs to be readily available to replicate and update the index.

The six data sources found to meet all criteria include the International Country Risk Guide (ICRG) published by the Political Risk Services Group (PRS), the USTR Special 301 Report, the Global Competitiveness Report (GCR) of the World Economic Forum (WEF), the Corruption Perceptions Index (CPI) created by Transparency International, the data on piracy rates are issued and reported by the Business Software Alliance (BSA) and the final data source used it the World Competitiveness Yearbook (WCY) of the International Institute of Management Development (IMD).

The transaction costs are divided into three sub costs; namely the servicing cost measures, the property rights protection cost measures and the monitoring costs measures, with each of these sub costs having different components to the patent system. These are discussed below.

3.3.1.1 **The Servicing Costs Measures**

When monitoring the service cost we are basically developing the quality of IP administration. The study uses two variables as a proxy for this measurement.

Firstly, the ability for a country to carry out new policies with as little disturbance to regular service of the government is measured by the bureaucracy quality index. The bureaucracy quality index is ranked by the PRS Group in the ICRG, where this is one of twelve

determinants of political risk score. Countries struggling and with weak bureaucratic structure, leads to the poor implementation of policy and affecting of daily governmental operations. Poor administration would score low for this variable as the variable is ranked between 0 and 4. The assumption is made that based on the quality of these institutions administering patent related laws and regulations can be approximated by the level of national bureaucratic performance.

The second variable used for proxy is the “bureaucracy does not hinder business activity” which is evaluated by the IMD in the WCY, which collects data through its executive opinion survey. This indicator is a measure between 0 and 10, with a lower score indicating high interferences with business activity. This indicator is added to measure the impact of patent related government agencies on business activity.

3.3.1.2 **The Property Rights Protection Costs Measures**

To measure for property rights protection costs the research looks at two main aspects, the one being judicial enforcement and the second the level of corruption in the judiciary. Three variables are used to calculate the judicial enforcement and one to estimate corruption levels. Judicial enforcement takes the three aspects of; the justice is fairly administered indicator, the law and order indicator and the judicial independence indicator.

The justice is fairly administered indicator is reported in the WCY, where a lower score, closer to zero is reflecting low levels of fairness and higher scores closer to 10 showing high levels of fairness. The assumption we make is the correlation associated with the way patent rights are enforced by a country and the overall fairness of a countries judiciary as seen by the perceptions of respondents.

The research measures the law and order aspects separately as quantified in the ICRG. Both these measures range between zero and three. The law component is explained to measure the strength and impartiality of a country’s legal system. The order component is evaluating popular beliefs concerning law enforcement. Together the variables value ranges between zero and six, when adding both components together.

The third variable to estimate the judicial enforcement uses the judicial independence indicator, retrieved from the executive opinion survey. It measures the response to a question

“is the judiciary in your country independent from political influences of members of government, citizens or firms?” When political influence is high a score of one is issued and in the situation that judicial systems are entirely independent a seven is issued. The assumption made here is that higher levels of political involvements, leads to a judicial enforcement which is weaker, and this has a negative impact on the property rights protection costs, by increasing it.

The level of corruption is estimated using the Corruption Perceptions Index (CPI), with the range from zero being an extremely corrupt country and ten being a very clean country. This data is taken from thirteen different sources and ten institutions, which estimate the corruption levels of a country.

3.3.1.3 The Monitoring Costs Measures

The monitoring costs measure is a construction of five different elements. These five elements include the perceptions of patent owners to change in a country’s patent protection and enforcement regime, cultural and societal attitudes towards the purchase of infringing goods, the levels of public commitment to patent protection in general, the effectiveness of police enforcement and the strength of border controls.

The first two elements looked at are the cultural and societal attitudes towards the purchase of infringing goods and levels of public commitment to patent protection. Four variables are identified as measurements which are the intellectual property rights indicator reported by WCY, the intellectual property protection indicator reported by GCR, the global PC software piracy study data by BSA, as well as the USTR special 301 report.

The intellectual property right indicator measures manager’s responses to the statement “Intellectual property rights are adequately enforced.” When enforcement is non-existent a zero is issued and when IP enforcement is stringent a 10 will be scored. This value is to analyse the feeling, patent owners have towards national patent enforcement.

The indicator for intellectual property protection is provided by GCR and measures the response by executives, “Is intellectual property protected well in your country. A one is achieved when the IP protection is weak and a seven when the protection is high.

Piracy levels and revenue lost to piracy are software related are published yearly in the BSA. This data is used to evaluate the readiness of domestics to use products of a questionable origin.

Lastly we use the effectiveness of police enforcement and the strength associated with border controls within the patent system, to indicate the level of concern in these countries with reference to enforcement. Three categories are established, the watch list², the priority watch list³ and section 306 monitoring⁴.

3.3.2 **HDI index**

The paper written by ul Haq (2003: 127) on the birth of the Human Development Index, confirms the search at the time for an index which measured socioeconomic progress in a more accurate manner. This was in comparison to the frequently used at the time indicator of GNP. This was in wake of the provision of the Human Development Report, under the sponsorship of the UNDP in 1989.

The HDI index maintains credibility, through the exclusion of countries where the information and data is deemed to be unreliable. This was noted in the 2011 Human Development Report, which continues to state that this limits the coverage of the index but maintains the validity.

Ul Haq (2003: 128) elaborates that HDI comprises of three components namely, longevity, knowledge and income. The knowledge and longevity variables are calculated relatively simply. The longevity is measured by the life expectancy at birth as the only variable in this component. The knowledge component of the HDI index considered two variables the one, adult literacy and the other mean years of schooling. These variables were assigned the weightings of two-thirds to literacy and one-third to mean years of schooling. The third component income was explained to be difficult to measure as the HDI was a stock figure and income is a flows figure. The HDI addressed this problem by providing a cut-off point, which is characterised by a level of income which meets a reasonable standard of living allowing for fulfilment of human capabilities. This cut-off is apparent in HDI index as ul Haq (2003: 129) emphasises that beyond the cut-off income has a sharp diminishing return.

The index is an average of the three components, as it is difficult to argue for different weights given the choice behaviour of consumers.

Ul-Haq (2003: 132) goes on to say that HDI as an index provides for a multidimensional profile for society. Thus it combines the economic progress of nations with the social development.

It is for this reason this research uses this indicator, measuring the social development of a country and comparing it to the level of patent protection. We expect to notice that as patent strength increases the HDI index should increase, as the NPS is largely influenced by legislation, which is exhibited in the literacy component of the HDI.

3.3.3 **GDP per capita PPP**

When looking at this figure there are the three defining characteristics. We first need to define what is considered when calculating Gross Domestic Product (GDP), we then have to understand the concept of per capita income and why it is chosen over the total GDP and then finally how PPP makes for a better measure for this value.

GDP is defined by McConnell and Brue (1999: 125) as the aggregate output of an economy; this is the total market value of all finished goods and services produced in a country during a period of one year. The authors elaborate that GDP is a monetary measure for a country's output and is also seen as a measure of the economic performance of a country. The data gives the log for real GDP per capita in PPP terms.

McConnell and Brue (1999: 142) continue to narrow the focus of a meaningful measure with regard to the economic well-being of a country. They raise the issue that GDP as a whole could misappropriate changes which impact the standard of living for individuals and households. The example provided is that GDP may increase, but this is in conjunction with a faster increase in the population, the living standard of people in the country will decline.

Taylor (2003: 437) places a simple definition on Purchasing Power Parity (PPP). He explains the exchange rate in terms of PPP, equates the unit of currency in a foreign economy and domestic economy. In a perfect society, consumers will receive the exact same goods and services as they would in a foreign country. In this study it allows for an easier comparison across countries, when looking at their GDP values in terms of PPP terms. The foreign

economy used as the bench mark for the data was the United States and their value is simply their real GDP.

The link the research is hoping to find is a correlation between increases in GDP per Capita PPP and an increase in the NPS index. We will then assume that there is possible causation present.

3.3.3(A) **Ul Haq differences between GNP & HDI.**

Ul haq (2003: 130) presents a comparison between the HDI and GNP as a measure of development. This is critical in understanding, because it helps with the explanation of the results of the processed data. He states that HDI is multidimensional as it measures health and education and not only income. This leads policy makers to develop policies which are focused on the objectives of development and not only the means. Due to the extreme disparities in income HDI is a much more accurate measure of human development, because there are not these large disparities when looking at life expectancy and literacy.

These cases have been proven empirically and ul Haq (ibid) provides examples in his study. The literacy rate in Saudi Arabia is far lower than that of Sri Lanka but, Saudi has a GDP per capita, which is 16 times larger than that of Sri Lanka. He states that the life expectancy for a black male in Harlem, New York City is lower than that of Bangladesh or Sudan.

3.3.4 **Patent grant**

It is explained by Rockman (2004: 5) that a United States patent grant, can only be issued by the United States government and in particular, the United States Patent and Trademark Office. He goes on to say that similar cases occur all around the world, as governments are the only issuer in conjunction with their intellectual property office of patent grants. In South Africa, when applying for a patent you have to register with the Companies and Intellectual Property Commission (CIPC), as stated by Government Communications (2013), which prevents anyone the use of your invention without your consent.

What exactly is defined under a patent grant and how it is protected is explained in chapter two in the section on the fields of IP protection.

This variable is used as a measure for the number of patent grants issued in a country each year. We expect to see an increase in the number of patents granted, due to the importance patents has in business innovation and we expect the IP office of a country to increase its ability to process patent application. Due to this assumption we expect to see an increase in the amount of patent grants when there is an increase in the new patent strength index.

3.4 Data Limitations

The data has certain limitations, but these limitations will only obstruct our interpretations slightly. The major problem we are faced with is the study by Papageorgiadis, Cross and Alexiou, excludes the United States as one of the countries given a NPS index score. This means we cannot see if the strength of the United States patent system has increased or not. The positive, which has been extensively emphasised in this research, is that the United States is the leader with regard to most IP related issues across the globe. We therefore make the assumption that the country would have scored well above the average scored and most probably featured in the top five and exhibit trends similar to the other developed countries in the study.

When looking at the GP index taking an average over the 30 year period, the USA had achieved a GP strength index of 4.1 out of 5, published by Park (2008: 763) which is considered to be very high. This stands as confirmation to the strength of the United States patent system.

In the cases of the United States where data on the NPS is not present, the research will just omit them from the interpretation of the results, but when referring to developed countries they will form part of these.

The correlation expectations are not expected to be high or strong but significance and deviation will play an important role in the analysis. The low correlations are due to the fact that intellectual property as a measurement has not been fully and deterministically proven as a form of economic growth.

3.5 The Model

The research essentially runs four regressions, with different explanatory variables. These outcome variables have been explained above. Two of the regressions use the NPS index as the outcome variable, another uses the HDI index as the outcome variable and the final one uses Real GDP as its outcome.

Each regression is run thrice, the first to analyse the impact of the explanatory variable on the dependent variable, the second, controls for the country dummy and the third regression accounts for the year dummy variable. Controlling for the country dummy allows us to analyse the impact from each country, with South Africa being our reference group, for the first three regressions as it is the country of focus for this research.

The regression using the Real GDP as an outcome variable uses the United States as the reference country instead of South Africa, because it is known that the United States is the country which receives the most economic benefit from intellectual property.

The first regression looks at how the HDI index affects the level of national patent security, the second regression looks at the effect real GDP has on the national strength of patents. Both of these regressions have the country dummy added to evaluate the independent effect from each country, when compared to South Africa. The third regression compares the logged patent grants effect on the HDI index. The final regression looks at the effect patent grants has on GDP, using the United States as our reference group, to compare how the other countries measure against the worlds benchmark.

CHAPTER FOUR: EMPIRICAL ANALYSIS

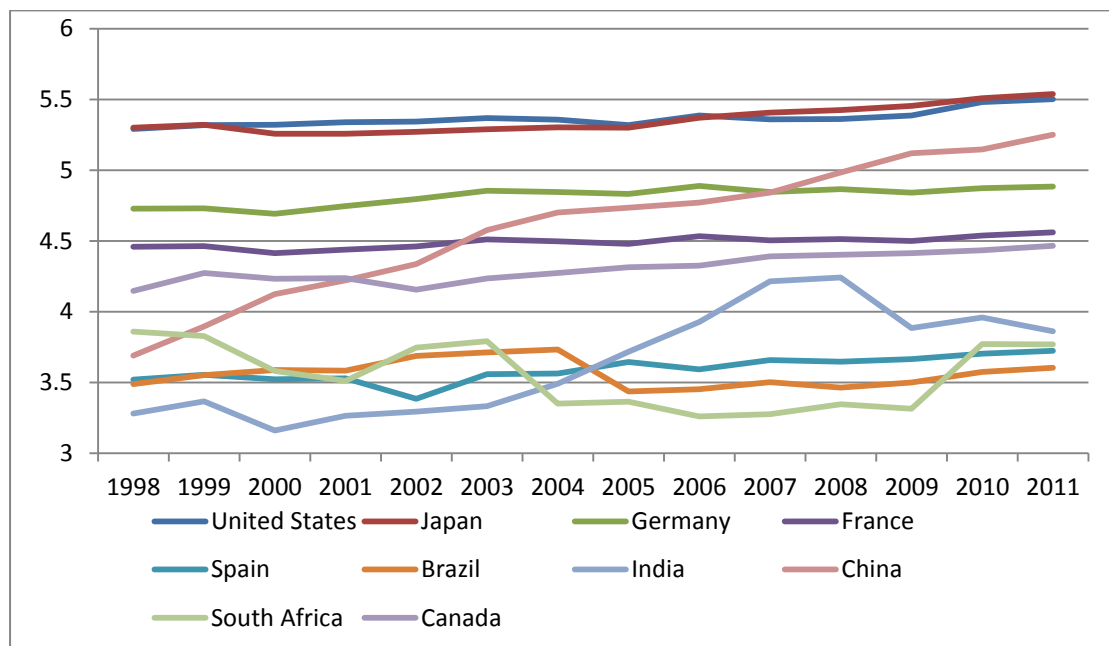
4.1 Introduction

This section of the paper is used to empirically analyse the data, by using a dated panel regression. The research follows four different regressions to analyse the impact of patents on, economic and human development. First, scatter plots are provided for South Africa and Canada/ USA and comparing, the Real GDP with the NPS and HDI indices. I then provide the correlation coefficients between countries for the NPS index and HDI index. Lastly the research provided the details for the regressions, which compare the effect on the NPS index, HDI index and Real GDP. Each regression is run thrice, the first just with the explanatory variable we wish to evaluate, then the second adding the country dummy and the third, adding a dummy for the years under investigation. The regression's all use the OLS method.

4.2 Descriptive statistics

The following section provides graphs which illustrate the trends which have occurred across the time period of focus in each country. The graphs look at the trends in patent grants, the NPS index, then compares the NPS index with Real GDP and patent grants with Real GDP, for South Africa and Canada and South Africa and United States respectively.

Figure 4.1: Logged Patent Grants (1998- 2011)



Source: Authors own calculations using data from WIPO (2014)

The research follows the trend of the logged number of patent grants issued each year for each country. This allows us to measure which country is the leader of the amount of yearly patent grants.

As the Figure 4.1 illustrates, Japan and the United States are the two countries with the largest amount of yearly patent grants, which is consistent of the entire period being examined. This is a clear reinforcement of the prior statements, that Japan and the United States are the two world leading countries, with reference to intellectual property. We notice a constant increase for both these countries, which indicates the continuous emphasis placed on the ensuring of patent grants being processed.

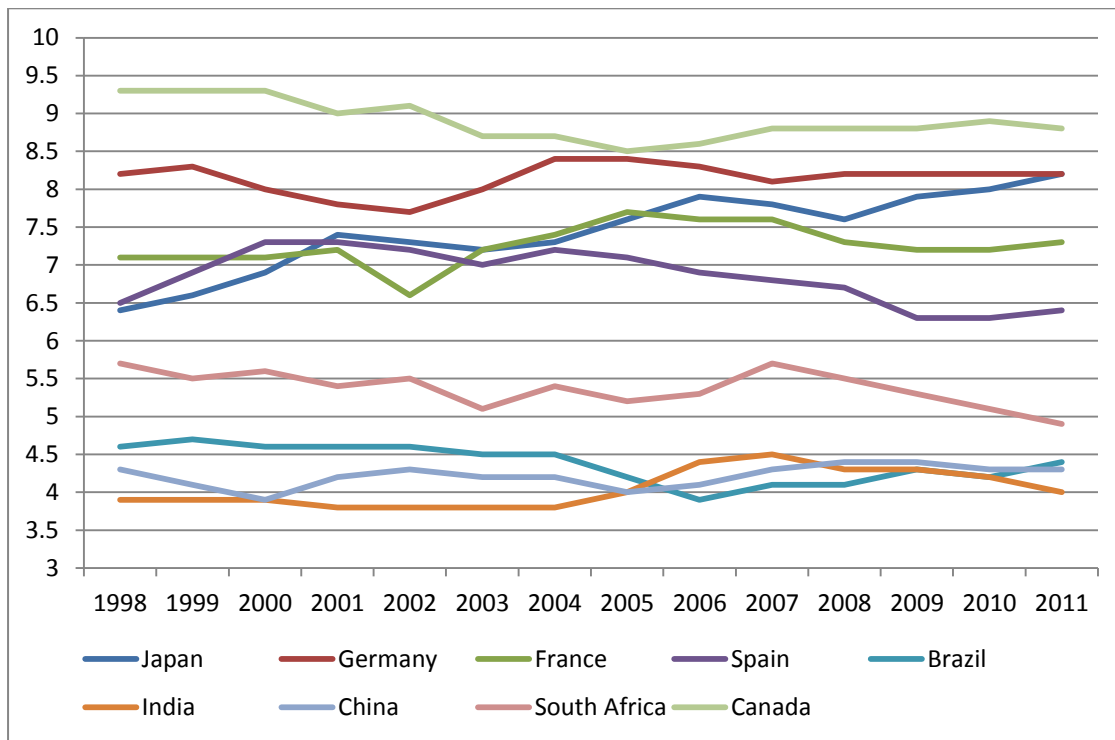
It is shown in the Figure that in 1998 out of the countries in question, we notice that India had performed the worse, however, when looking at 2011, the end of the investigated period, we notice that Brazil in the worst performer. India had experienced development in their number of patent grants, from 2000 and peaked in 2008, when it started to decline, but is still above the 1998 value, indicating progress has been made in this country.

Brazil had only been the worst performer for the last two years, as before that South Africa had been the country with the lowest amount of patent grants per year. The amount of patent grants for South Africa had been on a steady yearly decrease from 1998 until 2009, with a slight increase between the years of 2001 and 2003.

From Figure 4.1, the country which stands out is China, with a logged patent grant value of 3.69 in 1998 to 5.25 in 2011. China clearly made the largest year on year improvement for the number of patent grants issued. The growth in patent grants, ties in with the large economic boom the country is experiencing and causality is definitely present.

An abnormality from theory is the presence of Spain to have such a few patent grants issued each year; this is out of the ordinary due to Spain being classified as a developed country.

Figure 4.2 NPS index (1998- 2011)



Source: Authors own calculations using data from Papageorgiadis, Cross and Alexiou (2013)

Figure 4.2 illustrates the trends observed in the NPS index over the period from 1998 – 2011. This figure allows us to assess what has happened to the strength of intellectual property protection in each country, as time progresses.

As is expected Canada, due to its strong association with the United States, is the country with the highest NPS index. This high level of strength was sustained from 1998 until 2011, even though a downward trend is shown, this country should still be seen as a good model for strong IPR's, with an NPS index never dropping below 8.

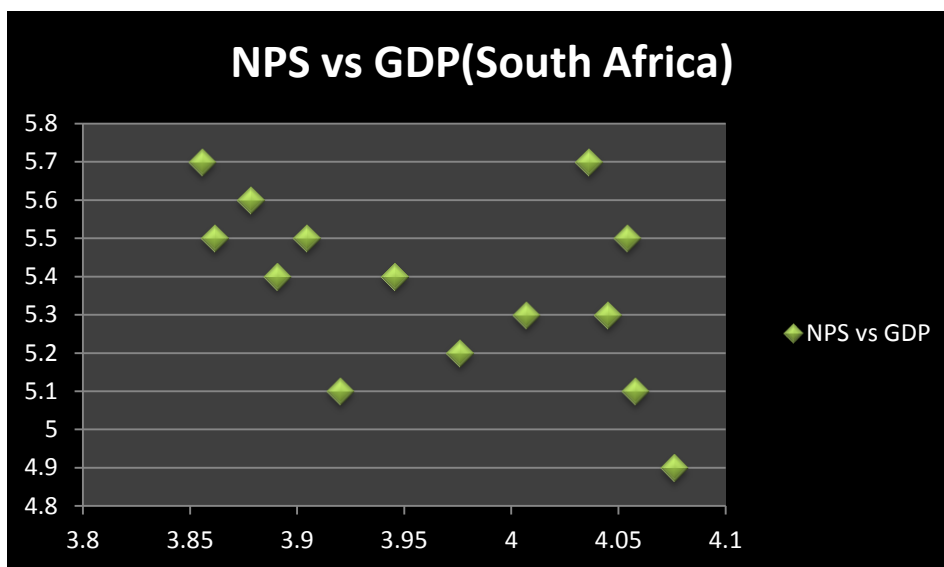
We also notice and expected that all the developed countries have high NPS index's, which is above 6, the developing countries however all find themselves below 5 with the exception of South Africa.

South Africa has experienced the greatest decrease of all the countries and is still on a downward trend, indicating that protection in the country is getting worst. The same can be

said for India, who also have been experiencing a downward trend for the strength of their IPR's, since 2007 as well.

Japan is shown to have had a consistent increase over the years of the strengthening of its IPR's, as in 1998 they had a NPS index of 6.4 and grew to 8.2 in 2011. This can be linked with the increase in the amount of patent grants they have experienced. The increase in patent grants would increase the demand for stronger protection and this has been proven in the case of Japan.

Figure 4.3 NPS Index versus Real GDP (South Africa)

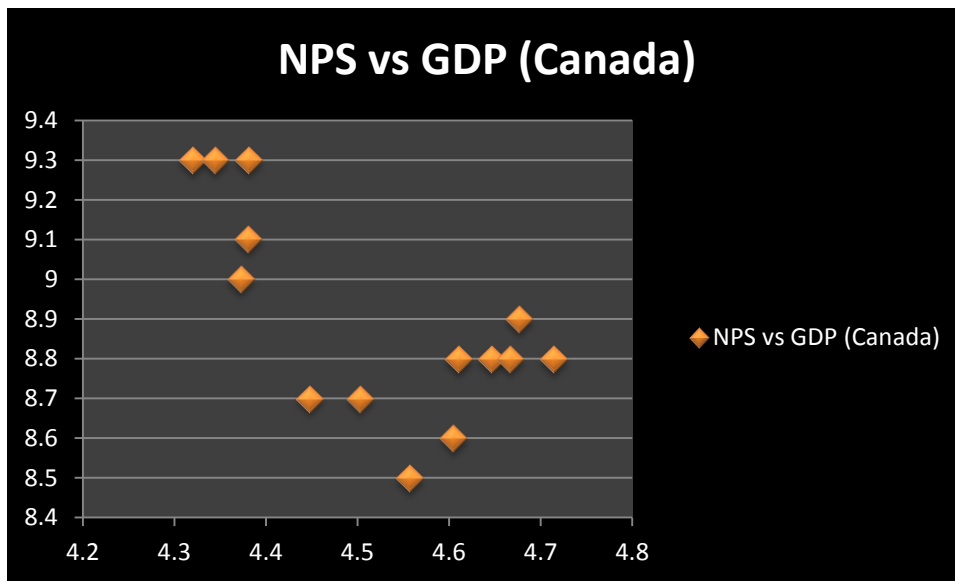


Source: Authors own calculations using data from Papageorgiadis, Cross and Alexiou (2013) and The World Bank (2014)

Figure 4.3 is a scatter plot, which tries to define the relationship between the NPS index and GDP. This is done to see if Real GDP is higher when the level of patent strength is high.

We observe that, in South Africa, they experience their highest NPS index value of 5.7, with high levels of logged real GDP of 3.85 and 4.03, with more of the high NPS index values correlated with lower logged Real GDP levels. This indicates that the strengthening of the intellectual property system in South Africa has minimal influence on the level of real GDP in South Africa and that South Africa tends to do better when the IPR's are not strong.

Figure 4.4 NPS Index versus Real GDP (Canada)

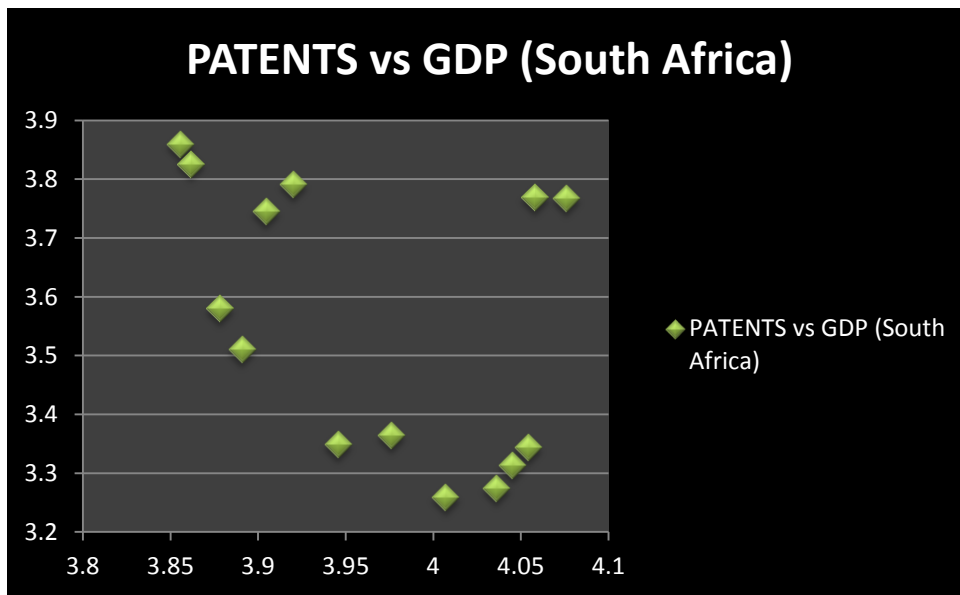


Source: Authors own calculations using data from Papageorgiadis, Cross and Alexiou (2013) and The World Bank (2014)

When comparing this with Figure 4.4, which illustrates Canada, we cannot make great inferences about this, due to the variation in Canada's NPS index. Due to the changes being so small, it is difficult for us to specify causality.

We notice with Canada, that their GDP achieves its best when the NPS index is around 8.8. From the figure, we can see that the higher NPS indices are associated with a lower logged Real GDP value, but at the same time, their lowest NPS index is not achieving high real GDP values.

Figure 4.5 Patent Grants versus Real GDP (South Africa)

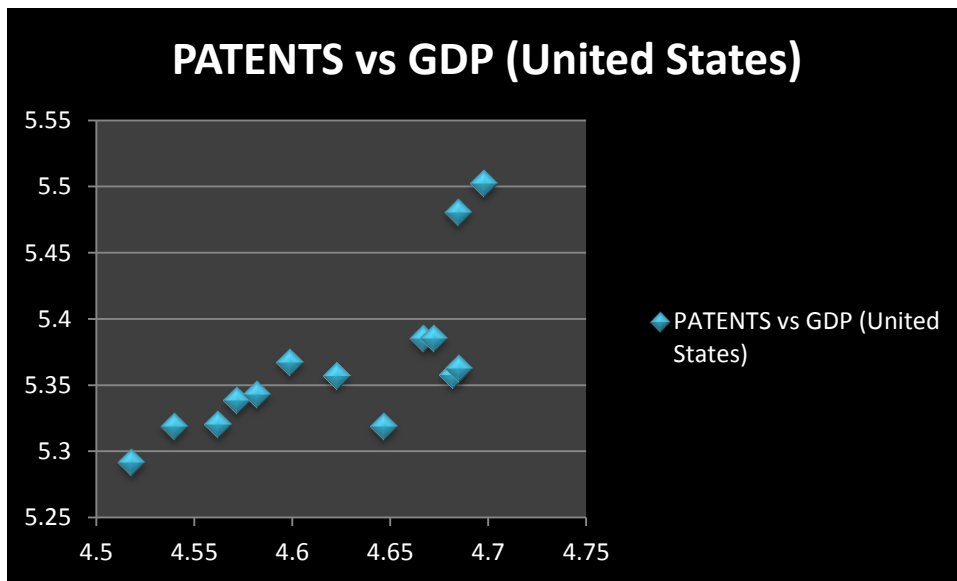


Source: Authors own calculations using data from WIPO (2014) and The World Bank (2014)

Figure 4.5 is another scatter plot, which defines the relationship between the logged patent grants and the logged Real GDP. This is done to see if Real GDP is higher when the amount of patent grants increase in a country.

The figure above indicates that in South Africa, besides the two outliers, the increase in the amount of patent grants has a negative impact on the Real GDP of South Africa. The years with higher levels of patent grants have been accompanied by low levels of Real GDP. This indicates that patent grants are not an important means of economic growth in South Africa. This is to be expected for a developing country, but is not what pro intellectual property economists want to hear.

Figure 4.6 Patent Grants versus Real GDP (United States)



Source: Authors own calculations using data from WIPO (2014) and The World Bank (2014)

In the case of the United States, it is different and we expect this to occur as the literature had suggested. In the United States, we see a positive relationship between the number of patent grants issued yearly and the Real GDP of the country. This is illustrated by the upward trend of the observations. The highest level of Real GDP is correlated with the highest number of patent grants.

This is a clear indicator that the United States economy is very reliant on patent grants. This was to be expected as the United States is known to be the world power house in intellectual property; therefore their economy is structured around the research and development aspects in most industries. Figure 4.6 has indicated the immense importance of patents to the United States economy and the benefit patent grants can have towards economic growth.

4.3 Econometric analysis

4.3.1 The model of the NPS Index and HDI Index

This regression analysis what impact human development has on the level of intellectual property strength. We control for countries focused in this study to measure developed against developing countries as to the size of impact, due to all being statistically significant. A year dummy variable is included, but proves to be statistically insignificant.

Table 4.1 Model of NPS index and HDI index

NPS Index	I	II	III
HDI Index	11.0713***	0.5318	1.4921
Brazil		-1.0471***	-1.1493***
Canada		3.3829***	3.1155***
China		-1.1918***	-1.2588***
France		1.7470***	1.4921**
Germany		2.6330***	2.3789***
India		-1.2843***	-1.2089***
Japan		1.9222***	1.6613**
Spain		1.3450***	1.0995*
y99			0.0483
y00			0.0646
y01			0.0739
y02			0.0012
y03			-0.0521
y04			0.0745
y05			0.0612
y06			0.0694
y07			0.1412
y08			0.1631
y09			0.1685
y10			0.1292
y11			0.1110
C	-2.7258***	5.0210***	4.3173**
N	126	126	126
R ²	0.7111	0.9730	0.9740
Adjusted R ²	0.7088	0.9709	0.9684

Source: Authors own calculations using data from Papageorgiadis, Cross and Alexiou (2013) and Human Development Reports (2000 – 2013)

Note: *** Significant at the one per cent level and less.

** Significant at the five per cent level

* Significant at the 10 percent level

Reference Groups: Country : South Africa

Year: 1998

From Table 4.1 it is seen that the HDI index is only significant in regression 1, when controlling for country and year, the HDI index becomes insignificant. The high t-Statistic in regression 1 indicates that the HDI definitely has a significant impact on the strengthening of IPR's. Another observation to make from these regressions is the increase in R^2 and the adjusted R^2 , once we control for the country and year dummy respectively. The lack of significance in the year dummy variable, would lead us to expect and it is observed that the adjusted R^2 is lower in regression 3.

The research uses regression 2 as the model regression. When comparing the impact human development has on the strengthening of IPR's, the constant states to us that all countries had felt a positive correlation between human development and the strengthening of IPR's. All the developed nations had outperformed South Africa, with Canada and Germany feeling the greatest effects.

South Africa performs well when compared to the other developing countries, as all have negative coefficients, due to the regression using South Africa as a reference group. All the countries have very low standard errors, which increases the accuracy of the coefficients as well as increase the reliability of the data for statisticians. This regression tells us that between the years of 1998 and 2011, human development has led to the strengthening of IPR's, for developed and developing countries. The impact has been felt greater in developed countries.

4.3.2 **The model of the NPS Index and Real GDP**

The model of the NPS index compared with the Real GDP is another way to measure instead of the human development, but rather the economic development as Ul Haq (2003: 130) notes. We measure economic development from the increased protection of intellectual

property. We control for the same dummy variables and find that Real GDP is statistically significant in the first and third regressions. Once again the country dummy is significant and the year dummy is not.

Table 4.2 Model of NPS index and Real GDP

NPS Index	I	II	III
REAL GDP	3.8974***	0.1194	-0.4424***
Brazil		-0.9999***	-0.9797***
Canada		3.4628***	3.7596***
China		-1.1233***	-1.2952***
France		1.8259***	2.0947***
Germany		2.7086***	2.9914***
India		-1.2686***	-1.5636***
Japan		2.0040***	2.2747***
Spain		1.4242***	1.6671***
y99			0.0567
y00			0.0903
y01			0.1088
y02			0.0498
y03			0.0154
y04			0.1623
y05			0.1787
y06			0.2042
y07			0.2971
y08			0.2170
y09			0.1926
y10			0.1718
y11			0.1931
C	-9.9490***	4.8979***	6.9997***
N	126	126	126
R ²	0.7612	0.9730	0.9741
Adjusted R ²	0.7592	0.9709	0.9685

Source: Authors own calculations using data from Papageorgiadis, Cross and Alexiou (2013) and The World Bank (2014)

Note: *** Significant at the one per cent level and less.

** Significant at the five per cent level

* Significant at the 10 percent level

Reference Groups: Country : South Africa

Year: 1998

The results from this regression is somewhat similar to the previous model, once again once we control for the country dummy Real GDP becomes a statistically insignificant variable, but the constant as well as regression 1 that Real GDP definitely has a positive impact on IPR's protection. The same effect happens with the R^2 and Adjusted R^2 , and we therefore use regression 2 as the model regression.

The developed countries are once again the only ones to outperform South Africa. This is restricted to the increase in patent strength due to economic growth of Real GDP. South Africa outperforming the developing countries indicates that South Africa has a strong link between economic growth and stronger intellectual property laws, as when compared to China and India, no one in the world could match their economic growth which started in the 1980's and forging ahead to present day as Srinivasan(2004:614) states

What we observe as a difference between the two models is the increase in the level of significance as well as the decrease in the standard errors of the coefficients, when using Real GDP to define the NPS Index instead of the HDI index. This states that Real GDP finds itself to be more significant and reliable than HDI as an explanatory term for the improvement of protection of intellectual property.

As mentioned in chapter two, the HDI index and Real GDP can both be used as measures for total economic growth. When we compare the impact each component of this growth separately, we notice a strengthening of patent protection. We find South Africa to increase protection as the humans develop as well as the economy. This same effect occurs in other countries, with South Africa performing the best out of all developing countries.

4.3.3 **The Model of the HDI Index and Patent Grants**

This model is used to compare what effect, the amount of patent grants a country has per year on the level of human development. This model is important to this research as it captures one of the main aspects of human development as set aside by Ul Haq (2003). The model once again controls for the country and year dummy variables. The year variable is significant for the first time in our study. The United States is added to this regression as data could now be sourced for them as well. This increases the sample size to 140.

Table 4.3 Model of HDI index and Patent Grants

HDI Index	I	II	III
Patent	0.1019***	-0.0265**	0.0118**
Brazil		0.1021***	0.0996***
Canada		0.2939***	0.2628***
China		0.0929***	0.0507***
France		0.2857***	0.2476***
Germany		0.2936***	0.2431***
India		-0.0808***	-0.0864***
Japan		0.3150***	0.2437***
Spain		0.2521***	0.2485***
United States		0.3212***	0.2495***
y99			0.0043
y00			0.0088*
y01			0.0095*
y02			0.0128**
y03			0.0179***
y04			0.0224***
y05			0.0313***
y06			0.0324***
y07			0.0356***
y08			-0.0366***
y09			-0.0537***
y10			-0.0509***
y11			-0.0326***
C	0.3850***	0.7533***	0.6193***
N	140	140	140
R ²	0.3089	0.9464	0.9936
Adjusted R ²	0.3039	0.9423	0.9923

Source: Authors own calculations using data from WIPO (2014) and Human Development Reports (2000 – 2013)

Note: *** Significant at the one per cent level and less.

** Significant at the five per cent level

* Significant at the 10 percent level

Reference Groups: Country : South Africa

Year: 1998

It is seen in regression 1 the low R^2 and Adjusted R^2 indicate that the model specification is completed underestimated. Once adding the country and year dummy variable we notice that the R^2 and Adjusted R^2 increases to great significance. We therefore make the assumption that patent grants are significant to human development, when controlling for countries and over an extended period of time has a positive effect. Due to the Adjusted R^2 in regression 3 being higher than regression 2 we use regression 3 as the model regression. The importance of this can also be seen in the increase in the constant.

We see that all countries besides India perform better than South Africa, when the effect of patent grants is measured against human development. In this model Canada performs the best and this stronger influence is seen amongst the other developed countries who feel the greatest impact towards human development. These impacts all range between 24%-26% impact, greater than the impact South Africa has.

When compared to the developing countries of China and Brazil, their impact is 5% and 9% greater than South Africa respectively. South Africa outperforms India, as India feels 8% less of an impact on human development due to patent grants.

The year variable was significant at all levels from 2003 onwards. The impact it had varied over the years. Between 2003 and 2007 the amount of patent grants increased the level of human development and then until 2011, it had a negative impact when compared to the effect of 1998.

4.3.4 The model of Real GDP and Patent Grants

The final model looks at the impact patent grants has on Real GDP. We are now analysing the economic benefit of patent grants. We want to capture this effect for the eventual comparison between HDI and GDP impacts due to patent grants. The same situation occurs with the R^2 and Adjusted R^2 as in the previous regression model. The first regression here has a low R^2 and Adjusted R^2 , but then increases to a significant level. We once again see the significance of the year dummy variable being present and this time its level of significance increases as the year's progress. The difference in this model is that the United States was used as the reference group in the country dummy variable.

Table 4.4 Model of Real GDP and Patent Grants

RealGDP <i>logged</i>	I	II	III
Patent <i>logged</i>	0.3068***	0.3504***	0.1718***
Brazil		0.0325	-0.2898***
Canada		0.2638***	0.0745**
China		-0.6730***	-0.8100***
France		0.1495***	-0.0069
Germany		0.0606**	-0.0378**
India		-0.5565***	-0.8646***
Japan		-0.1507***	-0.1524***
South Africa		-0.0234	-0.3387***
Spain		0.4191***	0.1017**
y99			-0.0054
y00			0.0268
y01			0.0389**
y02			0.0495**
y03			0.0586**
y04			0.0906***
y05			0.1193***
y06			0.1510***
y07			0.1748***
y08			0.1885***
y09			0.1860***
y10			0.1969***
y11			0.2160***
C	2.8840***	2.7428***	3.5948***
N	140	140	140
R ²	0.307601	0.962975	0.991304
Adjusted R ²	0.302583	0.960104	0.989579

Source: Authors own calculations using data from WIPO (2014) and The World Bank (2014)

Note: *** Significant at the one per cent level and less.

** Significant at the five per cent level

* Significant at the 10 percent level

Reference Groups: Country: United States

Year: 1998

Due to the low R^2 and Adjusted R^2 in regression 1 and the Adjusted R^2 being higher for regression 3, than 2, we select regression 3 as the model regression.

What is observed is the logged patent grants value has a positive relationship with the logged Real GDP, the values provided above are the elasticities. As the percentage change in the explanatory variables is explained by a percentage change in the dependent variable.

We notice Canada and Spain to outperform the United States when measuring the effect patent grants has on the Real GDP. The constant indicates that there is definitely a positive correlation between the two variables. As expected all the other countries perform worse when compared to the United States, with the developed countries not lagging to far behind but the developing countries especially India and China having a large difference even when compared to South Africa and Brazil.

The significant years begin from 2004, and the level of significance increases each year. We also notice the size of the impact increasing each year. This allows us to assume that patent grants have had an increasing importance in the improvement of economic growth.

4.4 Conclusion

From the data run we can see the effect of the increase in the strengthening of patent laws as well as the effect of the increase in the number of patent grants. We measure these changes against measures of human development as well as economic development, giving the all-round picture of the effect patents have on development.

The data suggests a positive effect on the strengthening of intellectual property laws on human development and economic development. This same positive correlation is seen with the number of patent grants issued per year. These effects are all consistent for South Africa as well, who performs well for a developing country.

The data has proven what we expected to see that the benefits felt from intellectual property had greater impact in developed countries than developing countries, why this is, is beyond the scope of this research.

CHAPTER FIVE: CONCLUSION

5.1 Introduction

This research looks at the effect that greater amounts of patent grants and the strengthening of patent laws, has on the development of people, economically and socially. The data used in the research was sourced from previous studies on patent strength and reports on human development. The research focuses on the years 1998 – 2011, due to the limitation in the data. The models were specified to state what each would set out to achieve, and the controlling for the impact of countries and the years for the study.

5.2 Review of findings

When following the trends of patent grants and the NPS index we notice China to have seen the greatest change in the amount of patents granted per year, over the period being observed. South Africa has not had constant growth in patent grants and finds itself registering less in 2011 than they did in 1998.

The trend of the NPS index indicate that South Africa has experienced the greatest decrease of all the countries and is still on a downward trend, indicating that protection in the country is getting worst. Japan experienced an increase in protection and is the only country to show a significant steady increase in the strengthening of intellectual property laws.

The results from the econometric models on the NPS index indicate to us that, South Africa performs well when compared to other developing countries, but does not outperform any developing countries. Thus we can make the conclusion that South Africa has felt positive effects due to the new patent system. These positive effects are with reference to economic and human development, as both the Real GDP and the HDI index had a positive effect on the NPS index, we now can state that we expect to see an improvement in the strengthening of patent rights, when the Real GDP per Capita increases and the human development index increases in South Africa.

When we model the HDI index and the number of patent grants, we notice that South Africa does not perform as great as the other countries; this includes the developing countries as South Africa only outperforms India. This is a concern for South Africa as we notice that

patent grants do not contribute greatly to human development, and according to the theory on human capital, greater innovation, will lead to greater human development. This effect is present in South Africa, but the impact felt is very small even though it is significant.

The final model of Real GDP and patent grants indicates a positive relationship between the two variables. This relationship was to be expected, as the innovation and intellectual property section states that, greater innovation, leads to an improvement in economic security. Using the United States as the reference group for this model, we notice that Canada and Spain outperform the United States and South Africa and the other developing countries. This indicates to us that the amount of patent grants benefit the economic development of the developed world more than the developing world. This impact has been documented in many literatures and has also been highlighted in this research.

The reason for this is provided above as the impact of the developing countries being more net importers of intellectual capital. This affected the structure and aims of the intellectual property authorities in a country. We noted earlier that developing countries would focus most of its money on the securing of imitations than trying to promote innovation.

5.3 Conclusion

We conclude this study by stating that patents grants and the strengthening of patent laws has a positive impact on economic and human development. We notice that the benefit is much greater for developed countries than developing countries; the reason for this is beyond the scope of this research, but is definitely a topic for further discussion.

When compared to other developing countries South Africa performs well with reference to patents and intellectual property protection, but as with most factors in the world, we are now seeing China to be the best performer with regard to economic and human development, with intellectual property playing a growing importance in this development.

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