**The Impact of Intellectual Property Law on Developing Countries: Patent Law and Essential Medicines**

by

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Abstract

The relationship between intellectual property and healthcare is ever growing, particularly when dealing with patent law and the access to essential medicines in the least developed countries. This study explores the socioeconomic statuses, and the impact it may have on patents and the access to essential medicines for a group of 102 countries, which is divided into three sets of 34 countries of various human development rankings—high human development, medium human development, and the least developed countries of Africa. The results of this study suggest that there are significant correlations between intellectual property, specifically patents, and the overall well-being of a country's population. Thus law and policy makers should take note and understand the implication of having such a patent system within our society, and understand how future decisions may affect the lives of millions.

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List of Abbreviations

World Health Organization ……..……..… WHO

United Nations ……..……..… UN

United Nations Industrial Development Organization …… UNIDO

World Trade Organization ……..……..... WTO

World Intellectual Property Organization ……..……...… WIPO

Mean……..…… M

Standard Deviation …..……. S.D.

Level of Significance …..…….. *p*

*F*-test ..... F-ratio / F

Chi-Square ….……...… $\chi 2$

Ordinary Least Squares …..…….. OLS

Standardized Regression Coefficient …..……..…….. B / Beta

Unstandardized Regression Coefficient …...…….. *b*

Standard Error …...……..….. s.e. / S.E.

Coefficient of Determination …..……..... R Squared / $R^2$

# Chapter I

## Background and Introduction

### 1.1. Background

Under the United Nations Economic and Social Council (ECOSOC), the Committee for Development Policy (CDP) is responsible for updating the data regarding the statuses of the least developed countries (LDCs) in the world (United Nations [UN], 2011). This process is performed once every three years on the basis of three criteria of a country's development state: per capita gross national income (GNI), human assets index (HAI), and economic vulnerability index (EVI). To join the list of LDCs, a country must satisfy all three dimensions, and the population of that country must not exceed 75 million (UN, 2013). Some common characteristics of LDCs include high levels of poverty, structural and resource weaknesses, and acute susceptibility to external economic factors, climate change and natural disasters (United Nations Industrial Development Organization [UNIDO], n.d.).

There are currently 48 members on the UN (2013) list of LDCs, as presented by Figure 1 (p. 2), with 34 of the countries located in Africa alone (UNIDO, n.d.). Around the globe, approximately 57 million people die each year; although most of them are still unfortunately inevitable, many of these deaths, however, are preventable—especially in the fatalities of children that occur in low- and middle-income countries (World Health Organization [WHO], 2011). According to WHO (2013), globally, about 1.7 million

people died from AIDS in 2012, with 1.2 million deaths in Africa alone. In addition, approximately 34 million people around the world lived with HIV in 2011, and again, Africa was the front-runner with about 23 million cases (WHO, 2013). The lingering question has to be "What is the rest of the world going to do about it?" As the Universities Allied for Essential Medicines (UAEM) reported in 2010, many people die in developing countries from illnesses without cure, but even more disturbingly, about 10 million people die each year from diseases that do have available cures or treatments. One of the main reasons for their deaths is the lack of essential medicines around the world due to problems of accessibility, among other issues.

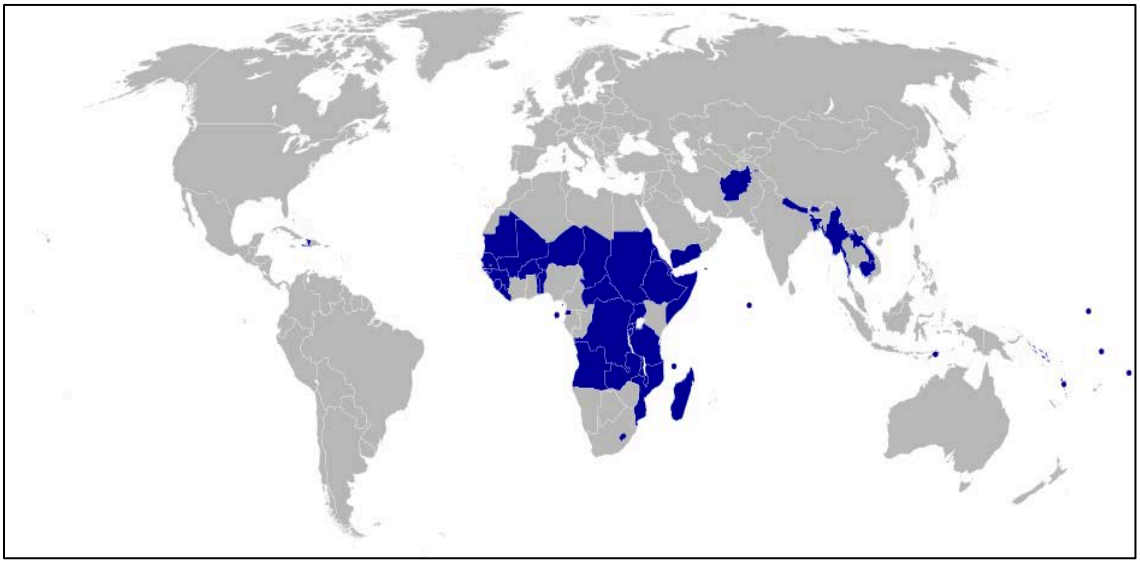

***Figure 1.*** Map of the least developed countries. This figure illustrates the 48 least developed countries of the world (shown in blue).

Source: The United Nations Industrial Development Organization (UNIDO).

The main purpose of this study is to investigate what impact, if any, intellectual property and patent law have on the lowest developing countries of Africa in regard to medicine and public health as a whole. Moreover, this study will take a close overview at some of Bourdieu's core concepts, and also, the possible implementations of those theories on today's main issues and concerns with public health and the patent system.

## 1.2. Introduction

### 1.2.1. The Problem

The accessibility issues of medicine has surrounded the system of intellectual property and intellectual property rights (IPR) for as long as the existence of the system, with more than one-third of the world's population without regular access to essential medicines (Sterckx, 2004, p. 58). The WHO defines essential medicines as medicines that satisfy the priority healthcare needs of a population. Obviously, the cure for providing medicine to the entire world is not a simple task, but this lack of accessibility for the poorest of countries is, though most definitely not limited to, a side effect of capitalism. In a capitalist society, money is the most central tool, and the obsession with innovation and profit in the most developed nations has overshadowed the poorest of countries filled with millions suffering. And while many would agree that patents—and intellectual property as a whole—should only provide protection in good faith, especially with the access to medicine and healthcare, many more would disagree on the significance of the threat patents may have on the poor (Attaran, 2004, p. 155). But as Attaran (2004) highlighted, there are many theories and results that have mistakenly shaped the policies

among public health activists, the pharmaceutical industry, and governments about how patents affect corporate revenues and the health of the world's poorest (p. 155).

In addition, at least a part of the reason for neglecting the most disadvantaged countries was due to an epidemic that was affecting even the most well-developed countries: AIDS. As the acquired immune deficiency syndrome, or AIDS, was clinically discovered in 1981—while malaria and tuberculosis were simultaneously taking the lives of millions—the fight against the HIV/AIDS epidemic grabbed the utmost attention of researchers because even the most developed nations were disturbed and struck by this discriminative disease. Hence the diseases that were not directly affecting the developed countries were put on a back burner, while HIV/AIDS moved to the forefront.

As research for the treatments and cure for HIV and AIDS took prominence, the awareness of the security of those novel pharmaceutical inventions was also, at least inadvertently, heightened. The patent holders for drugs—i.e., the antiretroviral drug—were clenching dearly to their discoveries and inventions, and the distributions of those medicines were well formulated to essentially monopolize sales to the public (Ito & Yamagata, 2007, p. 2). The consequential lack of competition allowed the prices of potential lifesaving drugs to become astronomical to countries and regions where only the patients of the most developed nations could both afford and, more importantly, have access to the medicines. This, again, only created a wider gap between the rich and poor—and ultimately, between the healthy and diseased, respectively.

Hence while researchers strived to develop novel inventions and drug discoveries with the intentions of saving lives, the research itself had the unintentional con of high cost. The stringent testing of the drugs to ensure absolute safety, quality, and efficacy of

the medicines for the general public can, however, cost the pharmaceutical firms an astounding estimate of $802 million; and that price is only to have the medicine reach the market (UAEM, 2010). Moreover, as the handful of pharmaceutical companies collected royalties, millions of people were still dying from not only the well-known illnesses of HIV/AIDS, malaria, and tuberculosis, but also from many other diseases found in the world's poorest areas that were being overlooked. Even today, only 10 percent of research and development (R&D) dollars are funneled in for the research of 90 percent of the world's health problems (UAEM, 2010).

Though the most developed countries cannot be fully blamed for the global sufferings, after all, why would a multibillion dollar pharmaceutical company from North America or Europe consider sacrificing business—or more importantly, people—by sending them to the most rural areas of the world with little to no protection of any sort—much less any intellectual property protection? Furthermore, in the early 1980s, the "inadequate" legal protection of IPRs in developing countries allowed many infringements to slip out of various industrial lobbies in the United States, which ultimately caused "enormous losses" (Sterckx, 2004, p. 59). Although many developing countries argued the "evolution of IPR protection in [industrialized] countries has always been determined by what these countries regard as their national interest," and "in view of [industrialized countries'] economic development objectives, developing countries need lower protection standards" (Sterckx, 2004, p. 59).

It seems logical to ask, then, how anybody can find justification in the actions of these government policies and pharmaceutical companies. How can they seem to get away with the tunnel vision on money—and only money—and blinders on the millions of

people suffering? The Constitution of WHO specifically declares in the Preamble that "the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition" (p. 1). The ethics and morals of the situation can, however, be an entire topic of itself. But another reason for the lack of medicines to treat or prevent these diseases, according to BIO Ventures for Global Health (BVGH) President Jennifer Dent, is "simply because they are not commercially attractive" (Jewell, 2013, p. 16). Similar to conventional business marketing strategies, a company's image is everything, and dumping money into the slums of Africa with little to no return is probably the way many of the pharmaceutical industries felt about investing in the developing countries and LDCs. As Lee and Mansfield (1996) concluded in their study, a country's system of intellectual property protection directly influences the volume and composition of United States' foreign direct investment in that country (p. 181).

Even if pharmaceutical companies have the interest of providing medicines to the developing countries, it must be recognized that patent protections are only valid within the jurisdictions of the Patent Office it has applied for protection (Sterckx, 2004, p. 59). Patent protection becomes a significant issue when dealing with the newest developed medicines. While many newer patented drugs are similar to existing treatments, especially in the sense of efficacy, it is also common that the new drugs provide no improvement at all (Abbott, 2011, p. 8). Moreover, as Abbott (2011) revealed, "[w]hile it may be helpful to have lower-priced versions of all new drugs and vaccines, it is probably not necessary to make such new versions available for many situations" (p. 8). Abbott (2011) also acknowledged that "there are a good number of newer patented medicines

that are currently outside the reach of a large part of the world's population, and it is reasonable to expect that new medicines that are a substantial improvement over existing ones will be developed and patented" (p. 8).

But what is a patent, exactly? Most people have heard of the term, or seen the word printed on everyday items such as on the bottom of coffee cups and soda bottles, but what exactly is the mystery behind the six letter word with what seems like a trail of abstract numbers? A patent is a type of right under the larger picture of intellectual property. Intellectual property rights are rights granted by a government—i.e., the United States—to an inventor for the protection of a product, or a process, under certain conditions for a limited period of time in exchange for public disclosure, which, in return, would encourage innovation.

### 1.3. Patent Systems

The patent systems in the United States, Europe, and other well-developed countries provide protection rights to an inventor for disclosure of the invention for a limited amount of time. The types of technology qualified for protection include utility patents—e.g., pharmaceutical drugs—and design patents—e.g., a new design for a plastic bottle—for twenty and fourteen years, respectively, from the date of the filing of the patent application. The protection includes technology of products and processes. A product patent is the final result—e.g., the physical object of a drug capsule or tablet—of the invention, and it is arguably "the most coveted form of protection" (Sterckx, 2004, p. 60). And a process patent is the method for which a particular product is made and also

for how the particular product is to be used. Sterckx (2004) warned that a process patent is only effective if the product of interest cannot be produced by any other way (p. 60).

As inventors seek justice for their inventions with the exchange of disclosure for granted patents, the same justice is, however, nowhere to be found for the disadvantaged countries with millions dying each year due to the lack of access and the affordability issues present for essential medicines. Sterckx (2004) questioned whether the patent system is preventing an equal access to drugs for the needy (p. 64), while another problem is the practice of prolonging the term of drug patents, or "patent evergreening." This phenomenon is the excessive protection period that allows the major pharmaceutical companies to further prevent generic drug firms from developing cheaper medicines that could potentially be more affordable for the LDCs. In fact, as reported by the *Kaiser Foundation,* a prescription brand-name medicine in the United States is 3.4 times higher in retail price than the competitive prices of generic drugs (Sterckx, 2004, p. 65).

As for foreign countries, in order to receive patent protection internationally, the applicant must register the patent in every country that an inventor would like protection rights provided for their invention. Moreover, since the Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement came into force in 1995, countries within the World Trade Organization (WTO) must abide by the agreement on the following issues:

(1) how basic principles of the trading system should be applied;

(2) how to give adequate protection to intellectual property rights;

(3) how countries should enforce those rights adequately in their own territories;

(4) how to settle disputes on intellectual properties between WTO members; and

(5) special transitional arrangements during the period when the new system is being introduced (WTO, 2013).

So Jennifer Dent's explanation above may have some merit, because how can anyone blame a major firm that does not want to risk investing in a developing country with relatively weak intellectual property protection?

Consequently, at the Fourth Ministerial Conference of the WTO in Doha in 2001, a Declaration on the TRIPS Agreement and Public Health was implemented. It stated that "patents should not be applied in cases where keeping the TRIPS Agreement would result in serious damage to public health" (Ito & Yamagata, 2007, p. 2). While the declaration was initially viewed as victorious for the developing countries, as prices for drugs and costs for treatments dropped substantially—which allowed more people to receive medicines and vaccines—the lowering of prices, however, may have also inadvertently reduced the development of innovations in medicine because "low prices reduce profits" (Ito & Yamagata, 2007, p. 3) for the pharmaceutical companies. What may have seemed like a glorious triumph just a moment ago has abruptly turned into a painful hangover. As Ito and Yamagata (2007) warned, drug companies may veer away from the risky field of diseases and refocus on innovation in medicines that are only successful in developed countries (p. 3).

As there are few pharmaceutical companies who do provide for the low-income countries, but because of the minuscule number of local companies, the patent holders of the drugs have monopolized sales and distributions, which consequently set astronomical

prices to the medicine essential to the developing countries. Therefore, affordability is another main issue for innovation in medicine for the most disadvantaged people.

A significance for this study can be found when the issues at hand are viewed from a particular perspective; that being, the warnings of Ito and Yamagata could be served as motivation to find another way to reach across the pond to solve the problem of the low-access of medicines by driving down the prices of necessary drugs that are essential to the least developing countries.

## 1.4. Organization of Study

The present study is divided into five separate chapters. Chapter two will review some of the relevant literature that exists regarding the cases against patents and intellectual property, the licensing of patents, and the network of games and power theories of Pierre Bourdieu. The section against patents will detail the key arguments, as well as some misconceptions, from the critics of intellectual property. The second section will highlight the most commonly practiced types of licensing agreements for patents and its technologies. The final section of this chapter will discuss the theories of Bourdieu, more specifically on the network of games and power, and how it can relate to the field of intellectual property and patent law. Chapter three will discuss the methodology and measures of this study. This chapter will also present the analyses of the dataset collected for the study. Chapter four will present the results and findings, as well as the analyses of those results, of the study. Lastly, chapter five will present a discussion regarding the results and findings of chapter four. In addition, this chapter will also discuss some of the limitations of the research, some implications and suggestions for future research, and a

conclusion for the study.

# Chapter II

## Conceptual Framework

This chapter is a review of the relevant literature. The first section reviews the case against patents—and the patent system—in the most developed nations. The literature is generally consistent with the views of political economy, due to its focus on previously studied relationships between the general well-being of society and the overall productivity of innovation and technology. The second section presents the common misconceptions and correlations between patents and the costs of medicines. The literature reveals theoretical foundations of intellectual property rights protection, as well as the inequalities of individual nations and market sizes. The third section discusses the different types of licensing of patents used in the United States and several developed foreign countries. With respect to the literature, it is worth noting that there is not a perfectly structured, one-size-fits-all, type of system in existence. The final section presents the theories of Pierre Bourdieu on the network of games and power, and the attempt to relate those theories to intellectual property and socioeconomics.

### 2.1. The Case Against Patents

The patent system, as we know it, has had its shares of praise and criticism since the day it was adopted, and the two-sided argument has only become more controversial with each passing decade filled with new technology and inventions. Boldrin and Levine

(2013) are no exception, as they are the strong advocates for abolishing the patent system entirely (p. 4). They argued that the patent system, from the political economy point of view, simply does not provide a positive impact for innovation or productivity.

The patent system in the United States is one that has been amended and polished throughout its lifetime, and it will only see more chiseling in the future. In the U.S., a utility patent may be granted a twenty-year lifespan beginning from the date of filing the patent application, and a design patent has the protection duration of fourteen years. Regardless of patent type, Boldrin and Levine (2013) believe that any lasting period under a strong patent protection system can only harm innovation, rather than promote it. They further argued that the protection period provides the patent holder the power of a monopoly which excludes small innovative companies from the race, while the large and static established companies sit on their granted patents and collect rent (Boldrin & Levine, 2013).

Moreover, the Boldrin-Levine arguments also implied that a strong patent protection system limits the competition of inventors, and, consequently, less innovation and productivity would result from the protection system, as they have asserted, “greater competition, not patents, is the main factor leading to innovation and greater productivity” (p. 7). But, eliminating patents completely would not be a simple solution, if a solution at all, as Boldrin and Levine admitted the extreme radicalism and unlikely approach of that proposal. Furthermore, Alderucci and Baumol (2013) highlighted in their correspondence to the Boldrin-Levine argument, “if an inventor were reasonably certain that others would not learn the details of an invention during the period of patent protection, then patenting would be unnecessary because competitors would be unable to

make the invention and appropriate any of the market from its inventor" (p. 223), as patents cannot promote the dissemination of technology. Accordingly, any positive effects of patents may, instead, result in the impedance of incentives for future innovation because of the inevitable legal actions and licensing demands from earlier patent holders (Boldrin & Levine, 2013, p. 7).

Boldrin and Levine (2013) also argued the reasoning behind owning a large portfolio of granted patents could be a purely defensive strategy. In the world of technology, many of the large companies are racking and stacking up numerous amounts of intellectual property, though not all are for any changes or improvements of their own products. For example, Google's acquisition of Motorola Mobility, according to Boldrin and Levine (2013), was not to improve upon their own products, per se, but to obtain Motorola's patent portfolio as a pure defensive move, as it can then be used to "countersue Apple and Microsoft and blunt their legal attack on Google" (p. 8). This type of patent strategy occurs more often than someone outside the patent world may realize, as each major corporation have stellar teams of legal counsels to protect and prevent other companies from infringing upon their intellectual property, namely patents. The defensive patenting strategy has no apparent improvements upon the purchasing company's own products, yet hundreds of millions of dollars could be wasted on legal fees; therefore, Boldrin and Levine (2013) further concluded that the act of counterbalancing patent portfolios provides an overall lack of social benefit (p. 8).

From a purely innovative standpoint, Boldrin and Levine (2013) explained that companies can gain advantage over potential competitors from the first-mover advantages, though only if the new and innovative company can be successful in

"crack[ing] the market" (p. 11). Thus, the first-mover advantages further benefit the one that holds the monopolized industry, while potential industry competitors struggle to enter the market—hence impeding competition and inhibiting innovation. Boldrin and Levine (2013) further explained that "[w]hen an industry matures, innovation is no longer encouraged; instead, it is blocked by the ever-increasing appeal to patent protection on part of the insiders" (p. 11).

An unfortunate realization is the fact that everyone does it—at least everyone that is capable of preventing competition would do so to further increase profit. Even the well-known industry giants, such as Microsoft, can perform such hypocrisy. As Boldrin and Levine (2013) reminded the struggles of Microsoft's entrance into the mobile phone and tablet markets, Bill Gates also once warned in 1991, "[i]f people had understood how patents would be granted when most of today's ideas were invented and had taken out patents, the industry would be at a complete standstill today" (p. 12). That may be true to a certain extent, yet, Microsoft is no stranger of using patent litigation to claim shares of other companies' profits in the market, as having patents is seemingly inevitable to stay ahead in the competitive industry race.

The creation of monopolies and the toleration of preemption from patents have become a part of the patent game. As Sachs (2014) explained, "[t]he ordinary type of preemption that comes from patent claims is an accepted part of the patent system—that's the whole point of claims, to define the metes and bounds of the invention so that others are preempted from making, using, and selling what's inside the bounds."

Luckily, not every company is like Microsoft or Apple in that regard. There is still a little hope for advocates of a patent-free world, such as Boldrin and Levine. On June

12, 2014, Tesla Motors and its CEO Elon Musk made the announcement that shook the world, at least the patent world. Tesla Motors, at least on paper and in layman terms, has done the unconventional and unthinkable task of "sharing" its entire portfolio of patents with the rest of the world and its competition "in the spirit of the open source movement, for the advancement of electric vehicle technology" (Musk, 2014). Although anyone familiar with the intellectual property process may not find it as astonishing news, as patents are already published and shared as public domain. But it was the way that Musk and Tesla announced its movement that made it seem unprecedented.

An already established pioneer in the field, Musk (2014) realized that in order to create a successful path for the compelling electric vehicles, it must not "lay intellectual property landmines behind" to inhibit competition. The sharing of patents—although not a novel idea, as patents are already available to the general public—would certainly please the likes of Boldrin and Levine. And as of late, even the Supreme Court would agree with the Tesla tactic, as the Court has stressed over the years that the monopolization of the basic tools of scientific and technological work "through the grant of a patent might tend to impede innovation more than it would tend to promote it" (Alice Corp. v. CLS Bank Int'l, 2014). Furthermore, Musk (2014) ensured the world that there would be no patent lawsuits by Tesla against "anyone who, in good faith, wants to use [Tesla's] technology." Though the ramifications of this unconventional move are undoubtedly yet to be determined.

While Boldrin and Levine (2013) provided copious amount of research advocating against patents, they, however, also admitted that the "accumulated findings of no positive relationship between patenting and productivity are not conclusive, and

arguments have raged over the specific data used" (p. 6). And while Alderucci and Baumol (2013) claimed that the Boldrin-Levine argument concluded that patents do not result in the dissemination of technology and technical information, the latter authors claimed instead, "the simple and standard argument according to which patents do promote the dissemination of technology and technical information is incorrect" (Alderucci et al., 2013, p. 224). Boldrin and Levine (2013) simply argued that "while patents may in some particular circumstances be useful to promote innovation, even in those cases, the 'collateral damages' they produce generate social costs arguably larger than their benefits" (Alderucci et al., 2013, p. 224).

As more recent calls for a patent reform—i.e., a change to the lifespan of patents—have made headline news, the issue has also caught the attention of the White House. In his *State of the Union Address* in 2014, President Obama made the call to Congress to "pass a patent reform bill that allows our businesses to stay focused on innovation, not costly, needless litigation." Accordingly, the advocates for a weaker patent system continue to argue for a shorter lifespan for patents; however, the lifespan of patents do have some mathematical reasoning behind it. As patent attorney Quinn (2014) explained, "How quickly the [patent] examiner will get to review the application varies greatly depending upon the complexity and technological area of invention. For some types of inventions it could literally take [three] years to hear from the examiner." Thus, if anyone is concerned about the potential negative effects of the current patent protection term regarding innovation, it should be duly noted—and reminded—that the life of a patent starts ticking down at the very second the patent application is filed—not after the patent is published or granted.

Furthermore, during an interview with Cory Johnson on Bloomberg Television, Deputy Director Michelle Lee (2014) of the PTO also argued in favor of the existing duration of patent protection of twenty-years, and that it is justified and needed for many industries—i.e., the biotech and pharmaceutical companies. The deputy director further argued that the current period of exclusivity is admissible due to the hundreds of millions of dollars invested into the development, research, and for the FDA approvals needed for the new drugs, as well as allowing those companies to have the opportunity to recoup their investments (Johnson & Lee, 2014). Thus it is an unfortunate fact that in some cases, the "production costs alone may preclude supplying [the newly developed and patented] drugs to larger parts of the world's population" (Abbott, 2011, p. 8).

Even as so, there are still many aspects of the patent system that needs attention, such as the fundamental asymmetry in the distribution of economic incentives, as highlighted by Boldrin and Levine (2004). Patent lawsuits are contested in a completely different court system from the rest in the United States. Lawyers fought for the Federal Courts Improvement Act, which resulted in a system that would be courted and judged by the ranks of patent attorneys. While the judge panel in this case may appear to be biased, it should go without question that the chosen judges are highly qualified and correctly chosen, as the majority of judges in the legal world do not have a background in patents, nor in a technical field. Hence it is imperative to have the referee of the patent game as knowledgeable in the patent field as possible, in order to provide the fairest of judgments. As Boldrin and Levine (2004) noted, while many patent lawsuits have a goods aspect, even more are not so. A plaintiff may file a claim that its patent has been infringed, and if the plaintiff is named victor, the plaintiff "appropriates all the benefits of winning the

lawsuit" (p. 16). If the defendant wins, however, the benefits are only partial of the whole prize. This fundamental asymmetry is of special interest, and the so-called "patent trolls" have successfully manipulated it.

A patent troll is a non-practicing entity with a portfolio of patents for the sole purpose of licensing out to others. This practice has been deemed a corrupted one from the innocent consumers to patent attorneys, and all the way up to the White House. As noted previously, a part of President Obama's initiative for 2014 is to "combat patent trolls and further strengthen our patent system and foster innovation". The call for change, though not yet fully answered, has been at least picked up for a listen. United States House Representative Lee Terry (R-NE) has released a draft bill to target misleading patent troll demand letters (Schwartz, 2014). Under the bill, there would also be protections that enable the Federal Trade Commission (FTC) and state attorneys to bring charges against the misleading companies (Schwartz, 2014).

One of Boldrin and Levine's (2013) reform list items deals with international trading, and more specifically of the agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which was signed by the WTO in 1995 as part of the World Intellectual Property Organization (WIPO) (p. 19). They argued against both cases due to the claim of TRIPS and WIPO are "focused on how to prevent ideas from high-income countries from being used in low-income countries" (Boldrin & Levine, 2013, p. 19). Furthermore, they claimed the nature of TRIPS and WIPO are nothing more than propaganda for a neo-mercantilist approach (Boldrin & Levine, 2013). The immoral and rootless language presented, however, cannot be ever more distant from the intentions of

the agreement and the organization, which were both signed by and are part of the United Nations.

There are rules and laws made for very specific reasons. More often than not, while one cannot deny there are exceptions throughout history, those same rules and laws were made for the overall good. In the world of patents, as well as other types of intellectual property, critics must view an inventor's intellectual property rights as a precious resource. For instance, when compared to a physical property (i.e., a house), if a neighborhood receives an alert that burglars are on a rise and the criminals have and will continue to break in without mercy to steal every possession they deem valuable, wouldn't every person on the block purchase the best security systems and alarms possible? The same can be argued for intellectual property. If every person should be able to gain access to every invention created, what is the point of having an economy in the first place? Would everybody work for free, be merry, and live happily ever after? Of course, not. And there is perhaps not a more evident sector than the pharmaceutical market.

As one may expect, the counterfeiting of drugs can have a detrimental effect on not only the health of individuals but also the safety of the public. According to WIPO (2003), "approximately six (6) percent of pharmaceutical products sold worldwide are counterfeit," and countries in the developing world "account for the largest portion of such sales, with up to 70 percent of medicine sold in some African countries being counterfeit." Hence the need and existence of the Bayh-Doyle Act, which was enacted in 1982 as a "uniform patent policy among the many federal agencies that fund research, enabling small businesses and non-profit organizations, including universities, to retain

title to inventions made under federally-funded research programs" (Association of University Technology Managers [AUTM], 2002). According to *The Economist*, the Bayh-Doyle Act has been viewed as "perhaps the most inspired piece of legislation to be enacted in America over the past half-century" (AUTM). However, Boldrin and Levine (2013) disagreed and further argued against the Bayh-Doyle Act by advocating a return to the laws pre-1980 when "the results of federally subsidized research cannot lead to patents, but should be available to all market participants" (p. 19). But, as previously noted, if that were the case, there would be not be any the incentive and motivation for research and development.

## 2.2. Misconceptions of Patents and Pricings

Perhaps, Goldberg (2009) gave a more practical insight of the patent system and its effects on low-income countries. More specifically, Goldberg (2009) argued against the common misconceptions of the effects of patents on pharmaceutical prices and research incentives (p. 1). Despite Boldrin and Levine's (2013) spell against the TRIPS Agreement, Goldberg (2009) maintained that neither effects of the "classic trade-off between the static efficiency loss" and the "potential dynamic gains...associated with IPR protection [would] materialize in the aftermath of TRIPS" (Goldberg, 2009, p. 2). In fact, an increase in price would be unlikely because most countries already have existing price controls and regulations; and this, perhaps, should not be a revelation because the "developing country consumers are simply too poor to afford higher priced medicines" (Goldberg, 2009, p. 3).

Goldberg (2009) further discussed the theoretical foundations of intellectual property rights protection. Monopoly powers of patent holders often results in higher prices of the patented goods, but that is exactly what is needed to "spur the research and innovation that will lead to the introduction of newer and better products" (Goldberg, 2009, p. 4). The reality, as Goldberg (2009) explained, is that not all countries are created equal. A harmonious global market sounds ethical and logical in theory, but it is simply impossible due to different welfare implications between developing and the developed countries. Similar to individual human beings, "countries differ both in size of their respective domestic markets and in their skill endowments and technical know-how" (Goldberg, 2009, p. 4). Moreover, Goldberg (2009) explained that a "patent policy harmonization is neither necessary nor a sufficient condition for global efficiency" (p. 5).

Goldberg (2009) also highlighted the causes of price differences between first world nations (i.e., United States and European nations) and the third world countries (i.e., India), and how the least developed countries created many of the wide concerns for patents today. For example, the Indian pharmaceuticals industry inadvertently created significantly higher prices for medicines than the pricings of foreign multinational firms. Perhaps it was the intention of the Indian parliament to keep foreign industries out. The Indian Patents Act (1970) replaced the British colonial law regarding intellectual property rights to specifically exclude pharmaceutical product patents and only admit process patents for a period of seven years (Goldberg, 2009, p. 14). As a result, the Indian pharmaceutical industry grew to become the world's largest producer of formulations in terms of volume and the world's largest producers of bulk drugs (Goldberg, 2009, p. 14).

## 2.3. Licensing Agreements

The question of whether the patent system is good for society has been in debate for as long as patents have been in existence. The critics of the system have argued that patents have discouraged innovation, eliminated competition, and increased product costs due to its monopolizing scheme. The supporters of patents view the system differently, however, with the exact opposite intentions, from the other side of the same coin. The purpose of this section is not to choose which side is correct, because there are larger issues—moral issues—at hand to solve that concern the rights provided—or not provided—by patents. Some of those moral issues include, but are definitely not limited to, medicines with potential life-saving functions, especially in the developing countries. But since the developing countries are mostly users and not producers of the life-saving drugs, the biggest hurdle between the sick and poor and their medicines is the ease of access to those drugs. Unfortunately, the name of that hurdle may perhaps be patents, more specifically the laws protecting those patents and its holders.

The critics of patents would remind the supporters at this point of why the system is immoral due to its impeding access to the expensive, yet, life-saving drugs that are protected by patents, which are held by major pharmaceutical companies. The obvious solution, as one might conclude, is to compromise by allowing limited access for the drugs to the people who needed the most under very specific circumstances. And there is such a solution, namely, patent licensing. This game is, however, not that simple; not every player would agree on that resolution, or solution—one player being the United States.

### 2.3.1. Compulsory Licensing

As a policy measure, many countries have sought after the considerations for compulsory licensing on top of price controls. Moser and Voena (2012) discussed the details behind such licensing agreements for firms in the developing countries to produce foreign inventions without the consent of the patent owners.

Advocates of compulsory licensing propose the "ability to produce foreign inventions," which may strengthen the incentives to "invest in complementary research and skills" and create more opportunities (Moser & Voena, 2012, p. 397). On the flipside, Moser and Voena (2012) explained that the critics of compulsory licensing argued that it may "discourage domestic invention if access to foreign inventions at below-market rates weakens incentives to develop alternative technologies domestically" (p. 397). As a litmus test for the effects of compulsory licensing, Moser and Voena (2012) took an in-depth look at the post-World War I act of Trading with the Enemy Act (TWEA), which stated in Section 10 of the Act to allow U.S. firms to "violate enemy-owned patents if they contributed to the war effort" (p. 397). As a result of TWEA, by 1919, all patents once owned by Germany were systematically licensed to U.S. firms (Moser & Voena, 2012, p. 397).

Moser and Voena (2012) compared the changes in the number of patents of domestic inventors across technologies affected by the TWEA (i.e., technologies related to organic chemistry). The resulting encouragement of domestic inventions provided improvements in the education and scientific training across chemical technologies, as chemical inventions in all of the USPTO's subclasses were affected by tariff barriers and improvements in education, but only some subclasses were affected by compulsory licensing (Moser & Voena, 2012, p. 397). They concluded for subclasses that "received

at least one license" of enemy-owned patents under the TWEA that "domestic inventors produced an average of 0.151 additional patents per year after the TWEA compared with other subclasses. This implies an increase in domestic patents of nearly 25 percent relative to an average of 0.619 patents per subclass between 1919 and 1939" (Moser & Voena, 2012, p. 397).

Moser and Voena (2012) discovered certain caveats for the results of the timings of U.S. inventors to license foreign products surrounding the proposal of the TWEA. To better understand the results, Moser and Voena (2012) conducted additional tests to control the potential influences of alternative factors, such as any unobservable characteristics that may have encouraged patenting by all non-German inventors in treated subclasses, by using triple difference regressions. The regressions confirmed that compulsory licensing indeed "encouraged patenting by domestic inventors, even relative to other non-German inventors. An alternative test "artificially exposes French inventors, who could not license enemy patents under the TWEA to 'treatment' by compulsory licensing," in which case compulsory licensing had no effect (Moser & Voena, 2012, p. 398).

Moser and Voena (2012) performed several additional tests, controls, and analyses for the changes in patenting, more specifically in chemical patents. They performed a "firm-level analysis that distinguishes the effects of patents that were licensed to a specific U.S. firm (Du Pont) from the effects of patents that were licensed to other firms" (Moser & Voena, 2012, p. 399). They learned that the "[e]ffects of own licenses are more likely to result from learning that occurs when a firm produces foreign inventions, while other licenses capture factors that benefit the industry more broadly,

such as improvements in education" (Moser & Voena, 2012, p. 399). Furthermore, Moser and Voena (2012) concluded, "both types of mechanisms were important, but effects of own licenses were roughly four times as large as effects of other firms' licenses" (p. 399). Therefore, consistent with Moser and Voena's (2012) results, compulsory licensing seems to encourage domestic invention, as the policy allows for important incentive effects on invention in the country whose inventions are licensed, such as the response of U.S. pharmaceutical industry in India, under which the TRIPS agreement provide a "promising contemporary setting" (Moser & Voena, 2012, p. 425).

### 2.3.2. Compulsory Licensing in Foreign Countries

In addition to the Moser-Voena study, Yosick (2001) explained "compulsory licensing occurs when the state requires a patent holder to license his patent to another. Although common in other countries, including Japan, Germany, and the United Kingdom, it is rarely applied in the United States" (p. 1276). Moreover, the nations that do practice the use of compulsory licensing do so after the patent is not being worked, when a dependent patent is being blocked, or when the patent relates to food or medicine (Yosick, 2001, p. 1276). At least in one sense, compulsory licensing sounds like the perfect plan that the world needs in order to save the ones who cannot save themselves. Yet, as Yosick (2001) further highlighted, the use of compulsory licensing in the United States, however, is "limited to a few very narrow statutory provisions and as a remedy for antitrust violations" (p. 1276). One can only imagine the confusion and exasperation this may have raised by the provision regarding compulsory licensing, or lack thereof.

Before making any wrongful accusations by jumping to conclusions too soon, one must understand the U.S. patent system. According to the U.S. Patent and Trademark Office (PTO) (2014), the granting of a patent does not give the patent holder the right to make, use, offer for sell, or sell his invention; but rather, the right to "exclude others from making, using, offering for sell, or selling" the invention in the United States or importing the product into the United States. As noted above, the patent system in the U.S. has not been particularly inviting to the practice of compulsory licensing, and the Supreme Court has taken note, as found in *Dawson Chemical Co. v. Rohm & Haas Co.*, by admitting that "[c]ompulsory licensing is a rarity in our patent system" (Yosick, 2001, p. 1277). Rare does not mean never, however, as Yosick (2001) acknowledged that "[c]ourts have used compulsory licensing to remedy antitrust violations, in order to 'pry open to competition a market that has been closed by… illegal restraints'" (p. 1277). Moreover, the limited use of compulsory licensing also has statutory provisions under the Atomic Energy Act and the Clean Air Act, for their respective inventions. It is understandable as to why the two Acts received provisions for compulsory licensing: both pertain to the well-being of human life and its health. Accordingly, the confusion only continues, as life-saving medicines would be at the center of that exact category.

In fact, it has been proposed numerous times—e.g., the Hart Bill in 1973 and the Affordable Prescription Drugs Act—for the amendment of the U.S. patent law "to require compulsory licensing under certain circumstances, typically to prevent the suppression or non-use of patents" when it relates to "public health, safety, or protection of the environment" (Yosick, 2001, p. 1278). None of the proposals have been passed, however, due to the strong opposition by pharmaceutical industries and patent practitioners, both of

whom argued against any evidence of suppression of patents; and further claimed compulsory licensing as an act of socialism (Yosick, 2001, p. 1278). The resulting tension between the absolute right of the patent holder and the public good has only been further conflicted by judicial decisions of the Supreme Court.

One of those judicial decisions came from the case of *Continental Paper Bag Co. v. Eastern Paper Bag Co.*, after the patentee sued the defendant for infringement of its patent on machinery used in the production of paper bags (Yosick, 2001, p. 1279). The defendant argued that the patentee was not using the invention disclosed in the patent, and that "a court of equity should not allow a patent owner who is suppressing a patent to obtain an injunction to prevent others from using the invention" (Yosick, 2001, p. 1280). The Supreme Court, however, sided with the patentee by concluding that "it is the privilege of any owner of property to use or not use it, without question of motive," and the U.S. Congress had not implement a policy against the right of the non-use of a patent (Yosick, 2001, p. 1280). Accordingly, the Supreme Court held the non-use and suppression of the patent by the owner "was not grounds for prohibiting the owner from restricting the use of her patent" (Yosick, 2001, p. 1280).

As part of the everlasting struggle for the topic, the Supreme Court contradicted itself in the later case of *Special Equipment Co. v. Coe* when Justice Douglas argued against the *Continental Paper Bag* doctrine as "inconsistent with the Constitution" (Yosick, 2001, p. 1280). Justice Douglas noted that the right of a patent is a privilege condition on the public purpose "[t]o promote the Progress of Science and useful Arts" (Yosick, 2001, p. 1280). As Yosick (2001) reminded, Justice Douglas further noted, "the

increasing practice of patent suppression ‘preclude[d] experimentation’ and ‘blocked off’ whole technologies, causing a barrier to the whole economy” (p. 1280).

The question must now be turned to the definition of what is public purpose and interest, as the courts have rarely provided any force on the patentee to license, with exceptions to remedy antitrust violations. Concerning antitrust violations, the courts have also presented shares of seemingly contradicting decisions, as depended upon the individual company’s assertion of patent rights and defense, rather than any intent to expand or contract compulsory licensing (Yosick, 2001, p. 1283).

Even though the courts have shown slim signs of agreeing to provide compulsory licensing, there are still many provisions regulating it, especially internationally. As the international patent system, although slowly, has seen movements in the right direction with the adoptions of the Paris Convention, the PCT, the TRIPs agreement, and the AIPA in the U.S., there are still many steps needed to reach a somewhat satisfying compulsory licensing agreement. As briefly mentioned above, many foreign countries are ahead of the U.S. in this regard, and that has come with the help of the Paris Convention and the TRIPs agreement.

For the few and far between nations that have permitted compulsory licensing, many of which are of the convention and agreement that adopted three basic situations: 1) where a dependent patent is being blocked, 2) the patent is not being worked, or 3) the invention relates to food or medicine (Yosick, 2001, p. 1287). Additionally, in most of those countries, compulsory licensing may be ordered if the patent has not been worked for three years, either consecutively, as is in Japan, or within that timeframe of the grant, as is in Canada and Germany (Yosick, 2001, p. 1290). Of course, no party is requesting

compulsory licensing to be an open policy for any circumstance, but it should at least be granted in limited situations that are indispensable in the public interest, i.e., providing potential life-saving medicines.

The developing countries should have a voice in demanding such a procedure and policy because there are medical ethics that forbid the overlooking of treatment needs of patients affected. If the matters were simple, however, then this section would not need existence at all. Compulsory licensing was introduced by the WTO to allow generic medicines to be manufactured and exported to poor countries that cannot manufacture their own (Attaran, 2004, p. 161). While the theory of the license may appear promising, "it is extremely doubtful that this use of compulsory licensing, although much celebrated, can be made practicable" (Attaran, 2004, p. 161), at least for the United States.

Attaran (2004) expounded that the reluctant usage of compulsory licensing is not just an issue for the poor countries (p. 161). Compulsory licensing is "so disused that even where a country's own citizens might benefit from it—never mind foreigners in poor countries—zero generic medicines have been manufactured this way…treating zero patients in any country worldwide" (Attaran, 2004, p. 161). Attaran (2004) further noted that the "[t]hreats of compulsory licensing might be useful when rattling sabers with drug companies to lower medicine prices, but only a single (and usually powerful) developing country, Brazil, has ever succeeded in so doing. As such, compulsory licensing or the threat of it has seldom had any practical effect for public health" (p. 161).

Attaran (2004) found similar results as Goldberg (2009) and suggested to not solely rely on a reformation of the law to ease the conflicts; rather, bring "targeted relief" to the cases where essential medicines are patented in developing countries (p. 162).

Attaran (2004) found that “nearly all of the patented, brand-name essential medicines (except Cipro and Lariam) are deeply discounted in developing countries, so that the original products and their generic counterparts are often priced similarly” (p. 162). Moreover, some brand-name products can cost more than generics, while others can cost less (Attaran, 2004, p. 162). Attaran (2004) suggested the technique of “out-licensing” by having brand-name companies to agree to voluntarily license generic alternatives, on restricted terms that would allow competition to lower prices in developing countries, but which excluded that competition and preserve the core pharmaceutical markets of rich countries (p. 162).

Out-licensing could be a better alternative to the others (i.e., compulsory licensing) if and only if the companies could be convinced to volunteer instead of being confronted or attacked to do so. Attaran (2004) further suggested the pharmaceutical companies to explore the option of out-licensing, as they could “answer the concern that patents deprive the world’s poor of essential medicines, while winning praise for helping to develop new products that are badly needed for public health reasons” (p. 162).

While the current patent system is far from perfect, there are certainly many more practical and intellectual approaches than the ones provided and proposed by Boldrin and Levine (2013) to abolish the system as a whole. Perhaps, a better educational system, as Moser and Voena (2012) taught from the TWEA, to improve the knowledge of science, technology, engineering, and mathematics (STEM) would be a good place to start. From that point, the graduates of the STEM fields could provide knowledge for the patent offices and governments around the world, to better examine patent applications, as one

of the largest problems faced by the patent offices is the backlog of having more applications filed than the applications processed due to the lack of qualified examiners.

The constant battle within the patent world has become ever-more-normal than before. This also means the patent system, for better or worse, is here to stay as long as the world continues to turn with new inventions, and as long as the U.S. Court of Appeals for the Federal Circuit, as well as the Supreme Court, are involved in the decisions. At least for now, the Boldrin-Levine argument can only be viewed as a utopian alternative that may just stay a little while longer on the shelf of "what ifs". And until the President's initiative can be fully answered, the plaintiff's attorneys, unfortunately, will live to file suit another day.

We must realize that the patent system is here to stay. And as Yosick (2001) warned, "if no patent protection was available, the inventor would have a large incentive to keep his invention secret, so that no competitor would be able to copy it" (p. 1291). On the other hand, while only a very few critics would argue for the complete abolition of the patent system, the patent system does generate an increase in social costs as a result of the monopolistic pricing of products (Yosick, 2001, p. 1291). Competition among companies to make the best product is what drives innovation, and as a result, benefits the economy and the public. Therefore, it is imperative to find a balance that would give enough protection—and fair royalties—to encourage innovation, all the while, keeping the social burdens to a minimum.

### 2.3.3. Ex-ante Licensing

In addition to compulsory licensing and out-licensing is the even less familiar form of ex-ante licensing. The idea of ex-ante licensing was theorized by the cumulative innovation process. In ex-ante licensing, the follow-on innovator would have negotiated the terms of licensing agreements prior to unleashing a fortune of investments into the R&D process. As Comino (2011) explained, this practice is effective when there are potential detrimental consequences for the innovation process, specifically when an industry has a cumulative innovation process (Comino, 2011, p. 288). Further, the ex-ante licensing process would mitigate any risk of a hold-up of future innovations.

This practice is less common in the patent world, as Comino (2011) explained the argument against ex-ante licensing to be rather simple and reasonable, as "given the intangible nature of the objects of transactions, licensing agreements are inherently difficult to negotiate" and "parties might have disparate expectations about the value of the invention, or the validity and the boundaries of patent rights might be unclear" (p. 389). The argument in favor of ex-ante licensing is equally simple, however, as the supporters argued "with ex-ante licensing the R&D costs of the inventor are taken into account during the negotiation process with the effect of mitigating the inefficiency," and "the feasibility of prior agreements is enough to restore full efficiency of licensing negotiations, thus completely eliminating the risk of hold-up" (Comino, 2011, p. 389).

As common sense would have it, Comino (2011) argued that having prior agreements would be inefficient "simply because the patent-holder is unable to observe the timing of the investment of the follow-on innovator;" moreover, Comino (2011) proved that whenever proposals are made by the patent-holder, negotiations are completely ineffective "since the equilibrium licensing fees are identical to those

imposed by the Court" (p. 389). Additionally, whenever the follow-on inventor makes the proposals, Comino (2011) further explained that at the equilibrium, "the two parties never sign efficient contracts" (p. 389).

As Comino (2011) noted, different licensing procedures are conducted by different industries. In a cumulative innovation process, such as software and semiconductors, it is more likely for these sectors, where there is the so-called "freedom to design/operate" clause to practice ex-ante licensing. On the other hand, as for chemical and pharmaceutical industries, a licensing agreement is "not intended to obtain a technology transfer from the patent-holder in order to allow/speed up the research project and, therefore, it does not need to be negotiated before investing in R&D" (Comino, 2011, p. 390).

The main point is that different industries, similar to the various laws of different countries, and individual cases have different goals in the world of innovation. The law, as in the case of license agreements, is not a one size fit all type of deal. There must be compromises with limitations required for different situations, and for even more specific ideals, while still promoting a common good for the general public and society as a whole.

## 2.4. Bourdieu's Network of Games and Power

Pierre Bourdieu (1930-2002) was a French sociologist, anthropologist, and philosopher, whose studies and research covered a vast spectrum of topics, including sports, literature, science, law, and many others. While Bourdieu's profound knowledge on the copious amount of matters is impressive, many people, consequently, have found

his writings to be enigmatic. Among the sophisticated frameworks developed and introduced by Bourdieu were his key concepts of illusio, habitus, field, and capital (Baert & Carreira da Silva, 2010, p. 35). In Bourdieuian terms, the former pair of concepts dealt with reasons for the involvement and the dispositions of a particular "game", respectively, while a field is defined as a theory of many groups and games, and capital is defined as the strategies on how to "win" a particular game.

### 2.4.1. Field and Capital

This study now turns its focus to Bourdieu's concepts of field and capital. A "field," as briefly explained above, is the game itself. Moreover, a field can also be complex with many groups or games involved, such as "those areas of social life in which…struggles take place with respect to valuable goods or resources" (Baert & Carreira da Silva, 2010, p. 37). To be more specific, a field is "a set of objective, historical relations between positions anchored in certain forms of power" (Bourdieu & Wacquant, 1992, p.16). The field can be a game with a particular set of rules which can either provide assistance or hinder with tension and struggles for the players involved. For instance, a field can be explained as a simple children's game, such as baseball, and the "capital" of baseball can be the optional designated hitter rule. For ones less skilled in the art and game of baseball, the designated hitter position (Major League Baseball [MLB], 2012), as used in the American League (AL), has been an ongoing controversy over the past four decades between the AL and the National League (NL). Although seemingly minute to discourses outside of baseball, the one-sided rule can result in extreme ramifications, due to the claimed advantage of an extra skilled batter in the AL

over the NL. The imbalance of the two leagues provides different power and strategies for the game, or capital. Bourdieu coined the term "capital" when referring to the "goods and resources which are at stake" (Baert & Carreira da Silva, 2010, p. 37), and the stake from the aforementioned example is to win a baseball game.

Similar to life itself, not all of the competitors who are participating in the game will wholeheartedly agree with every written law, especially the rules that may translate into conflicts. As Bourdieu and Wacquant (2002) explained, "Any field… 'presents itself as a structure of probabilities—of rewards, gains, profits, or sanctions—but always implies a measure of indeterminacy,'" and "even in the universe par excellence of rules and regulations, playing with the rule is part and parcel of the rule of the game" (p. 18). Furthermore, the game of any particular field cannot be static; it is a dynamic one that has to be in motion with the ability to accept change and to adjust with each given obstacle. In terms of Bourdieu, "Every field is the site of a more or less overt struggle over the definition of the legitimate principles of the division of the field" (as cited in Martin, 2003, p. 31). The goal of the game, of course, is to win. There are particular guidelines required, and are necessary, to help define the correct ways—as well as the incorrect ways—to play and win the game of interest within a specific field. The simple act of winning does not, however, fulfill the stakes at hand. The more important aspect, rather, is the way in which a game is won and how different competitors apply different forms of methods to win the field.

Furthermore, a field is comprised with a central binary, or what Martin (2003) calls a "theoretically rich dualism" (p. 54). There are the common rival oppositions of night/day, black/white, and static/dynamic, but Bourdieu's field is contained with a more

superficial touch of one's perception of self. To Bourdieu, it is "a sense of one's place" (as cited in Martin, 2003, p. 54), as opposed to the Marxist estranged labour, where the man has lost all sense and self within his own body (Tucker, 1978, p. 77). The richness of the dualism comes when the man is in the process of perceiving himself. As this phenomenon occurs, not only does the man becomes aware of the world in relation to his position in the field, but the man also receives information about his own position (Martin, 2003, p. 54). There is a broad network within the man that allows holistic functions to identify the man's different positions. Thus, this network can be identified as the dominating factor of the dualism, whereas, the dominated is the group of lesser hierarchy. In terms of a game, the side of domination translates into the victor, and the dominated as the loser.

### 2.4.2. Field and Capital of IP

If the field is defined as our society and the game is defined as survival, then the winners and losers of intellectual property and patent systems can be clearly identified as the well-developed nations and the least developed countries, respectively. It is without a doubt that the countries with the most economic wealth will almost invariably dominate. In other words, the competitor with the most funds would be able to buy the most toys, such as research and development, and the ones with the most toys would typically have the better socioeconomic status. Conversely, on the other side of the same coin, the players with lower socioeconomic statuses would be the poor and underdeveloped countries.

It has been argued that modern day intellectual property law is a transformation of the medieval sumptuary codes. While it is not suggested that our society should return to the practice of sumptuary codes of the old, we should, nonetheless, reconsider the limitations of intellectual property law. Beebe (2010) explained that the previous sumptuary codes did not disappear, as it is commonly believed, but it has inadvertently transformed into the modern day intellectual property laws with the help of industrialization and democratization (p. 813). The intellectual property law, as we know it, has become "the prevention of misappropriation and the promotion of technological and cultural progress" (Beebe, 2010, p. 813). The transformed law still contains, however, the topical issue of the gap between the rich and the poor. As Beebe (2010) pointed out, there still remain the two conflicting sides of the law:

> the familiar progressive side of the law, which works, in the terms of the U.S. Constitution, "To promote the Progress of Science and useful Arts," and the unappreciated sumptuary side of the law, which is not progressive but rather socially and technologically reactionary. (p. 814)

In order to become a dominating player or country, such as the U.S., the member must have more access to more resources. As previously defined as capital, the resources are the means for a player to become the winner of the game.

Just as there are many types of fields, there are also different forms of capital and resources. The three most common forms of resources are financial capital, social capital, and cultural capital (Bourdieu & Wacquant, 2002, p. 119). The financial capital is the economic resource, or simply money. It goes without saying that having money can be useful in many games and fields including intellectual property. A social capital can be

defined as “the sum of the resources, actual or virtual, that accrue to an individual or a group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition” (Bourdieu & Wacquant, 2002, p. 119). A member with great amounts of economical and social capital would invariably have the third form of resources, the cultural capital. A cultural resource is the useful knowledge one has in a particular field. It is not by accident that someone who has more money and more connections would also have more tools for success in their field. As Bourdieu proposed the fact that “after controlling for economic position and social origin, students from more cultured families not only have higher rates of academic success but exhibit different modes and patterns of cultural consumption and expression” (Bourdieu & Wacquant, 2002, p. 160).

In the legal field, the judges and jurists, as well as ethics and morals, are to have, or should have, a universal view that is strictly objective. The legal norms should be provided and presented as “neutral common goods” despite the nature of the situation (Madsen, 2006, p. 1). We know, however, that the world is not fair and different countries have different amount of resources; consequently, inequality and conflict in that sense are inescapable. Bourdieu warned that we must avoid the “scholastic fallacy” —the error of “taking the things of logic for the logic of things” (Bourdieu & Wacquant, 2002, p. 123). We must, instead, reanalyze the situation and allow things to rationalize without worrying about arbitrary theories and effects of patents.

## 2.5. Chapter Summary

This section reviewed literature related to the current study, which focused on the general views of patents and the intellectual property law system as a whole, and its effect on the access of essential medicines in the African LDCs, as well as the overall health of those countries in relation to socioeconomics status. Generally, the existence of a patent system is better than the alternative, but the question of how much and how strong should the law dictate is yet to be answered. In addition, the literature was reviewed regarding the concepts of Pierre Bourdieu on the networks of game and power, and how those theories could be applied to the problems of patent law with socioeconomics and health. On the basis of the literature review, eleven hypotheses were developed for the study.

### 2.5.1. Research Question

Based on Attaran's and others' studies, it was assumed that a better socioeconomic status would increase the availability and access to essential medicines, as well as an increase in overall health in the African LDCs. Since 1990, the Human Development Report Office of the UN has produced the one-of-kind report to study the global progress of human being achievements and developments. The annually published Human Development Report has certainly shaped the world from an economics standpoint with its countless data and analyses, as well as significant influences on different government policy decisions, particularly in regard to the global health statuses of humans (United Nations Development Programme [UNDP]). "Human development, as an approach, is concerned with…the basic development idea: namely, advancing the richness of human life, rather than the richness of the economy in which human beings

live, which is only a part of it," said Amartya Sen (1998), a Nobel Laureate professor of economics at Harvard University (UNDP).

The UNDP analyzes each individual country—and its people and their abilities—with the Human Development Index (HDI). It is the geometric mean of normalized indices with an overview measurement of the three key dimensions necessary for human development: a long and healthy life, being knowledgeable and have a decent standard of living (UNDP).

This study examines the potential factors and variables involved in the inhibition and encumbrance surrounding the necessary, yet extraordinarily essential medicines needed by the developing world. And patents, however, may only play a small part in the limited access, as Attaran (2004) suggested a more evident and devastating antagonist: poverty. More specifically, Attaran (2004) found that "patents for essential medicines are uncommon in poor countries and cannot readily explain why access to those medicines is often lacking, suggesting that poverty, not patents, impose the greater limitation on access" (p. 156). Based on this assumption, specific data are examined by statistical methods to identify the potential relationship among patents, socioeconomics, and the access of essential medicines. In addition to UN's Global Health Observatory's Data Repository, the UNDP's Human Development Reports can only benefit with the necessary dimension and information needed for this study.

# Chapter III

# Methods

This chapter briefly reviews the background information and the details for the methodology and measures utilized to conduct this study. This study is a quantitative analysis of different socioeconomic circumstances of 102 countries of various wealth and development levels, including the 34 least developing countries of Africa, 34 countries of medium human development, and 34 countries of the highest human development. The data collected are exclusively from the umbrella of the United Nations, particularly the Global Health Observatory's Data Repository of the World Health Organization (WHO) and the United Nations Development Programme's (UNDP) Human Development Reports.

## 3.1. Background

Under the UN Economic and Social Council, the Committee for Development Policy (CDP) updates data regarding the Least Developed Countries (LDCs) once every three years, and this process is performed based on three criteria: per capita gross national income (GNI), human assets index (HAI), and economic vulnerability index (EVI). To join the list of LDCs, a country must satisfy all three criteria, and the population of that country must not exceed 75 million (UN). Currently, there are 48 members on the UN list of LDCs, and 34 of the countries are located in Africa alone. This study will examine and

analyze the available data of the contrasting wealth and development of 102 countries, including the 34 African LDCs, 34 countries with medium human development rankings, and the 34 countries on top of the human development rankings for 2013, which includes the United States at third place.

While patents are great for the promotion of innovation, it can also have the negative side effect of allowing patent holders to charge any price—no matter how expensive—they wish for their inventions. The pricing issue is the cause of both low affordability and low accessibility of the medicines needed. Hence it is proposed that a set of laws and regulations be placed on the potential licensing agreements of the patented drugs made for the most essential medicines for the LDCs, whose patent holders may not only be from the universities—as proposed by UAEM—but also any pharmaceutical companies who are the sole assignees of the patents. In the case of a university, the licensing process shall be provided through the office of technology transfer, or the like, between the owner of the IP and the pharmaceutical company. The possibility of an "evergreening" patent must not be allowed for the patents of essential medicines. Additionally, the license agreements shall include the clear percentage of royalties to the inventors, and the protection period of the technology shall be the same as other utility patents (i.e., twenty years). The agreement must also include the lower prices of said drugs for the disadvantaged, as lower cost can potentially provide easier access for the medicines.

Moreover, the proposed plan should be applied whenever an essential medicine patent is licensed to a pharmaceutical company, the same agreement shall be eventually licensed to a generic company for a cheaper pricing of the same drug to provide for the

LDCs. While this idea may sound plausible in theory, the actuality of a reform occurring can only be judged by time. And theoretically, the major pharmaceutical companies should not worry about losing their next bonus paycheck because of the sharing of ownership of patents with generic companies because the brand name industries' customers will still be present regardless of price; while the generic companies for essential medicines can simultaneously provide for the disadvantaged in a place far away.

In similar fashion, a major pharmaceutical company can (and should) model after Blake Mycoskie and his idea for every pair of Toms shoes purchased, that exact number of shoes would be matched and given to someone who does not own a pair of shoes. Of course, the shoe business is drastically different from the pharmaceutical industry mainly because of the stringent testing and requirements by the Food and Drug Administration (FDA) for drugs. It also does not, however, prove the idea to be completely fraud, as the Toms procedure can still be used as a base to model after.

## 3.2. Methods

In order to understand the full impact intellectual property, namely patents, may have on the developing world, more specifically the least developed countries, and the access issue of essential medicines, it is necessary to conduct a study that examines the relationship between health and socioeconomic statuses of the 34 least developed African countries with 34 countries of medium human development levels, and 34 countries with the highest human development levels. However, the one benefit of using available data can also be the one drawback of utilizing such a study, as the data of some countries, particularly LDCs, may not be available.

This study explores the relationship of the human development index value with the following independent variables: the gross national income per capita (PPP int. $); the percentage of population living in urban areas; the percentage of population with access to essential drugs; the under-five mortality rate per 1,000 live births (also a dependent variable for one case); the life expectancy at birth in years; the number of patents granted to residents and nonresidents per million people; the population's median age in years; and the general government expenditure on health as a percentage of total government expenditure.

Ideally, this research should be a longitudinal study to record the changes of the data with the timetable of at least ten years, as potential new laws and regulations are implemented on drug licensing to pharmaceutical companies and governments around the world. As for this particular study, the dataset collected for the study variables are from several researched periods—ranging from as early as 1999 (one variable) and up to the more recent 2013—as provided by and collected from the most available databases. The dataset collected for the nine different variables are from a variety of years due to the incomplete data information provided by the repository of the databases. Consequently, the years chosen for each respective variable are intended to provide the most accurate, consistent, and reliable set of data possible. The data collection for this study will be exclusively from the UN, more specifically the WHO's Global Health Observatory's (GHO) Data Repository and the UNDP's Human Development Reports. The data collected were extracted and entered into an Excel spreadsheet. Correlation statistics, analysis of variances, and ordinary least squares regression were conducted using SPSS Statistics.

Because this research methodology relies solely on the best available data and estimates provided by the UN, a small number of errors are likely to exist, although not so many as to materially affect the conclusions. It is strongly recommended for anyone wishing to rely on these findings to check and review the GHO Data Repository and the Human Development Reports for the more updated or revised data, as they become available.

## 3.3. Measures

This study includes the following two dependent variables: the human development index value of 102 countries (Tables 2 and 3) and the under-five mortality rate per 1,000 live births (Table 4). The independent variables used for this study are as follows: the gross national income per capita (PPP int. $); the percentage of population living in urban areas; the percentage of population with access to essential drugs; the life expectancy at birth in years; the number of patents granted to residents and nonresidents per million people; the population median age in years; the general government expenditure on health as a percentage of total government expenditure; as well as the under-five mortality rate per 1,000 live births.

### 3.3.1. Dependent Variables

The dependent variable of the human development index value is a measuring system of the United Nations; specifically it is “a measure…developed by the United Nations Development Programme, which ranks national development based on measures of life expectancy at birth, educational attainment, and adjusted real per capita income. It

is designed to give a more holistic view of a country's development status, compared to per capita income (the measure used by the World Bank to rank countries)" (WHO, 2014).

The second dependent variable of the under-five mortality rate per 1,000 live births in the African Region is an indicator of the GHO Data Repository. The WHO defines the indictor as "the probability of a child born in a specific year or period dying before reaching the age of five, if subject to age-specific mortality rates of that period" (WHO, 2011). Trends of under-five mortality with standardized methodology by group of countries depending on the type and quality of source of data available are provided by the Inter-agency Group for Child Mortality of Estimation, which includes representatives from UNICEF, WHO, the World Bank, and the United Nations Population Division (WHO, 2011).

### 3.3.2. Independent Variables

The first independent variable is the GHO indicator of the gross national income (GNI) per capita based on purchasing power parity (PPP). This socioeconomic ratio data is defined by the WHO as "the gross national income converted to international dollars using purchasing power parity rates" (WHO, 2011). Further, "an international dollar has the same purchasing power over GNI as a U.S. dollar has in the United States. The GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad" (WHO, 2011). The method of

estimation is based on the available estimates taken from the World Bank's World Development Indicator (WHO, 2011).

The second independent variable is the percentage of population living in urban areas, which is an indicator of the GHO Data Repository. The WHO defines the demographic percent data as the "percentage of de facto population living in areas classified as urban according to the criteria used by each area or country as of 1 July of the year indicated" (WHO, 2011). Furthermore, the population data are estimated from the most recent UN Population Division's "World Population Prospects" (WHO, 2011).

The percentage of population with access to essential drugs is the third independent variable. The data on the access to essential drugs are based on statistical estimates received from the individual WHO countries, regional offices, and regional advisers, and through the World Drug Situation Survey carried out in 1998 to 1999 (Human Development Report, 2001). The WHO defines this variable as the percentage of the population for whom a minimum of twenty of the most essential drugs are continuously and affordably available at public or private health facilities or drug outlets within one hour's travel from home (WHO).

Similar to the already defined dependent variable of the under-five mortality rate per 1,000 live births in the African Region, the fourth independent variable is also an indicator of the GHO Data Repository. The WHO defines the indictor as "the probability of a child born in a specific year or period dying before reaching the age of five, if subject to age-specific mortality rates of that period" (WHO, 2011). Trends of under-five mortality with standardized methodology by group of countries depending on the type and quality of source of data available are provided by the Inter-agency Group for Child

Mortality of Estimation, which includes representatives from UNICEF, WHO, the World Bank, and the United Nations Population Division (WHO, 2011).

The fifth independent variable is the life expectancy at birth in years. The WHO defines this variable as the "number of years a newborn infant could expect to live if prevailing patterns of age-specific mortality rates at the time of birth stay the same throughout the infant's life (WHO).

The number of patents granted to residents and nonresidents per million people is the sixth independent variable. The WHO defines this variable as the number of exclusive rights granted for an invention, which is a product or a process that provides a new way of doing something or offers a new technical solution to a problem, expressed per one million people (WHO).

The seventh independent variable is the statistical indicator of population median age in years, which is also found in the GHO Data Repository. The WHO defines the demographic statistic as the "age that divides the population in two parts of equal size, that is, there are as many persons with ages above the median as there are with ages below the median" (WHO, 2011). The population data for median age are also taken from the most recent UN Population Division's "World Population Prospects" (WHO, 2011).

The final independent variable is the general government expenditure on health as a percentage of total government expenditure on health in the African Region. The WHO defines this health systems resource indicator simply as the "level of general government expenditure on health expressed as a percentage of total expenditure on health" (WHO, 2011). It is a concern of the WHO, as this is "a core indicator of health financing

systems" (WHO, 2011). Additionally, the indicator "contributes to understanding the relative weight of public entities in total expenditure on health," and it "includes not just the resources channeled through government budgets to providers of health services but also the expenditure on health by parastatals, extrabudgetary entities and notably the compulsory health insurance payments" (WHO, 2011).

The statistical tests for this data analysis will include a section of descriptive statistics of the study variables, followed by correlation statistics of all independent variables, an analysis of variance of the human development index with five independent variables, and a least squares regression of the under-five mortality rate with three independent variables (WHO).

### 3.3.3. Analysis of Data

A constant throughout this study was the lack of data for several countries, as only one variable was provided with data for all 102 countries—life expectancy at birth. The data for life expectancy at birth, and the data for the population median age were rounded to the nearest tenth—e.g., 23.64 years were treated as 23.6 years.

The number of patents granted to residents and nonresidents had the most missing values with 49 countries without available data; therefore, only 53 countries were examined (N = 53) for this variable. The data for the number of patents granted were rounded to the nearest tenth—e.g., 758.77 patents were treated as 758.8 patents.

Moreover, eight countries did not have available data for the percentage of population with access to essential drugs, and seven countries did not have data for the general government expenditure on health as a percentage of total government

expenditure. The data for the percentage of population with access to essential drugs were rounded to the nearest whole number, while the percentages of general government expenditure on health were rounded to the tenth—e.g., 47.2 percent and 19.78 percent were treated as 47.0 percent and 19.8 percent, respectively.

The analysis for the population median age was examined on the 98 countries (N = 98) with available data. Moreover, only 100 countries (N = 100) were given data for the following variables: the gross national income per capita and the under-five mortality rate, and there were two unranked countries for the human development index—Somalia and South Sudan. The data for the gross national income and under-five mortality rates were rounded to the nearest whole number—e.g., 8626.34 dollars and 18.23 mortalities were treated as 8626.0 dollars and 18.0 mortalities, respectively. The human development index value was rounded to the nearest thousandth—e.g., 0.8615 unit was treated as 0.862 unit.

The only country without available data for the percentage of population living urban areas was Palestine. The data were rounded to the nearest tenth—23.21 percent was treated as 23.2 percent.

Furthermore, the total mean and standard deviation of the mean were rounded to the nearest hundredth place, and the range of the data were rounded to the nearest tenth place—e.g., 32.498 units, 4.196 units, and 1.432 unit would be treated as 32.50 units, 4.20 units, and 1.4 unit, respectively.

Naturally, the term “affordability” varies for each nation, as some treatments may seem affordable—i.e., for acute respiratory infection—many developing country populations, however, are earning less than the lowest-paid government worker

(Cameron, Ewen, Ross-Degnan, Ball, & Laing, 2009, p. 248). According to the WHO (2005) data, nearly 56 percent of the LDCs in Africa lived under $1 a day (Appendix A: Table 1).

# Chapter IV

# Findings

This chapter is a presentation of the statistical results and findings of the study. The descriptive statistics are presented first, with the chosen independent variables examined after, followed by the results for the correlation statistics, analysis of variance, and the ordinary least squares regression analyses. For each of the statistical analysis sections, an introduction of the analysis used with the chosen independent variables is presented first, followed by the results of each examination and analyses.

The test results of the selected variables are presented in tables 1, 2, 3, and 4, as located below, as well as Appendix A. All of the statistical test outputs were generated using SPSS Statistics, and the results are presented as follows:

## 4.1. Variables

A total of nine variables were examined to some individual extent for this study. The variables chosen and tested are from the WHO's Global Health Observatory (GHO) Data Repository and the United Nations Development Programme (UNDP) Human Development Reports. As a disclaimer, the data collected are the best estimates of WHO and the UN and are only updated and revised as more data become available. Therefore, the data presented hereafter may not be identical to the individual nation's official estimates. At the time of this study, the two mentioned sources are, however, arguably the

most reliable for generating this dataset, as well as for any information regarding the most remote areas, such as the African Region.

The selected variables of human development index value; the gross national income per capita; the percentage of population living in urban areas; the percentage of population with access to essential medicines; the under-five mortality rate per 1,000 live births; the life expectancy at birth in years; the number of patents granted to residents and nonresidents per one million people; the population median age in years; and the general government expenditure on health as a percentage of total government expenditure were examined.

The dependent variables were chosen from the above variables depending on its relevance to the individual tests performed. More specifically, the dependent variables used in this study are the human development index value (Table 2, 3, 4) and under-five mortality rate per 1,000 live births (Table 4). The independent variables used for this analysis are as follows: the gross national income; the percentage of population living in urban areas; the percentage of population with access to essential drugs; the under-five mortality rates; the life expectancy at birth in years; the number of patents granted to residents and nonresidents per one million people; the population median age in years; and the general government expenditure on health.

## 4.2. Descriptive Statistics

There are currently a total of 48 members on the UN list of the least developed countries (LDCs) in the world, and 34 of the LDCs are located in Africa (N = 34). In Table 1 (below), only one of the variables selected was provided with a complete dataset

for the countries of interest. The overall data collected, however, expanded a wide range from 53 countries to the one complete variable with all 102 countries (N = 53-102).

Table 1 presents the descriptive statistics for the study variables of (1) human development index (N = 100); (2) the gross national income per capita (PPP int. $) (N = 100); (3) the percentage of population living in urban areas (N = 101); (4) the percentage of population with access to essential medicines (N = 94); (5) under-five mortality rate per 1,000 live births (N = 100); (6) the life expectancy at birth in years (N = 102); (7) the number of patents granted to residents and nonresidents per one million people (N = 53); (8) the population median age in years (N = 98); and (9) the general government expenditure on health as percentage of total government expenditure in the African Region (N = 95).

The table shows the mean of gross national income per capita of the 102 countries to be $15,536.21 with a standard deviation of $18,275.46, and a range interval of $80,691.00 with the minimum amount at $320.00 in the Democratic Republic of the Congo to the drastic maximum of $81,011.00 in Liechtenstein.

Regarding the percentage of population from 101 countries living in urban areas, the range difference is another astounding interval with 88.80 percent, from Burundi's minimum of only 11.20 percent all the way up to the extreme maximum of both Hong Kong and Singapore's 100.00 percent. The mean of the urban area population is 53.8 percent (M = 53.826) with a standard deviation of 21.21 percent (SD = 21.214).

The 94 countries examined for the percentage of population with access to essential medicines provided similar trends to the percentage of population living in urban areas. The overall average of the population's access to essential drugs is 77

percent (M = 76.734) with a standard deviation of just below 23 percent (SD = 22.833). The country with the least access to essential drugs is Madagascar's population at only 15 percent, while the populations of twenty countries have the extraordinary maximum access of 100 percent to essential drugs.

The one variable that is likely to strike a chord for most people is the under-five mortality rate per 1,000 live births. For the 100 countries examined, the average probability of dying for children of five years old and under is a disturbing number of 45 deaths (M = 45.020) per every 1,000 live births, and a standard deviation rate of also 45 deaths (SD = 45.277). While many countries, particularly the ones with high human development rankings, have single digit probabilities, many more countries do not appear as fortunate. There are two countries tied with the fewest children death rate of 2 mortalities per 1,000 live births: Iceland and Liechtenstein. While on the other end, Burkina Fuso has the highest under-five mortality rate per 1,000 live births at 178 deaths.

From the unfortunately inevitable event of death, we now turn to a more unknown and unpredictable, but not without limit, variable of life expectancy. All 102 countries of interest were examined, and the average length for life expectancy at birth is 65 years (M = 65.1088), with a standard deviation of 13 years (SD = 13.3813). The range of life expectancy is 42.50 years expanding from the shortest expectancy of 38.30 years for Mozambique to the longest of 80.80 years for Japan.

The number of patents granted to residents and nonresidents per one million people showed a mean of about 220 patents per one million people (M = 220.432) and a standard deviation of about 368 patents (SD = 368.1163). The country with the fewest granted patents per one million people was Gambia with only 0.2 granted patent per one

million people, while the most granted patents belong to Japan with 1759.9 granted patents per one million people.

The population median age of 98 countries was also examined. The mean of the median age is 27 years old (M = 27.046) with a standard deviation of 9.32 (SD = 9.325). The interval of median ages stretches from the youngest of only 15.50 years old in Niger—meaning one-half of Nigerians are above the age of 15.50 years old, while the other half are under the age of 15.50 years old—to 44.7 years old in Japan—meaning one-half of the Japanese population are above the age of 44.7 years old, while the other half of Japanese people are under the age of 44.7 years old (Range difference = 29.2).

Finally, the general government expenditure on health as a percentage of total government expenditure was examined for 95 countries. The average percentage amount of expenditure on health of a government's total expenditure is 12.4 percent (M = 12.401) with a standard deviation of 4.3 percent (SD = 4.289). Although seven countries did not have available data information on government expenditure, the country found with the lowest percent of expenditure on health was Rwanda at only 1.8 percent, while the highest was from the government of Andorra at 21.3 percent of its total government expenditure.

Table 1. *Descriptive Statistics for Study Variables of 102 Countries of Various HDI Ranks and Various Years*

| Variables | Mean | SD | Range | Min. | Max. | N |
|---|---|---|---|---|---|---|
| Human Development Index (HDI) Value, 2012 | .662 | .202 | .651 | .304 | .955 | 100 |
| Gross national income per capita (PPP int. $), 2010 | 15536.21 | 18275.46 | 80691.00 | 320.00 | 81011.00 | 100 |
| Population living in urban areas (%), 2010 | 53.83 | 24.21 | 88.80 | 11.20 | 100.00 | 101 |
| Population with access to essential drugs (%), 1999 | 76.73 | 22.83 | 85.00 | 15.00 | 100.00 | 94 |
| Under-five mortality rate (per 1,000 live births), 2011 | 45.02 | 45.28 | 176.00 | 2.00 | 178.00 | 100 |
| Life expectancy at birth (years), 2012 | 65.11 | 13.38 | 42.50 | 38.30 | 80.80 | 102 |
| Patents granted to residents and nonresidents (per million people), 2010 | 220.43 | 368.12 | 1759.70 | 0.20 | 1759.90 | 53 |
| Population median age (years), 2010 | 27.05 | 9.32 | 29.20 | 15.50 | 44.70 | 98 |
| General government expenditure on health of total government expenditure (%), 2010 | 12.40 | 4.29 | 19.50 | 1.80 | 21.30 | 95 |

## 4.3. Correlation Analysis

The first test examined the general impact and significance of people of various socioeconomic statuses has on the (1) human development index value. A correlation was tested for each of the following independent variables: (2) gross national income per capita; (3) the percentage of population living in urban areas; (4) the percentage of population with access to essential drugs; (5) the under-five mortality rate per 1,000 live births; (6) the life expectancy at birth in years; (7) the number of patents granted to residents and nonresidents per one million people; (8) the population median age in years; and (9) the percentage of general government expenditure on health. The correlation results are presented below in Table 2.

### 4.3.1. Correlation of Variables

Table 2 (below) presents the correlation statistics for the dependent variable of the human development index value (N = 100) with (2) the gross national income per capita (PPP int. $) (N = 100); (3) the percentage of population living in urban areas (N = 101); (4) the percentage of population with access to essential medicines (N = 94); (5) under-five mortality rate per 1,000 live births (N = 100); (6) the life expectancy at birth in years (N = 102); (7) the number of patents granted to residents and nonresidents per one million people (N = 53); (8) the population median age in years (N = 98); and (9) the general government expenditure on health as percentage of total government expenditure in the African Region (N = 95).

The independent variables—gross national income, percentage of population living in urban areas, percentage of population with access to essential drugs, life

expectancy at birth in years, the number of patents granted to residents and nonresidents, the population median age, and the general government expenditure on health—were hypothesized to have a positive linear relationship with the dependent variable, such that as the amount of national income, the percentage of population in urban areas, the percentage of population with access to essential drugs, the life expectancy at birth, the number of patents granted, the population median age, and the percentage of government expenditure on health increases, the higher the human development (HDI) index value would become. The correlation between the HDI value and the gross national income per capita is .813 with 98 degrees of freedom. The significance level is reported as .000, suggesting that when assuming that everything else in this model is correct, the probability of such a result to occur by chance is only 0.1 percent. Thus, it can be concluded that the two variables are significantly and strongly positively correlated, meaning the greater the amount of gross national income, the more likely the value of HDI will increase.

Similarly, the correlation between the HDI value and the percentage of population living in urban areas is .736 with 97 degrees of freedom. The significance level is reported as .000, suggesting that when assuming that everything else in this model is correct, the probability of such a result to occur by chance is only 0.1 percent. Thus, it can be concluded that the two variables are significantly and strongly positively correlated, meaning the greater the percentage of population is living in urban areas, the more likely the value of HDI will increase.

Moreover, the correlation between the HDI value and the percentage of population with access to essential drugs is .708 with 90 degrees of freedom. The

significance level is reported as .000, suggesting that when assuming that everything else in this model is correct, the probability of such a result to occur by chance is only 0.1 percent. Thus, it can be concluded that the two variables are significantly and strongly positively correlated, meaning the greater the percentage of population with access to essential drugs, the more likely the value of HDI will increase.

Further, the correlation between the HDI value and the life expectancy at birth in years is .907 with 98 degrees of freedom. The significance level is reported as .000, suggesting that when assuming that everything else in this model is correct, the probability of such a result to occur by chance is only 0.1 percent. Thus, it can be concluded that the two variables are significantly and strongly positively correlated, meaning the higher in years of the life expectancy at birth, the more likely the value of HDI will increase.

Similarly, the correlation between the HDI value and the patents granted to residents and nonresidents per one million people is .449 with 51 degrees of freedom. The significance level is reported as .001, suggesting that when assuming that everything else in this model is correct, the probability of such a result to occur by chance is only 0.1 percent. Thus, it can be concluded that the two variables are significantly and strongly positively correlated, meaning the higher the number of patents granted to residents and nonresidents per one million people, the more likely the value of HDI will increase.

Moreover, the correlation between the HDI value and the population median age in years is .859 with 96 degrees of freedom. The significance level is reported as .000, suggesting that when assuming that everything else in this model is correct, the probability of such a result to occur by chance is only 0.1 percent. Thus, it can be

concluded that the two variables are significantly and strongly positively correlated, meaning the higher the population median age in years, the more likely the value of HDI will increase.

Furthermore, the correlation between the HDI value and the general government expenditure on health of total government expenditure is .419 with 91 degrees of freedom. The significance level is reported as .000, suggesting that when assuming that everything else in this model is correct, the probability of such a result to occur by chance is only 0.1 percent. Thus, it can be concluded that the two variables are significantly and strongly positively correlated, meaning the greater the percentage of general government expenditure on health of total government expenditure, the more likely the value of HDI will increase.

The independent variable of under-five mortality rate per 1,000 live births was, however, conversely hypothesized to have a negative relationship with the dependent variable, such that the higher the mortality rate, the lower the HDI value would become. The correlation between the HDI value and the under-five mortality rate per 1,000 live births is -.841 with 96 degrees of freedom. The significance level is reported as .000, suggesting that when assuming that everything else in this model is correct, the probability of such a result to occur by chance is only 0.1 percent. Thus, it can be concluded that the two variables are significantly and strongly negatively correlated, meaning the greater the under-five mortality per 1,000 live births, the more likely the value of HDI will decrease.

Table 2. *Correlation of Study Variables for 102 Countries of Various HDI Ranks and Various Years*

| Variables | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Human Development Index (HDI) Value, 2012 | Pearson Correlation | -- | | | | | | | | |
| | Sig. (2-talied) | | | | | | | | | |
| | N | 100 | | | | | | | | |
| 2. Gross national income per capita (PPP int. $), 2010 | Pearson Correlation | .813** | -- | | | | | | | |
| | Sig. (2-talied) | .000 | | | | | | | | |
| | N | 100 | 100 | | | | | | | |
| 3. Population living in urban areas (%), 2010 | Pearson Correlation | .736** | .650** | -- | | | | | | |
| | Sig. (2-talied) | .000 | .000 | | | | | | | |
| | N | 99 | 99 | 101 | | | | | | |
| 4. Population with access to essential drugs (%), 1999 | Pearson Correlation | .708** | .664** | .588** | -- | | | | | |
| | Sig. (2-talied) | .000 | .000 | .000 | | | | | | |
| | N | 92 | 92 | 94 | 94 | | | | | |
| 5. Under-five mortality rate (per 1,000 live births), 2011 | Pearson Correlation | -.841** | -.623** | -.566** | -.675** | -- | | | | |
| | Sig. (2-talied) | .000 | .000 | .000 | .000 | | | | | |
| | N | 98 | 98 | 100 | 94 | 100 | | | | |
| 6. Life expectancy at birth (years), 2012 | Pearson Correlation | .907** | .641** | .602** | .660** | -.876** | -- | | | |
| | Sig. (2-talied) | .000 | .000 | .000 | .000 | .000 | | | | |
| | N | 100 | 100 | 101 | 94 | 100 | 102 | | | |

| Variables | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 7. Patents granted to residents and nonresidents (per million people), 2010 | Pearson Correlation | .449** | .421** | .434** | .318* | -.292* | .305* | -- | | |
| | Sig. (2-talied) | .001 | .002 | .001 | .021 | .035 | .027 | | | |
| | N | 53 | 53 | 53 | 52 | 52 | 53 | 53 | | |
| 8. Population median age (years), 2010 | Pearson Correlation | .859** | .840** | .713** | .722** | -.732** | .732** | .399** | -- | |
| | Sig. (2-talied) | .000 | .000 | .000 | .000 | .000 | .000 | .003 | | |
| | N | 98 | 98 | 98 | 93 | 97 | 99 | 53 | 99 | |
| 9. General government expenditure on health of total government expenditure (%), 2010 | Pearson Correlation | .419** | .454** | .366** | .422** | -.495** | .378** | .375** | .468** | -- |
| | Sig. (2-talied) | .000 | .000 | .000 | .000 | .000 | .000 | .007 | .006 | |
| | N | 93 | 93 | 95 | 90 | 95 | 95 | 50 | 93 | 95 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

## 4.4. Analysis of Variance

The analysis of variance (ANOVA) is used to compare statistical means to determine if any significant differences exist between two or more means. This test examined the dependent variable of the 102 countries' different human development index values with five independent variables of (1) patents granted to residents and nonresidents per one million people; (2) life expectancy at birth in years; (3) under-five mortality rate per 1,000 live births; (4) the percentage of population with access to essential drugs; and (5) the general government expenditure on health as a percentage of total government expenditure by conducting an analysis of variance. The ANOVA results are presented below in Table 3.

### 4.4.1. ANOVA

Table 3 presents an analysis of variance (ANOVA) of the human development index (HDI) value with (1) the number of patents granted to residents and nonresidents (N = 53); (2) the life expectancy at birth in years (N = 102); (3) the under-five mortality rate per 1,000 live births (N = 100); (4) the percentage of population with access to essential drugs (N = 94); and (5) the general government expenditure on health as a percentage of total government expenditure.

The number of patents granted to residents and nonresidents per one million people was hypothesized to have a positive relationship with the dependent variable, such that a higher the number of patents awarded would result in a higher HDI value. The results show the highest mean of patents granted to fall under the "very high" group of HDI values with 466.22 patents per one million people, and a standard deviation of

470.47 patents awarded. Thus, there exists a statistically positive relationship between the two variables with an F statistic value of 7.93 significant at the .001 alpha level. The mean (and standard deviation in parentheses) for the "high" group of HDI is 76.24 (75.39), the mean (SD) for the "medium" group of HDI values is 14.60 (28.17), and the mean (SD) for the "low" HDI group is 1.80 (no SD data).

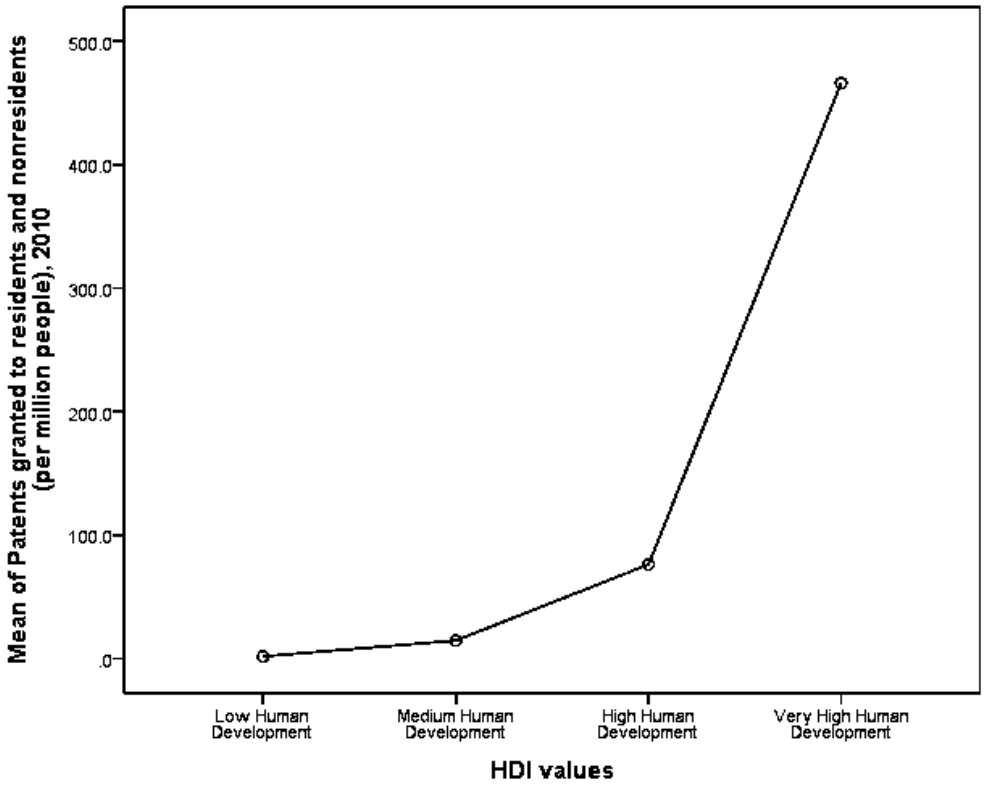


***Figure 2.*** Means plot between the mean of patents granted to residents and nonresidents per one million people and the HDI values.

Similarly, although with much smaller differences among the HDI groups than the number of granted patents, the life expectancy at birth for the 102 countries also has a steady rise in years as the HDI value of countries increases. In other words, the life

expectancy at birth in years was hypothesized to have a positive relationship with the dependent variable, such that a higher the life expectancy in years would result in a higher HDI value. Accordingly, the highest average of life expectancy at birth in years falls under the “very high” group of HDI values with 78.11 years and a standard deviation of 1.06. The second longest average life expectancy is 73.53 years and a standard deviation of 3.90, which belongs to the countries with a “high” HDI values. Moreover, the trend continues with the means (and standard deviations) of “medium” and “low” HDI groups to be 55.91 years (11.16) and 43.68 years (4.04), respectively. Thus, there exists a statistically positive relationship between the two variables with an F statistic value of 63.83, which is significant at the .001 alpha level.

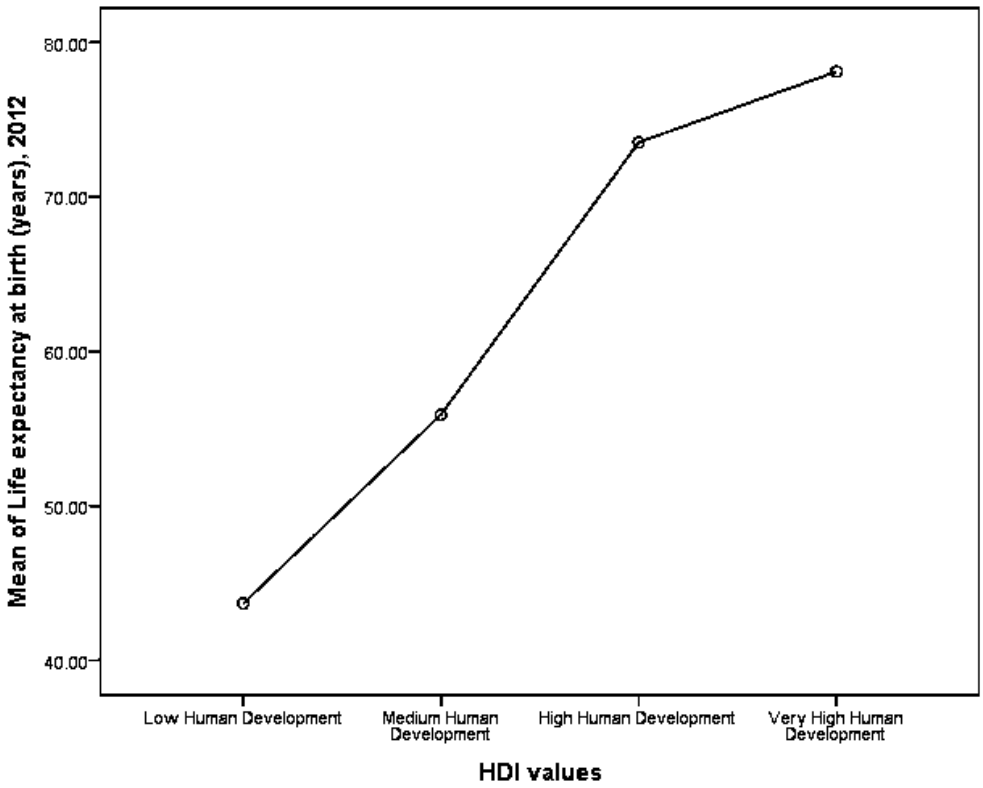


***Figure 3.*** Means plot between the mean of life expectancy at birth in years and the HDI values.

The trend of the highest means falling under the "very high" human development group stops here with the variable of the under-five mortality rate per 1,000 live births. The under-five mortality rates of 100 countries were hypothesized to have a negative relationship with the dependent variable, such that a higher mortality rate would result in a lower HDI value—which is the exact opposite trend from the previous two variables by now coupling the highest means with the lowest human development values. Accordingly, the results show the highest mean of under-five mortality rate of 125.40 deaths per 1,000 live births under the "low" HDI value group and a standard deviation of 35.77, while the "medium," "high," and "very high" groups show a consistent decrease in

means (and standard deviations) of 71.94 mortality rate (38.98), 17.07 mortality rate (15.99), and 4.19 mortality rate (1.37), respectively. As a result, there is a statistically negative relationship between the two variables with an F statistic value of 48.73, which is significant at the .001 alpha level.

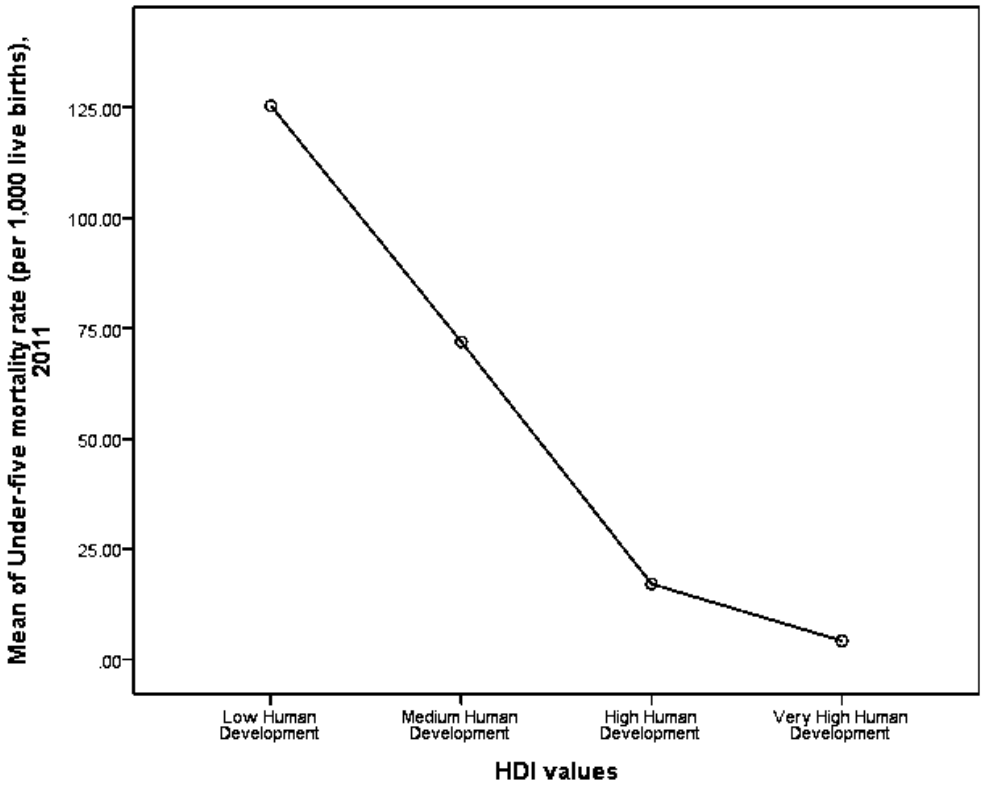


***Figure 4.*** Means plot between the mean of under-five mortality rate per 1,000 live births and the HDI values.

The percentage of population with access to essential drugs was also examined. In this case, we return to the original consistent direction of having countries with the highest human development levels also having the highest mean amount, or average percentage for this case. In accordance to that trend, the percentage of population with access to essential drugs was hypothesized to have a positive relationship with the

dependent variable, such that an increase in the percentage of population with access to essential drugs would result in a higher HDI value. The results show the percentage of population with the most access to essential drugs is the “very high” group of HDI values with 99.52 percent and a standard deviation of 0.60. The second highest mean was 84.36 percent population with a standard deviation of 20.85 for the “high” group of HDI values. Next, the “medium” HDI group has a mean of 64.28 percent population and a standard deviation of 17.92, and the “low” group is 50 percent population with a standard deviation of 22.09. Thus, it can be seen that the hypothesis is supported statistically with a positive relationship between the two variables with an F statistic value of 26.20, which is significant at the .001 alpha level.

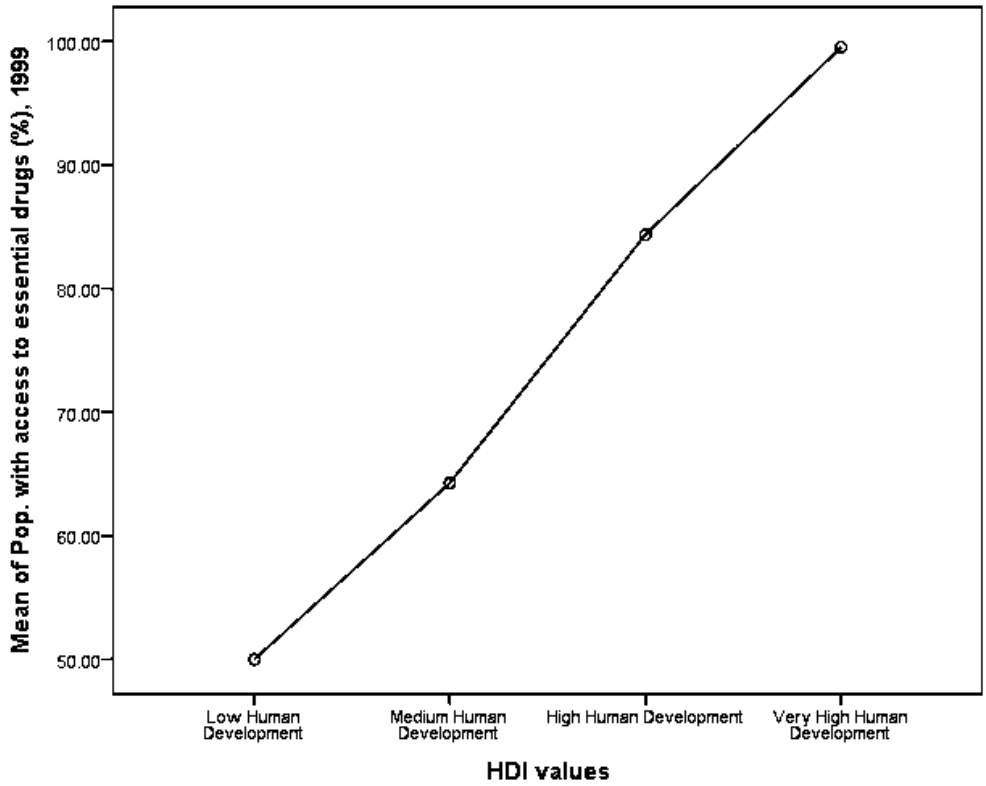


***Figure 5.*** Means plot between the mean of the percentage of population with access to essential drugs and the HDI values.

Lastly, the fifth independent variable of the general government expenditure on health as a percentage of total government expenditure concludes the ANOVA analysis, as well as the familiar trend of the relationship between the variables. Hence the percentage of government expenditure on health was hypothesized from 95 countries to have a positive relationship with the dependent variable, such that an increase in the percentage of government expenditure on health would result in a higher HDI value. The results show the highest mean of percentage of government expenditure on health of total government expenditure under the "very high" group of HDI values with 16.08 percent and a standard deviation of 3.28. As before, except for the one case of under-five mortality rates, the "high" HDI group has the second highest mean with 12.44 percent and a standard deviation of 3.50. Similarly, the "medium" group and "low" group finish the test results with the third and fourth highest means (and standard deviations) of 10.95 percent (4.08) and 8.94 percent (4.46), respectively. Thus, the hypothesis is supported statistically with a positive relationship between the two variables with an F statistic value of 10.11 that is significant at the .001 alpha level.

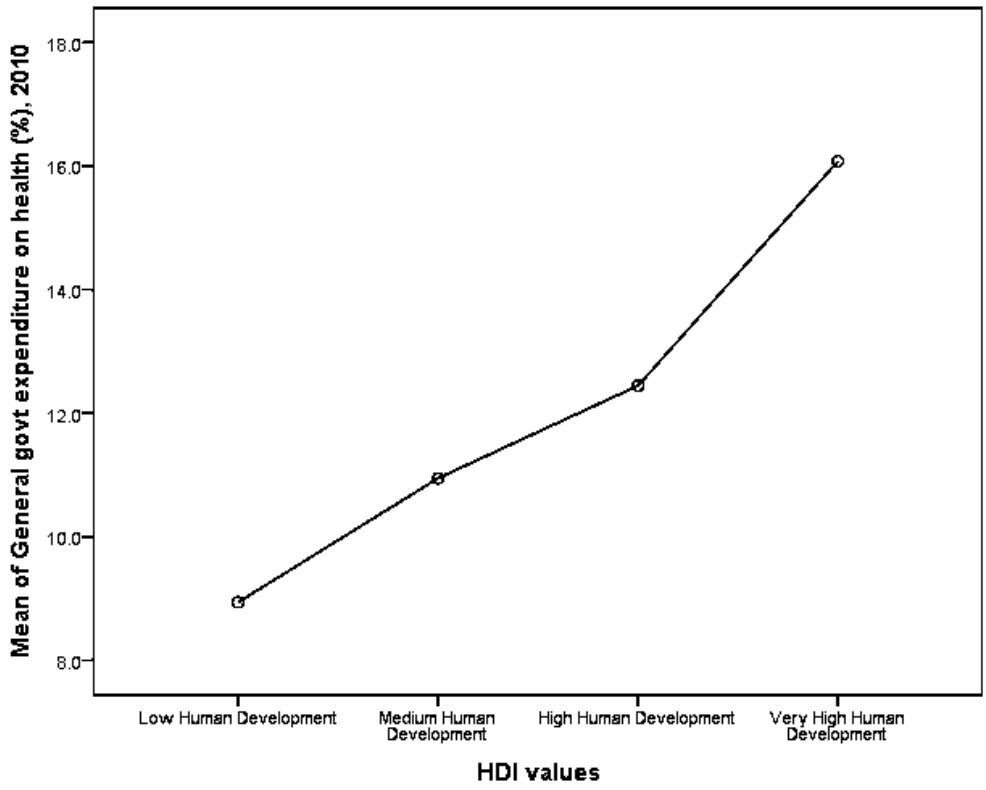


***Figure 6.*** Means plot between the mean of general government expenditure on health as a percentage of total government expenditure and the HDI values.

Table 3. *ANOVA of Dependent by Independent Variable of 102 Countries of Various HDI Ranks and Various Years*

| | | Human Development Index (HDI) Value, 2012 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Low (0.000-0.334) | Medium (0.335-0.667) | High (0.668-0.889) | Very High (0.890 or higher) | df | F | Sig. |
| Patents granted to residents and nonresidents (per million people), 2010 | Mean | 1.800 | 14.600 | 76.238 | 466.223 | 52 | 7.928 | 0.000 |
| N = 53 | (SD) | -- | (28.172) | (75.394) | (470.472) | | | |
| Life expectancy at birth (years) | Mean | 43.680 | 55.911 | 73.531 | 78.109 | 101 | 63.833 | 0.000 |
| N = 102 | (SD) | (4.044) | (11.162) | (3.903) | (1.057) | | | |
| Under-five mortality rate (per 1,000 live births), 2011 | Mean | 125.400 | 71.935 | 17.071 | 4.191 | 99 | 48.733 | 0.000 |
| N = 100 | (SD) | (35.774) | (38.982) | (15.991) | (1.365) | | | |
| Population with access to essential drugs (%), 1999 | Mean | 50.000 | 64.279 | 84.360 | 99.524 | 93 | 26.204 | 0.000 |
| N = 94 | (SD) | (22.091) | (17.921) | (20.848) | (0.602) | | | |
| General govt expenditure on health of total govt expenditure (%), 2010 | Mean | 8.940 | 10.948 | 12.444 | 16.076 | 94 | 10.111 | 0.000 |
| N = 95 | (SD) | (4.462) | (4.082) | (3.502) | (3.280) | | | |

*Note.* Statistical significance depending on the p value: Significant at the $p < 0.05$ level.

## 4.5. Ordinary Least Squares Regression

The regression analysis is used to investigate if any of the independent variables contribute significantly to the dependent variable. The final statistical test examined the OLS regression of under-five mortality rate per 1,000 live births on the selected independent variables of (1) the percentage of population with access to essential drugs; (2) the general government expenditure on health as a percentage of total government expenditure; and (3) the percentage of population living in urban areas. The OLS results are presented below in Table 4.

### 4.5.1. OLS Regression

The OLS regression analysis consists of several parts, but only the regression coefficients are included for this study. The first row of the Coefficients table (Table 4), labeled (Constant), reports the Standardized Regression Coefficients, which represents the slope of the regression line as "Beta" in the first column, and the Unstandardized Regression Coefficients of the Y-intercept, labeled as "*b*" in the second column. The third column of this row reports the Standard Error (SE) of the Y-intercept, which is an estimate of the average amount that sample Y-intercepts differ from the Y-intercept found in the examined percentages. The last two columns of this row represent the t-value, which is obtained by dividing the Y-intercept by the Standard Error of the Y-intercept, and the associated significance level, which tests whether the Y-intercept is significantly different from zero.

For the Constant, the Y-intercept for the regression is 168.74, the SE of the Y-intercept is 12.55, and the resulting t-value is 13.44, which is significant since the alpha

level (.000) is less than .05. The significant t-value suggests that the Y-intercept is significantly different from 0.

The percentage of population with access to essential drugs is the first predictor variable. In this case, *b* is -.924, meaning for every percent of population that gains access to essential drugs, the under-five mortality rate decreases by .924. The SE of *b* is the estimate of the average amount that values for *b* obtained from samples differ from the value of *b* in the population percentage. In this case, *b* is -.924, the SE of *b* is .183, and t-value is -5.06, which is significant at least at the .001 level. The Beta is -.458, indicating a strong negative linear relationship between the population percentage and the mortality probability (Figure 7). Thus, it can be concluded that the percentage of population with access to essential drugs is a meaningful predictor of the under-five mortality rate per 1,000 live births.

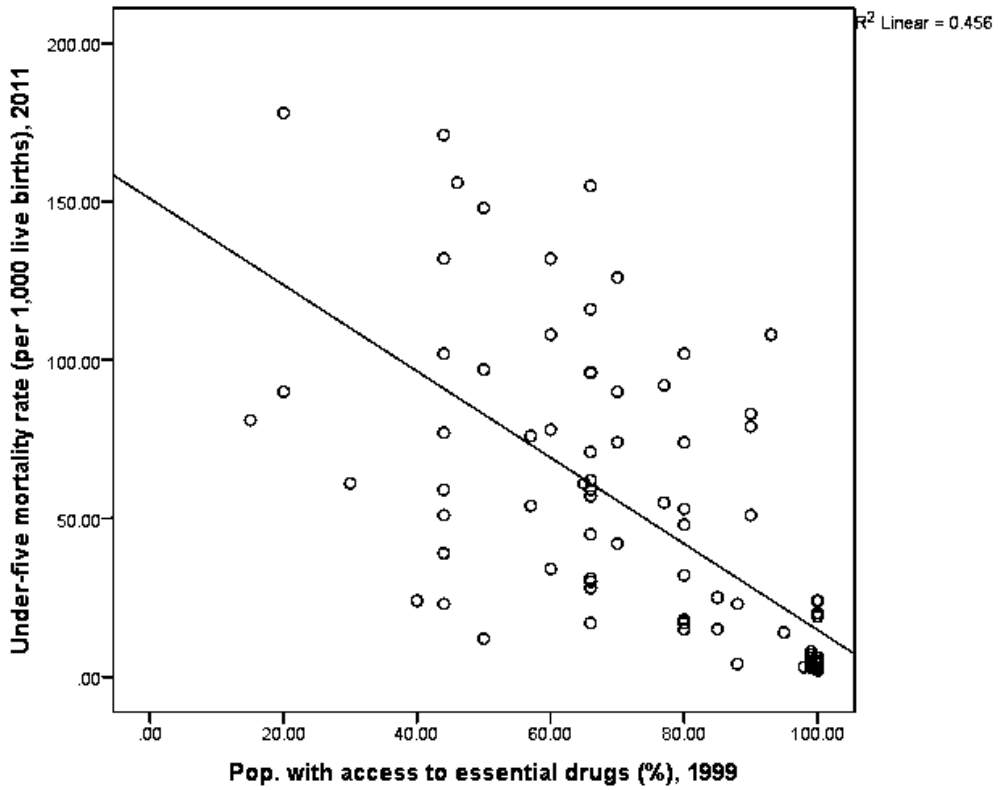


***Figure 7.*** Regression scatterplot between the percentage of population with access to essential drugs and under-five mortality rate per 1,000 live births.

The percentage of general government expenditure on health of total government expenditure is the second predictor variable. Similar to the first case, the *b* is -2.01, meaning for every percent increase in government expenditure on health of total government expenditure, the under-five mortality rate decreases by 2.01. The SE of *b* is the estimate of the average amount that values for *b* obtained from samples differ from the value of *b* in the population. In this case, the *b* is -2.01, the SE of *b* is .850, and the t-value is -2.37, which is significant since the alpha level (.020) is less than .05. The Beta, or slope of the regression line, is -.189, indicating a strong negative linear relationship between the percentage of government expenditure on health of total government

expenditure and the under-five mortality probability (Figure 8). Thus, it can be concluded that the percentage of government expenditure on health of total government expenditure is a meaningful predictor of the under-five mortality rate per 1,000 live births.

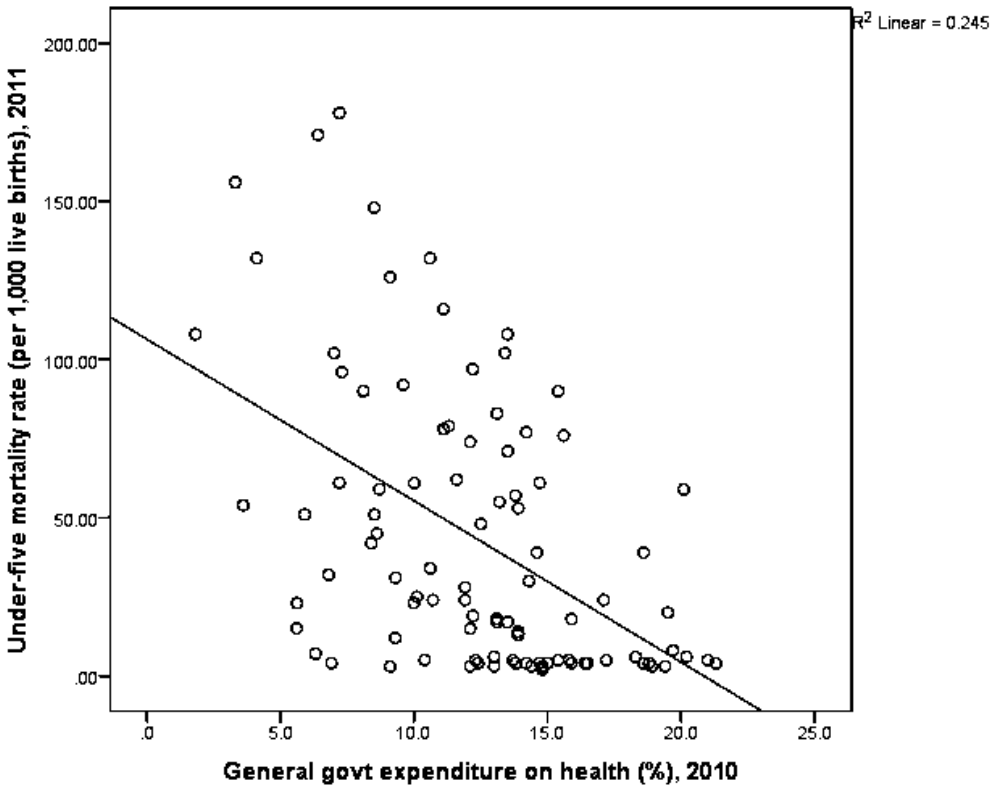


***Figure 8.*** Regression scatterplot between general government expenditure on health as a percentage of total government expenditure and under-five mortality rate per 1,000 live births.

The percentage of population living in urban areas is the third and last predictor variable for the regression analysis. Consistent with the previous two cases, the *b* for the population living in urban areas is -.511, meaning for every percent increase in the population living in an urban area, the under-five mortality rate decreases by .511. The

SE of *b* is the estimate of the average amount that values for *b* obtained from samples differ from the value of *b* in the population. In this case, *b* is -.511, the SE of *b* is .175, and the t-value is -2.93, which is significant with the alpha level of .004 is much lower than .05. The slope of the regression line, Beta, is -.263, indicating strong negative linear relationship between the percentage of population living in urban areas and the mortality probability (Figure 4). Thus, it can be concluded that the percentage of population living in urban areas is a meaningful predictor of the under-five mortality rate per 1,000 live births.

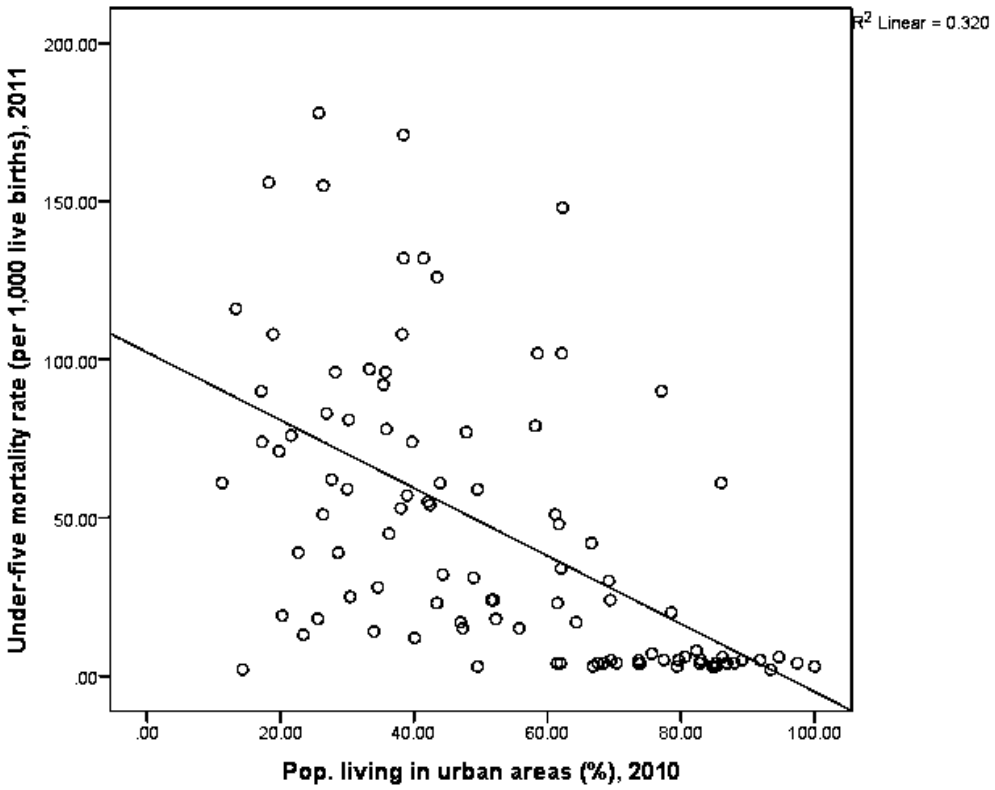


***Figure 9.*** Regression scatterplot between the percentage of population living in urban areas and under-five mortality rate per 1,000 live births.

Table 4. *OLS Regression of Under-five Mortality Rate (per 1,000 live births) on Selected Independent Variables of 102 Various Countries, Various Years*

| | Under-five Mortality Rate (per 1,000 live births), 2011 | | | | |
|---|---|---|---|---|---|
| | Beta | b | S.E. | t-value | Sig. |
| (Constant) | -- | 168.735 | 12.552 | 13.443 | .000 |
| Population with access to essential drugs (%), 1999 | -.458 | -.924 | .183 | -5.060 | .000 |
| General govt expenditure on health of total govt expenditure (%), 2010 | -.189 | -2.012 | .850 | -2.367 | .020 |
| Population living in urban areas (%), 2010 | -.263 | -.004 | .003 | -2.926 | .004 |
| R | .755 | | | | |
| $R^2$ | .570 | | | | |
| F | 38.048 | | | | |

*Note.* Statistical significance depending on the p value: Significant at the $p < 0.05$ level.

# Chapter V

# Discussion, Limitations, and Conclusion

## 5.1. Discussion

Although it has been criticized and speculated that as the number of granted patents increase, it can only lead to detrimental effects on innovation and productivity, especially in the realm of pharmaceuticals. This study suggests otherwise, however, with the use of available data to explore for possible relationships between the number of patents granted to residents and nonresidents per million people and the overall health and socioeconomic statuses of 102 countries at various human development levels.

The amount of a country's general government expenditure on health as a percentage of its total government expenditure was found to have a significant correlation with the country's human development levels. Accordingly, a government's expenditure on health may also lead to a stronger focus on the government's spending on innovation and intellectual property, namely patents. In order to better understand this phenomenon, recall from Chapter I that patents are intellectual property rights awarded by government agencies to protect novel inventions for a limited period of time with an exchange for public disclosure, which would be used to help educate future researchers and inventors with the encouragement to innovate, produce, and patent even more superior products. It is reasonable to assume, then, that at least some of those superior products and patents would fall into the category of pharmaceuticals, particularly essential medicines.

Additionally, the chance of a population to receive access to essential drugs is also correlated with their particular areas of residence. Specifically, if the population is located in an urban area, as opposed to rural areas, the likelihood of receiving essential drugs can be expected to increase. An explanation for this scenario might be related to the general locations of healthcare facilities, namely hospitals and pharmacies. Hence the closer a patient is located to a healthcare facility, the higher the chances would become for the patient to effectively benefit from the necessary essential medicines.

Therefore, while the countries that are more capable of producing high quantities of innovative products and patents are more likely to have high availability to essential drugs, their population's location of residence can also play a significant role in obtaining those necessary medicines. Based on the findings, the countries with the highest percentage of population that has access to essential drugs are also the countries with the highest human development levels. As a result, the countries with the highest human development also have the longest life expectancy, and consequently, they also have the lowest level of under-five mortality rates, which is, as shown in the study, due to the fact that more people in those countries live in urban areas. Accordingly, the value of the findings of the study is to highlight the most efficient route for providing the world's poorest people with the necessary essential medicines to survive.

Furthermore, the findings of the ANOVA, further support the findings as discussed in the previous paragraph. According to the findings, the human development index (HDI) values were significantly correlated with all five independent variables. As indicated by Table 3, Chapter IV, the countries with the highest HDI values also have the most patents granted, the longest life expectancy at birth, the most access to essential

medicines, and the highest government expenditure on health. Conversely, the ANOVA findings showed the countries with the lowest HDI values to have the highest under-five mortality rates. All this is a strong indication that the human development in a country determines the government's expenditure on healthcare and patented drugs, which in turn would affect the life expectancy at birth and especially on the under-five mortality rate in the country.

In terms of the impact on the under-five mortality rates, the study found that three independent variables, namely the percentage of population with access to essential drugs, the general government expenditure percentage on health, and the percentage of population living in urban areas, accounted for 57 percent of the variance of the under-five mortality rates. As indicated by the OLS Regression findings in Table 4, Chapter IV, as population with access to essential drugs goes up by one unit (one percentage point), the under-five mortality rates will decrease by .458; and as government expenditure goes up by one unit (one percentage point), the under-five mortality rates would go down by .189, indicating that the more access people have to essential drugs and the more the government spends on healthcare, the lower are the rates of mortalities for children under age 5, and vice versa. Additionally, the regression analysis also found that the countries with higher percentages of populations living in urban areas have significantly lower mortality rates for children under 5. The findings clearly illustrate that all three of the variables discussed in this paragraph have significant impact on the under-five mortality rates in a country.

## 5.2. Potential Objections and Limitations

Critics might find some of the results to be unreliable due to the severe lack of data for several independent variables, particularly the information regarding the number of patents granted to residents and nonresidents per one million people. Although the data for the number of patents granted were limited, it does not take away from the fact that the countries with available data were also the ones with the highest human development rankings. And the only ways to receive such high rankings are to have the highest results for all three of UNDP's designated criteria, which are high life expectancy at birth, best educational attainment, and the highest adjusted real per capita income. All three measures are essential to having a long and healthy life.

Another possible objection might be the choice of the data collection process, that being the use of available data from government databases—i.e., GHO Data Repository. Consequently, several study variables did not have data for many countries. The data for this study was taken only as provided by the available sources, hence, the unfortunate result of having missing data was inescapable and was taken into account, as the lack of information may affect the data results of the study.

Out of the nine study variables used in the study, the independent variable for the number of patents granted presented the highest amount of missing data, as noted above, with only 53 countries providing available and valid data. In order to provide the most accurate results possible, the countries without patent information could not be assumed to have an amount of zero patents granted, as the lack of data does not equal zero data. Based on the full scale of the data obtained, it was evident that a trend was present in the types of countries with available patent information versus the countries that did not have any data recorded.

Possible explanations for the lack of data, among others, might be the result of the failure of data collection; or the data obtained were never submitted or updated appropriately. In addition, the weakness of the selected variables can also impede upon the results of this study; however, a more accurate explanation for the lack of data is simply because of the unavailability of the data of interest, or possibly a combination of all of the above.

Another limitation of this study is the location of the subject, more specifically Africa. It is difficult to know for certain the situations across a country, much less across the globe. Hence it is difficult to have the most accurate and reliable data available from some of the most remote areas of the world, such as the 34 least developing African countries. Therefore, the distance between the researcher and the subject of interest can provide a limitation on the studied data and information.

A further limitation of this study is the time period of the study data. Of the data information collected, the earliest studied datasets were from as early as 1999, and the most recent was from 2013. The timeframe itself can create limitations, as a longitudinal study of at least ten years would be more ideal and significant for this research, as many changes can occur without the control of the sociological, medical, and political worlds, but a longer period than ten years can also provide skew data, as a country's human development rankings may change from year to year.

Additionally, this study deals with the government and policy makers, as that can be out of the reach and control of the researcher. As a result, politics can also be a limitation for this study. The passing and amending of laws by lawmakers seem to be a constant and everlasting phenomenon. Every newly appointed or elected official of the

most industrialized nations or the switching of the guards of the intergovernmental organizations may alter intellectual property laws, practices, and policies significantly. Until that day comes, however, politics can only play the part of a limitation.

## 5.3. Implications and Future Research

Though the results of this study might not ignite a call for an immediate change to any policies overnight, it should, however, add a small piece to the ever-growing curiosity on the topic of intellectual property and patent law and its effect on healthcare around the world. Regardless of the numerous efforts initiated by the WHO in solving this issue, there are still too many questions without answers, even with both sides of the issue advocating for a mutual advantage of protection for intellectual property producers while providing better health for users of those intellectual properties.

An elitism society, per se, may not have been strictly intended, nor is it suggested or encouraged at this time. We do, however, live in a world that is, unfortunately, on the far end of an egalitarian society, where dominance in government and corporate policies can be obtained through wealth. As warned by Attaran (2004), more studies are still needed with regard to the workings of poverty (p. 163), as it was suggested, and now supported by this study, that poverty, not patents, may impose the greater limitation on the access to essential medicines (p. 156).

For future research, many more variables should be considered to better identify the relationship between patents and the well-being of the 34 LDCs in Africa. Accordingly, more data is still desperately needed to conduct a more thorough investigation for future studies.

Although much more difficult to execute, future studies should also propose for new laws of reforms and regulations on the practice of licensing agreements for patented drugs made for the most essential medicines to the LDCs, whose patent holders can include not only universities but also any pharmaceutical company that is the sole assignee of the patents.

## 5.4. Conclusion

The overall goal of this study was to provide a quantitative analysis of the different socioeconomic statuses with the different healthcare circumstances of the least developing countries of Africa, as compared with countries of high and medium human development rankings, in regard to intellectual property and patent law. A correlation, an analysis of variance, and a regression were tested among the selected variables of interest. The findings show a country's human development level and socioeconomics can play a significant role on its ability to provide access to essential medicines. Some reasons for that relationship are attributed to the amount of patents granted to a country's residents and nonresidents, the percentage of general government expenditure on health of its total expenditure, and also the location of its population's residence, i.e., urban areas.

While the results can only provide a small part of the story, more research and work still needs to be done to provide better global health by lowering the prices of essential medicines. As this study moves forward, laws and policies should be provided to protect not only the inventors, but also the most disadvantaged of the world that need those novel inventions and products, not as a compliment to their lives, but to simply

survive. Additionally, those same laws shall protect the world over, including the most industrialized nations, because the poor are not only located in Africa, as they could very well be living across town from you in a well-developed country such as our own. Additionally, the average rate of 45 under-five mortalities per 1,000 live births for the 102 countries (112 mortality rate for the 34 LDCs) is simply too large of a number. We must urgently lower the mortality rates for children, and please pardon the cliché, as they are the world's future.

A new study was launched in 2013 on promoting health, intellectual property and trade by the heads of the three intergovernmental organizations—WHO, WIPO, and the WTO. According to the WHO's (2013) news release, the study will make "policies needed to advance medical and health technologies and to ensure they reach the people who need them." With the recent spread of Ebola out of West Africa, the need for a better patent policy in order to provide the necessary medicines to fight against the disease is ever more evident. Finally, future research should focus on all medicines for all diseases, not only the most well-known illnesses, but also for the neglected diseases around the world in hopes of longer life expectancies and a healthier humanity as a whole.

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Appendix A: Table Results

Table 1. *Descriptive Statistics for Study Variables of 102 Countries of Various HDI Ranks and Various Years*

| Variables | Mean | SD | Range | Min. | Max. | N |
|---|---|---|---|---|---|---|
| Human Development Index (HDI) Value, 2012 | .662 | .202 | .651 | .304 | .955 | 100 |
| Gross national income per capita (PPP int. $), 2010 | 15536.21 | 18275.46 | 80691.00 | 320.00 | 81011.00 | 100 |
| Population living in urban areas (%), 2010 | 53.83 | 24.21 | 88.80 | 11.20 | 100.00 | 101 |
| Population with access to essential drugs (%), 1999 | 76.73 | 22.83 | 85.00 | 15.00 | 100.00 | 94 |
| Under-five mortality rate (per 1,000 live births), 2011 | 45.02 | 45.28 | 176.00 | 2.00 | 178.00 | 100 |
| Life expectancy at birth (years), 2012 | 65.11 | 13.38 | 42.50 | 38.30 | 80.80 | 102 |
| Patents granted to residents and nonresidents (per million people), 2010 | 220.43 | 368.12 | 1759.70 | 0.20 | 1759.90 | 53 |
| Population median age (years), 2010 | 27.05 | 9.32 | 29.20 | 15.50 | 44.70 | 98 |
| General government expenditure on health of total government expenditure (%), 2010 | 12.40 | 4.29 | 19.50 | 1.80 | 21.30 | 95 |

Table 2. *Correlation of Study Variables for 102 Countries of Various HDI Ranks and Various Years*

| Variables | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Human Development Index (HDI) Value, 2012 | Pearson Correlation | -- | | | | | | | | |
| | Sig. (2-talied) | | | | | | | | | |
| | N | 100 | | | | | | | | |
| 2. Gross national income per capita (PPP int. $), 2010 | Pearson Correlation | .813** | -- | | | | | | | |
| | Sig. (2-talied) | .000 | | | | | | | | |
| | N | 100 | 100 | | | | | | | |
| 3. Population living in urban areas (%), 2010 | Pearson Correlation | .736** | .650** | -- | | | | | | |
| | Sig. (2-talied) | .000 | .000 | | | | | | | |
| | N | 99 | 99 | 101 | | | | | | |
| 4. Population with access to essential drugs (%), 1999 | Pearson Correlation | .708** | .664** | .588** | -- | | | | | |
| | Sig. (2-talied) | .000 | .000 | .000 | | | | | | |
| | N | 92 | 92 | 94 | 94 | | | | | |
| 5. Under-five mortality rate (per 1,000 live births), 2011 | Pearson Correlation | -.841** | -.623** | -.566** | -.675** | -- | | | | |
| | Sig. (2-talied) | .000 | .000 | .000 | .000 | | | | | |
| | N | 98 | 98 | 100 | 94 | 100 | | | | |
| 6. Life expectancy at birth (years), 2012 | Pearson Correlation | .907** | .641** | .602** | .660** | -.876** | -- | | | |
| | Sig. (2-talied) | .000 | .000 | .000 | .000 | .000 | | | | |
| | N | 100 | 100 | 101 | 94 | 100 | 102 | | | |

| Variables | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 7. Patents granted to residents and nonresidents (per million people), 2010 | Pearson Correlation | .449** | .421** | .434** | .318* | -.292* | .305* | -- | | |
| | Sig. (2-talied) | .001 | .002 | .001 | .021 | .035 | .027 | | | |
| | N | 53 | 53 | 53 | 52 | 52 | 53 | 53 | | |
| 8. Population median age (years), 2010 | Pearson Correlation | .859** | .840** | .713** | .722** | -.732** | .732** | .399** | -- | |
| | Sig. (2-talied) | .000 | .000 | .000 | .000 | .000 | .000 | .003 | | |
| | N | 98 | 98 | 98 | 93 | 97 | 99 | 53 | 99 | |
| 9. General government expenditure on health of total government expenditure (%), 2010 | Pearson Correlation | .419** | .454** | .366** | .422** | -.495** | .378** | .375** | .468** | -- |
| | Sig. (2-talied) | .000 | .000 | .000 | .000 | .000 | .000 | .007 | .006 | |
| | N | 93 | 93 | 95 | 90 | 95 | 95 | 50 | 93 | 95 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3. *ANOVA of Dependent by Independent Variable of 102 Countries of Various HDI Ranks and Various Years*

| | | Human Development Index (HDI) Value, 2012 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Low (0.000-0.334) | Medium (0.335-0.667) | High (0.668-0.889) | Very High (0.890 or higher) | df | F | Sig. |
| Patents granted to residents and nonresidents (per million people), 2010 | Mean | 1.800 | 14.600 | 76.238 | 466.223 | 52 | 7.928 | 0.000 |
| N = 53 | (SD) | -- | (28.172) | (75.394) | (470.472) | | | |
| Life expectancy at birth (years) | Mean | 43.680 | 55.911 | 73.531 | 78.109 | 101 | 63.833 | 0.000 |
| N = 102 | (SD) | (4.044) | (11.162) | (3.903) | (1.057) | | | |
| Under-five mortality rate (per 1,000 live births), 2011 | Mean | 125.400 | 71.935 | 17.071 | 4.191 | 99 | 48.733 | 0.000 |
| N = 100 | (SD) | (35.774) | (38.982) | (15.991) | (1.365) | | | |
| Population with access to essential drugs (%), 1999 | Mean | 50.000 | 64.279 | 84.360 | 99.524 | 93 | 26.204 | 0.000 |
| N = 94 | (SD) | (22.091) | (17.921) | (20.848) | (0.602) | | | |
| General govt expenditure on health of total govt expenditure (%), 2010 | Mean | 8.940 | 10.948 | 12.444 | 16.076 | 94 | 10.111 | 0.000 |
| N = 95 | (SD) | (4.462) | (4.082) | (3.502) | (3.280) | | | |

*Note.* Statistical significance depending on the p value: Significant at the $p < 0.05$ level.

Table 4. *OLS Regression of Under-five Mortality Rate (per 1,000 live births) on Selected Independent Variables of 102 Various Countries, Various Years*

| | | Under-five Mortality Rate (per 1,000 live births), 2011 | | | | |
|---|---|---|---|---|---|---|
| | | Beta | *b* | S.E. | t-value | Sig. |
| (Constant) | | -- | 168.735 | 12.552 | 13.443 | .000 |
| Population with access to essential drugs (%), 1999 | | -.458 | -.924 | .183 | -5.060 | .000 |
| General govt expenditure on health of total govt expenditure (%), 2010 | | -.189 | -2.012 | .850 | -2.367 | .020 |
| Population living in urban areas (%), 2010 | | -.263 | -.004 | .003 | -2.926 | .004 |
| | R | .755 | | | | |
| | $R^2$ | .570 | | | | |
| | F | 38.048 | | | | |

*Note.* Statistical significance depending on the p value: Significant at the $p < 0.05$ level.

## Appendix B: List of Countries

The data obtained from the UN for the following 34 least developed African countries, 34 high human development countries, and 34 medium human development countries, as of 2013:

African LDCs:

| | |
|---|---|
| Angola | Madagascar |
| Benin | Malawi |
| Burkina Faso | Mali |
| Burundi | Mauritania |
| Central African Republic | Mozambique |
| Chad | Niger |
| Comoros | Rwanda |
| Democratic republic of the Congo | Sao Tome and Principe |
| Djibouti | Senegal |
| Equatorial Guinea | Sierra Leone |
| Eritrea | Somalia |
| Ethiopia | South Sudan |
| Gambia | Sudan |
| Guinea | Togo |
| Guinea-Bissau | Uganda |
| Lesotho | United Republic of Tanzania |
| Liberia | Zambia |

Medium Human Development:

Belize
Bolivia, Plurinational State of
Botswana
China
Dominican Republic
Egypt
El Salvador
Fiji
Gabon
Guyana
Honduras
Indonesia
Jordan
Kiribati
Kyrgyzstan
Maldives
Micronesia, Federated States of
Moldova, Republic of
Mongolia
Namibia
Palestine, State of
Paraguay
Philippines
Samoa
South Africa
Suriname
Syrian Arab Republic
Tajikistan
Thailand
Tonga
Turkmenistan
Uzbekistan
Vanuatu
Viet Nam

High Human Development:

Andorra
Australia
Austria
Belgium
Brunei Darussalam
Canada
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hong Kong
Iceland
Ireland
Israel
Italy
Japan
Liechtenstein
Luxembourg
Malta
Netherlands
New Zealand
Norway
Republic of Korea
Singapore
Slovenia
Spain
Sweden
Switzerland
United Kingdom
United States